ENCLOSURE

Peach Bottom Atomic Power Station, Units 2 and 3
Revised Station Blackout Analysis

April 1991

TABLE OF CONTENTS

INTRODUCTION

On July 21, 1988, the NRC amended its regulations in 10CFR50. 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. 10CFR50.63 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," (August, 1988) which describes a means acceptable to the NRC for meeting the requirements of 10CFR50.63. 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, "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 10CFR50.63. 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 in NUMARC 87-00, except where RG 1.155 takes precedence. The results of this evaluation were submitted to the NRC as required by 10CFR50.63(c)(1) by our letter dated April 17, 1989. As a result of subsequent NRC reviews of licensee submittals and NRC discussion with NUMARC, NUMARC 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 were to affirm our understanding that the emergency diesel generator (EDG) target reliability would be maintained. Accordingly, we evaluated our April 17, 1989, station blackout submittal with respect to the requirements of 10CFR50.63, including recent clarifications of the guidance in NUMARC 87-00, and submitted a revised SBO analysis to the NRC on April 3, 1990.

In our April 3, 1990 submittal, we verified that 1) our use of the NUMARC 87-00 guidance is consistent with the recent clarifications, 2) the applicability of the NUMARC 87-00 assumptions is documented, and 3) identified and described all departures from the accepted NUMARC 87-00 methodology.

The NRC reviewed our April 3, 1990, station blackout submittal and issued a Safety Evaluation Report (SER) on August 8, 1990. In the SER, the NRC concluded that PBAPS, Units 2 and 3 do not conform to the station blackout rule and that a revised response should be submitted.

At an April 5, 1991 meeting with the NRC, we presented more detailed SBO analysis information and changes to our previous submittals based on our March 12, 1991 commitment to manage the essential Design Basis Accident EDG loads to its corrected 2000-hour rating of 3000 kW, with one exception noted. Accordingly, this letter documents the information presented during this meeting as well as serving as a complete SBO analysis for PBAPS, Units 2 and 3, superseding our April 3, 1990 and April 17, 1989 submittals.

The applicable NUMARC 87-00 sections are shown in parenthesis.

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 the basis for the determination that an alternate AC (AAC) power supply is available to power safe shutdown loads during a SBO event.

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 of the two offsite power sources 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 (see Figure 1). Every 4 kV emergency switchgear bus is energized from one of these two sources at all times during normal operation. Upon loss of one offsite power source, 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 four shared EDGs and, therefore, by design affects both units. 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 factors (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).

   All six cases for the various combinations of two EDGs have been analyzed to establish that the necessary safe shutdown loads for both units can be powered by the two EAC EDGs. Table 1 is a summary of the results of this analysis. Table 1 contains the loading for all equipment that is required to maintain both units in long-term safe shutdown. By design, Table 1 differs from Updated Final Safety Analysis Report Tables 8.5.2c through 8.5.21, which list loads for a simultaneous Loss of Coolant Accident (LOCA) and LOOP. Since all battery chargers are powered by the two EDGs, redundant channels of safe shutdown Control Room instrumentation will be available. In addition, Table 1 contains some discretionary loads that are energized in the analyzed configuration, but are not required for safe shutdown. In all cases, the EDG loading is within its 2000-hour rating of 3000 kW.

   A modest number of operator actions are needed to maintain both units in long-term safe shutdown with two EDGs available. Table 3 summarizes these operator actions.

   The PBAPS, Units 2 and 3 standby AC power supply system consists of four shared EDGs and eight 4 kV emergency auxiliary switchgear buses. Each EDG feeds one 4 kV bus per unit. Because all four EDGs are shared between the two units, the single failure criterion applies to the shared EDG system, not on a per unit basis. Therefore, since two EDGs are needed to power safe shutdown loads for both units, a third EDG satisfies the minimum redundancy requirement.

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.

An EDG reliability program will be implemented to monitor and maintain the EDG target reliability of 0.975 utilizing the guidance in Regulatory Guide 1.155, Section 1.2. If the EDG performance falls below the target reliability level of 0.975, action will be taken as required by the EDG reliability program to restore the affected EDG to the target reliability level.

4. An AAC power source will be utilized at the PBAPS to power safe shutdown loads for both units during a SBO event which meets the criteria specified in Appendix B to NUMARC 87-00. The AAC power source is the remaining Class 1E EDG since this EDG meets the assumptions in Section 2.3.1 of NUMARC 87-00. That is, one EDG is available to serve as the AAC during an SBO event after assuming that the required EAC power sources, accounting for single failure, are not available to power safe shutdown loads.

The AAC power source for the PBAPS utilizes the excess redundancy of the EDG configuration. PBAPS has four EDGs shared between two units. A LOOP event or a station blackout affects both units at the same time (i.e., there is not one blacked-out unit and one non-blacked out unit). Our station blackout analysis was performed based on both units being blacked out at the same time, which is consistent with the design of the electrical distribution system at PBAPS.

A loading analysis has been performed which confirms 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 a Residual Heat Removal (RHR) pump or a High Pressure Service Water (HPSW) pump. The results of the loading analysis are applicable to the loading of the AAC power source.

In accordance with NUMARC 87-00, Section 2.4.1, the PBAPS AAC power source will be available to power necessary safe shutdown equipment within one hour of the onset of the station blackout event. Any one of the four EDGs can be used as an AAC power source, and has sufficient capacity and capability to operate systems necessary to shutdown both units during a station blackout event.

An AC independent coping analysis was performed for the one hour duration prior to bringing the AAC power source on-line during an SBO event. This one hour coping assessment confirmed that the plant emergency equipment ensures the safe shutdown of both units. The one-hour period was used as the basis for the coping assessment. It does not mean that all of the identified operator actions are required at exactly one hour into the station blackout event.

The EDG used as the AAC power source during a station blackout has the capability of powering safe shutdown systems and equipment to provide reactor vessel water level and pressure control, battery charging, selected room ventilation, selected emergency lighting, emergency service water, and necessary system controls and instrumentation. Table 2 is a summary of the EDG loading during the station blackout condition. This table shows the specific configuration for the E-1 EDG; however, this EDG loading is typical of the loading associated with the other three EDGs. All four EDGs, each serving as the AAC, were analyzed. Table 2 contains the maximum loading that could be powered by the AAC EDG; however, not all of the equipment loaded on the AAC EDG is required to maintain both units in a safe shutdown condition for the eight-hour coping duration. The required SBO safe shutdown equipment is annotated on Table 2.

A limited number of operator actions will be required to connect safe shutdown loads to the AAC EDG. Table 4 contains a summary of these operator actions.

B. Procedure Description

Plant procedures have been reviewed for SBO with the following results.

1. Off-site AC power restoration in accordance with NUMARC 87-00, Section 4.2.2.

   a. System Operation (i.e., the load dispatcher) procedure, "System Restoration following Complete Shutdown" establishes a priority for the load dispatcher for restoration of a transmission path to energize the PBAPS startup electrical power feeds.

   b. Station procedure SO 53.7G, "Offsite AC Power Restoration following Loss of Grid" coordinates with System Operation restoration procedure and establishes a sequence of switching operations required to restore AC power via the normal station startup electrical power feeds.

   c. Station procedure SE-11, "Station Blackout" will be revised to coordinate with SO 53.7G.

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

a. Emergency Response Procedure ERP-101 requires an "unusual event" to be declared in the event that a hurricane warning is issued from the load dispatcher predicting wind speeds of 75 MPH or greater at the station.

b. A new severe weather procedure will include the following actions.

