APS

10 CFR 50.63

Palo Verde Nuclear
Generating Station

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ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Units 1, 2 and 3
Docket Nos. 50-528/529/530
Revised Station Blackout (SBO) Evaluation

The station blackout (SBO) coping requirements of 10 CFR 50.63, Loss of All Alternating Current Power, are currently met for the Palo Verde Nuclear Generating Station (PVNGS) by having the capability to cope with an SBO for up to four hours. Arizona Public Service Company (APS) has agreed to revise the PVNGS SBO coping duration from four hours to 16 hours to gain margin relative to nuclear safety. By letter No. 102-05313, dated July 19, 2005, Arizona Public Service Company (APS) committed to complete its evaluations and analyses for coping with an SBO for 16 hours, and to submit them to the NRC for review and approval by October 31, 2005 along with a schedule for implementation of the revised coping strategy. The results of the evaluation are provided in the Enclosure. By letter No. 102-05363, dated October 21, 2005, APS proposed a license condition to implement the changes needed to revise from a four hour station blackout coping duration to a 16 hour coping duration within six months following NRC approval of the proposed coping changes.

The revised SBO evaluation and analysis were performed to provide the information required by 10 CFR 50.63, and were performed using the guidance provided in Regulatory Guide 1.155, "Station Blackout" and in NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors." The evaluation has determined that PVNGS can cope with a 16 hour SBO. In order to implement 16 hour SBO coping, changes to procedures will be required and training will need to be conducted on those procedure changes. Also, the control air system will be supplemented to support atmospheric dump valve operation for the longer coping period.

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If changes are required to the Security or Emergency Preparedness programs, these changes will made in accordance with 10 CFR 50.54 (p) and 10 CFR 50.54 (q), respectively.

No commitments are being made to the NRC by this letter.

Should you have any questions, please call Mr. Thomas N. Weber at (623) 393-5764.

Sincerely,

David Mauldin

CDM/TNW/RAB/ca

Enclosure:

Palo Verde Nuclear Generating Station, Units 1, 2 and 3, Station Blackout Evaluation

cc:	B. S. Mallet	NRC Region IV
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Enclosure

Palo Verde Nuclear Generating Station
Units 1, 2 and 3
Station Blackout Evaluation

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PALO VERDE NUCLEAR GENERATING STATION
UNITS 1, 2, and 3
STATION BLACKOUT EVALUATION

INTRODUCTION

10 CFR Part 50.63 requires that each light water-cooled nuclear power plant be able to withstand and recover from a station blackout (SBO) of a specified duration.

This evaluation revises the Palo Verde SBO coping strategy from a 4 hour coping plant to a 16 hour coping plant. In order to gain margin relative to nuclear safety, a 16 hour SBO coping will be implemented.

The original Palo Verde study for SBO (Reference 1), for a 4 hour coping strategy, was reviewed and accepted by the NRC in Reference 2. This study assumed that the unit would achieve and maintain Hot Standby using the steam generator (SG) atmospheric dump valves (ADVs) for heat removal, and that a charging pump would be used for reactor coolant system (RCS) inventory control.

The proposed 16 hour coping strategy ensures the alternate AC (AAC) is started and loading during the first hour. At the end of 4 hours, the operators would start a cooldown to shutdown (SDC) entry conditions. The ADVs will be used for heat removal, the pressurizer vent will be used for RCS pressure control, and RCS inventory will be controlled using a high pressure safety injection (HPSI) pump.

This submittal requests NRC approval for methodologies different from those described in NUMARC 87-00 (Reference 3). The following analyses were performed using methodologies different from those recommended in NUMARC 87-00:

- The CENTS computer code is used to simulate plant performance.
- The computer program COPATTA is used to calculate containment temperature and pressure.

Palo Verde will implement the modifications and procedures proposed in this submittal within 6 months of approval by the NRC.

A. COMPARISON OF STATION BLACKOUT DURATION

Table 1 provides a comparison of the 4 hour and 16 hour coping strategies.

