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TECHNICAL EVALUATION REPORT
BYRON STATION UNITS 1 AND 2
STATION BLACKOUT EVALUATION

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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 16 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 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 (13) 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 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 April 17, 1989 (10) and March 30, 1990 (16), the information available in the plant Updated Final Safety Analysis Report, (UFSAR) (12), a telephone conversation between NRC/SAIC and the licensee on February 26, 1990, and a

follow up response from the licensee dated March 29, 1990 (17); 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, Commonwealth Edison Company (CECO), calculated (10 and 16) a minimum acceptable SBO duration of four hours for the Byron Station Units 1 and 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 "P1" based on:

   a. Independence of offsite power group is "I2,"

   b. Estimated frequency of loss of offsite power (LOOP) due to severe weather (SW) places Byron in SW group "2,"

   c. Estimated frequency of LOOP due to extremely severe weather (ESW) places Byron in ESW Group "1," and

   e. Expected frequency of grid-related LOOP does not exceed once per 20 years.

2. Emergency AC (EAC) Power Configuration Group

   The EAC power configuration of the plant is "C." Each of the two units at Byron are 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 for each unit 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: a) greater than 0.90 for the last 20 demands for both units, b) greater than 0.94 for the last 50 demands for both units, and c) greater than 0.95 for the last 100 demands for Unit 1 (data for Unit 2 is not yet available due to limited operating history) consistent with the NUMARC 87-00 selection criteria.

Review of Licensee's Submittal

Factors which affect the estimation of the SBO coping duration are: the independence of offsite power system grouping, the expected frequency of LOOP 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 condition is consistent with the guidance provided in NUMARC 87-00, Table 3-3, using multiple rights-of-way transmission lines. Likewise, the extremely severe weather grouping is consistent with that given in Table 3-2 of NUMARC 87-00.

Our review of the Byron Station UFSAR (Section 8.0) indicates that, (see Figure 1):