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

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

   iii. Review station blackout procedures.

   iv. Review operability of Emergency Core Cooling Systems (ECCS) equipment.

   v. Initiate emergency repairs, as needed, of ECCS and other selected systems required to cope with a blackout.

   vi. Suspend appropriate surveillance test procedures.

   vii. Evaluate the need for calling in additional personnel.

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

   a. SE-11 has been revised to address the use of security keys.

   b. SE-11 will be revised to ensure that on-shift Operations personnel have guidance regarding the verification of isolation valves listed in Table 5, as appropriate.

   c. SE-11 will be revised to address the maintenance of water inventory in the Condensate Storage Tank (CST).

   d. SE-11 will be revised to address the location of portable lighting.

   e. SE-11 will be revised to address the removal of selected ceiling tiles and the opening of selected control panel doors.

   f. SE-11 will be revised to show tables for loading of EDGs as AAC power sources.

   g. SE-11 will be revised to deenergize selected MCCs and non-essential equipment.

4. SO procedures for starting RHR and HPSW pumps have been revised to address checking of existing EDG loading.

C. Proposed Coping Assessment

The ability of PBAPS to cope with a station blackout event in accordance with RG 1.155, Section 3, and NUMARC 87-00, Section 7, has been evaluated using both NUMARC 87-00 calculations and non-NUMARC 87-00 calculations. Most of the evaluations used in the station blackout assessment are non-NUMARC 87-00 computer or manual calculations. The simplified methodology of the NUMARC 87-00 calculations were not appropriate for most plant areas.

The coping assessment considered (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, (5) the ability to maintain containment integrity, (6) the ability to maintain adequate reactor coolant inventory, and (7) the use of safety related equipment (i.e., equipment within the scope of our Quality Assurance Program).

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

   Using the guidance provided in Section 7.2.1 of NUMARC 87-00, we have calculated that 166,713 gallons per unit of make-up water to the reactor vessel are required during the 8-hour station blackout event. The breakdown of make-up water is as follows: 117,066 gallons for decay heat removal; 17,280 gallons for recirculation pump seal leakage; 20,367 gallons for vessel level shrinkage when depressurizing the reactor pressure vessel; and 12,000 gallons for identified Technical Specifications allowed primary system leakage (25 gpm).

   A calculation determined that a minimum of 100,018 gallons were available in the condensate storage tank for High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) system suction. Therefore, the difference between the total required condensate inventory (166,713 gallons) and the CST dedicated volume (100,018 gallons) is about 66,700 gallons. Assuming a minimum torus water level, we have determined that 66,700 gallons of additional make-up water corresponds to less than one foot of torus water level. Therefore, a combination of CST water and torus water is sufficient for the HPCI and RCIC system to provide make-up water to the reactor vessel during the station blackout coping duration. Note, each unit has a dedicated CST. Also, HPCI and RCIC may be initially aligned with either the CST or the torus. Both alignments have been considered, and neither affects the safe shutdown analysis.

2. Class 1E Battery Capacity (Section 7.2.2)

The AAC power source energizes the 125V battery chargers within one hour of the onset of station blackout. These battery loads include power restoration from either the EAC EDG power supplies or the preferred offsite power source. A battery capacity calculation has been performed in accordance with NUMARC 87-00, Section 7.2.2, to verify that the Class 1E batteries have sufficient capacity to meet station blackout loads for one hour without battery charging and for the subsequent seven hours with charging. Operator actions are credited in this analysis at one hour to reduce the DC loading.

3. Compressed Air (Section 7.2.3)

Air-operated valves relied upon to cope with a station blackout for eight hours have sufficient backup air/nitrogen sources to perform their required functions or fail in the safe position. The Automatic Depressurization System (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 event. 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.

a. HPCI and RCIC Pump Room Analysis

The initiation of a station blackout event will result in an immediate reactor scram. Both HPCI and RCIC systems will initiate on low reactor water level.

Within about 10 minutes into the transient, operators will secure the HPCI system and use the RCIC system to maintain adequate core cooling. The RCIC system is designed to provide adequate make-up water to the reactor vessel following reactor shutdown.

Operability of the equipment in the HPCI pump room is ensured by an analysis performed as part of the station fire protection analysis which calculates that the ambient air temperature will be about 156°F after four hours of HPCI operation without supplemental cooling. This analysis demonstrates operability of HPCI room components at temperatures in excess of 156°F. Therefore, operation of the HPCI system is verified for the short duration (about 10 minutes) of the initiation of a station blackout event.

A non-NUMARC 87-00 analysis was performed to determine the resulting air temperature in the RCIC room during a station blackout event. The analysis assumed that the RCIC pump room cooler would not be operational for the first hour of the station blackout event. No credit was taken for improved ventilation by opening the doors leading out of the RCIC pump room. The RCIC pump room cooler comes on-line at one hour into the transient when the AAC EDG comes on line. The analysis shows the maximum air temperature in the RCIC pump room to be 145°F after one hour, at which point the room cooler comes on-line. The maximum RCIC pump room temperature after eight hours of RCIC operation is calculated to be 144°F. In this analysis only the safety-related components of the RCIC pump are assumed to be available. This analysis was performed without crediting the operation of the non-safety related gland seal condenser, which conservatively increases the room heat load. In addition, the operators will defeat the system high temperatures and low steam supply isolations to ensure long term availability of the RCIC and HPCI systems.

The station fire protection analyses demonstrated equipment operability of RCIC system components up to 163°F for 12 hours. This envelopes the RCIC pump room temperature profile for the eight hour station blackout event.

b. Control Room Analysis

A non-NUMARC 87-00 analysis was used to calculate the ambient air temperatures in the shared Unit 2 and Unit 3 Control Room during a station blackout event. Ventilation is lost in the Control Room for the first hour of the transient. Then the emergency ventilation system comes on-line when the AAC EDG is loaded. Heat loads included in the calculations were obtained from existing Heating, Ventilation and Air Conditioning (HVAC) calculations. These heat loads accounted for the absence of AC powered lighting which would not be operational during a station blackout event.

At one hour into the station blackout transient, the Control Room temperature was calculated to be 105°F without room cooling or operator actions. With room cooling operational and operator actions to remove ceiling tiles one hour into the station blackout event, the resulting temperature after eight hours was calculated to be 118°F assuming conservative initial conditions. The initial Control Room conditions assumed a 76°F ambient temperature, 30%

relative humidity, 95°F outside air temperature, and 105°F adjacent room temperature. Operator actions include removing selected ceiling tiles before control room temperature reaches 105°F to establish adequate cross ventilation. Also, to ensure proper equipment operability, doors to Control Room cabinets containing shutdown equipment must be opened within 30 minutes of the start of the station blackout event.

c. Cable Spreading Room Analysis

A non-NUMARC 87-00 analysis was performed to determine the ambient air temperature in the cable spreading room during an 8-hour station blackout induced loss of ventilation. Heat generation during station blackout is from operating electrical components such as 125 VDC power distribution panels, relays, and emergency lighting. The calculation predicted that the 8-hour loss of ventilation temperature would be 147°F.

The Arrhenius equation was applied to ensure the operability of the electronic components located in the cable spreading room which are needed to safely shutdown both units during a SBO event. Based on our analysis, we concluded that the electrical components can reasonably be expected to operate at 147°F in the cable spreading room for at least the 8-hour period of the station blackout event.

d. Containment Analysis

A non-NUMARC 87-00 analysis was used to determine the primary containment (drywell) and suppression pool (torus) response to a station blackout event. The containment and suppression pool will heatup during the station blackout due to reactor decay heat and assumed primary system leakage. In accordance with NUMARC 87-00, a primary system leakage of 61 gpm was assumed. This includes 25 gpm identified leakage (i.e., maximum leakage allowed by Technical Specifications) plus 18 gpm leakage from each recirculation pump seal.

