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April 3, 1990

Docket Nos. 50-277
50-278

License Nos. DPR-44
DPR-56

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Peach Bottom Atomic Power Station, Units 2 and 3
10 CFR 50.63, "Loss of All Alternating Current Power"
Supplemental Information

Dear Sir:

On July 21, 1988, the NRC amended its regulations in 10 CFR 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. 10 CFR 50.63 further required that each licensee submit the following information.

1. A proposed station blackout duration, including a justification for its selection based on the redundancy and reliability of the on-site emergency alternating current (AC) power sources, the expected frequency of loss of offsite power, and the probable time needed to restore offsite power.

2. A description of the procedures that will be implemented for station blackout events for the duration (as determined in 1 above) and for recovery therefrom.

3. A list and proposed schedule for any needed modifications to equipment and associated procedures necessary for the specified station blackout duration.

The NRC also issued Regulatory Guide 1.155, "Station Blackout," which describes a means acceptable to the NRC for meeting the requirements of 10 CFR 50.63. Regulatory Guide (RG) 1.155 states that the NRC has determined that the document issued by the Nuclear Utility Management and Resources Council, NUMARC 87-00,

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"Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout At Light Water Reactors," also provides guidance that is in large part identical to the RG 1.155 guidance and is acceptable to the NRC for meeting the requirements of 10 CFR 50.63. Table 1 to RG 1.155 provides a cross-reference between RG 1.155 and NUMARC 87-00 and notes where the RG takes precedence.

Philadelphia Electric Company (PECo) evaluated the Peach Bottom Atomic Power Station (PBAPS) in accordance with the requirements of the SBO rule using guidance from NUMARC 87-00, except where R.G. 1.155 takes precedence. The results of this evaluation were submitted to the NRC as required by 10 CFR 50.63(c)(1) by our letter dated April 17, 1989. As a result of subsequent NRC reviews of licensee submittals and NRC discussions with NUMARC, NUMARC has requested that we supplement our April 17, 1989 submittal to the NRC indicating that 1) our April 17, 1989 submittal was based on use of the NUMARC 87-00 guidance including recently provided clarifications, and/or 2) any deviations from the accepted NUMARC 87-00 guidance have been or will be clearly indicated. Also, we are to affirm our understanding that the emergency diesel generator (EDG) target reliability is to be maintained. Accordingly, we have evaluated our April 17, 1989 submittal and PBAPS Units 2 and 3 with respect to the requirements of 10 CFR 50.63, including recent clarifications of the guidance in NUMARC 87-00.

We have verified that 1) our use of the NUMARC guidance is consistent with the recent clarifications, 2) the applicability of the NUMARC 87-00 assumptions is documented, and 3) all departures from the accepted NUMARC 87-00 methodology are identified and described below. Accordingly, this letter details the plant factors identified in the determination of the proposed station blackout coping duration. In addition, the ability of the PBAPS to cope with a station blackout of this proposed duration is addressed. The results of this evaluation, including a description of any departures from the NUMARC 87-00 guidance, are detailed below. Applicable NUMARC 87-00 sections are shown in parentheses.

A. Proposed Station Blackout Duration

NUMARC 87-00, Section 3, was used to determine a required coping duration category of eight hours. This section documents the plant factors that were identified in determining the proposed station blackout duration and describes the proposed Alternate AC power supply.

1. AC Power Design Characteristic Group is P2 based on the following.

   a. Expected frequency of grid-related loss of offsite power (LOOP) events does not exceed once per 20 years (Section 3.2.1, Part 1A, p. 3-3).

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

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

d. The offsite power system is in the I1/2 Group (Section 3.2.1, Part 1D, p. 3-10).

Each offsite power source is stepped down from 13 kV to 4 kV through an emergency auxiliary transformer and is connected through interlocked circuit breakers to every 4 kV emergency switchgear bus. Every 4 kV emergency switchgear bus is energized from one of these two sources at all times during normal operation. Upon loss of power, automatic transfer is made to the second source. Each offsite source can supply all engineered safeguard buses to ensure that all safe shutdown loads can be accommodated. Loss of both offsite power sources results in the automatic starting and alignment of the EDGs. The loads are progressively and sequentially added such that core cooling, containment integrity, and other vital safe shutdown functions are maintained.

2. The emergency AC (EAC) power configuration group is "D" based on the following (Section 3.2.2, Part 2C, p. 3-13).

   a. There are three shared EAC power supplies not credited as alternate AC power sources for the station (Section 3.2.2, Part 2A, p. 3-15).

   b. Two EAC power supplies are necessary to operate safe shutdown equipment for both units for an extended period following a station loss of offsite power event (Section 3.2.2, Part 2B, p. 3-15).

   NOTE: A limited amount of operator actions are credited to initiate cross-ties between electrical power sources in order to justify a two out of three EAC configuration. More detail on the required operator actions is provided in subsequent sections.