1. all offsite power sources are connected to the plant through one switchyard,

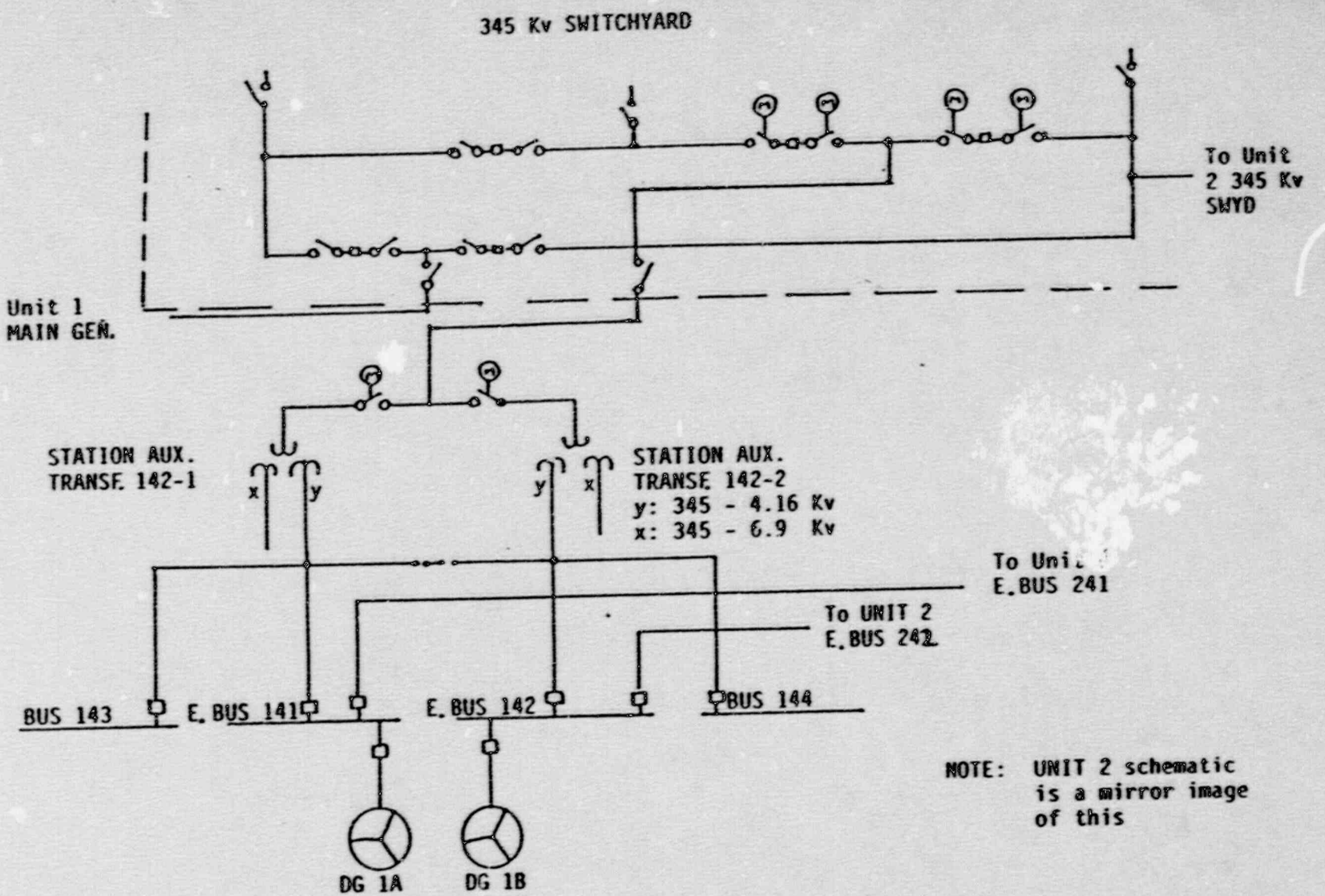

Figure 1 BYRON STATION UNIT 1

2. there are two emergency safety feature divisions in each unit, and each division is normally powered from a separate system auxiliary transformer (SAT),

3. the unit SATs (two per unit) are fed through one power line which connects them to the corresponding unit 345 kV ring bus (preferred power source for the emergency buses),

4. each SAT is capable of supplying the design basis accident loads of both divisions of one unit and the safe shutdown loads of both divisions of the other unit simultaneously, and

5. upon loss of preferred power source, all safe shutdown buses can be connected to the alternate power source by a manual transfer.

The alternate power source for each of the emergency buses is from the emergency bus of the opposing unit. The manual line-up requires a total of four circuit breakers (two on each cross-tie) to be closed for establishing power to all emergency buses of the opposing unit. Using the guidance provided in Table 5 of RG 1.155, we conclude that the licensee has correctly established the independence of plant offsite power grouping as "I2."

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. Byron has two dedicated EAC sources with one required after a LOOP, placing the plant in EAC Group "C" (RG 1.155 Table 3) as the licensee correctly identified.

The final characteristic needed to establish the duration of Byron's required coping capability is the target EDG reliability. The licensee has selected a target EDG reliability of 0.95 consistent with the RG 1.155 and NUMARC 87-00 guidance. We were unable, however, to verify the demonstrated start and load-run reliability of the plant EDGs. This

information is only available onsite as part of the submittal's supporting documents. In response to the requirement for an EDG reliability program the licensee stated during a telephone conversation on February 26, 1990, that a reliability program consistent with the guidance provided in RG 1.155 and NUMARC 87-00 is being developed. This was not documented in the licensee's submittals; however, it is committed to maintain the targeted EDG reliability of 0.95.

With regard to the expected frequency of grid-related LOOPs at the site, we can not confirm or reject 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. Neither unit was in commercial operation before 1984. During the telephone conversation on February 26, 1990, the licensee stated that none of the CECO's nuclear stations has had any grid-related LOOP 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 Byron site is "P1" with a minimum required SBO duration of four hours.

3.2 Alternate AC (AAC) Power Source

Licensee's Submittal

The licensee stated that the AAC power source at Byron Station (BS) will be the emergency AC power source from the non-blacked out unit which meets the criteria specified in Appendix B to NUMARC 87-00 and the assumptions in Section 2.3.1 of NUMARC 87-00. The AAC power source is available within 10 minutes of the onset of the SBO event by manual operation of cross-tie breakers from the control room. Each of Byron's two units have two dedicated EDGs. Upon the loss of offsite power and failure of one unit's diesels to operate, either one of the other unit's

diesels is capable of providing power for safe shutdown of both units for four hours.