The containment and suppression pool analysis assumed that the RHR torus cooling and RHR shutdown cooling modes of operation were not available during the station blackout event. No credit needs to be taken for torus pressurization in order to achieve and maintain safe shutdown during the SBO event and recovery. The resulting primary containment temperatures and pressures were calculated to be 284°F and 40 psig, respectively, at eight hours into the station blackout event (see the attached Figures 4 and 5). The primary containment temperature of 284°F is less than the primary containment LOCA qualification ter rature. The resulting containment pressure of 40 psig is significantly less than the primary containment design pressure of 56 psig.

The suppression pool temperature and pressure response to a station blackout event is shown in the attached Figures 6 and 7. The resulting pressure of about 38 psig is less than the design suppression pool pressure which is 56 psig.

The integrated volume of water used from the CST to provide make-up water to the reactor vessel during the station blackout is shown in Figure 8. The containment suppression pool analysis shows that the total water inventory requirement from the CST will be less than 90,000 gallons, which is less than the initial minimum CST inventory.

The containment and suppression pool analysis shows that there will be significant margin between the suppression pool temperature heat capacity temperature limits (HCTL) during depressurization of the reactor vessel. However, the calculation indicates that at about seven hours into the transient and at 150 psig reactor pressure and 215°F suppression pool temperature, the HCTL will be reached and exceeded by about 8°F. However, this was concluded to be acceptable because a further analysis was performed which assumed reactor vessel depressurization from 150 psig to zero reactor pressure at this point. The resulting containment pressure would be about 44 psig which is less than the containment design pressure of 56 psig. The attached Figures 2 through 9 summarize the calculated containment and suppression pool response to a station blackout event of eight hours.

e. Other Plant Areas

Increased temperature in the steam tunnel at PBAPS does not affect any equipment necessary for safe shutdown during a station blackout. Therefore, it was not considered a possible dominant area of concern and was not analyzed.

The EDG room was not analyzed for loss of ventilation because room ventilation is provided when the AAC EDG comes on-line.

The electrical inverters are located in open areas throughout the plant. We determined that any heat generated from the inverters would have minimal thermal effect on the plant area. Thus, these areas were not considered as a potential dominant area of concern.

The emergency switchgear room and emergency service water pump rooms do not contain any equipment necessary to support safe shutdown during the first hour of the station blackout. These rooms have ventilation fans which become operational at one hour into the station blackout event when the AAC EDG comes on-line. Therefore, these rooms are not considered a potential dominant area of concern.

A NUMARC 87-00 analysis was performed to determine the steady state operating temperature of the battery rooms. Heat loads in the battery rooms include the 125V DC batteries, 24V batteries, 250V distribution panels, and cables to batteries. The NUMARC 87-00 calculation predicted the steady state room temperature to be 110°F. Since this temperature is less than 120°F and room ventilation is provided at one hour into the transient these battery rooms are not considered a potential dominant area of concern.

5. Containment Isolation (Section 7.2.5)

The list of containment isolation valves for each unit 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 attached Table 5 contains primary containment isolation valves that do not qualify for exclusion as defined in NUMARC 87-00, Section 7.2.5. Also, this list includes valves that are normally closed and that fail as-is. These valves can be accessed and verified as being closed, as necessary during a station blackout, by mechanical position indication or by manually closing. Where applicable, the inboard and outboard valves have been identified; however, only one valve would be required to be verified in the closed position in order to ensure containment integrity.

6. Reactor Coolant Inventory (Section 2.5)

The station batteries and the AAC source power equipment necessary to maintain adequate reactor coolant system inventory to ensure that the core is cooled for the required coping duration.

7. Equipment Quality Assurance

Most of the equipment that is assumed to achieve and maintain safe shutdown of both units during a SBO event is safety related and is covered by PECo's Quality Assurance (QA) program as required by Appendix B of 10CFR50. Station blackout equipment that is not safety-related will be maintained in accordance with the guidance of Regulatory Guide 1.155 Section 3.5 and Appendix A. Examples of non-safety related station blackout equipment include the CST, CST water level instrumentation, and the

4 kV bus 00A19. No part of the 13kV system is needed for response to a SBO event.

D. Proposed Plant Modifications

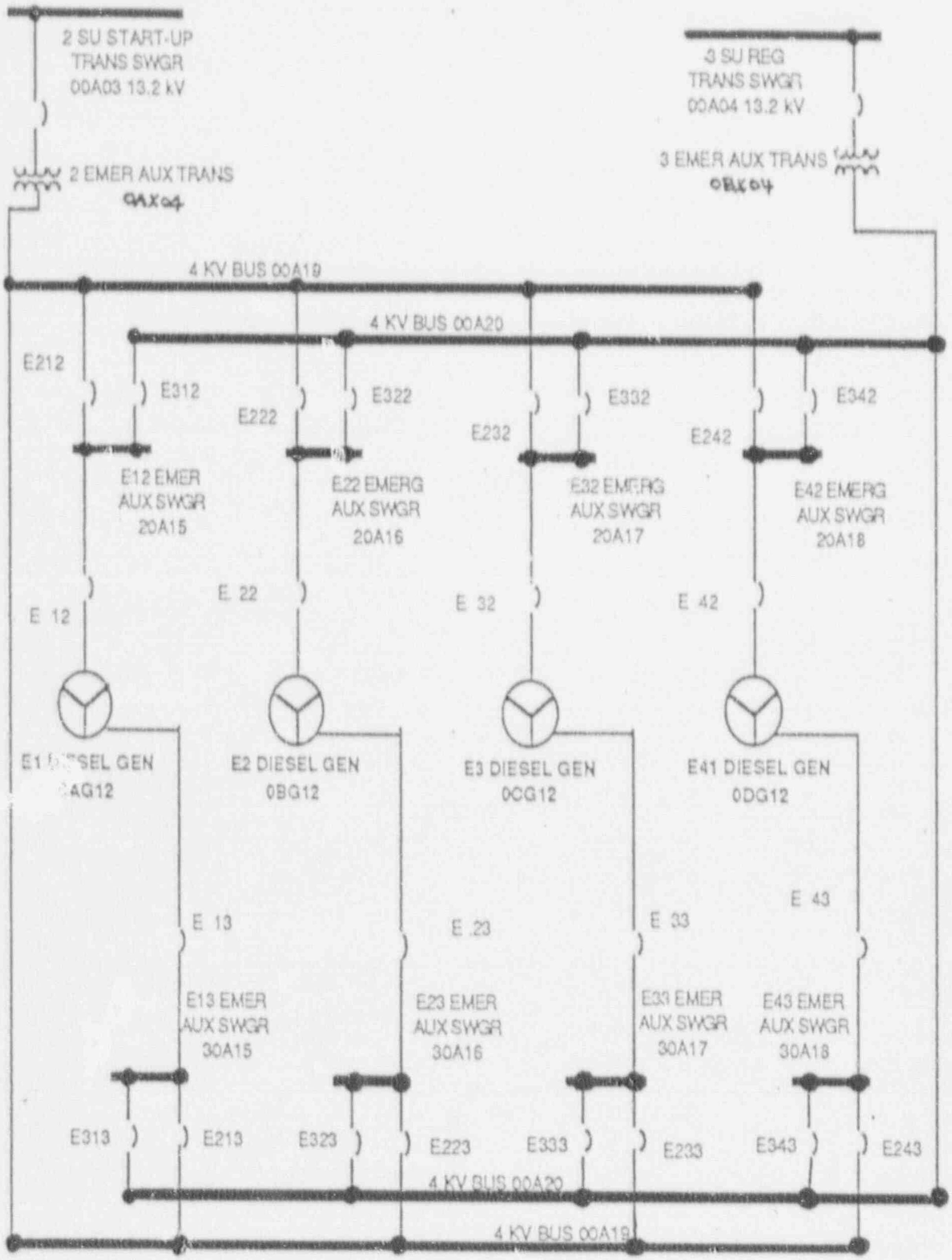
The guidelines in Regulatory Guide 1.155 and the methodology presented in the NUMARC 87-00 document were used to verify proper operability of plant equipment during a station blackout event. Therefore, no plant equipment modifications are necessary to satisfy station blackout requirements specified in 10CFR50.63.

