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May 18, 1990

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden Station Units 2 and 3
Quad Cities Station Units 1 and 2
Revised Response to Station Blackout Rule
NRC Docket Nos. 50-237/249 and 50-254/265

References: (a) 10 CFR Part 50.63, Loss of all Alternating Current Power.
(b) M. Richter (CECo) letter to T.E. Murley (NRC), dated April 17, 1989.
(c) B. Lee (NUMARC) letter to NUMARC Board of Directors, dated January 4, 1990.
(d) M. Richter (CECo) letter to T.E. Murley (NRC), dated March 30, 1990.

Dr. Murley:

Reference (a) requires that each light-water-cooled nuclear power plant be able to withstand and recover from a station blackout (SBO) of a specified duration. A response to the SBO rule was required from each licensee by April 17, 1989. Reference (b) provided Commonwealth Edison Company's (CECo) initial response to the SBO rule for Dresden and Quad Cities Stations. Following the NRC review of the responses for Dresden and Quad Cities Stations, CECo/NRC staff working group meetings were conducted to discuss the responses. As a result of these discussions, and the clarifications presented in Reference (c), new alternatives to comply with the SBO rule were evaluated for these stations. During a meeting on March 28, 1990, the selected alternative was presented to the staff. The staff indicated that the selected alternative complied with the SBO rule, and that submittal of a revised response for each station was required.

The Enclosures (1 and 2) to this letter provide CECo's revised response for Dresden and Quad Cities Stations to the SBO rule. CECo is proposing to install an alternate AC power source at each station to meet the SBO rule.

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As requested during the CECo/NRC staff working group meetings, CECo has reviewed NUREG-1032 for Dresden and Quad Cities Stations and determined that no corrections are necessary. However, it should be noted that since issuance of NUREG-1032, there have been two (2) single unit loss of offsite power events at Dresden Station. These events are documented in Licensee Event Reports 249-89-001 and 237-90-002.

Please address any questions that you may have concerning this response to this office.

Respectfully,

Milton H. Richter

M.H. Richter
Generic Issues Administrator

Attachments: Enclosure 1 - Response to Station Blackout Rule for Dresden Station.
Enclosure 2 - Response to Station Blackout Rule for Quad Cities Station.

cc: A.B. Davis, Regional Administrator - RIII
Senior Resident Inspectors - D/QC
P. Eng. - NRR Project Manager - Dresden
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ENCLOSURE 1

RESPONSE TO STATION BLACKOUT RULE

FOR DRESDEN STATION

ENCLOSURE 1

RESPONSE TO STATION BLACKOUT RULE
FOR DRESDEN STATION

On July 21, 1988, the Nuclear Regulatory Commission (NRC) amended its regulations in 10 CFR, Part 50. A new section, 50.63, was added which requires that each light-water-cooled nuclear power plant be able to withstand and recover from a station blackout (SBO) of a specified duration. Licensees were required to submit station blackout responses by April 17, 1989. In accordance with the rule, Commonwealth Edison Company (CECo) submitted a response for Dresden Station on that date.

Following the NRC review of several licensee responses, it was determined that additional guidance/clarifications were necessary for the industry. The NRC and NUMARC subsequently agreed upon a set of clarifications to the NUMARC guidance consisting of a set of questions and answers. This supplement to NUMARC 87-00 was issued to the industry by NUMARC on January 4, 1990.

Prior to the issuance of the NUMARC letter (January 4, 1990), however, CECo had been involved in discussions with the NRC staff on the SBO responses for Dresden and Quad Cities Stations. As a result of these discussions and the clarifications presented in the NUMARC letter, new alternatives to comply with the SBO rule were evaluated for these stations. During a meeting on March 28, 1990, the selected alternative was presented to the Staff. The Staff indicated that this alternative complied with the SBO rule and that submittal of a revised response for each station would be required.

CECo has evaluated Dresden Station against the requirements of the SBO rule using the recent clarifications of NUMARC 87-00 except where Regulatory Guide 1.155 takes precedence. In some instances, alternative technical methodologies were used. These alternate approaches are highlighted in this response where appropriate.

This response details the plant factors considered in the determination of the proposed station blackout coping duration. In addition, the ability of Dresden Station to cope with a station blackout of this proposed duration is addressed. Finally, procedure revisions and modifications required to conform to the guidance are described. The results of this evaluation are detailed in the response. (Applicable NUMARC 87-00 sections are shown in parentheses.)

A. <u>Proposed Station Blackout Duration</u>

NUMARC 87-00, Section 3, combined with recently issued guidance, was used to determine a proposed SBO duration of four hours. The plant factors considered in determining the proposed station blackout duration and defining the proposed Alternate AC power source are discussed in this section.

1. The current AC Power Design Characteristic Group is P2, however, the modification described in item 'd' will upgrade the site to P1.

   a. Expected frequency of grid-related LOOPs does not exceed once per 20 years (Section 3.2.1, Part 1A, p. 3-3);

   b. Estimated frequency of LOOPs due to extremely severe weather places the plant in ESW Group 1 (Section 3.2.1, Part 1B, p. 3-4);

   c. Estimated frequency of LOOPs due to severe weather places the plant in SW Group 2 (Section 3.2.1, Part 1C, p. 3-7);

   d. The off-site power system is currently in the I3 Group (Section 3.2.1, Part 1D, p. 3-10). However, a plant modification will be made to improve the off-site power system to the I 1/2 group. This modification consists of installing a cross-tie between safety busses 23-1 and 33-1 (as part of the Alternate AC power source modification). Upon installation of this cross-tie, <u>all</u> safety busses on site will have the capability of being supplied by any one of two independent sources of off-site power. Each unit's reserve auxiliary transformer is capable of supplying the safe shutdown loads of both units. A one line diagram of Dresden's Alternate AC configuration is shown on Figure 1.