Review of Licensee's Submittal

Except for the following concern, we agree with the licensee's statement that the AAC power source (site EDGs) meets the criteria in Appendix B of NUMARC 87-00:

> **Paragraph B.9 of Appendix B states," .... At a multi-unit site, except for 1/2 Shared or 2/3 emergency AC power configuration, an adjacent unit's Class 1E power source may be used as an AAC power source for the blacked-out unit if it is capable of powering the required loads at both units."**

During the telephone conversation on February 26, 1990, the licensee stated that all of the LOOP safe shutdown loads, except for the auxiliary feedwater (AFW) motor driven pump and the component cooling water pumps will be powered on the non-blacked out (NBO) unit. The licensee added that the diesel driven AFW pump will be used instead of the motor driven pump, and the component cooling system will not be required. The licensee also stated that the SBO loads on the blacked-out unit will be almost the same as those on the NBO unit. The difference is the common equipment loads such as main control room heating, ventilation and air conditioning (HVAC) that need to be powered from the NBO unit. Based on this load management scheme and the capacity of the unit EDGs (with a 2000 hour rating of 5934 KW each), the licensee claims that all the equipment needed for safe shutdown operation in both units can be powered from one EDG within 10 minutes.

The guidance on the use of existing EDGs as AAC power sources at multi-unit sites is documented in RG 1.155, Section 3.3.5, NUMARC 87-00, Section 2.3.1(3) and further detailed under question 3.4 and B.3 in NUMARC 87-00 Supplemental Questions/Answers which was reviewed and endorsed by the NRC staff (13). The SBO rule states that at multi-unit

sites where the combination of EAC power sources *'exceeds the minimum redundancy requirements for safe shutdown (non-DBA) of all units, the remaining EAC sources may be used as AAC sources'* provided that they meet the applicable requirements.

The rule statement requires *'minimum redundancy.'* This means that in order for an EDG to qualify as an AAC source there must be an EDG available in the NBO unit in addition to the number of EDGs required to meet the minimum EDG redundancy requirement for powering a normal safe shutdown loads following a LOOP event. Thus, the EDGs in a two-unit site with two dedicated EDGs per unit would not qualify as AAC sources. Two EDGs per unit would meet only the minimum redundancy requirement, and there is no excess EDG.

However, there are some plants at multi-unit sites which have EDGs that just meet the minimum redundancy but each EDG has sufficient capacity to power all the normal LOOP loads of the NBO unit and also has sufficient excess capacity to power the required safe shutdown loads of the SBO unit. Recognizing the existence of this type of situation, the staff has interpreted the *'literal'* excess EDG redundancy requirement of the SBO rule to allow large capacity EDGs to qualify as AAC source, provided other applicable requirements are met.

In order to take credit for this interpretation, the NRC staff's basic position has been (14, 18 and 19) that:

1. no action should be taken that would exacerbate the already difficult situation in the NBO unit. Any actions that make operator tasks more difficult such as load switching or disablement of information readouts or alarms in the control room are also considered to be a degradation of normal safe shutdown capability for LOOP in the NBO unit. And,

2. excess capacity of the EDG being designated as an AAC source should not be the capacity made available by shedding or not

powering normal safe shutdown loads in the NBO unit. Examples of such loads are: motor driven auxiliary feedwater pumps; heating, ventilation and air conditioning loads; the power supply of the plant computer; one or more sets of redundant instrumentation; etc. The shedding of such loads constitutes degradation of the normal safe shutdown capability of the NBO unit.

It is not in the interest of safety to reduce the capability to handle various eventualities in one unit for the purpose of meeting the SBO rule in another unit. Each unit must meet the SBO rule on its own merits without reducing another unit's capability to respond to its own potential problems.

The excess capacity of the EDG in the NBO unit that qualifies it as an AAC source is, therefore, *'only that available capacity within the normal continuous rating but above the EDG load represented by the complete contingent of safety related and non-safety related loads normally expected to be available for the LOOP condition.'*

Our review of the licensee's proposed actions to meet the requirements of the SBO rule (10 CFR part 50.63) indicates that the proposed load shedding scheme on the NBO unit is not consistent with the guidance stated above. The licensee has proposed to shed loads which will result in the degradation of the NBO unit safe shutdown capability. If these loads were not shed, the AAC power source would not have suffic'ent capacity to power the equipment needed for safe shutdown operation of the blacked out unit. Therefore, the licensee's submittal does not conform with the requirements of the SBO rule.