Table 1, Comparison of 4 Hour and 16 Hour Coping Strategies

	4 Hour Coping	16 Hour Coping
Unit Condition	Reflux boiling, hot standby for 4 hours.	Natural circulation, hot standby for 4 hours followed by a cooldown to SDC conditions.
Secondary Heat Removal	Use steam driven auxiliary feedwater (AFW) pump and ADVs to maintain RCS conditions	Use steam driven AFW pump and ADVs to maintain RCS conditions. After cooldown enter SDC.
Primary Heat Removal	Reflux boiling.	Natural circulation through the SGs. After SDC entry, essential spray pond system (SPS) and essential cooling water system (EWS)
Primary Inventory Control	Charging pump	HPSI pump (1)
Primary Pressure Control	Pressurizer sprays	Pressurizer vent
RCS Leakage	120 gpm	111 gpm
Air Supply	ADV accumulators	ADV accumulators, the control air system will be supplemented
AAC Source Power	3400 kW_e	3400 kW_e
Note (1):	HPSI is used for bounding RCS leakage. If the event results in smaller RCS leakage, the charging pump(s) can be used.	

The decay heat used for the 16 hour analyses discussed herein is based on the ANSI/ANS-5.1 1979 decay heat curve, plus a 2 sigma uncertainty. The time dependent decay heat is developed using the following parameters:

- Fuel enrichment = 5%
- Fuel burnup up to 70,000 MWD/MTU
- Power level = 3990 MW_t

The resultant decay heat curve is conservative, bounding, and consistent with industry practices for this type of evaluation.

B. COPING STUDY

The ability of PVNGS to cope with an SBO was assessed, with the following results.

1. Condensate Inventory for Decay Heat Removal

   The original evaluation (Reference 1), completed per NUMARC 87-00 guidelines, required approximately 156,000 gallons of condensate. The revised evaluation, using the CENTS Code, requires approximately 242,000 gallons to make-up for decay heat, sensible heat, and the heat from SG inventory.

   Technical Specification (TS) 3.7.6 requires ≥ 29.5 ft or a usable volume of ≥ 300,000 gallons in the condensate storage tank (CST).

   No plant or procedure changes are required to implement a 16 hour coping strategy.

2. Assessing the Class 1E Battery Capacity

   There is no effect on the Class 1E batteries caused by the increased coping period. As in the original study, the battery chargers are loaded onto the gas turbine generators (GTGs) at 1 hour. The batteries have more than adequate capacity to supply the required loads during the first hour of an SBO event.

   No plant or procedure changes are required to implement a 16 hour coping strategy.

3. AAC Power Source

   Two GTGs designated as AAC power sources are available at 1 hour of the onset of the SBO event. Each GTG has sufficient capacity and capability to operate those systems necessary for coping with an SBO for the required duration of 16 hours to bring the plant to and maintain the plant in a safe shutdown condition.

   The AAC evaluation presented in Reference 1 remains applicable for a coping duration of 16 hours.

   The alternate AC (AAC) source has the capacity and capability to power the equipment necessary to cope with an SBO, for the required coping duration of 16 hours. The summary of loads required to cope with a 16 hour SBO is provided in Table 2. The continous load on a single GTG is 3364.3 Kw.

   Before delivery to Palo Verde, each GTG was factory tested and demonstrated a 5.8% capacity margin above 3400 kW_e. The GTGs are maintained and tested to ensure their capability to supply the load required to cope with an SBO for 16 hours.

   The fuel tanks associated with the GTGs are maintained with sufficient fuel to support operation of the two GTGs for 16 hours.

   Procedure changes for operation and loading the GTG are required to support a 16 hour coping strategy. These changes are described in Sections C and E.

Table 2, Loads - 16 Hour Station Blackout Coping [1] Page 1 of 3					
Location	Load	Load Units	Bhp	kW	Description
1ENKNH21	96.00	kVA		81.6	NON CLASS IE BATTERY CHARGER
1ENNAV13	23.00	kVA		19.6	SINGLE PHASE VOLTAGE REGULATING TRANSFORMER
1EPHAD31	14.00	kVA		12.6	120/240 AC DISTRIBUTION PANEL
1EPHAD33	5.00	kVA		4.5	120/240 AC DISTRIBUTION PANEL
1EPHAD37	5.00	kVA		4.5	120/240 AC DISTRIBUTION PANEL
1EPKAH11	80.00	kVA		68.0	CLASS IE BATTERY CHARGER (A)
1EPKCH13	58.00	kVA		49.3	CLASS IE BATTERY CHARGER (C)
1EQBAV01	25.00	kVA		21.3	SINGLE PHASE VOLTAGE REGULATING TRANSFORMER
1EQBND91	90.00	kW		90.0	MAIN ESSENTIAL LIGHTING PANEL
1EQFND23	25.00	kVA		21.3	COMM EQ UPS POWER SUPPLY DISTRIBUTION PANEL
1EQFNN02	30.00	kVA		28.5	COMM UPS PANEL
1EQFNX01	12.00	kVA		10.8	MICROWAVE ROOM DISTRIBUTION PANEL TRANSFORMER
1EQMAV31	6.00	kVA		5.4	SINGLE PHASE REGULATING TRANSFORMER
1ERCNJ01A	150.00	kW		150.0	PRESSURIZER BACKUP HEATERS J-BOX (CLASS 1E FED)
1ESQND01	14.90	kVA		13.4	RADIATION MONITOR DISTRIBUTION PANEL
1JECAE01	5.03	kVA		4.3	ESSENTIAL CHILLER AUXILIARY POWER PANEL
1JSQARU29	1.50	HP	1.5	1.9	RADIATION MONITOR BLOWER MOTOR FOR CONTROL ROOM
1MDGAM01	40.00	kW		40.0	DIESEL GENERATOR (DG) JACKET WATER HEATER
1MDGAM02	19.00	kW		19.0	DIESEL GENERATOR 'A' LUBE OIL WARM-UP HEATER
1MDGAM03	4.00	kW		4.0	DIESEL GENERATOR 'A' CRANKCASE HEATER
1MDGAP01	5.00	HP	5.0	4.6	DIESEL GENERATOR WATER JACKET HEATER PUMP