E. Proposed Schedule to Implement Station Blackout Procedural Changes

The future procedure changes identified in Parts A, B, and C of this submittal will be completed within one year after the notification provided by the Director, Office of Nuclear Regulation in accordance with 10CFR50.63(c)(3).

2122a.doc

FIGURE 1 STATION ONE-LINE DIAGRAM



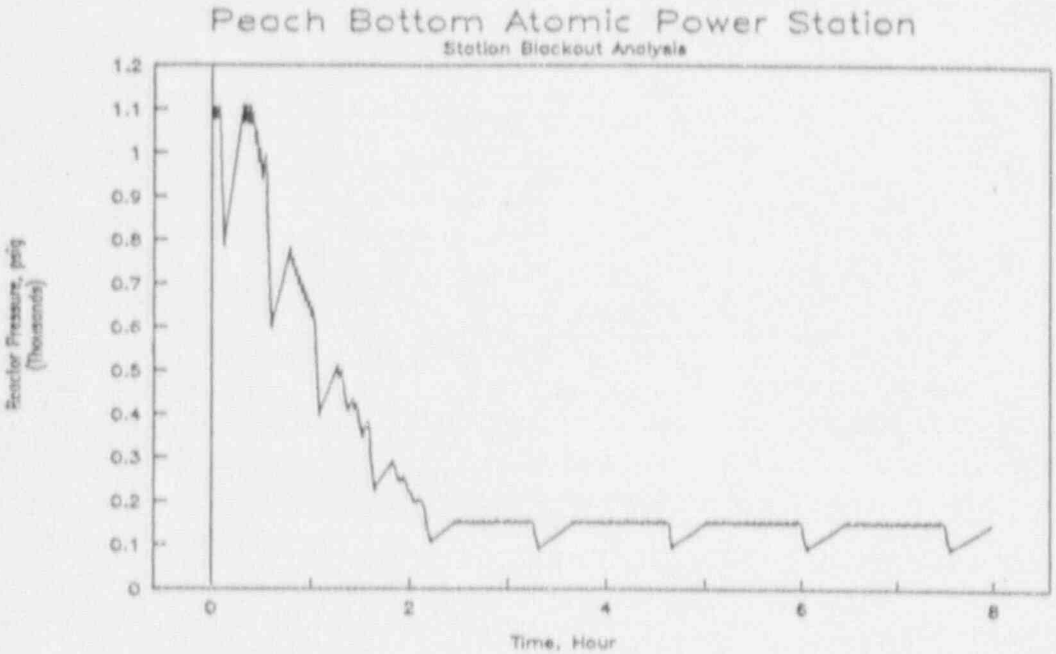


Figure 2

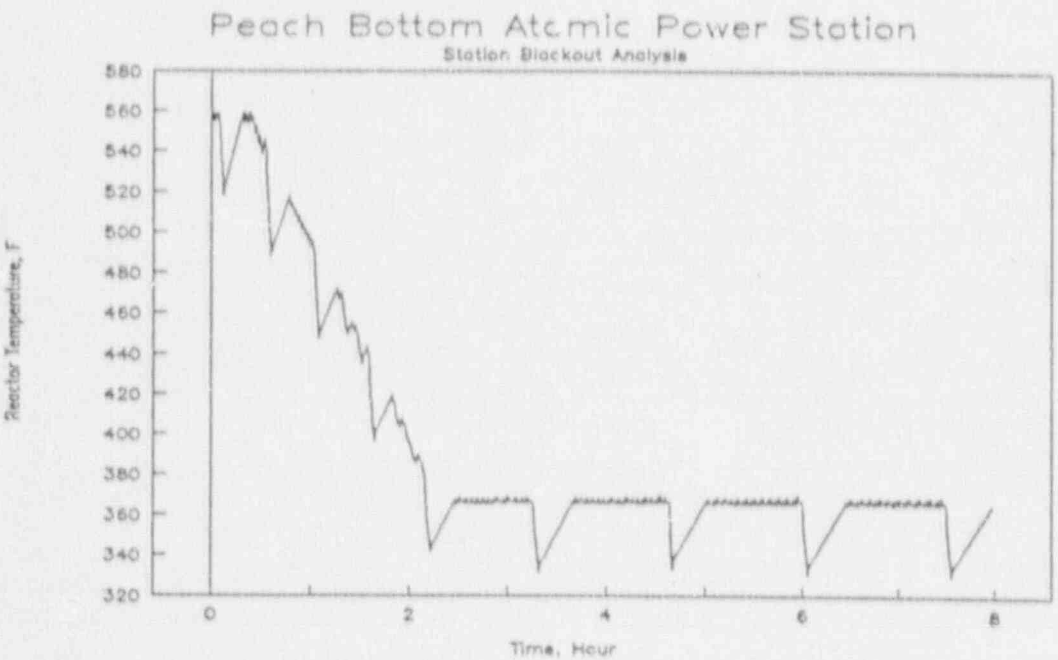


Figure 3

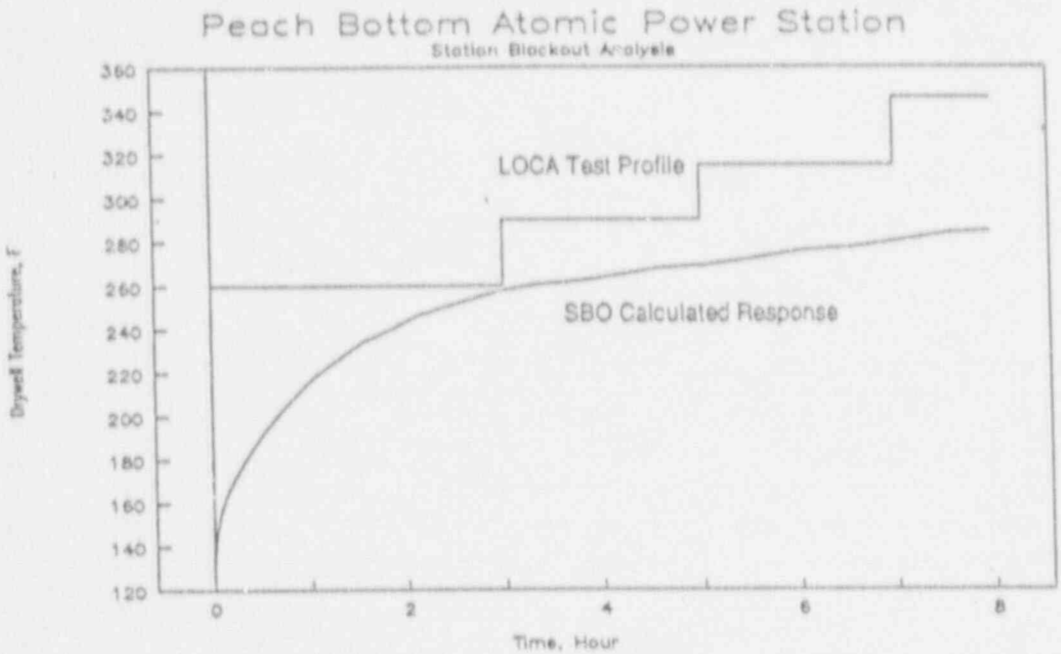


Figure 4

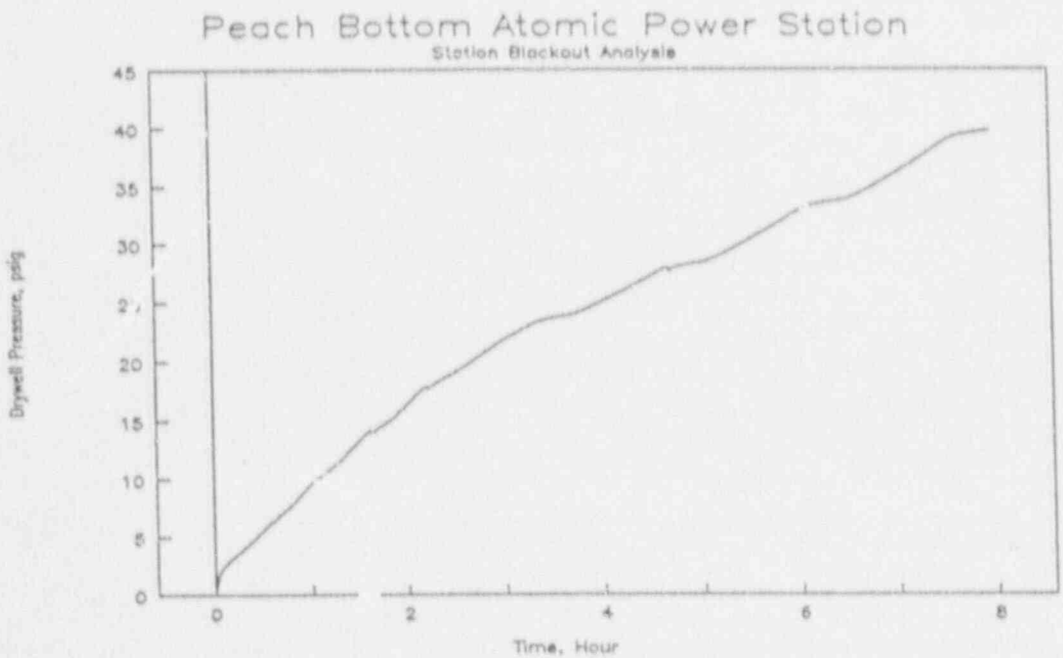


Figure 5

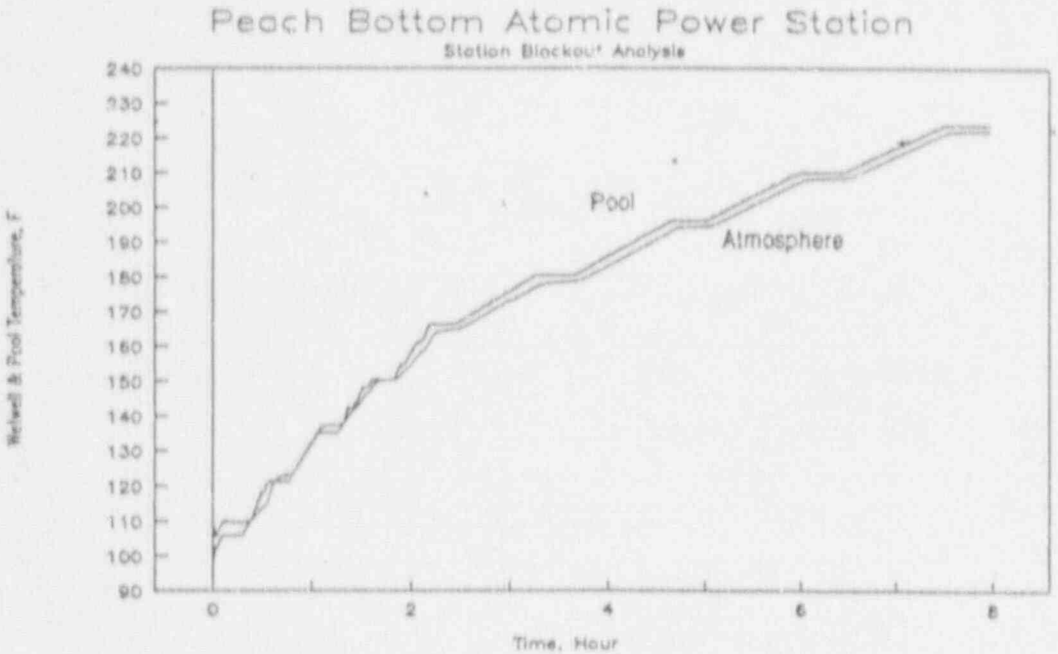


Figure 6

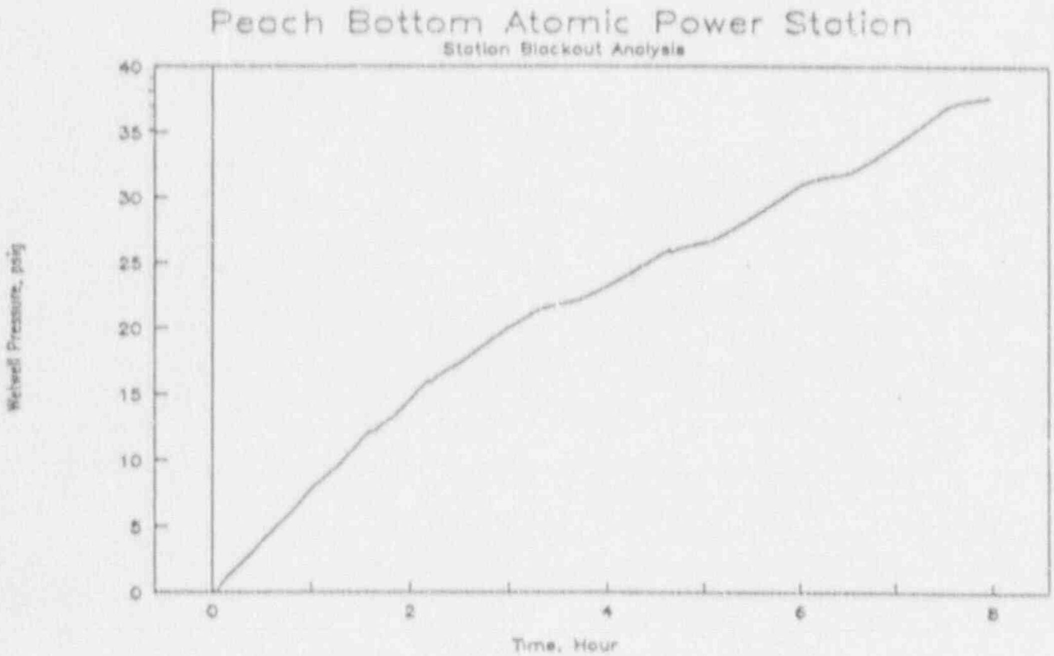


Figure 7

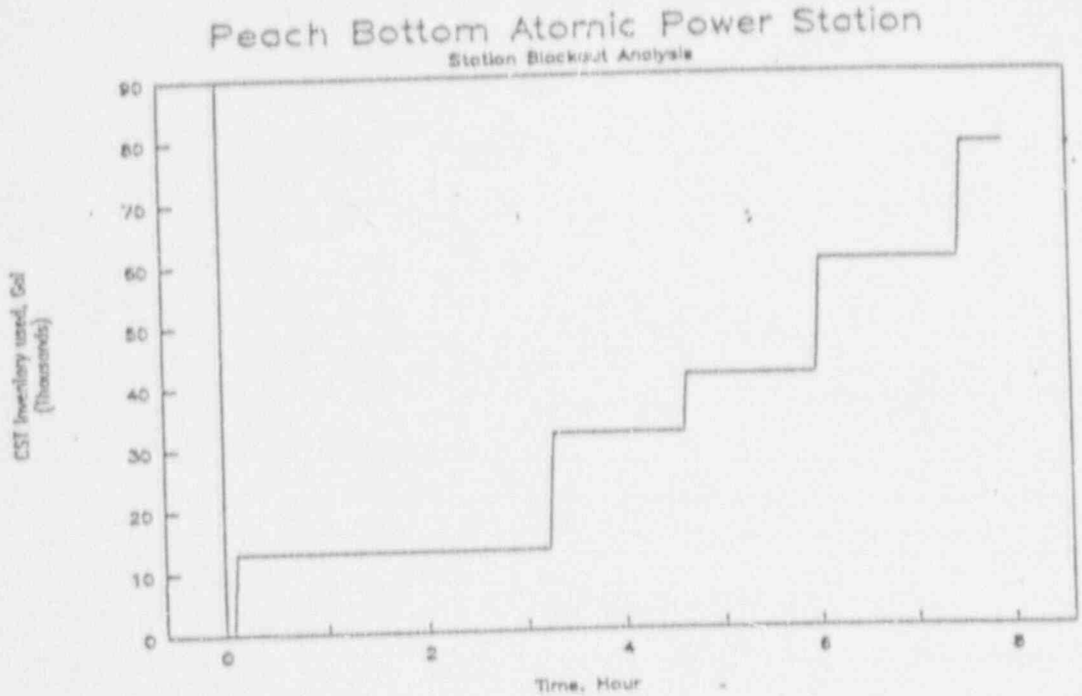


Figure 8

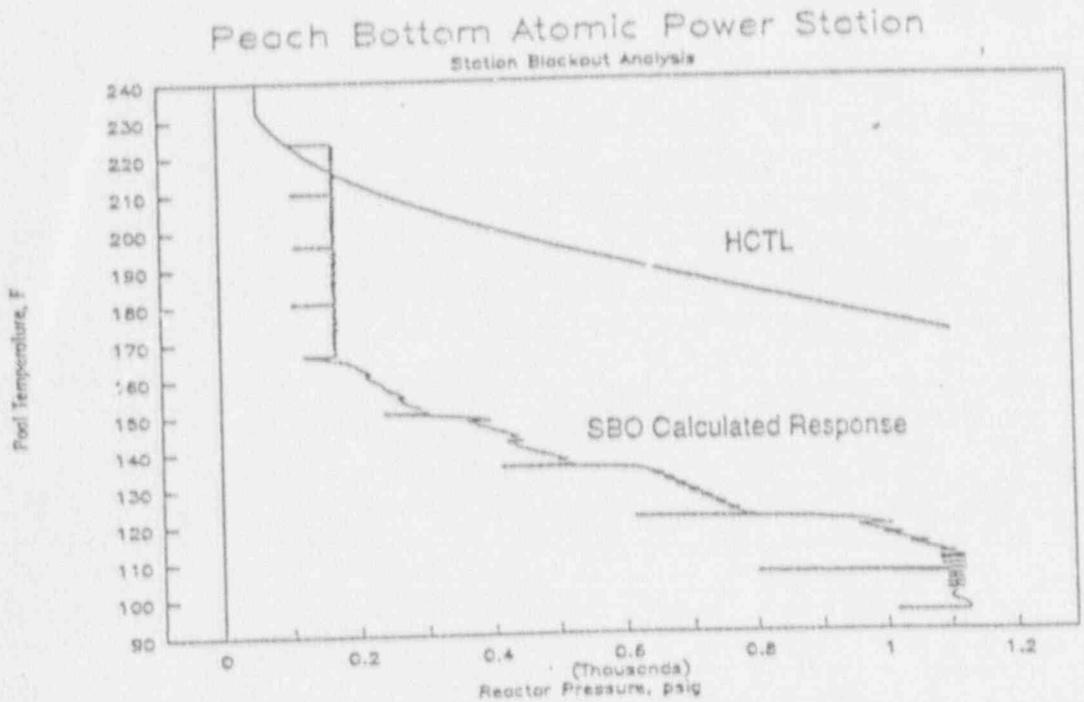


Figure 9

TABLE 1
SAFE SHUTDOWN LOADS DURING A LOOP
BOTH UNITS - 2 EDGs

EAC DIESEL COMBINATION LOADING SUMMARY