3.3 Station Blackout Coping Capability

The licensee stated that since the AAC power source will be available within 10 minutes, the coping evaluations for class 1E battery capacity, compressed air, and containment isolation need not be addressed per 10 CFR 50.63 (c)(2). It is assumed that since the AAC is available within 10 minutes

the functions needed to cope an SBO are available and adequately powered for the required duration. The plant coping capability with an SBO event for the required duration of four hours is assessed based on the following results:

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

   Licensee's Submittal

   The licensee stated that a total of 78,858 gallons of water is required per unit for decay heat removal without cooldown during the 4-hour SBO event. The minimum permissible condensate storage tank level by technical specifications provides 200,000 gallons of water per unit, which exceeds the required quantity for coping with a 4-hour SBO.

   Review of Licensee's Submittal

   The condensate inventory needed to remove decay heat was estimated using the information available in the plant UFSAR and the guidance provided in NUMARC 87-00, Section 7.2.1 assuming no cooldown of the primary system. Our calculations indicate that the licensee has properly evaluated the condensate requirements to remove decay heat during a 4-hour SBO event. The licensee stated that, at a minimum, each unit would have 200,000 gallons of condensate water. Therefore, we agree with the licensee that the site has sufficient condensate inventory to successfully cope with and recover from a 4-hour SBO event.

2. **Class 1E Battery Capacity**

   Licensee's Submittal

   The licensee's submittal does not address the battery capacity. During the telephone conversation on February 26, 1990, the licensee stated that since the AAC is available within 10 minutes

from the onset of an SBO event, the battery calculations do not need to be addressed per guidance provided in NUMARC 87-00, Section 7.1.2, and 10 CFR Part 50.63 (c)(2). He added that no cross-connect capability exits between the ESF divisions in each unit.

Review of Licensee's Submittal

Information in the plant UFSAR indicates that each division battery can support the connected loads for more than 30 minutes and can last for four hours if the inverter loads were shed after 30 minutes. The available information, however, is insufficient to be able to confirm the stated results. The licensee did not provide battery sizing calculation base on the assumptions that the AAC power source will charge one division of Class 1E station batteries. Since our review indicates that the proposed AAC power source does not meet the requirements of the SBO rule, the assumption that the AAC source will power one division of Class 1E battery chargers within the 10 minutes is invalid. To conform with the guidance provided in NUMARC 87-00 Supplemental Questions/Answers (13), the licensee needs to assess battery capacity, or provide charging capability to verify that all normal battery-backed plant monitoring and electrical system controls remain operational for successfully coping with and recovering from an SBO event.

3. **Compressed Air**

The licensee's submittal does not address the compressed air system. During the telephone conversation on February 26, 1990, the licensee stated that no air operated valves are relied upon to cope with an SBO event. Since AAC power source will be available within 10 minutes, analysis of the compressed air system is not required.

Review of Licensee's Submittal

The UFSAR states that failure of the compressed air systems will not prevent safety related components or systems from performing as intended. The auxiliary feedwater control valves are air operated. Upon a loss of air, these valves can be controlled locally (manually). The decay heat is released to the atmosphere through a combination of atmospheric dump valves (ADVs) and main steam safety relief valves (MSSVs). The ADVs, (a total of four), are electro-hydraulically operated valves with manual backup capability. The licensee stated that each ESF division powers two ADVs. After the AAC power source is established, the two ADVs on the steam generators (SGs) powered from the available ESF division can be operated from the control room. The MSSVs on the remaining two SGs would modulate to release the decay heat and maintain steam pressure near the lowest MSSV pressure setpoint.

Although this proposed decay heat release process produces an asymmetric temperature in the reactor coolant loops, it will not affect the safety of the plant. We believe proper operation of the two ADVs will eventually stop the MSSVs modulation once the ADVs release capacity exceeds the decay heat generation rate. However, the licensee needs to simulate this decay heat removal operation scenario and train the operators appropriately.

In addition, since the AAC power source does not meet the requirements of the SBO rule, the assumption that the AAC source powers two of the ADVs thereby enabling the operators to modulate these valves from the control room is invalid. Therefore, the licensee needs to provide an alternate power source for the operation of the ADVs, and simulate the process to train the operators.