2. The current Emergency AC power configuration group is D (Section 3.2.2, Part 2C, p. 3-13).

   a. There are three emergency AC power supplies not credited as Alternate AC power sources (Section 3.2.2, Part 2A, p. 3-15);

   b. Two emergency AC power supplies are currently necessary to operate safe shutdown equipment for an extended period following a loss of off-site power (Section 3.2.2, Part 2B, p. 3-15).

   c. The shared emergency diesel generator (EDG 2/3) breaker logic will be modified to allow the diesel generator to connect to safety busses 23-1 and 33-1 simultaneously from the control room.

3. The target EDG reliability to be maintained by the site is 0.95.

   a. A target EDG reliability of 0.95 was selected based on the addition of a non-Class 1E diesel generator meeting the following requirements in addition to the Alternate AC criteria defined in Appendix B of NUMARC 87-00:

      (i) The power source will be connectable to all 4 kV safety busses at the site. These busses are 23-1, 24-1, 33-1, and 34-1.

      (ii) The power source will have the capacity of two existing emergency diesel generators (5,700 kW at 2,000 hours) and will therefore be capable of supplying all loads necessary to achieve and maintain safe shutdown (hot shutdown) for <u>both</u> units at the site during a loss of off-site power. An electrical one-line diagram is shown on Figure 1.

      (iii) The power source will be available within one hour of the onset of the station blackout. A one hour AC independent coping assessment evaluation has been performed and is discussed in Section B of this response.

      (iv) The unit average EDG reliability for the last 100 demands is greater than 0.95, consistent with NUMARC 87-00, Section 3.2.4.

   A diesel generator reliability program incorporating the five elements discussed in Regulatory Guide 1.155 will be established to ensure this target is maintained. In addition, CECo is monitoring the resolution of Generic Issue B-56: Diesel Generator Reliability. When the final guidance on the resolution of this issue is published, CECo will review, and if necessary, revise the program in a manner consistent with the new guidance.

B. Proposed Coping Assessment

The ability of Dresden to cope with a one-hour station blackout in accordance with NUMARC 87-00, Section 7.1.2 is assessed in this section. An Alternate AC power source capable of powering all loads necessary for achieving and maintaining safe shutdown (hot shutdown) for both units at the site in accordance with NUMARC 87-00, Section 3.2.5 will be available after one hour. The coping assessment considers (1) the adequacy of the condensate inventory, (2) the capacity of the Class 1E batteries, (3) the station blackout compressed air requirements, (4) the effects of loss of ventilation on station blackout response equipment, and (5) the ability to maintain containment integrity. Attachment A to this response provides a summary on the coping assessment calculations.

1. Condensate Inventory For Decay Heat Removal (Section 7.2.1)

The isolation condenser would be used in conjunction with the HPCI system for decay heat removal during a station blackout. Since the isolation condenser system receives makeup from the river, an inexhaustible supply of condensate inventory for decay heat removal is available.

It has been determined that less than 20,000 gallons of water are required for reactor makeup water for four hours. The Condensate Storage Tank maintains a minimum volume of 90,000 gallons in reserve for the HPCI system. This amount exceeds the required quantity for coping with a four hour station blackout. A leakage rate of 18 gpm was assumed from each recirculation pump in this analysis. No plant modifications or procedure revisions are needed to utilize this water source.

2. Class 1E Battery Capacity (Section 7.2.2)

The Alternate AC power source will energize a battery charger on each unit within one hour. Calculations have been performed which indicate that these batteries have sufficient capacity to meet the station blackout loads, with no load shedding, for one hour. It was determined for the 24/48 Vdc and 125 Vdc batteries that at least 25% aging margin exists. For the 250 Vdc batteries, it was determined that at least 8% aging margin exists. The station performs a rated load discharge test on these batteries every refueling outage in accordance with the Technical Specifications (surveillance requirement 4.9.A.3). Surveillance procedures will consider aging margin when evaluating battery capacity requirements.

3. Compressed Air (Section 7.2.3)

No air-operated valves are relied upon to cope with a station blackout for one hour. The relief valves needed for depressurization and decay heat removal are dc-powered and do not depend on compressed air for operation. However, compressed air can be restored once the Alternate AC power source becomes available after one hour.

4. Effects of Loss of Ventilation (Section 7.2.4)

The Alternate AC power source will energize heat removal systems such as required HVAC within one hour. However, areas containing SBO response equipment will lose ventilation for one hour. This section documents that reasonable assurance of operability is established for the containment and all dominant areas of concern during the first hour.

a. Dominant Areas of Concern

The dominant areas of concern (DACs) at Dresden were chosen from rooms that, based on documented engineering judgement, (1) contained station blackout response equipment, (2) have substantial heat sources, and (3) lack adequate heat removal systems due to the blackout. These areas are listed in the following table along with their associated station blackout temperature, type of heatup analysis performed, and justification for Reasonable Assurance of Operability (RAO).

AREA	ONE HR. TEMP.	ANALYSIS	RAO JUSTIFICATION
Aux Elect Equip Room	118°F*	NUMARC	less than 120°F
Control Room	119°F	transient (non-NUMARC)	less than 120°F
HPCI Room	130°F	transient (non-NUMARC)	equipment evaluation
Isolation Condenser Area	167°F*	NUMARC	installation of qualified transmitter

* - These temperatures were determined using the methodology outlined in NUMARC 87-00, Section 7.2.4. As documented in NUMARC 87-00, Appendix E, these temperatures are steady-state approximations to the four hour station blackout bulk room temperatures.

Reasonable assurance of equipment operability is established without further analysis if temperatures in the DAC are calculated to be equal to or less than 120°F (NUMARC 87-00 Supplemental Questions/Answer #2.2).