Table 2, Loads - 16 Hour Station Blackout Coping [1] Page 2 of 3					
Location	Load	Load Units	Bhp	kW	Description
1MDGAP04	20.00	HP	20.0	17.5	DIESEL GENERATOR PRE-LUBE PUMP
1MECAE01	503.00	HP	503.0	402.6	ESSENTIAL CHILLER
1MECAP01	20.00	HP	14.4	11.8	ESSENTIAL CHILLED WATER PUMP
1MEWAP01	800.00	HP	698.6	550.3	ESSENTIAL COOLING WATER SYSTEM PUMP
1MHAAZ01	5.00	HP	3.2	3.0	AUX BLDG HPSI PUMP ROOM ESSENTIAL AIR CONTROL UNIT (ACU)
1MHAAZ02	3.00	HP	1.2	1.2	AUXILIARY BLDG LPSI PUMP ROOM ESSENTIAL ACU
1MHAAZ03	3.00	HP	2.0	1.9	AUX BUILDING CONTAINMENT SPRAY PUMP ROOM ESSENTIAL ACU
1MHAAZ04	5.00	HP	3.2	3.0	AFW PUMP ROOM ESSENTIAL ACU
1MHAAZ05	3.00	HP	2.0	1.9	AUX BUILDING ESSENTIAL COOLING WATER PUMP RM ESSENTIAL ACU
1MHAAZ06	3.00	HP	1.8	1.7	AUXILIARY BUILDING ELECTRIC PENETRATION RM ESSENTIAL ACU
1MHDAA01	20.00	HP	14.8	12.4	DG BLDG CONTROL RM ESSENTIAL AIR HANDLING UNIT
1MHJAF04	125.00	HP	109.7	87.1	CONTROL ROOM ESSENTIAL AIR FILTER
1MHJAJ01A	1.00	HP	0.4	0.5	CONTROL BLDG BATTERY ROOM A ESSENTIAL EXHAUST FAN
1MHJAJ01B	1.00	HP	0.4	0.5	CONTROL BLDG BATTERY ROOM C ESSENTIAL EXHAUST FAN
1MHJAZ03	7.50	HP	6.0	5.4	CONTROL BLDG ESF SWITCHGEAR ESSENTIAL AIR HANDLING UNIT
1MHJAZ04	7.50	HP	6.0	5.1	CONTROL BLDG ESF EQUIPMENT ESSENTIAL AIR HANDLING UNIT
1MHJNJ06	13.00	kVA		11.1	MICROWAVE ROOM AIR CONDITIONER
1MHSAJ01	10.00	HP	9.5	8.0	SPRAY POND PUMP HOUSE EXHAUST FAN
1MHTNJ02A	1.50	HP	0.7	0.9	TURBINE BUILDING BATTERY ROOM EXHAUST FAN
1MPCAP01	100.00	HP	64.7	52.3	FUEL POOL COOLING PUMP
1MSIAP02	1000.00	HP	997.7	785.9	HIGH PRESSURE SAFETY INJECTION PUMP [2]