4. Effect of Loss of Ventilation

Licensee's Submittal

The licensee stated that the AAC power source provides power to heating, ventilation and air conditioning (HVAC) systems serving dominant areas of concern to achieve and maintain safe shutdown during an SBO event. Therefore, consistent with the NUMARC 87-00, Sections 7.2.4 and 7.2.1 the effects of loss of ventilation were not assessed.

Review of Licensee's Submittal

During the telephone conversation on February 26, 1990, the licensee stated that HVAC systems for the following areas will be available once AAC power source is established:

- control room (common to both units),
- auxiliary electrical equipment room,
- miscellaneous electrical equipment room,
- essential service water cubicle,
- containment air recirculation fans,
- charging pump cubicle,
- auxiliary feedwater pump area,
- diesel generator room, and
- battery room.

The licensee added that the component cooling water system will not be operating in the blacked-out unit. This system provides cooling water to several systems including containment penetrations. The plant UFSAR indicates a need for 44 gpm of CCW water flow through 29 penetrations during normal, or LOOP/hot shutdown/cooldown conditions. Loss of this cooling flow causes the local concrete surface temperature to rise and eventually approach the temperature of the piping which passes through the penetration. The maximum temperature could be as high as the steam line temperature which is around 550°F. The American Concrete Institute (ACI 348-80) (15) states, "for accident or short term period the temperature should not exceed 350°F for the surface." The licensee stated that an analysis of the effect of loss of CCW will be performed for the SBO unit later (17).

Our analysis of capacity of the AAC power source indicates that the available capacity is not sufficient to power the HVAC systems of the areas mentioned above. Therefore, the licensee needs to provide calculations for equipment operability in the blacked-out unit.

5. Containment Isolation

Licensee's Submittal

The licensee's submittal does not address the containment isolation system. During the telephone conversation on February 26, 1990, the licensee stated that the AAC power source will be available within 10 minutes and has sufficient capacity to power the containment isolation valves (CIVs) requiring closure capability during an SBO event. Therefore, no analysis of CIVs is necessary.

Review of Licensee's Submittal

During the telephone conversation on February 26, 1990, it became apparent that, if the AAC power were to be available, only one division of ESF buses would be powered. Therefore, not all the CIVs would be operational. However, our review indicates that the AAC power is not capable of powering all the proposed loads in the blacked out unit and the licensee needs to verify that appropriate containment integrity can be assured during an SBO event.

6. **Reactor Coolant Inventory**

Licensee's Submittal

The licensee stated that the AAC source powers the necessary makeup system to maintain adequate reactor coolant system inventory to ensure that the core is cooled for the required coping duration.

Review of Licensee's Submittal

The reactor coolant system (RCS) losses which the licensee needs to consider are:

1. 25 gpm per pump losses through reactor coolant pump seals per NUMARC guidelines,

2. maximum allowable RCS leakage per plant technical specifications.

Byron has four reactor coolant pumps which will lose a total of 100 gpm seal leakage from the reactor coolant system (RCS). The licensee stated that the maximum allowed RCS leakage per technical specification is 11 gpm. Therefore, a total of 111 gpm leakage from the RCS must be made up in order to maintain inventory.

Since the licensee's AAC power source does not conform to the NRC's guidance and the requirements of the SBO rule, the assumption that the AAC powers the make-up system is invalid. Therefore, the licensee needs to perform an evaluation showing that, with an RCS leakage of 111 gpm, the core will not be uncovered during an SBO event.

3.4 Proposed Procedure and Training

Licensee's Submittal

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

1. AC power restoration, and

2. Severe weather (tornado).

Procedures dealing with SBO response have been reviewed and will be modified to:

1. start and load the AAC,

2. ensure operation of the diesel-driven AFW pump,

3. start a charging pump, and

4. restore offsite and EAC power when available.

The licensee stated that procedure changes required to conform with the NUMARC guidelines will be implemented within one year of the notification from the NRC staff per 10 CFR 50.63(c)(3).

Review of Licensee's Submittal

The affected procedures were not submitted by the licensee for the NRC staff review. We view these procedures as plant specific actions concerning the required activities to cope with an SBO. We believe that 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 the that associated training needs are carried out accordingly.

3.5 Proposed Modifications

Licensee's Submittal

The licensee did not identify any needed modifications to equipment at Byron to cope with a 4-hour SBO event .

Review of Licensee's Submittal

No equipment modifications were discussed in the licensee's submittal. Our analysis indicates that some modifications in terms of changing procedures and/or coping approach are necessary to conform with the requirements of the SBO rule.