One modification is required to provide reasonable assurance of equipment operability in the above areas. An isolation condenser level indication transmitter qualified for the expected station blackout thermal profile will be installed to ensure that control room indication is provided during a station blackout event. Procedure revisions are required for opening access and panel doors in the Control Room, and panel doors in the Auxiliary Electric Equipment Rooms.

b. Containment

A loss of ventilation analysis has been performed for the drywell under station blackout conditions. This analysis determines that the drywell bulk temperature would be less than 207°F after one hour of a station blackout. This calculation indicates that the drywell temperature does not reach the point at which operators are required to manually depressurize the reactor.

c. Suppression Pool

Relief valve actuations and HPCI turbine exhaust will increase the temperature of the suppression pool in a station blackout. However, since the isolation condenser is the primary means of decay heat removal from the reactor throughout the transient, the suppression pool does not heat up significantly (less than 10°F).

5. Containment Isolation (Section 7.2.5)

The Alternate AC power source will be capable of energizing all containment isolation valves after one hour. However, the station list of containment isolation valves has been reviewed to ensure that containment integrity can be provided during station blackout conditions if this becomes necessary. Valves meeting the exclusion criteria listed in NUMARC 87-00, Section 7.2.5 were excluded from consideration. In addition, valves meeting the following criteria were also excluded from consideration.

(1) Valves that are always procedurally closed during 100% power operation,

(2) Valves that are upstream or downstream of containment isolation valves that meet the NUMARC 87-00 exclusion criteria.

The valves that may require manual actuation to ensure appropriate containment integrity under station blackout conditions will be incorporated into the appropriate station procedure.

6. Quality Assurance

A QA program meeting the requirements of Regulatory Guide 1.155 Appendices A and B will be applied to cover non-safety related equipment needed for coping with a station blackout that are not already covered by existing QA requirements in Appendices B or R of 10 CFR 50.

C. Proposed Procedures and Modifications

This section documents the procedure revisions and modifications required for Dresden to conform to the guidance in NUMARC 87-00. Procedure revisions that are not associated with a modification will be completed one year after the notification provided by the Director, Office of Nuclear Reactor Regulation in accordance with 10 CFR 50.63 (c) (3).

Contingent on notification provided by the Director, Office of Nuclear Reactor Regulation in accordance with 10 CFR 50.63 (c) (3), the modifications, and related procedure revisions, not associated with the installation of the Alternate AC power source (C.2.c and C.2.d) will be completed by the end of the Fall 1992 refueling outage for Unit 3.

The modifications, and related procedure revisions, associated with the Alternate AC power source (C.2.a and C.2.b) will be completed by December 1995, provided notification is provided by the Director, Office of Nuclear Reactor Regulation by August 1990. An installation time exceeding two years is necessary due to the:

- high complexity of the proposed modification,
- equipment ordering lead times required, and
- number of outages required to tie in the new equipment to all safety busses in both units.

1. Procedure Revisions

The following potential procedure revisions have been determined to be necessary to meet the station blackout rule.

TOPIC	PROCEDURE #	NATURE OF REVISION
Loss of Ventilation	DOA 5750-1	open access and panel doors
Containment Isolation	DGA-12	valves that may require manual actuation
Severe Weather	DOA 010-2	inspection for potential missiles, restoration of plant systems
SBO Response	DGA-12	instruction on isolation condenser and HPCI use, instructions on diesel generator loading, instructions on AC power recovery, appropriate references to other procedures
Station Battery Performance Tests	DEP 8300-18,19,20	aging margin accounted for when evaluating battery capacity requirements
Restoration of AC Power	SPSO I-1	system load dispatcher guidance

2. Modifications

The following modifications are proposed:

a. The installation of an Alternate AC power source as described in Section A.3 of this response.

b. Installation of a crosstie between safety busses 23-1 and 33-1 to improve the offsite power system to the I 1/2 group, as described in Section A.1 of this response.

c. Logic changes allowing the shared emergency diesel generator to connect to safety busses 23-1 and 33-1 simultaneously from the control room, as mentioned in Section A.2 of this response.

d. The installation of an isolation condenser level indication transmitter qualified for the expected station blackout thermal profile, as mentioned in Section B.4 of this response.