Table 2, Loads - 16 Hour Station Blackout Coping [1] Page 3 of 3					
Location	Load	Load Units	Bhp	kW	Description
1MSPAP01	600.00	HP	601.3	476.7	ESSENTIAL SPRAY POND PUMP
AENHNM73	77.50	kVA		65.9	GAS TURBINE GENERATOR AUXILIARIES
U1-SWYD	200.00	kVA		170.0	PVNGS SWITCHYARD LOADS
MISC. LOAD				33	TRANSFORMER & LINE LOSSES
TOTAL LOAD				3364.3	TOTAL CONTINUOUS LOAD ON A SINGLE GAS TURBINE GENERATOR [2]
1MCHAP01	100.00	HP	74.9	60.5	CHARGING PUMP [2]
1MCHEP01	100.00	HP	74.9	60.5	CHARGING PUMP [2]

Notes (1): This Table provides specific data for Palo Verde Unit 1 and is representative of Palo Verde Units 1, 2, and 3. The Table does not include intermittent loads such as motor operated valves that have no significant effect on GTG capacity.

(2): The charging pumps are run separately from the HPSI pump and not included in the 3364.3 kW load. With 2 charging pumps in operation the total GTG load is 2699.4 kW.

4. Compressed Air

   The SG ADVs are the primary means of heat removal during an SBO. The ADVs are air operated valves with a backup nitrogen accumulator. For the 16 hour coping time, the backup accumulators would be marginal, requiring a supplementary compressed air system. The control air system will be supplemented to support ADV operation for a 16 hour SBO.

   A plant modification and procedure changes to provide a supplement to the control air system for the ADVs is required to support a 16 hour coping strategy. These changes are described in Sections C and E.

5. Effects of Loss of Ventilation

   a. Inside Containment

   No design basis accidents (DBAs) (i.e., loss of coolant accidents (LOCAs) or steam line breaks) or beyond DBAs (i.e., resulting in core damage) are assumed coincident with an SBO. Therefore, environmental concerns inside containment are limited to (1) loss of cooling water, and (2) loss of ventilation systems and (3) limited reactor coolant pump (RCP) seal leakage. SBO results in a slow heatup of containment due to loss of ventilation and RCP leakage and temperatures in a 16 hour SBO are bounded by thermal profiles considered for DBA – LOCA event.

   An analysis has been performed to determine the 16 hour SBO temperature and pressure response of the containment atmosphere. Since the duration of the event exceeded the bases provided within NUMARC 87-00. The NUMARC 87-00 do not include the effects of possible RCS leakage. In lieu of the NUMARC 87-00 method, the computer program COPATTA (quality related software, Bechtel Corp) is used. The COPATTA computer code is the program used to perform Palo Verde's LOCA and main steam line break (MSLB) containment temperature and pressure analyses as presented in the UFSAR.

   The design basis accident model is adjusted for SBO. The containment temperature and pressure response to a 16 hour SBO has been calculated considering both the sensible and the latent heat addition to the containment. The sensible heat is from the component hot surfaces including the primary and secondary system. The latent heat addition is from the RCS and RCP seal leakage of 111 gpm (25 gpm/RCP plus 11 gpm TS 3.4.14 leakage) in addition to RCS discharge from pressurizer vent valve. The analysis credits a conservative heat transfer for passive heat sinks in the containment, however no active cooling by sprays or air coolers is assumed. Selection of the heat transfer coefficient is based on leakage from RCP seals to containment environment that will produce a saturated atmosphere, and the dominant means of heat transfer will be by condensation. Consistent with previous analyses of the long-term containment responses, the Uchida condensing heat transfer correlation is used. Use of the Uchida condensing heat transfer is conservative, as the turbulence induced by the RCS discharge into the containment is not considered. To

produce a conservative bounding model for the containment environment the following additional conservatism has been built into the methodology:

i. RCP leakage rate and enthalpy has been assumed constant for duration of 16 hours.

ii. Sensible heat from the RCS and secondary system has been selected to reflect conditions at 100% power operation, and it is assumed constant for the duration of event.

iii. Minimal quantities of containment heat sinks are assumed available for the duration of the event. All heat sink areas are conservatively reduced to account for the possibility that not all the containment heat sinks would directly see the full effects of the RCP seal discharge and the sensible heat load. Specifically, the heat sink area outside the SG compartment D-rings below the operating deck may not be as effective. Based on the physical drawings, by inspection this area accounts for about one third of the total height of the containment. Therefore, all heat sink areas are reduced by 30 percent. This is a very conservative assumption because (1) the areas of all heat sink categories are reduced and (2) the heat sink area outside the SG compartment D-rings below the operating deck would be expected to have some effectiveness. Mixing will result from steam rising to the top of the containment, and natural drafts will be enhanced by steam condensing throughout the containment.