This EAC power configuration group is different than that originally identified in our submittal of April 17, 1989. The original submittal presented an EAC configuration group "C". We have changed our EAC configuration group to "D" based on the results of our containment suppression pool heatup analysis. Our original understanding of the requirement that the EAC power source be capable of powering safe shutdown electrical loads for an "extended period of time" was that this period be slightly greater than the proposed station blackout coping duration, i.e., greater than the original coping duration category of four hours. The suppression pool heatup analysis shows that using only one Residual Heat Removal (RHR) pump in the suppression pool cooling mode, alternating between each unit's suppression pool as originally proposed, would result in suppression pool temperatures that would affect the RHR pump net positive suction head after approximately eight hours following the loss of offsite power event. Therefore, we have concluded that two EAC power supplies are necessary to maintain both units in a safe shutdown conditions for an extended period of time as recently clarified. Additionally, the use of two EAC power supplies instead of one allows the flexibility to power loads for both units in a manner that is more consistent with that described in the Updated Final Safety Analysis Report (UFSAR).

3. The target EDG reliability of 0.975 will be maintained.

A target EDG reliability of 0.975 is justified based on having a nuclear unit average EDG reliability for the last 100 demands greater than 0.95, consistent with NUMARC 87-00, Section 3.2.4.

Additionally, we are following the resolution of Generic Safety Issue B-56, "Diesel Reliability," and will review the guidance documents for their applicability to the PBAPS upon completion.

4. An alternate AC (AAC) power source will be utilized at the PBAPS which meets the criteria specified in Appendix B to NUMARC 87-00. The AAC source is a Class IE EAC power source which meets the assumptions in Section 2.3.1 of NUMARC 87-00.

A dynamic loading analysis has been performed which demonstrates that the EDGs can power the required safe shutdown loads while maintaining the appropriate voltage and frequency standards during a LOOP event. This analysis has identified loading conditions that must be met prior to the starting of an RHR or High Pressure Service Water pump. This analysis has also identified the potential for contactors to de-energize during the voltage transient caused by starting these large pump motors. Field testing has demonstrated that the contactors do not, in actuality, drop out; the analysis only considered the drop out values referenced by the manufacturer. The impact of these loads being de-energized has been reviewed and found to be acceptable. The results of the dynamic loading analysis are applicable to the loading of the AAC power source.

The AAC power source is available within one hour of the onset of the station blackout event and has sufficient capacity and capability to operate systems necessary for coping with a station blackout for the required station blackout duration of eight hours to achieve and maintain the station in a safe shutdown condition. An AC independent coping analysis was performed for the one hour required to bring the AAC power source on line.

The AAC power source for the PBAPS utilizes the excess redundancy of the EAC configuration. PBAPS has four EDGs shared between two units. Therefore, for the purposes of this evaluation, a LOOP event or a station blackout is assumed to affect both units at the same time (i.e., there is not one blacked-out unit and one non-blacked-out unit). Typical loads used to support safe shutdown of the station during a LOOP event are listed below. Each EDG is rated for 200 hour operation at 3100 kw. Table 1 below represents the actual loads necessary to maintain PBAPS in a safe shutdown condition.

TABLE 1

STATION SAFE SHUTDOWN LOADS DURING A LOOP (BOTH UNITS)

LOAD DESCRIPTION	UNIT KW LOAD	NO. OF COMPONENTS	TOTAL LOAD (KW)
RHR Pump	1410	2	2820
High Pressure Service Water (HPSW) Pump	760	2	1520
Emergency Service Water (ESW) Pump	196	1	196
Emergency Lighting	40 + 54	2	188
EDG Fuel Oil Transfer Pump	9	2	18
250V/24V Battery Chargers	27	2	54
125V Battery Charger	30	8	240
Uninterruptable (UI) AC Inverter	15	4	80
Reactor Building (RB) Cooling Water Pump	60	2	120
Drywell Cooler Fan	4	4	16
Control Room Vent Fan	8	1	8
Emergency SWGR Supply Fan	40	1	40
Emergency SWGR Exhaust Fan	20	1	20
EDG Vent and Pump Room Fan	45 + 41	2	172
Battery Room Exhaust Fan	12	2	24
RHR Pump Room Cooler Fan	12	2	24
High Pressure Coolant Injection (HPCI) Pump Room Cooler Fan	4	2	8
Reactor Core Isolation Cooling (RCIC) Pump Room Cooler Fan	4	2	8
120V/208V Power Distribution Panel	9+8+37	2	108
RB Area Ventilation	34	2	68
Standby Gas Treatment Exhaust Fan	40	2	80
Air Compressor	80	2	160
		TOTAL KW	5972

The components listed in Table 1 are representative of those loads which can be carried by two (2) EDGs in order to support a LOOP event on both units. In general, the load values listed represent figures from the design basis (full load) conditions. The actual station blackout loads would typically be less than these values due to system configurations, diversities, and conditions. The recently completed EDG dynamic loading study has identified that some of the load values (i.e., from the UFSAR) have changed. These changes do not result in a change to the final conclusions regarding the response of the PBAPS to a station blackout event (i.e., total AAC loads remain less than 3100 KW).

Since all battery chargers are powered by the EAC power source, redundant channels of safe shutdown Control Room instrumentation will be maintained operable.

The AAC power source considers a shutdown methodology using the following systems to perform their related functions.

Function	Systems
Reactor Level Control	HPCI or RCIC
Reactor Pressure Control	Safety/Relief Valves (SRVs)
Suppression Pool Cooling	RHR and HPSW
Support Systems	ESW and 125V DC

Depending on the EDG that is available as the AAC power source, a limited number of operator actions will be necessary to bring the EDG on line. Figure 1 illustrates the PBAPS electrical system single line diagram, while Figures 2 through 5 illustrates the loads that are directly powered from the various EDGs.