	DIESELS E1 & E2			DIESELS E1 & E3			DIESELS E1 & E4		
	E12	E13	E2 BKFD	E12	E13	E3 BKFD	E12	E13	E4 BKFD
1 RHR Pump (1)	1410	0	1410	1410	0	1410	1410	0	1410
2 Core Spray Pump	0	0	0	0	0	0	0	0	0
3 HP Service Wtr Pmp (1)	802	0	802	802	0	802	802	0	802
4 Emer Service Wtr Pmp (1)	0	0	205	0	0	205	0	0	205
5 CRD Pump	0	0	0	0	0	0	0	0	0
6 Motor Operated Vlvs	0	0	0	0	0	0	0	0	0
7 Emergency Lighting (2)	64	26	39	64	26	64	64	26	47
8 DG Jckt Cool Aux Pmp & Lube Oil Aux Pump	0	0	0	0	0	0	0	0	0
9 DG Fuel Oil Trns Pmp (1) & Aftr Cool Aux Pmp	5 #	0	5 #	5 #	0	5 #	5 #	0	5 #
10 DG Start Air Comp	0	0	0	0	0	0	0	0	0
11 250V & 24V Bat Chrgr	1	1	18	1	1	18	1	1	18
12 125V Batt Chargers (3)	60	30	150	60	30	150	60	30	150
13 Inst AC & UPS Invrtr (2)	22	18	25	22	18	25	22	18	25
14 RBCW Pumps	0	0	0	0	0	0	0	0	0
15 Drywell Cooler Fans	0	0	0	0	0	0	0	0	0
16 Cntrl Rm Vent Fans (1)	0	0	10	0	0	10	0	0	10
17 Emerg Swgr Sply Fans (1)	0	0	41	0	0	41	0	0	41