iv. To bound all conditions, initial event conditions were selected to be at TS limits used are:

- Initial containment temperature 120 °F TS 3.6.5 (the indicated limit of 117 °F ensures that the actual limit of 120 °F will not be exceeded
- Initial containment pressure 2.5 psig TS 3.6.4

Based on the conservative assumptions stated above, bounding 16 hour containment temperature and pressure profiles during SBO with RCP leakage are shown in Figure 1 and Figure 2. The peak temperature and pressure remain well below the LOCA and MSLB DBA for the duration of the event. Therefore, equipment within the containment will perform their intended function for the duration of the event. The current equipment qualification (EQ, 10 CFR 50.49) bounds the SBO environment.

No plant or procedure changes are required to implement a 16 hour coping strategy.

Figure 1
Containment Pressure Response during SBO

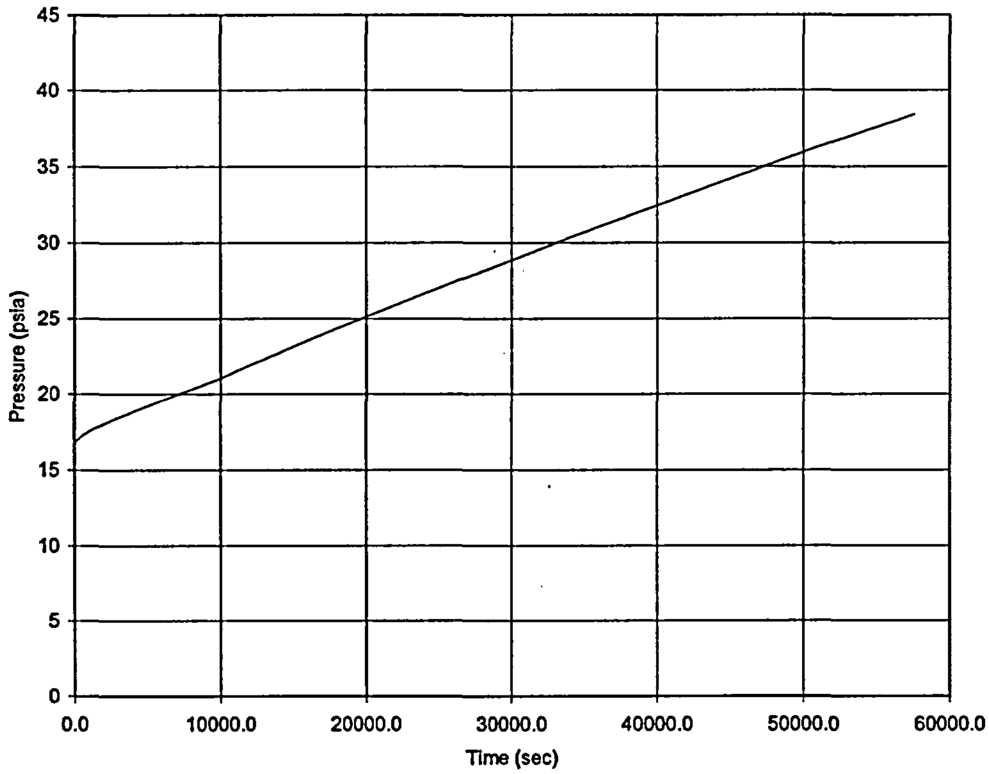
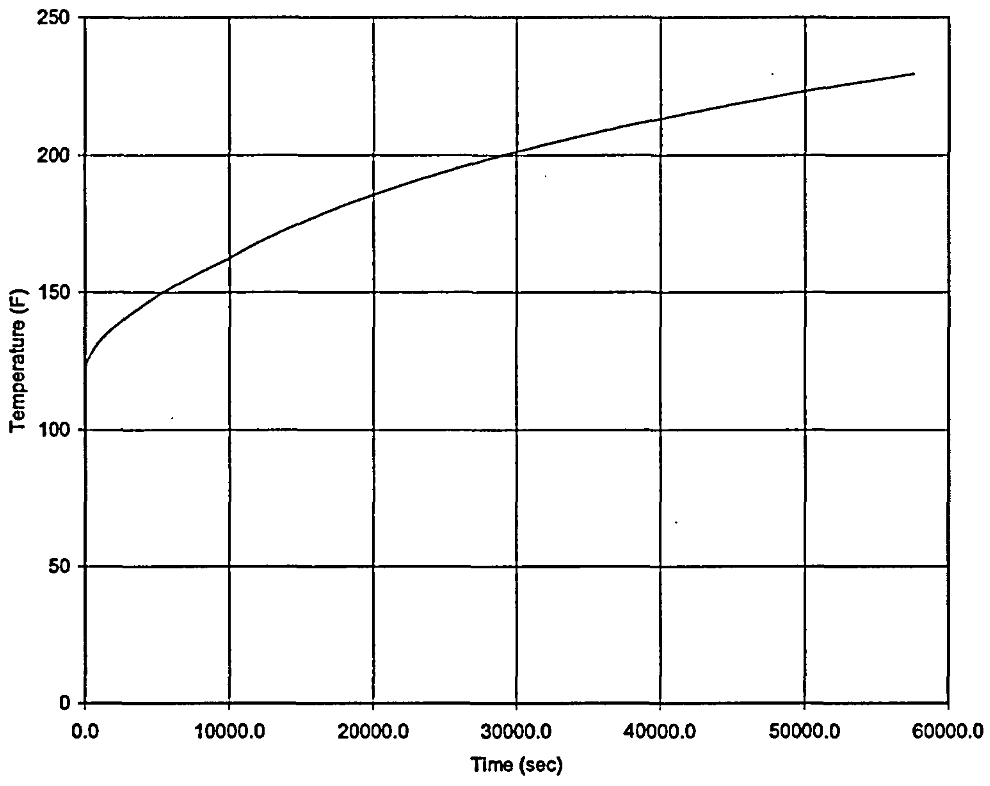