The loads required to support a station blackout are given below.

TABLE 2

STATION BLACKOUT SAFE SHUTDOWN AAC LOADS (BOTH UNITS)

LOAD DESCRIPTION	UNIT KW LOAD	NO. OF COMPONENTS	TOTAL LOAD (KW)
RHR Pump	1410	1	1410
HPSW Pump	760	1	760
ESW Pump	196	1	196
Emergency Lighting	40 + 54	2	108
125V Battery Charger	30	4	120
RB Cooling Water Pump	60	2	120
Drywell Cooler Fan	4	4	16
Control RM Vent Fan	8	1	8
Emergency SWGR Supply Fan	40	1	40
Emergency SWGR Ex. Fan	20	1	20
EDG Vent & Pump Room Fan	45 + 41	2	86
Battery Room Exhaust Fan	12	2	24
RHR Pump Room Cooler Fan	12	2	24
HPCI Pump Room Cooler Fan	4	2	8
RCIC Pump Room Cooler Fan	4	2	8
120V/208V Power Distribution Panel	27	2	54
SB Gas Treatment Exhaust Fan	40	2	80
		TOTAL KW	3082

The components listed in Table 2 are representative of those loads which can be carried by one (1) EDG in the event of a station blackout.

PBAPS is a two unit BWR with four EDGs normally aligned to both units. Each EDG powers safe shutdown loads for both units during a LOOP event. Because of this configuration, both units are subjected to a blackout under the conditions imposed by 10 CFR 50.63 and therefore a distinction cannot be made between the

blacked out and the non-blacked out unit. For the purposes of the analysis, both units are considered to be blacked out consistent with the definitions of Appendix A to NUMARC 87-00.

The AAC power source utilized at PBAPS is one of the EAC power supplies. This includes an EDG, a DC power supply, and all the support systems necessary for the operation of the AAC source. This AAC power source will energize battery chargers, service water, selected ventilation loads, and other safe shutdown loads within one hour of the onset of a station blackout. This AAC system is capable of maintaining safe shutdown in both units for the eight hour station blackout duration.

B. Procedure Description

Plant procedures have been reviewed and will be revised, if necessary, to meet the guidelines in NUMARC 87-00, Section 4, in the following areas.

1. Off-site AC power restoration per NUMARC 87-00, Section 4.2.2.

   a. System Operation Division Procedure - "System Restoration following Complete Shutdown."

2. Severe weather in accordance with NUMARC 87-00, Section 4.2.3.

   a) Create a new severe weather procedure to include the following actions.

      i. Inspect the site for missile hazards and reduce such hazards.

      ii. Initiate emergency repairs, as needed, of Emergency Core Cooling Systems (ECCS) and other selected systems required to cope with a blackout.

      iii. Demonstrate EDG operability prior to the arrival of a hurricane.

      iv. Review station blackout procedures.

      v. Review operability of ECCS equipment.

      vi. Place station batteries on EQUALIZE charge as needed.

      vii. Suspend appropriate surveillance test procedures.

   b) Revise Emergency Response Procedure ERP-101 such that an "Alert" is declared in the event of a hurricane warning that involves the station area.

Plant procedures have been reviewed and changes necessary to meet NUMARC 87-00 will be implemented in the following areas.

1. Station blackout response in accordance with NUMARC 87-00, Section 4.2.1.

   a) Revise station blackout Special Event (SE) procedure SE-11 to add an appendix of valves that may require closure should containment isolation be required.

   b) Revise SE-11 to refer to the AC power restoration procedure.

   c) Revise SE-11 to remove steps to open HPCI and RCIC pump room doors.

   d) Revise SE-11 to refer to a new System Operating (SO) procedure concerning maintenance of water inventory in the Condensate Storage Tank (CST) using makeup from Refueling Water Storage Tank (RWST), Torus Water Storage Tank, and Fire System.

   e) Revise SE-11 to address the location of portable lighting and security system keys.

   f) Revise SE-11 to refer to the loss of the Control Room ventilation procedure to address removal of ceiling tiles.

   g) Revise SE-11 to show tables for loading of EDGs as AAC power sources.

   h) Revise SO procedures to provide guidance consistent with the EDG dynamic loading concerns. (This procedure change has been added to the list provided in our April 17, 1989 submittal to account for the EDG dynamic loading evaluation performed as a result of the recent guidance.)

   Note: The list of necessary procedure changes in our April 17, 1989 submittal included a revision to the SE-11 entry condition. Upon further evaluation, we have determined that this change is not needed. Accordingly, it is not included here.

C. Proposed Coping Assessment

The ability of PBAPS to cope with a station blackout in accordance with NUMARC 87-00, Section 3.2.5 has been assessed using NUMARC 87-00, Section 7. This coping assessment considers (1) the adequacy of the condensate inventory, (2) the capacity of the class IE 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.