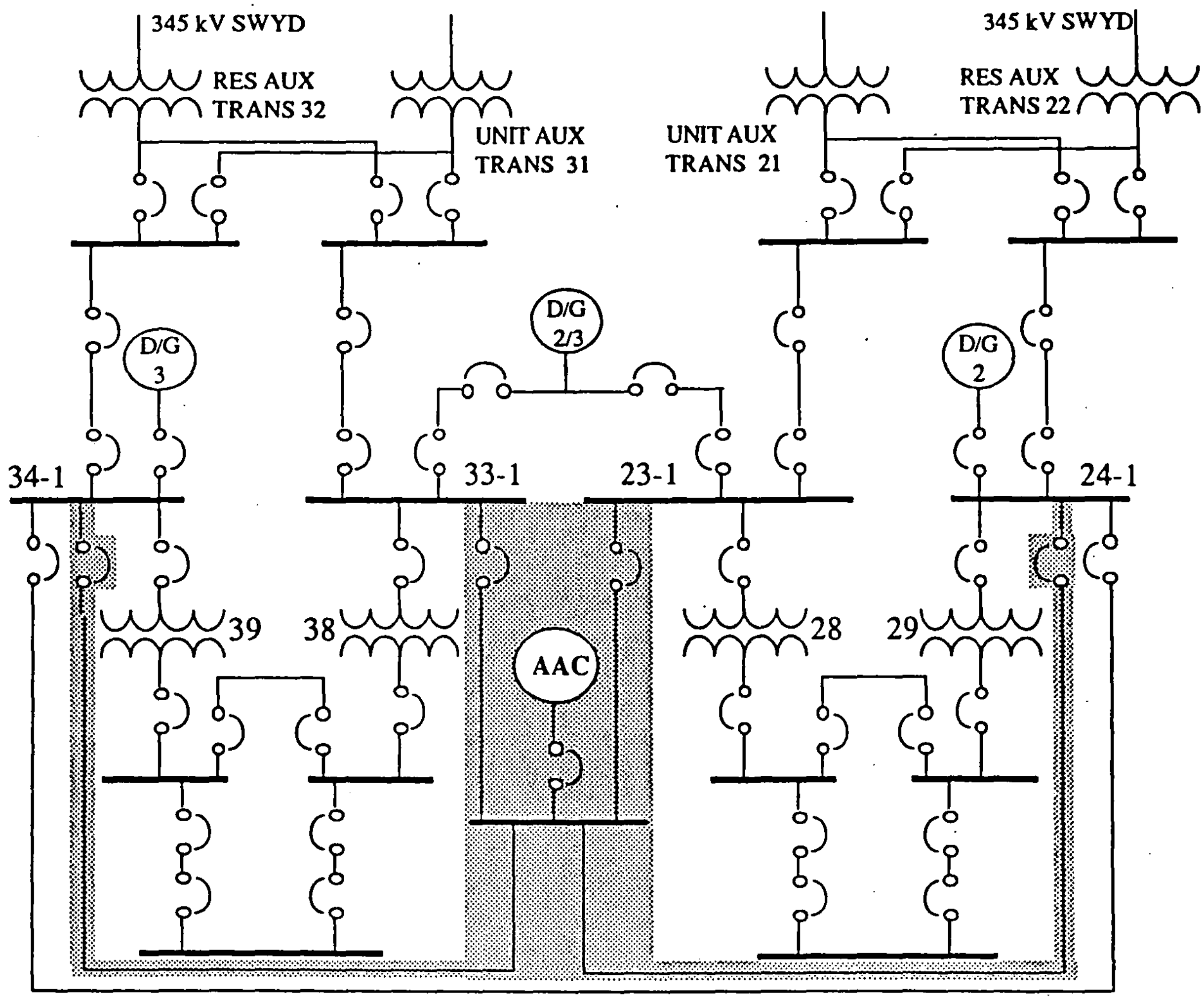

Figure 1: Dresden Electrical One Line Diagram With AAC

Dresden Station Blackout Coping Assessment During Alternate AC Activation

The purpose of this discussion is to demonstrate the ability of Dresden Station to cope without AC power during a station blackout (SBO) event. The proposed alternate AC source will be available within one hour of a blackout event, and will provide the ability to achieve and maintain the plant in a safe shutdown condition for the duration of the event. Previous efforts to address the station blackout issue resulted in the generation of four hour coping calculations for Dresden. These calculations covered the station batteries, suppression pool heatup, vessel inventory, drywell heatup, and heatup of specified areas (such as the control room, isolation condenser area, auxiliary electric equipment room, and the HPCI room). This document will reference and summarize those calculations to demonstrate the ability of Dresden Station to withstand the loss of AC power for a period of 1 hour.

The coping calculations, with the exception of the battery capacity calculations, were all premised on the assumption of a minimum of four hours of blackout. Therefore, operator actions consistent with the Emergency Operating Procedures (EOPs) were identified to manage the usage of DC power and maintain the plant in a stable configuration for as long as possible. The preferred operating strategy was to maintain the plant in a hot shutdown condition for as long as possible, using the isolation condenser to remove decay heat.

Given the assumption of 1 hour versus 4 hour AC availability, Commonwealth Edison has reviewed the previous calculations for applicability and determined that they are directly applicable and demonstrate that the plant can withstand the one hour coping duration. As noted previously, the battery capacity calculations were reperformed for a one hour load profile (to reflect no load shedding).

Drywell Temperature

A calculation was performed to address the effects of loss of drywell cooling during the blackout transient. This calculation was performed with the CONTEMPT-LT026 computer code and allows for drywell heat loads as well as enhanced leakage from the recirculation pump seals. The total leakage considered is 61 gpm; 18 gpm/recirculation pump, plus 25 gpm leakage per plant technical specifications. This calculation demonstrated that drywell temperatures would remain below operator action levels per the EOPs for a minimum of four hours. The drywell heat loads assumed are the full power operating loads, minus the recirculation pump heat load since the pumps are lost initially in the event. After one hour of a station blackout, it was determined that the drywell bulk temperature would be less than 207^{o}F.

Suppression Pool Temperature/Condensate Inventory

A calculation was performed which addressed suppression pool temperature, and vessel pressure and level response, during the blackout transient. This calculation was performed, using the RETRAN-02 computer code, to conservatively estimate the heatup of the suppression pool. A vessel model was included to allow the calculation of vessel parameters (level, pressure) during the event in order to determine the required makeup flow. The model included representation of the isolation condenser both in automatic actuation and under operator controlled cooldown. Reactor makeup requirements are limited due to the ability of the isolation condenser to remove decay heat without reducing vessel inventory. The four hour calculation demonstrates that with an initial short duration HPCI run raising the vessel level to the high level setpoint, the plant can sustain four hours of leakage (61 gpm) plus a limited cooldown (25°F/hr) while retaining the core in a covered condition. Following restoration of AC power, there would be ample water remaining in the condensate storage tank to allow refill of the vessel to normal levels. Since the isolation condenser is the primary means of decay heat removal from the reactor, the suppression pool does not heat up significantly (less than 10°F). The plant's ability to withstand a one hour time period to allow for initiation and loading of the alternate AC source is clearly demonstrated.

DC Battery Capacity

Battery cell sizing calculations were performed for the 24/48 Vdc, 125 Vdc, and 250 Vdc batteries. These calculations considered a one hour load profile with no load shedding, a battery cell electrolyte temperature of 65°F, and recovery loads. It was determined for the 24/48 Vdc and 125 Vdc batteries that at least 25% aging margin exists. For the 250 Vdc batteries, it was determined that at least 8% aging margin exists. These calculations indicate that the batteries have adequate capacity.

Control Room Ventilation

A calculation was performed to address the effects of the loss of the Control Room HVAC system during the blackout transient. This calculation was performed with the Sargent & Lundy computer codes KITTY1S and KITTY1A, and allows for control room heat loads as well as all available heat sinks. This calculation determined that with the boundary doors open, the temperature would be 119°F in one hour. In addition, the control panel doors will be opened to help provide an even temperature distribution across the control panel equipment.