18 Emerg Swgr Exh Fans (1)	0	0	21	0	0	21	0	0	21
19 Bat Room Exh Fans (1)	0	0	13	0	0	13	0	0	13
20 DG Vnt & Pmp Rm Fans (1)	43	0	43	43	0	43	43	0	43
21 RHR Rm Cool Units (1)	13	0	13	13	0	13	13	0	13
22 HPCI Rm Cool Units	0	0	0	0	0	0	0	0	0
23 RCIC Rm Cool Units (1)	1	1	0	1	1	0	1	1	0
24 CS Rm Cool Units	0	0	0	0	0	0	0	0	0
25 SGTS Exh Fans	0	0	0	0	0	0	0	0	0
26 SGTS Exhaust Htr	0	0	0	0	0	0	0	0	0
27 SLC Pump	0	0	0	0	0	0	0	0	0
28 SLC Heater	0	0	0	0	0	0	0	0	0
29 SW Vib & Travl Scrn & Screen Wash Pump	46 #	0	0	46 #	0	0	46 #	0	0
30 120/208V Dist Pnls	37	20	74	37	20	64	37	20	64
31 Plant Stack Dil Fan	0	0	0	0	0	0	0	0	0
32 Rx Area, Ref Flr & Comp Htrs & Vnt Fns	0	0	22	0	0	22	0	0	22
33 D-6 Skid Mtd Equip	0	0	0	0	0	0	0	0	0
34 Air Compressors	0	0	0	0	0	0	0	0	0
35 Misc Loads/Sys Loss (2)	109 *	13	74 @	109 *	13	68 @	109 *	13	68 @
TOTAL	2613	109		2613	109		2613	109	
DIESEL TOTAL		2722	2965		2722	2974		2722	2957