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

   Using Section 7.2.1 of NUMARC 87-00, we have determined that 118,200 gallons of water are required per unit for decay heat removal for eight hours. An additional 17,300 gallons are required to account for recirculation pump seal leakage per unit (this value was determined assuming an 18 gpm leak

rate from each reactor recirculation pump seal). An additional 20,400 gallons per unit will be needed if reactor depressurization is performed to maintain safe shutdown. The minimum permissible CST volume in accordance with design criteria provides 100,000 gallons. Additional sources of water which will provide the amount needed for reactor makeup to both units, include the RWST and Torus. A pump is not needed to transfer water from the RWST to the CST.

2. Class IE Battery Capacity (Section 7.2.2)

The AAC power source energizes the battery charger for the AAC power division within one hour of the onset of station blackout. These loads include power restoration from either the EAC power supplies or the preferred power source. A battery capacity calculation has been performed in accordance with NUMARC 87-00, Section 7.2.2 to verify that the Class IE batteries have sufficient capacity to meet station blackout loads for one hour.

3. Compressed Air (Section 7.2.3)

Air-operated valves relied upon to cope with a station blackout for eight hours have sufficient backup sources independent of the preferred and blacked out unit's Class IE supply to perform their required functions or fail in the safe position. The ADS valves are provided with a separate short-term, safety grade, pneumatic supply and also a long-term, backup, safety grade, pneumatic supply of nitrogen.

4. Effects of Loss of Ventilation (Section 7.2.4)

The AAC power source will provide ventilation to various areas within one hour of a station blackout. Certain of these areas will contain significant heat loads prior to the initiation of ventilation. Descriptions of the ambient air temperature analyses for the identified dominant areas of concern are provided below.

HPCI and RCIC Pump Rooms

The HPCI and RCIC pump rooms were analyzed using a heatup model developed by the station's Architect/Engineer (i.e., Bechtel), rather than the NUMARC 87-00 methodology. The initial ambient temperature of these rooms was taken to be 110°F, and continuous and intermittent pump operation was considered. No credit was taken for opening of room doors or other supplemental cooling activities. The results of this analysis shows that the steady state temperature is 170°F in the HPCI pump room, and 163°F in the RCIC pump room. This analysis also shows that after four hours, the temperatures are 156°F and 151°F for the HPCI and RCIC pump rooms respectively. Since ventilation will be restored to these rooms one hour after a station blackout, the actual room temperatures will be less than the values given above assuming no room ventilation for four hours.

Control Room

The PBAPS Control Room heatup was analyzed using the NUMARC 87-00 methodology. An initial temperature of 90°F was assumed. This temperature represents an average of the normal Control Room air temperature and the maximum expected temperature of the surrounding areas. Heat inputs to the Control Room were taken from existing Heating, Ventilation, and Air Conditioning (HVAC) calculations, and reduced to account for the absence of heat loads from AC powered lighting. Additionally, non-essential loads were reduced and perimeter ceiling tiles were assumed to be removed to allow credit to be taken for the surface area above the suspended ceiling. Procedures are presently in place to reduce these loads and remove the ceiling tiles for a variety of other scenarios. The removal of the ceiling tiles provides a flow path for heat generated from the annunciator panels to the area above the suspended ceiling. The results of this analysis shows that the room temperature will reach 116.8°F after four hours. However, emergency ventilation will be powered by the AAC power source one hour after the station blackout, and existing calculations show that the Control Room temperature would be maintained at 114°F.

Cable Spreading Room

Our April 17, 1989 submittal provided the results of the room heatup analysis for the Cable Spreading Room after four hours using the NUMARC 87-00 methodology. Since ventilation is not provided to this room by the AAC power source, an evaluation is presently being performed for the Cable Spreading Room to determine the room temperature at the end of eight hours.

Containment

Drywell heatup calculations were performed using a non-NUMARC methodology for station blackout scenarios. These calculations demonstrate that drywell temperatures during an eight hour time frame do not increase beyond 250°F. These analyses account for heat sinks within the drywell and do not credit any equipment or operator actions in reducing drywell temperature.

Reasonable assurance of the operability of station blackout response equipment in the above dominant areas of concern have been assessed using a plant specific analysis which is consistent with the methodology of Appendix F to NUMARC 87-00. No equipment necessary for safe shutdown is found in the Steam Tunnel at PBAPS, therefore it is not considered a dominant area of concern.

The assumption in NUMARC 87-00, Section 2.7.1 that the Control Room will not exceed 120°F during a station blackout has been assessed. We have determined that the Control Room at PBAPS does not reach 120°F during a station blackout and therefore is not a dominant area of concern. Note that the 120°F limit is not

reached at PBAPS provided the operators take actions to provide supplemental cooling by removing selected ceiling tiles within 30 minutes. Ventilation is available to the Control Room within one hour.

The following areas were not considered to be dominant areas of concern due to the presence of ventilation provided by the AAC power source after one hour.

1. EDG Rooms
2. Service Water Pump Rooms
3. Emergency Switchgear Rooms
4. RHR Pump Rooms

Additionally, heat sources in these areas will not be present until the AAC power source is available.

The following areas were not considered to be dominant areas of concern due to the absence of significant heat loads.

1. Battery Rooms
2. 135' Elevation of the Turbine Building (houses the static inverters)

The static inverters at PBAPS are located in an open area on the Turbine Building 135' Elevation. The heat load due to the inverter is less than 5 Kw. A large open hatch is located in the ceiling of the area would transmit most of the heat away from the inverter.