Auxiliary Electric Equipment Room Ventilation

A calculation was performed to address the effects of the loss of the HVAC system serving the Auxiliary Electric Equipment Room during the blackout transient. This calculation was performed using the methodology identified in NUMARC 87-00. This calculation determined that with all doors closed, the steady-state bulk room temperature would be 118°F (after four hours), therefore, room temperature after one hour would be acceptable. As a result, the only required operator action would be to open the electrical equipment panel doors to help provide an even temperature distribution across the equipment.

Isolation Condenser Area

A calculation was performed to address the effects of the loss of the reactor building ventilation system which serves the Isolation Condenser area during the blackout transient. This calculation was performed using the methodology identified in NUMARC 87-00. This calculation determined that with all doors closed, the steady-state bulk temperature would be 167^{O}F (after four hours). A review of the SBO required electrical components in the area was performed, and it was determined that equipment operability is assured when a qualified level transmitter for the isolation condenser is installed. Installation of the qualified transmitter will allow for monitoring of isolation condenser level in the control room during the blackout event. This will preclude local monitoring of level in the isolation condenser area.

HPCI Room Heatup

A transient calculation was performed to determine the effects of loss of the room cooler during HPCI operation. This calculation was performed with the RELAP4M6 computer code. This calculation determined that the room temperature would be 130^{O}F in one hour. A review of the SBO required electrical components in the room was performed, and it was determined that equipment operability would be assured. Additionally, a manual calculation using the NUMARC 87-00 methods was performed, and it was determined that the heat loads utilized in the transient calculation were appropriate.

Conclusion

The previous work performed to demonstrate four hour coping capability for Dresden Station is directly applicable to the current one-hour requirement. No further studies are required. Operator actions required in the first hour are very limited and basically focus on establishing the plant in a stable hot shutdown condition until the Alternate AC power source is available.

ENCLOSURE 2

RESPONSE TO STATION BLACKOUT RULE

FOR QUAD CITIES STATION

ENCLOSURE 2

RESPONSE TO STATION BLACKOUT RULE FOR QUAD CITIES STATION

On July 21, 1988, the Nuclear Regulatory Commission (NRC) amended its regulations in 10 CFR, Part 50. A new section, 50.63, was added which requires that each light-water-cooled nuclear power plant be able to withstand and recover from a station blackout (SBO) of a specified duration. Licensees were required to submit station blackout responses by April 17, 1989. In accordance with the rule, Commonwealth Edison Company (CECo) submitted a response for Quad Cities Station on that date.

Following the NRC review of several licensee responses, it was determined that additional guidance/clarifications were necessary for the industry. The NRC and NUMARC subsequently agreed upon a set of clarifications to the NUMARC guidance consisting of a set of questions and answers. This supplement to NUMARC 87-00 was issued to the industry by NUMARC on January 4, 1990.

Prior to the issuance of the NUMARC letter (January 4, 1990), however, CECo had been involved in discussions with the NRC staff on the SBO responses for Dresden and Quad Cities Stations. As a result of these discussions and the clarifications presented in the NUMARC letter, new alternatives to comply with the SBO rule were evaluated for these stations. During a meeting on March 28, 1990, the selected alternative was presented to the Staff. The Staff indicated that this alternative complied with the SBO rule and that submittal of a revised response for each station would be required.

CECo has evaluated Quad Cities Station against the requirements of the SBO rule using the recent clarifications of NUMARC 87-00 except where Regulatory Guide 1.155 takes precedence. In some instances, alternative technical methodologies were used. These alternate approaches are highlighted in this response where appropriate.

This response details the plant factors considered in the determination of the proposed station blackout coping duration. In addition, the ability of Quad Cities Station to cope with a station blackout of this proposed duration is addressed. Finally, procedure revisions and modifications required to conform to the guidance are described. The results of this evaluation are detailed in the response. (Applicable NUMARC 87-00 sections are shown in parentheses.)

A. <u>Proposed Station Blackout Duration</u>

NUMARC 87-00, Section 3, combined with recently issued guidance, was used to determine a proposed SBO duration of four hours. The plant factors considered in determining the proposed station blackout duration and defining the proposed Alternate AC power source are discussed in this section.

1. The current AC Power Design Characteristic Group is P2, however, the modification described in item 'd' will upgrade the site to P1.

   a. Expected frequency of grid-related LOOPs does not exceed once per 20 years (Section 3.2.1, Part 1A, p. 3-3);

   b. Estimated frequency of LOOPs due to extremely severe weather places the plant in ESW Group 1 (Section 3.2.1, Part 1B, p. 3-4);

   c. Estimated frequency of LOOPs due to severe weather places the plant in SW Group 2 (Section 3.2.1, Part 1C, p. 3-7);

   d. The off-site power system is currently in the I3 Group (Section 3.2.1, Part 1D, p. 3-10). However, a plant modification will be made to improve the off-site power system to the I 1/2 group. This modification consists of installing a cross-tie between safety busses 13-1 and 23-1 (as part of the Alternate AC power source modification). Upon installation of this cross-tie, <u>all</u> safety busses on site will have the capability of being supplied by any one of two independent sources of off-site power. Each unit's reserve auxiliary transformer is capable of supplying the safe shutdown loads of both units. A one line diagram of Quad Cities' Alternate AC configuration is shown on Figure 1.

2. The current Emergency AC power configuration group is D (Section 3.2.2, Part 2C, p. 3-13).

   a. There are three emergency AC power supplies not credited as Alternate AC power sources (Section 3.2.2, Part 2A, p. 3-15);

   b. Two emergency AC power supplies are currently necessary to operate safe shutdown equipment for an extended period following a loss of off-site power (Section 3.2.2, Part 2B, p. 3-15).

   c. The shared emergency diesel generator (EDG 1/2) breaker logic will be modified to allow the diesel generator to connect to safety busses 13-1 and 23-1 simultaneously from the control room.