* Includes intake structure ventilation
\# Intermittent loads (See Attachment 5 for details)
@ Includes transformer 0AX04 no-load losses (18kW)
(1) Required loads
(2) Some loads may be required
(3) Only 6 of 8 battery chargers are required

TABLE 1 (Cont.)

EAC DIESEL COMBINATION LOADING SUMMARY

	DIESELS E2 & E3			DIESELS E2 & E4			DIESELS E3 & E4		
	E22	E23	E3 BKFD	E22	E23	E4 BKFD	E32	E33	E4 BKFD
1 RHR Pump (1)	0	1410	1410	0	1410	1410	1410	0	1410
2 Core Spray Pump	0	0	0	0	0	0	0	0	0
3 HP Service Wtr Pmp (1)	0	802	802	0	802	802	802	0	802
4 Emer Service Wtr Pmp (1)	205	0	0	205	0	0	205	0	0
5 CRD Pump	0	0	0	0	0	0	0	0	0
6 Motor Operated Vlvs	0	0	0	0	0	0	0	0	0
7 Emergency Lighting (2)	20	39	96	20	39	104	25	0	124
8 DG Jckt Cool Aux Pmp & Lube Oil Aux Pump	0	0	0	0	0	0	0	0	0
9 DG Fuel Oil Trns Pmp (1) & Aftr Cool Aux Pmp	0	5 #	5 #	0	5 #	5 #	5 #	0	5 #
10 DG Start Air Comp	0	0	0	0	0	0	0	0	0
11 250V & 24V Bat Chrgr	16	16	4	16	16	4	1	1	19
12 125V Batt Chargers (3)	30	60	150	30	60	150	30	30	180
13 Inst AC & UPS Invrtr (2)	19	19	46	19	19	46	6	9	59
14 RBCW Pumps	0	0	0	0	0	0	0	0	0
15 Drywell Cooler Fans	0	0	0	0	0	0	0	0	0
16 Cntrl Rm Vent Fans (1)	0	0	10	0	0	10	10	0	0
17 Emerg Swgr Sply Fans (1)	0	0	41	0	0	41	41	0	0
18 Emerg Swgr Exh Fans (1)	0	0	21	0	0	21	21	0	0
19 Bat Room Exh Fans (1)	0	0	13	0	0	13	13	0	0
20 DG Vnt & Pmp Rm Fans (1)	0	43	43	0	43	43	43	0	43
21 RHR Rm Cool Units (1)	0	13	13	0	13	13	13	0	13
22 HPCI Rm Cool Units	0	0	0	0	0	0	0	0	0
23 RCIC Rm Cool Units (1)	0	0	2	0	0	2	0	0	2
24 CS Rm Cool Units	0	0	0	0	0	0	0	0	0
25 SGTS Exh Fans	0	0	0	0	0	0	0	0	0
26 SGTS Exhaust Htr	0	0	0	0	0	0	0	0	0
27 SLC Pump	0	0	0	0	0	0	0	0	0
28 SLC Heater	0	0	0	0	0	0	0	0	0
29 SW Vib & Travl Scrn & Screen Wash Pump	46 #	0	0	46 #	0	0	0	0	46 #
30 120/208V Dist Pnls	32	29	103	32	29	88	35	16	101
31 Plant Stack Dil Fan	0	0	0	0	0	0	0	0	0
32 Rx Area, Ref Flr & Comp Htrs & Vnt Fns	0	0	22	0	0	22	22	0	0
33 D-G Skid Mtd Equip	0	0	0	0	0	23	0	0	0
34 Air Compressors	0	0	0	0	0	0	0	0	0
35 Misc Loads/Sys Loss (2)	104 *	22	123 @	104 *	22	123 @	60	40	168 *@
TOTAL	472	2458		472	2458		2742	96	
DIESEL TOTAL		2930	2904		2930	2920		2838	2972

* Includes intake structure ventilation
\# Intermittent loads (See Attachment 5 for details)
@ Includes transformer 0AX04 no-load losses (18kW)
(1) Required loads
(2) Some loads may be required
(3) Only 6 of 8 battery chargers are required

TABLE 2
SAFE SHUTDOWN LOADS DURING A STATION BLACKOUT
BOTH UNITS - 1 EDG

DIESEL E1
(Typical)

			E12	E13	E22	E23	E32	E33	E42	E43
1	RHR Pump		0	0	0	0	0	0	0	0
2	Core Spray Pump		0	0	0	0	0	0	0	0
3	HP Service Wtr Pmp		0	0	0	0	0	0	0	0
4	Emer Service Wtr Pmp	(1)	0	0	0	0	205	0	0	0
5	CRD Pump		0	0	0	0	0	0	0	0
6	Motor Operated Vlvs		0	0	0	0	0	0	0	0
7	Emergency Lighting	(2)	64	26	20	39	25	0	78	68
8	DG Jckt Cool Aux Pmp & Lube Oil Aux Pump		0	0	0	0	0	0	0	0
9	DG Fuel Oil Trns Pmp & Aftr Cool Aux Pmp	(1)	5	0	0	0	0	0	0	0
10	DG Start Air Comp		0	0	0	0	0	0	0	0
11	250V & 24V Bat Chrgr		1	1	16	16	1	1	1	1
12	125V Batt Chargers	(3)	30	30	30	30	30	30	30	30
13	Inst AC & UPS Invrtr	(2)	22	18	19	19	6	9	25	0
14	RBCW Pumps		0	0	62	62	0	0	0	0
15	Drywell Cooler Fans		0	22	0	17	0	9	0	26
16	Cntrl Rm Vent Fans	(1)	0	0	0	0	10	0	0	0
17	Emerg Swgr Sply Fans	(1)	0	0	0	0	41	0	0	0
18	Emerg Swgr Exh Fans	(1)	0	0	0	0	42	0	0	0
19	Bat Room Exh Fans	(1)	0	0	0	0	13	0	0	0
20	DG Vnt & Pmp Rm Fans	(1)	43	0	0	0	0	0	0	0
21	RHR Rm Cool Units		0	0	0	0	0	0	0	0
22	HPCI Rm Cool Units		0	0	0	0	0	0	0	0
23	RCIC Rm Cool Units	(1)	1	1	0	0	0	0	0	0
24	CS Rm Cool Units		0	0	0	0	0	0	0	0
25	SGTS Exh Fans		40	0	0	0	0	40	0	0
26	SGTS Exhaust Htr		46	0	0	46	0	0	0	0
27	SLC Pump		0	0	0	0	0	0	0	0
28	SLC Heater		0	0	0	0	0	0	0	0
29	SW Vib & Travl Scrn & Screen Wash Pump		46	0	46	0	0	0	0	0
30	120/208V Dist Pnls		37	20	32	29	35	16	38	40
31	Plant Stack Dil Fan		17	0	0	0	17	0	17	0
32	Rx Area, Ref Flr & Comp Htrs & Vnt Fns		0	0	0	0	11	0	11	0
33	D-G Skid Mtd Equip		0	0	0	23	23	0	0	23
34	Air Compressors		0	81	0	0	81	0	0	0
35	Misc Loads/Sys Loss	(2&4)	146	27	252	113	78	57	89	134
	E BUS TOTAL		498	226	477	394	618	162	289	322
	DIESEL TOTAL		2986							