5. Containment Isolation (Section 7.2.5)
The plant list of containment isolation valves has been reviewed to verify that the valves which must be capable of being closed or that must be operated (cycled) under station blackout conditions can be positioned (with indication) independent of the preferred and blacked out station's AC power supplies. The following procedure change is required to ensure that appropriate containment integrity can be provided if necessary, under station blackout conditions.

Procedure SE-11 - "Station Blackout" - Revise to show the containment isolation valves that are required to be manually operated should containment isolation be required. These valves include the following. (Note: This list represents the isolation valves for each unit)

MO-13-016	RCIC Steam Supply
MO-23-016	HPCI Steam Supply
MO-10-13,A,B,C,D	RHR Pump Suction
MO-12-18	Reactor Water Cleanup (RWCU) Pump Suction
MO-14-7A,B,C,D	Core Spray Pump Suction
MO-10-31A or B	RHR Containment Spray
MO-10-26A or B	RHR Containment Spray

MO-10-34A or B	RHR Test and Pool Cooling
MO-10-38A or B	RHR Torus Spray
MO-10-39A or B	RHR Torus Spray
MO-14-26A or B	Core Spray Full Flow Test Line
MO-2-77	Main Steam Drain
MO-10-33	RHR Head Spray
MO-13-41	RCIC Torus Suction
MO-14-71	Torus Water Filter Pump Suction
MO-23-58	HPCI Pump Suction
MO-23-31	HPCI Test Line
MO-10-18	RHR Shutdown Cooling Suction

While the above list was not included in our April 17, 1989 submittal, the original list has been revised to include normally closed valves that fail-as-is. These valves are procedurally closed during power operation and were not originally considered as degrading containment integrity during a station blackout. Recent guidance has identified these valves as being necessary to ensure containment integrity, if necessary, during a station blackout and therefore these valves will be included in PBAPS station blackout procedures.

6. Reactor Coolant Inventory (Section 2.5)
The AAC source powers the necessary make-up systems to maintain adequate reactor coolant system inventory to ensure that the core is cooled for the required coping duration.

The associated procedure changes identified in Parts A, B, and C above 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).

Very truly yours,

G. A. Hunger, Jr.

G. A. Hunger, Jr.
Manager
Licensing Section
Nuclear Services Department

Attachment

cc: W. T. Russell, Administrator, Region I, USNRC
J. J. Lyash, USNRC Senior Resident Inspector, PBAPS