3.6 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. The licensee stated that all the SBO equipment is covered by the normal plant quality assurance program and technical specifications. The licensee needs to verify that the SBO equipment is covered by appropriate QA and technical specifications 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 Byron station, we find the submittal does not conform with the SBO rule for the following reasons:

1. **Emergency Diesel Generator Reliability Program**

   The licensee's submittals do not document the conformance of the plant's EDG reliability program with the guidance of the RG 1.155, Section 1.2 and NUMARC 87-00, Appendix D. The licensee stated that plant engineering is in the process of developing a reliability program consistent with the above guidance. The licensee is committed, however, to maintain the targeted EDG reliability of 0.95.

2. **Alternate AC power source**

   The licensee's proposed load shedding of the non-blacked-out (NBO) unit is not in conformance with the requirements of the SBO rule and the guidelines provided in RG 1.155, NUMARC 87-00 Supplemental Questions/Answers. The proposed load shedding scheme will result in the degradation of LOOP safe shutdown capability of the NBO unit. This excess capacity made available by proposed load shedding could not be credited as an AAC source for the blacked out unit (see the discussion under the AAC power source in Section 3.2). Therefore, the AAC power source does not have sufficient capacity to power the proposed safe shutdown equipment in the blacked out unit.

3. **Class 1E Battery Capacity**

   The plant UFSAR indicates that each class 1E battery will last for four hours if the inverter loads on this battery are shed after 30

minutes into the accident. To comply with the NUMARC 87-00 Supplemental Questions/Answers the licensee needs to assess the battery capacity to verify that all normal battery-backed monitoring and electrical system controls are operational during the entire duration of an SBO event and subsequent recovery.

4. **Compressed Air**

The licensee stated that the diesel-driven auxiliary feedwater pump will be used in conjunction with the manual operation of the feedwater and steam release valves to control the decay heat removal process. Since the AAC power source does not conform to the requirements of the SBO rule, and it may not power the ADVs, the licensee needs to provide an alternate means for modulating these valves and simulate the process to train the operators accordingly.

5. **Effects of Loss of Ventilation**

Our review indicates that the AAC power source does not have sufficient capacity to load all the proposed equipment in the blacked-out unit (see item 2 above). The licensee needs to verify that the operability of SBO equipment will not be degraded, and to perform a committed analysis to evaluate the effect of loss of component cooling water flow on the integrity of the containment penetrations.

6. **Containment Isolation**

Our review indicates that the AAC power is not capable of powering all the proposed loads in the blacked out unit. Therefore, the licensee needs to verify that appropriate containment integrity can be assured during an SBO event.

7. Quality Assurance and Technical Specifications

The licensee needs to verify that the SBO equipment is covered by an appropriate QA and technical specification program consistent 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. Nuclear Safety Analysis Center, "The Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants," NSAC-108, Wyckoff, H., September 1986.

10. Richter, M. H., letter to T. E. Murley, Director of Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, "Dresden Station

Units 2 and 3, Quad Cities Station Units 1 and 2, Zion Station Units 1 and 2, La Salle County Station Units 1 and 2, Byron Station Units 1 and 2, Braidwood Station Units 1 and 2, Response to Station Blackout Rule, NRC docket Nos. 50-237/249, 50-254/265, 50-254/265, 50-295/304, 50-373/374, 50-454/455, and 50-456/457," dated April 17, 1989.

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

12. Byron/Braidwood Stations, Updated Final Safety Analysis Report.

13 Thadani, A. C., letter to A. Marion of NUMARC, "Publicly Noticed Meeting December 27, 1989," dated January 3, 1990.

14. Rosa, F., letter to Duquesne Light Company - Beaver Valley Units 1 and 2, "Meeting Summary - Meeting of February 22, 1990, on Station Blackout Issues (TAC 68510/68511)," Docket Nos. 50-334 and 50-412, dated March 6, 1990.

15. ACI 349-80, "Code Requirements for Nuclear Safety Related Concrete Structures (ACI 349-80)," American Concrete Institute, Dated April 1981.