Notes:
(1) Required Loads
(2) Some loads may be required
(3) Six of eight battery chargers are required
(4) Transformer 0AX04 no-load losses included in E12 (18kW)

TABLE 3

EAC OPERATOR ACTIONS - TWO EDGs AVAILABLE

If a LOOP event occurred with only two EDGs available, a modest number of operator actions are needed to maintain both units in long-term safe shutdown. The following summarizes these operator actions.

When any two EDGs start, cooling water will be automatically available to the EDGs from either an Emergency Service Water (ESW) or an Emergency Cooling Water (ECW) pump. Following confirmation that only two EDGs are available, the operators will initiate the appropriate plant procedures to backfeed selected 4 kV buses and establish battery charging as follows:

1. In the main control room, the chief operator will align the appropriate offsite 4 kV feeder breakers control switches to the open (TRIP) position.

2. A floor operator is dispatched to the Emergency Switchgear Room to remove the control power fuses for the undervoltage trip feature on only one offsite 4 kV feeder breaker associated with the EDG that is to used to backfeed the others elected 4 kV buses. The purpose of this action is to remove the undervoltage trip signal for the breaker so that this breaker can be closed. When this breaker is closed there is voltage available on the feeder side of the other offsite 4 kV feeder breakers and, therefore, the other breakers can be closed without further action.

   The floor operator will also need to remove control power fuses to large loads (e.g., RHR, Core Spray (CS), HPSW) on each bus to be backfed. This is done to prevent overload of the EDG, if these pumps would inadvertently start.

3. In the main control room, the chief operator will close the 4 kV feeder breaker that had the undervoltage trip defeated, then close the 4 kV feeder breakers to the two or three (depending on the EDG combination) 4 kV buses to be backfed and energize the appropriate load centers. During this operation, deliberate operator action by use of the synch switch to allow closing of the 4 kV feeder breaker would be required to erroneously tie the EDGs together and is therefore not expected to occur.

4. The operator in the switchgear room will then be directed to establish battery charging to the 2 or 3 (depending on EDG

Table 3 (cont'd)

combination) batteries not being charged by using the installed Appendix R transfer switches.

5. Selected non-essential DC loads will be de-energized using:

   a. control switches in the control room

   b. circuit breakers in the cable spreading room at two panels

6. For the E1/E4 EDG combination, the control room operators will start an ESW pump and secure the ECW pump.

These operator actions for backfeeding and battery charging can easily be achieved within the one-hour assumed in the analysis for battery capacity and essential area ventilation. The operators have been trained in the use of the existing backfeed procedures and use of the existing Appendix R transfer switches.

The next operator action is to perform load management activities to reduce EDG loading so that an RHR and HPSW pump can be placed in service for each unit. Based on our containment analysis for station blackout with no RHR in service, the operators would have at least eignt hours from the initiation of the LOOP event to place the RHR system in torus cooling or shutdown cooling. These load management actions are:

1. An operator will be diopatched to the Reactor Building to 2 or 3 (depending on the EDG combination) load centers to open the load center feed breakers to de-energize selected MCCs associated with non-essential equipment for the LOOP event.

2. In the main Control Room the operators will use the control switches to turn off selected non-essential equipment for the LOOP event. This equipment includes the Reactor Building Closed Cooling Water (RBCCW) pumps, drywell cooler fans, Standby Gas Treatment System, Instrument Air Compressors, Main Turbine Auxiliaries and the Plant Stack Dilution Fans.

The final operator action is to place RHR and HPSW in service using the normal operating procedure. The load management activities and placing RHR and HPSW in service can easily be achieved within the analyzed eight hour period.

2122c.doc

TABLE 4

STATION BLACKOUT OPERATOR ACTIONS - ONE EDG AVAILABLE

If a station blackout occurs, the 3 EDGs that are required to respond to a LOOP event (including the required EDG redundancy) will be unavailable. The following describes the operator actions that are needed to maintain safe shutdown for the required duration of eight hours with one EDG available. EDG E-1 will be used as an example since this EDG would require additional actions to establish EDG cooling water compared to those actions taken if the E-2, E-3 or E-4 EDG was used as the AAC.

If EDG E-1 is the only EDG to start, the operators are trained to trip the EDG within three minutes. If the operator fails to take this action, the EDG will trip on a protective trip of high jacket water temperature or high lube oil temperature within several minutes. This trip results in no damage to the EDG. Note that each EDG has a separate closed cooling water system which is cooled by ESW.

The operators will then initiate the procedure to backfeed the 4 kV buses as follows:

1. In the main control room, the chief operator will align the offsite 4 kV feeder breakers control switches to the open trip position.

2. A floor operator is dispatched to the Emergency Switchgear Room to remove the control power fuses for the undervoltage trip feature on E-212 4 kV feeder breaker.

3. Restart the E-1 EDG using existing procedures.

4. In the main control room the chief operator will close E-212 and E-232 4 kV feeder breakers and verify that the B ESW pump has auto started.

5. In the main control room, the chief operator will close the 4 kV feeder breakers to the remaining 4 kV buses and energize the appropriate load centers.

6. Selected non-essential DC loads will be de-energized using:

   a. control switches in the control room

   b. circuit breakers in the cable spreading room at two panels

These operator actions can easily be achieved within the one hour AC independent coping analysis for battery capacity and essential area ventilation. The above actions are contained in existing procedures and the operators have been trained in their use on the PBAPS simulator.

TABLE 5

Containment Isolation Valves* that do not
Meet the NUMARC Exclusion Criteria
PBAPS Units 2 & 3

System	Containment Isolation Valve
RCIC Steam Supply	MO-13-16 or MO-13-15
RCIC Torus Suction	MO-13-41 or MO-13-39
HPCI Steam Supply	MO-23-16 or MO-23-15
HPCI Torus Suction	MO-23-58 or MO-23-57
HPCI Test Line	MO-23-31 or MO-23-24
RHR Pump Suction	MO-10-13A, B, C, and D
RHR Containment Spray	MO-10-31A or MO-10-26A
RHR Containment Spray	MO-10-31B or MO-10-26B
RHR Test & Pool Cooling	MO-10-34A and MO-10-34B
RHR Torus Spray	MO-10-38A or MO-10-39A
RHR Torus Spray	MO-10-38B or MO-10-39B
RHR Shutdown Cooling	MO-10-18 or MO-10-17
Core Spray Pump Suction	MO-14-7A, B, C, and D
Core Spray Full Flow Test Line	MO-14-26A and MO-14-26B
Torus Water Filter Pump Suction	MO-14-71 or MO-14-70
RWCU Pump Suction	MO-12-18 or MO-12-15
Main Steam Drain	MO-2-77 or MO-2-74

* Unit 2 valves are numbered MO-2-XX-XX
Unit 3 valves are numbered MO-3-XX-XX

2122b.doc