PBAPS STATION ONE LINE DIAGRAM

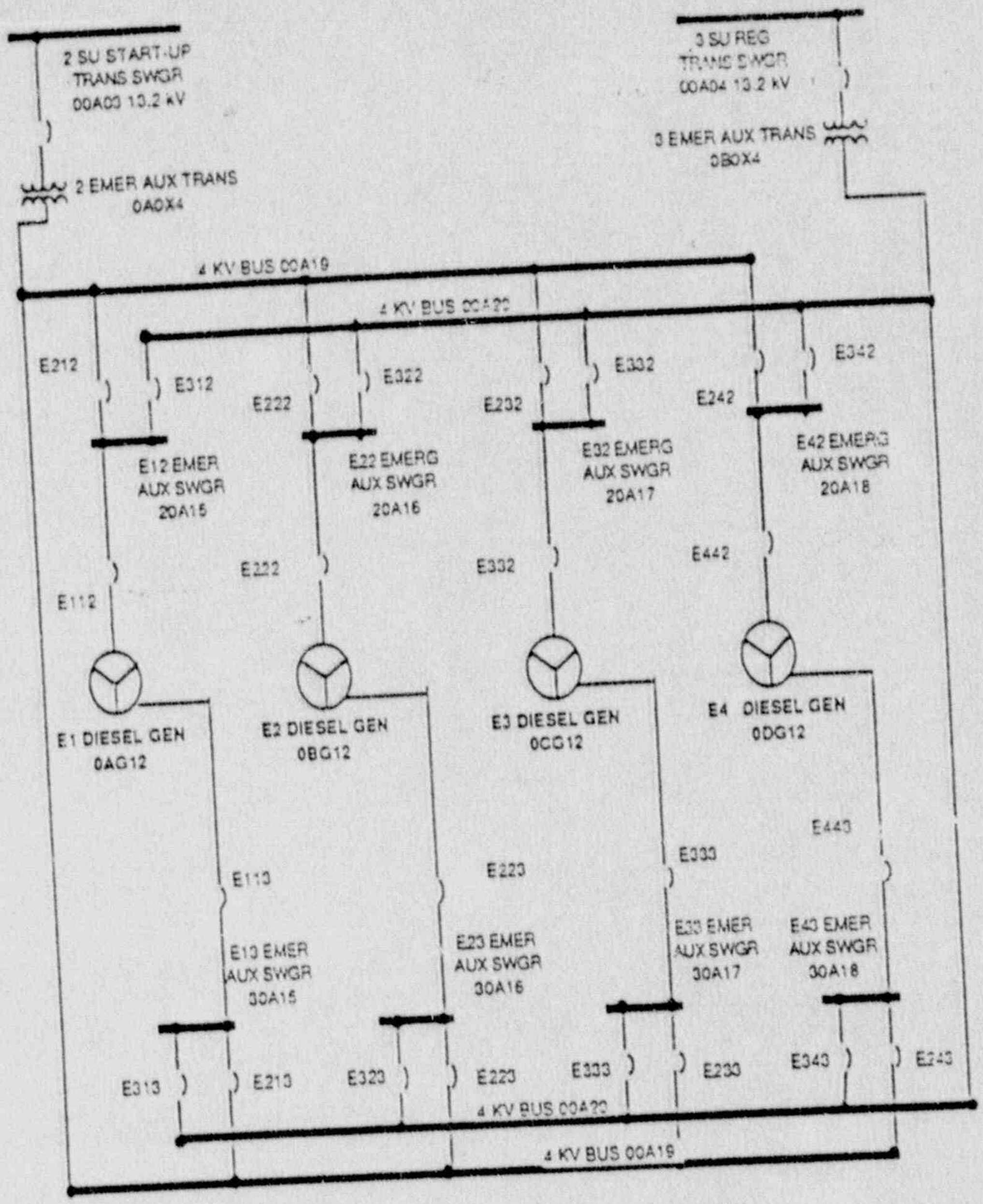

Figure 1

PBAPS STATION BLACKOUT LOADS FOR EDG 1

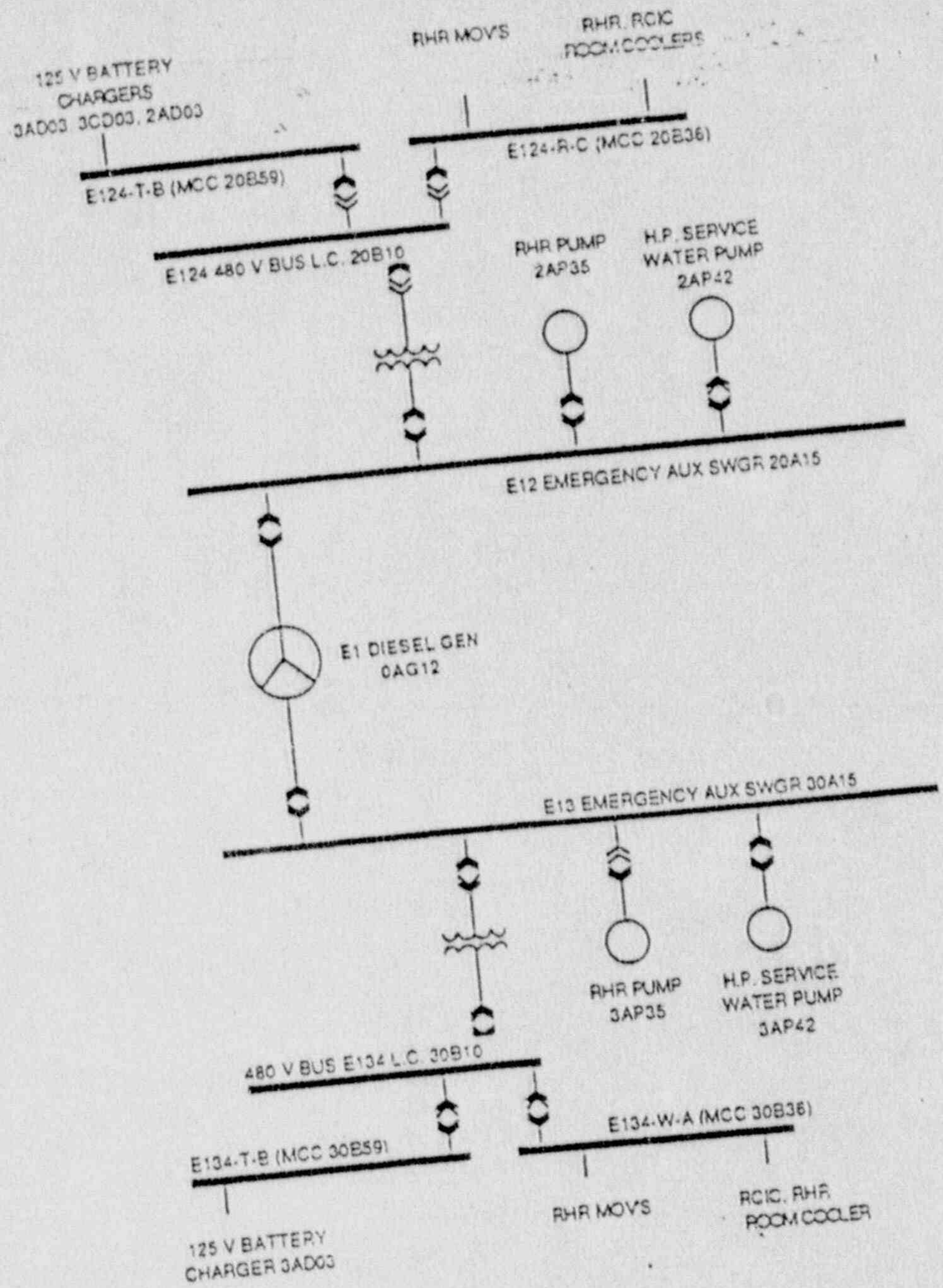