3. The target EDG reliability to be maintained by the site is 0.95.

a. A target EDG reliability of 0.95 was selected based on the addition of a non-Class 1E diesel generator meeting the following requirements in addition to the Alternate AC criteria defined in Appendix B of NUMARC 87-00:

(i) The power source will be connectable to all 4 kV safety busses at the site. These busses are 13-1, 14-1, 23-1, and 24-1.

(ii) The power source will have the capacity of two existing emergency diesel generators (5,700 kW at 2,000 hours) and will therefore be capable of supplying all loads necessary to achieve and maintain safe shutdown (hot shutdown) for <u>both</u> units at the site during a loss of off-site power. An electrical one-line diagram is shown on Figure 1.

(iii) The power source will be available within one hour of the onset of the station blackout. A one hour AC independent coping assessment evaluation has been performed and is discussed in Section B of this response.

(iv) The unit average EDG reliability for the last 100 demands is greater than 0.95, consistent with NUMARC 87-00, Section 3.2.4.

A diesel generator reliability program incorporating the five elements discussed in Regulatory Guide 1.155 will be established to ensure this target is maintained. In addition, CECo is monitoring the resolution of Generic Issue B-56: Diesel Generator Reliability. When the final guidance on the resolution of this issue is published, CECO will review, and if necessary, revise the program in a manner consistent with the new guidance.

B. Proposed Coping Assessment

The ability of Quad Cities to cope with a one-hour station blackout in accordance with NUMARC 87-00, Section 7.1.2 is assessed in this section. An Alternate AC power source capable of powering all loads necessary for achieving and maintaining safe shutdown (hot shutdown) for both units at the site in accordance with NUMARC 87-00, Section 3.2.5 will be available after one hour. The coping assessment considers (1) the adequacy of the condensate inventory, (2) the capacity of the Class 1E batteries, (3) the station blackout compressed air requirements, (4) the effects of loss of ventilation on station blackout response equipment, and (5) the ability to maintain containment integrity. Attachment A to this response provides a summary on the coping assessment calculations.

1. Condensate Inventory For Decay Heat Removal (Section 7.2.1)

   It has been determined from Section 7.2.1 of NUMARC 87-00 that 78,000 gallons of water are required for decay heat removal for four hours. The Condensate Storage Tank (per FSAR Section 4.5.3) maintains a minimum volume of 90,000 gallons in reserve for the RCIC system. In addition, RCIC suction can be switched to the suppression pool, which contains approximately 800,000 gallons. Each water source exceeds the required quantity for coping with a four hour station blackout. A leakage rate of 18 gpm was assumed from each recirculation pump in this analysis. No plant modifications or procedure revisions are needed to utilize either water source.

2. Class 1E Battery Capacity (Section 7.2.2)

   The Alternate AC power source will energize a battery charger on each unit within one hour. Calculations have been performed which indicate that these batteries have sufficient capacity to meet the station blackout loads, with no load shedding, for one hour. It was determined for the 125 Vdc batteries that at least 25% aging margin exists. For the 250 Vdc batteries, it was determined that at least 18% aging margin exists. The station performs a rated load discharge test on these batteries every refueling outage in accordance with the Technical Specifications (surveillance requirement 4.9.B.3). Surveillance procedures will consider aging margin when evaluating battery capacity requirements.

3. Compressed Air (Section 7.2.3)

   No air-operated valves are relied upon to cope with a station blackout for one hour. The relief valves needed for depressurization and decay heat removal are dc-powered and do not depend on compressed air for operation. However, compressed air can be restored once the Alternate AC power source becomes available after one hour.

4. Effects of Loss of Ventilation (Section 7.2.4)

The Alternate AC power source will energize heat removal systems such as required HVAC within one hour. However, areas containing SBO response equipment will lose ventilation for one hour. This section documents that reasonable assurance of operability is established for the containment and all dominant areas of concern during the first hour.

a. Dominant Areas of Concern

The dominant areas of concern (DACs) at Quad Cities were chosen from rooms that, based on documented engineering judgement, (1) contained station blackout response equipment, (2) have substantial heat sources, and (3) lack adequate heat removal systems due to the blackout. These areas are listed in the following table along with their associated station blackout temperature, type of heatup analysis performed, and justification for Reasonable Assurance of Operability (RAO).

AREA	ONE HR. TEMP.	ANALYSIS	RAO JUSTIFICATION
Aux Elect Equip Room	117°F*	NUMARC	less than 120°F
Control Room	111°F	transient (non-NUMARC)	less than 120°F
RCIC Room	<120°F	transient (non-NUMARC)	less than 120°F

* - This temperature was determined using the methodology outlined in NUMARC 87-00, Section 7.2.4. As documented in NUMARC 87-00, Appendix E, this temperature is a steady-state approximation to the four hour station blackout bulk room temperature.

Reasonable assurance of equipment operability is established without further analysis if temperatures in the DAC are calculated to be equal to or less than 120°F (NUMARC 87-00 Supplemental Questions/Answer #2.2).

No modifications are required to provide reasonable assurance of equipment operability in the above areas. Procedure revisions are required for use of a portable fan to provide air circulation in the Control Room, for opening access and panel doors in the Control Room, and for opening panel doors in the Auxiliary Electric Equipment Rooms.

b. Containment

A loss of ventilation analysis has been performed for the drywell under station blackout conditions. This analysis determines that the drywell bulk temperature would be less than 207°F after one hour of a station blackout. This calculation indicates that the drywell temperature does not reach the point at which operators are required to manually depressurize the reactor.

c. Suppression Pool

Relief valve actuations and RCIC turbine exhaust will increase the temperature of the suppression pool in a station blackout. Since RHR will only be available after one hour, the suppression pool thermal behavior was analyzed to ensure that the temperature/pressure limits were not exceeded. This analysis indicates that these limits are not exceeded during the first hour.

5. Containment Isolation (Section 7.2.5)

The Alternate AC power source will be capable of energizing all containment isolation valves after one hour. However, the station list of containment isolation valves has been reviewed to ensure that containment integrity can be provided during station blackout conditions if this becomes necessary. Valves meeting the exclusion criteria listed in NUMARC 87-00, Section 7.2.5 were excluded from consideration. In addition, valves meeting the following criteria were also excluded from consideration.