16. Richter, M. H., letter to T. E. Murley of U.S. Nuclear Regulatory Commission, "Dresden Station Units 2 and 3, Quad Cities Station Units 1 and 2, Zion Station Units 1 and 2, La Salle County Station Units 1 and 2, Byron Station Units 1 and 2, Braidwood Station Units 1 and 2, Supplemental Response to Station Blackout Rule, NRC docket Nos. 50-237/249, 50-254/265, 50-254/265, 50-295/304, 50-373/374, 50-454/455, and 50-456/457," dated March 30, 1989.

17. Schuster, T. K., letter to T. E. Murley of U.S. Nuclear Regulatory Commision, "Byron Station Units 1 and 2, Braidwood Station Units 1 and 2, Response to Station Blackout (SBO) Questions, NRC Docket Nos. 50-454/455 and 50-456/457," dated March 29, 1990.

18. Tam P. S., Memorandum for, "Daily Highlight-Forthcoming Meeting with NUMARC on Station Blackout (SBO) Issues (TAC 40577)," (providing a Draft Staff Position Regarding Use of Emergency AC Power Sources (EDGs) as Alternate AC (AAC) Power Sources, dated April 24, 1990), dated April 25, 1990.

19. Russell, W. T., letter to W. Rasln of NUMARC, "STATION BLACKOUT," dated June 6, 1990.

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

ENCLOSURE 3

JUN 6 1990

Mr. William Rasin, Director
Technical Division
Nuclear Management and Resources Council (NUMARC)
1776 Eye Street, N.W., Suite 300
Washington, D.C. 20006-2496

SUBJECT: STATION BLACKOUT

Dear Mr. Rasin:

Mr. Alex Marion's letter to Mr. Ashok Thadani dated May 7, 1990, (Enclosed) proposed an alternate position on the use of existing emergency diesel generators (EDGs) as alternate AC (AAC) sources at multi-unit sites for the purpose of meeting the requirement (AAC option) of the station blackout (SBO) rule.

Mr. Marion's letter indicates that our staffs have not been able to reach agreement on the definition of the "excess EDG capacity" required for qualifying EDGs as an AAC source at multi-unit sites where the EDGs just meet the minimum EDG redundancy requirement. The NRC's long-held position is that such excess capacity should not be attained by load shedding in the non-blackout (NBO) unit which results in a degradation of its normally available safe shutdown capability for the loss-of-offsite-power (LOOP) condition. Any actions that would add to the burden of operators that are already in a high stress environment, such as load switching or disablement of information readouts or alarms in the control room, are considered to be a degradation of normal safe shutdown capability for LOOP in the NBO unit. Each unit must meet the SBO rule on its own merits without reducing another unit's capability to respond to its own potential problems. The NUMARC position, on the other hand, would permit load shedding which may degrade the ability of the non-blackout unit to safely shut down.

"Excess EDG capacity" is difficult to define generically because of the diversity of site and plant design features that must be considered. So it is not unexpected that our staffs would fail to reach agreement on this issue. I believe the net effect of the NRC/NUMARC coordination in regard to SBO has been a positive one and has been effective in reaching agreement on generic resolution of many aspects of SBO rule implementation.

The staff review of licensee responses to the SBO rule which propose to use "excess EDG capacity" will continue based on the NRC position and the previously issued guidance (i.e., R.G. 1.155, NUMARC 87-00, and the NUMARC Supplemental Guidance dated December 27, 1989).

Sincerely,

/S/

William T. Russell, Associate Director
for Inspection and Technical Assessment
Office of Nuclear Reactor Regulation

Enclosure:
Letter from A. Marion (NUMARC) to
A. Thadani (NRC) dated May 7, 1990,
Subject: Station Blackout - TAC 40577

ENCLOSURE 1

NUCLEAR MANAGEMENT AND RESOURCES COUNCIL

1776 Eye Street, N.W. • Suite 300 • Washington, DC 20006-2496
(202) 872-1280

May 7, 1990

Mr. Ashok C. Thadani
Office of Nuclear Reactor Regulation
Division of Systems Technology
U.S. Nuclear Regulatory Commission
8 E2
Washington, DC 20555

Subject: Station Blackout - TAC 40577

Dear Mr. Thadani:

This letter provides our preliminary thoughts in response to concerns expressed by you and members of your staff at our meeting on April 25th. These concerns relate to the use of existing emergency diesel generators (EDGs) to support an alternate AC (AAC) capability at multi-unit sites for the purposes of responding to a station blackout event.