Figure 2

PBAPS STATION BLACKOUT LOADS FOR EDG 2

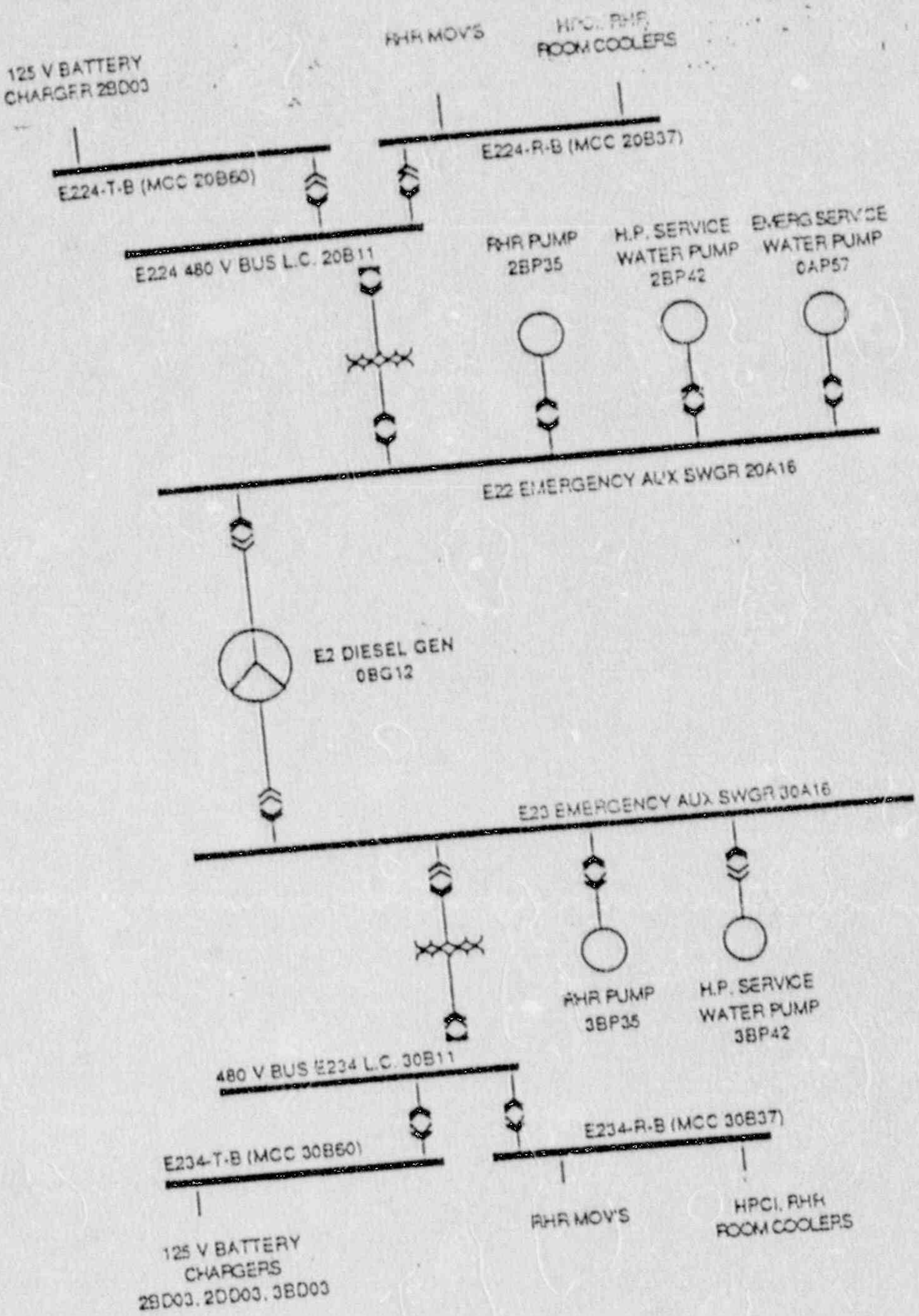

Figure 3

PBAPS STATION BLACKOUT LOADS FOR EDG 3