(1) Valves that are always procedurally closed during 100% power operation,

(2) Valves that are upstream or downstream of containment isolation valves that meet the NUMARC 87-00 exclusion criteria.

The valves that may require manual actuation to ensure appropriate containment integrity under station blackout conditions will be incorporated into the appropriate station procedure.

6. Quality Assurance

A QA program meeting the requirements of Regulatory Guide 1.155 Appendices A and B will be applied to cover non-safety related equipment needed for coping with a station blackout that are not already covered by existing QA requirements in Appendices B or R of 10 CFR 50.

C. Proposed Procedures and Modifications

This section documents the procedure revisions and modifications required for Quad Cities to conform to the guidance in NUMARC 87-00. Procedure revisions that are not associated with a modification will be completed one year after the notification provided by the Director, Office of Nuclear Reactor Regulation in accordance with 10 CFR 50.63 (c) (3).

Contingent on notification provided by the Director, Office of Nuclear Reactor Regulation in accordance with 10 CFR 50.63 (c) (3), the modifications, and related procedure revisions, not associated with the installation of the Alternate AC power source (C.2.c) will be completed by the end of the Spring 1993 refueling outage for Unit 2.

The modifications, and related procedure revisions, associated with the Alternate AC power source (C.2.a and C.2.b) will be completed by December 1995, provided notification is provided by the Director, Office of Nuclear Reactor Regulation by August 1990. An installation time exceeding two years is necessary due to the:

- high complexity of the proposed modification,
- equipment ordering lead times required, and
- number of outages required to tie in the new equipment to all safety busses in both units.

1. Procedure Revisions

The following potential procedure revisions have been determined to be necessary to meet the station blackout rule.

TOPIC	PROCEDURE #	NATURE OF REVISION
Loss of Ventilation	QOA 5750-15	open access and panel doors, use portable fan
Containment Isolation	QOA 6100-4	valves that may require manual actuation
Severe Weather	QOA 010-10	inspection for potential missiles, restoration of plant systems
SBO Response	QOA 6100-4	instruction on RCIC and HPCI use, instructions on diesel generator loading, instructions on AC power recovery, appropriate references to other procedures
Station Battery Testing	new procedure	aging margin accounted for when evaluating battery capacity requirements
Restoration of AC Power	SPSO I-1	system load dispatcher guidance

2. Modifications

The following modifications are proposed:

a. The installation of an Alternate AC power source as described in Section A.3 of this response.

b. Installation of a crosstie between safety busses 13-1 and 23-1 to improve the offsite power system to the I 1/2 group, as described in Section A.1 of this response.

c. Logic changes allowing the shared emergency diesel generator to connect to safety busses 13-1 and 23-1 simultaneously from the control room, as mentioned in Section A.2 of this response.