At the April 25th meeting, we received a draft position, "Staff Position Regarding Use of Emergency AC Power Sources (EDGs) as AAC Power Sources." Also, we agree with the underlying tenet expressed in this draft position that the safe shutdown capability of the non-blacked-out (NBO) unit should not be degraded for the purpose of providing AC power to the blacked-out (SBO) unit. However, we are concerned that certain aspects of this draft position are inconsistent with the previous understandings during the development of the final SBO rule and the approved supporting guidance.

We offer the enclosure for your review and consideration. We believe this position accomplishes the following important objectives common to both Industry and NRC:

1. Emphasize that the safe shutdown capability of the NBO should not be degraded in response to a SBO at an adjacent unit.

2. Establish important definitions consistent with the SBO rule and approved supporting guidance necessary for clear understanding and consistent application to individual plants.

3. Provide guidance for achieving and maintaining safe shutdown following a station blackout event.

That the revised position is similar to the Staff's draft underscores that both NUMARC and NRC wish to ensure proper use of EDGs as AAC sources at multi-unit sites. You will note, however, that sample AAC configurations are

not addressed. We believe there is sufficient guidance currently available in both NUMARC 87-00 and RG 1.155. Also, the main focus of the enclosed position is to achieve and maintain a safe shutdown condition at the NBO unit.

It is important to emphasize that the present concern is ancillary to the primary objective of the SBO rule: to reduce the risk from a station blackout. This risk reduction is achieved by maintaining reliable onsite emergency ac power sources and taking steps (including design modifications and procedure development) to assure the capability of plants to cope with and recover from a station blackout. We believe this objective has been satisfied as demonstrated by utility actions in response to the Station Blackout Rule and the resolution of Generic Issue B-56, EDG Reliability.

Consistent with the SBO rule, many utilities (including several multi-unit sites) recognized the safety benefit in establishing crosstie capabilities between units to facilitate use of EDGs from the NBO unit as AAC sources. Utilities undertaking the necessary plant modifications to establish the SBO response capability were also mindful of NRC preference for the AAC option in lieu of AC-Independent coping. The Staff recognized via question answer (Q/A) B.3 in conjunction with Q/A 3.4 of NUMARC's January 4, 1990, supplemental guidance to utilities that load management may occur to facilitate use of EDGs as AAC sources provided that:

(1) the loss of offsite power (LOOP) safe shutdown capability of the NBO unit is not degraded (Q/A B.3) and

(2) utilities identify to NRC those design basis LOOP loads which are conserved and ensure that appropriate justification is available (Q/A 3.4).

The verification and training on plant procedures ensures that contemplated load management actions will not unduly burden operators. Given that these provisions are satisfied, it is our belief that load management that achieves safe shutdown of all units should be acceptable.

Central to the acceptability of appropriate load management actions is the established consensus reaffirmed via Q/A B.1 of January 4, 1990, supplemental guidance that given a station blackout event at a multi-unit site, with one unit in a blacked-out condition, the limiting single failure at the remaining adjacent unit is the loss of one EDG. Since no further single failures need be considered, we believe load management that demostrates the capability to achieve safe shutdown functions consistent with appropriate Emergency Operating Procedures is acceptable. For example, provided that justification is available demonstrating that turbine driven auxiliary feedwater pumps are sufficient to satisfy the decay heat removal shutdown

function and since no other single failures are assumed, then the turbine driven pump can be credited to support this function.

In addition to being consistent with the SBO rule and supporting guidance, the proposed guidance offers the following additional practical benefits:

1. Encourages utilities to pursue plant modifications to achieve the preferred AAC response capability.

2. Recognizes that plant operations personnel are trained to respond to SBO from a site perspective and that utilizing available resources of an adjacent unit to respond to SBO is a logical application of this response philosophy.

3. Permits development of plant SBO response procedures consistent with SBO rule licensing basis.

We respectfully request your review and consideration of the enclosure and we look forward to an opportunity to discuss the proposed guidance with you and members of your staff. With your acceptance of the guidance, we propose to expeditiously forward it to industry as we have in the past. In addition, we intend to incorporate this guidance with examples into the planned revision to NUMARC 87-00 in the near future.

Please contact me if you have any questions.

Consistent with past practice we understand this transmittal will be placed in the public document room.

Sincerely,

Alex Marion

Alex Marion
Manager, Technical Division

AM/baa

cc: A. W. Serkiz, NRC
P. S. Tam, NRC