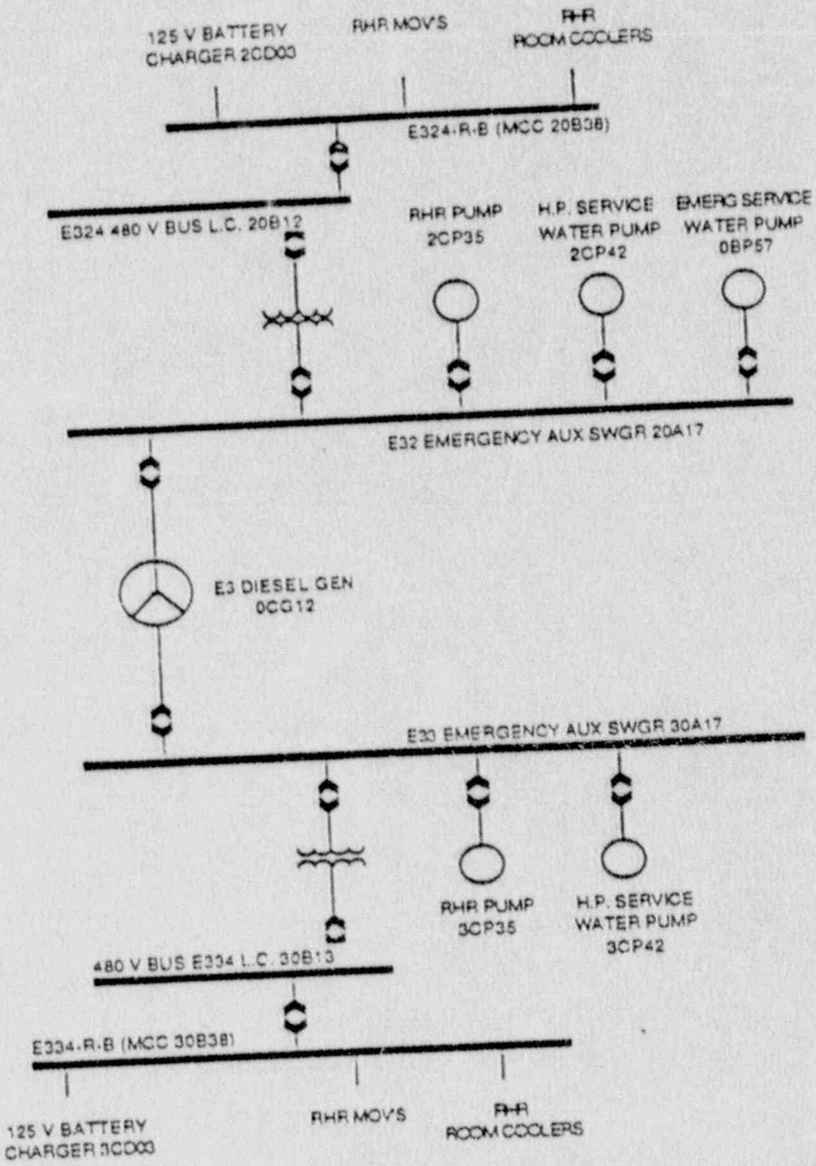

Figure 4

PBAPS STATION BLACKOUT LOADS FOR EDG 4

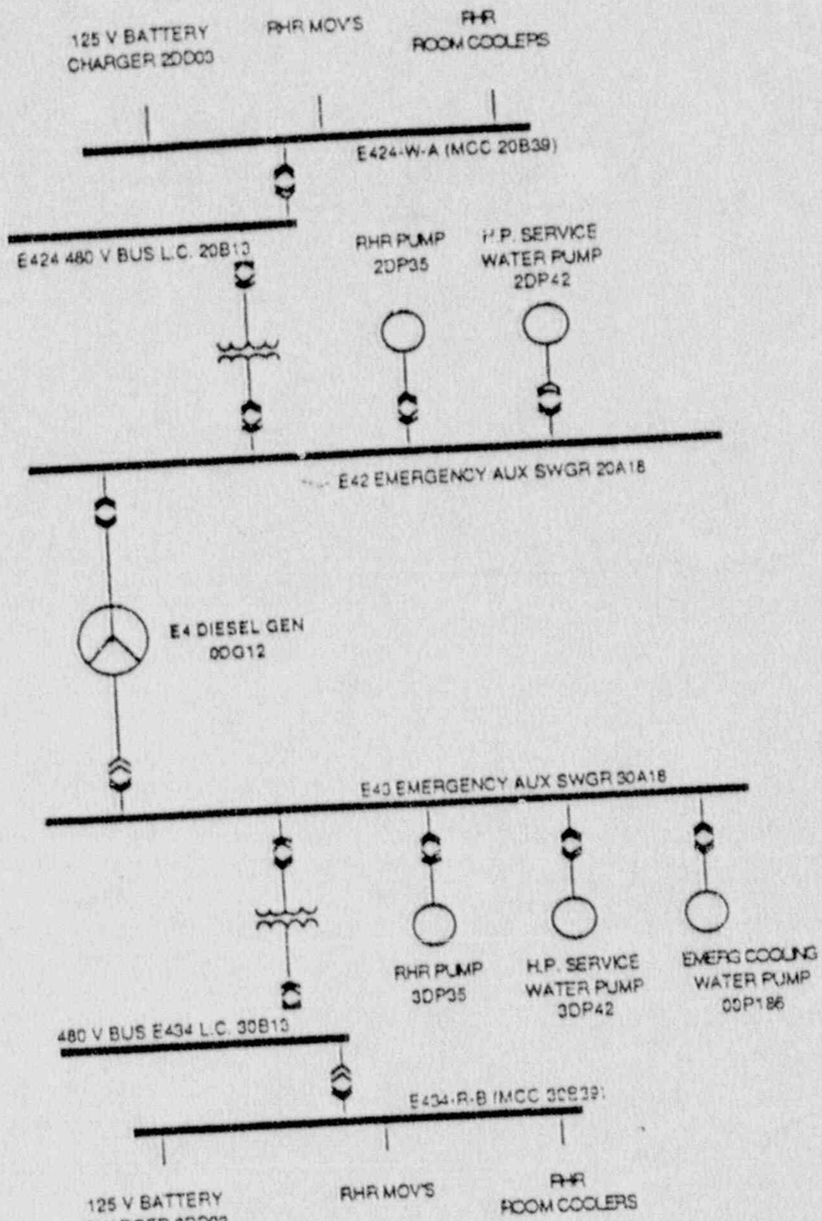

Figure 5