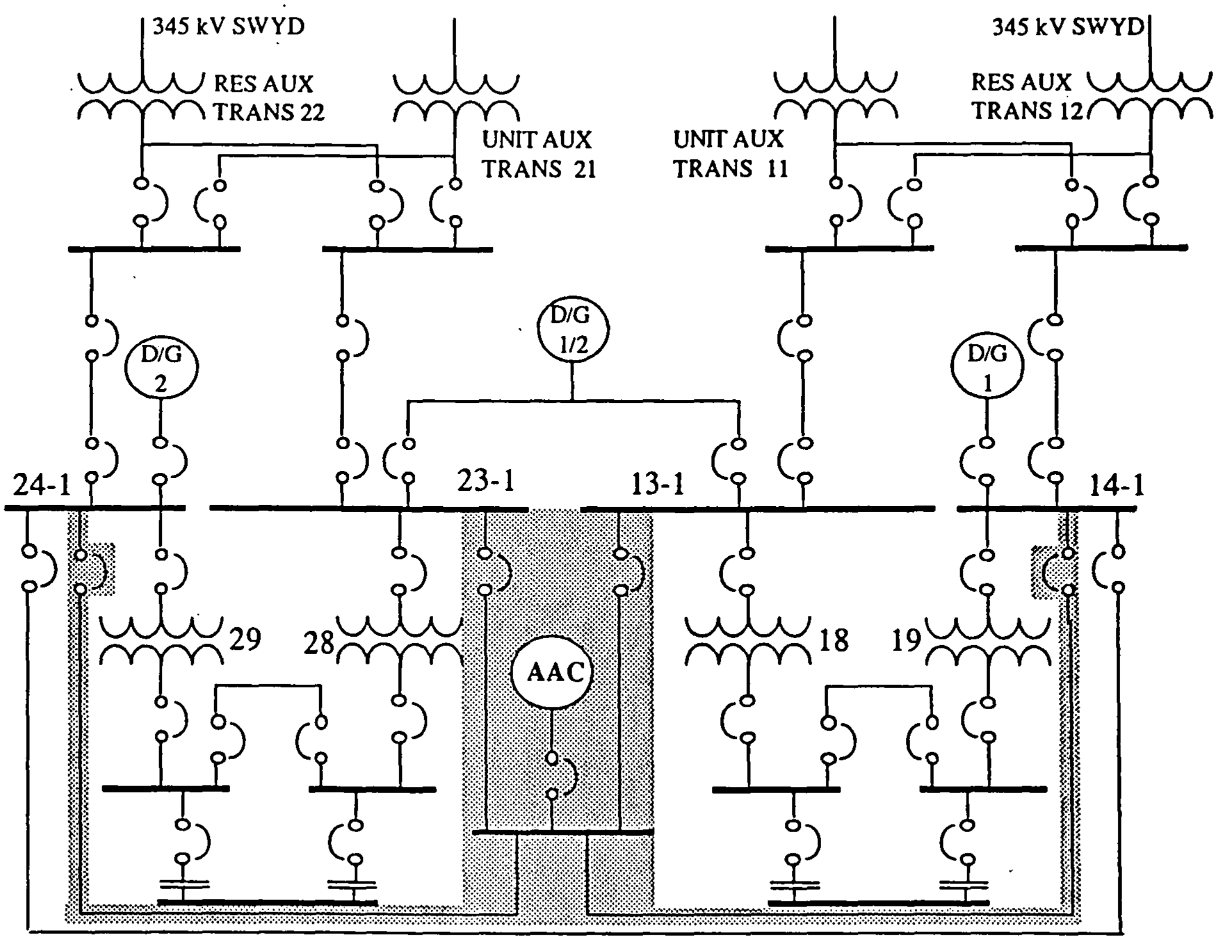

Figure 1: Quad Cities Electrical One Line Diagram with AAC

Quad Cities Station Blackout Coping Assessment During Alternate AC Activation

The purpose of this discussion is to demonstrate the ability of Quad Cities Station to cope without AC power during a station blackout (SBO) event. The proposed alternate AC source will be available within one hour of a blackout event, and will provide the ability to achieve and maintain the plant in a safe shutdown condition for the duration of the event. Previous efforts to address the station blackout issue resulted in the generation of four hour coping calculations for Quad Cities. These calculations covered the station batteries, suppression pool heatup, vessel inventory, drywell heatup, and heatup of specified areas (such as the control room, auxiliary electric equipment room and RCIC room). This document will reference and summarize those calculations to demonstrate the ability of Quad Cities Station to withstand the loss of AC power for a period of 1 hour.

The coping calculations, with the exception of the battery capacity calculations, were all premised on the assumption of a minimum of four hours of blackout. Therefore, operator actions consistent with the Emergency Operating Procedures (EOPs) were identified to manage the usage of DC power and maintain the plant in a stable configuration for as long as possible. The preferred operating strategy was to maintain the plant in a hot shutdown condition for as long as possible, beginning cooldown only when the suppression pool temperature limits require vessel depressurization.

Given the assumption of 1 hour versus 4 hour AC availability, Commonwealth Edison has reviewed the previous calculations for applicability and determined that they are directly applicable and demonstrate that the plant can withstand the one hour coping duration. As noted previously, the battery capacity calculations were reperformed for a one hour load profile (to reflect no load shedding).

Drywell Temperature

A calculation was performed to address the effects of loss of drywell cooling during the blackout transient. This calculation was performed with the CONTEMPT-LT026 computer code and allows for drywell heat loads as well as enhanced leakage from the recirculation pump seals. The total leakage considered is 61 gpm; 18 gpm/recirculation pump, plus 25 gpm leakage per plant technical specifications. This calculation demonstrated that drywell temperatures would remain below operator action levels per the EOPs for a minimum of four hours. The drywell heat loads assumed are the full power operating loads, minus the recirculation pump heat load since the pumps are lost initially in the event. After one hour of a station blackout, it was determined that the drywell bulk temperature would be less than 207°F.

Suppression Pool Temperature/Condensate Inventory

A calculation was performed which addressed suppression pool temperature, and vessel pressure and level response, during the blackout transient. This calculation was performed, using the RETRAN-02 computer code, to conservatively estimate the heatup of the suppression pool. A vessel model was included to allow the calculation of vessel parameters (level, pressure) during the event in order to determine the required makeup flow. The model also allowed for the simulation of operator actions to depressurize the vessel based on suppression pool temperature requirements. This calculation demonstrates that with the appropriate operator response the plant can meet the requirements of the EOPs over a four hour period, with only the RCIC pump and manual actuation of Electromatic relief valves. The amount of water injected by the RCIC System in the four hour calculation is within the Technical Specification limits for the minimum required level in the condensate storage tank. It was also determined that the suppression pool temperature achieved in one hour did not exceed 130^{o}F. The plant's ability to withstand a one hour time period to allow for initiation and loading of the alternate AC source is clearly demonstrated.

DC Battery Capacity

Battery cell sizing calculations were performed for the 125 Vdc and 250 Vdc batteries. These calculations considered a one hour load profile with no load shedding, a battery cell electrolyte temperature of 65^{o}F, and recovery loads. It was determined for the 125 Vdc batteries that at least 25% aging margin exists. For the 250 Vdc batteries, it was determined that at least 18% aging margin exists. These calculations indicate that the batteries have adequate capacity.

Control Room Ventilation

A calculation was performed to address the effects of the loss of the Control Room HVAC system during the blackout transient. This calculation was performed with the Sargent & Lundy computer codes KITTY1S and KITTY1A, and allows for control room heat loads (both internal and external) as well as all available heat sinks. This calculation determined that with all boundary doors closed, the temperature would exceed 120^{o}F in one hour. Operator action is required to place a portable fan in operation to enhance flow through open doorways and reduce the temperature to 111^{o}F. In addition, the control panel doors will be opened to help provide an even temperature distribution across the control panel equipment.

Auxiliary Electric Equipment Room Ventilation

A calculation was performed to address the effects of the loss of the HVAC system serving the Auxiliary Electric Equipment Room during the blackout transient. This calculation was performed using the methodology identified in NUMARC 87-00. This calculation determined that with all doors closed, the steady-state bulk room temperature would be 117^{o}F (after four hours), therefore, room temperature after one hour would be acceptable. As a result, the only required operator action would be to open the electrical equipment panel doors to help provide an even temperature distribution across the equipment.

RCIC Room Heatup

A transient calculation was performed to address the effects of the loss of the HVAC system and room cooler serving the RCIC room. This calculation was performed with the RELAP4M6 computer code. It was determined that after one hour, room temperature will be less than 120°F. Additionally, a manual calculation using the NUMARC 87-00 methods was performed, and it was determined that the heat loads utilized in the transient calculation were conservative.

Conclusion

The previous work performed to demonstrate four hour coping capability for Quad Cities Station is directly applicable to the current one-hour requirement. No further studies are required. Operator actions required in the first hour are very limited and basically focus on establishing the plant in a stable hot shutdown condition until the Alternate AC power source is available.