Figure 2
Containment Temperature Response during SBO



b. Outside Containment

The change in SBO duration to 16 hours has no impact on the previous conclusion supporting the 4 hour SBO. The extended coping duration does not add any new dominant areas of concern for consideration since for all rooms with essential equipment, the essential air handling unit (AHU) will be available after AAC is available (at 1 hour). Table 3 provides a list of rooms reviewed or reanalyzed. Small deviations from NUMARC 87-00 were necessitated due to plant specific geometries and heat sources. Additionally a heat sink (floor) was included where the rooms were located in plant areas with no contact to soil. Similar to the original coping study (Reference 1), additional heat source steam leakage was added to the AFW steam driven pump room evaluation to assure a bounding analysis.

Required SBO support equipment in the rooms was evaluated to ensure a basis existed to provide an adequate assurance of operation in accordance with NUMARC 87-00.

No plant or procedure changes are required to implement a 16 hour coping strategy.

Table 3, Assessment of Equipment Operability Outside the Containment During SBO
In all cases essential heating ventilation and air conditioning (HVAC) will be available after AAC is available (at 1 hour)

Room	Methodology	Room Classification NUMARC 87-00, 2.7.1(2)	Remarks
Control Room	NUMARC 87-00, 2.7.1(2) and 7.2.4, Appendix F and H	Condition 1	Heat sinks considered, in addition to NUMARC 87-00 heat sinks, the floor slab was added. Equipment within room was reviewed for operability and it is concluded all equipment are operable/functional for duration of event.
DC Equipment Rooms	NUMARC 87-00, 2.7.1(2) and 7.2.4, Appendix F and H	Condition 2	Heat sinks considered, in addition to NUMARC 87-00 heat sinks, the floor slab was added. Equipment within room was reviewed for operability and it is concluded all equipment are operable/functional for duration of event.
Emergency Switchgear Rooms	NUMARC 87-00, 2.7.1(2) and 7.2.4, Appendix F and H	Condition 1	Heat sinks considered, in addition to NUMARC 87-00 heat sinks, the floor slab was added. Equipment within room was reviewed for operability and it is concluded all equipment are operable/functional for duration of event.
Battery Rooms	No specific analysis	Condition 1	These rooms have no heat load during SBO event. Equipment within room was reviewed for operability and it is concluded all equipment are operable/functional for duration of event.
Charging Pump Rooms	NUMARC 87-00, 2.7.1(2) and 7.2.4, Appendix F and H	Condition 2	Heat sinks considered, in addition to NUMARC 87-00 heat sinks, the floor slab was added. Equipment within room was reviewed for operability and it is concluded all equipment are operable/functional for duration of event.
ESF Pump Rooms	No new analysis required	Condition 1	Components can not be started until availability of AAC. SBO is no different than any design basis event (DBE). The equipment is operable under current DBE 10CFR50.49 program. Therefore equipment would remain operable during an SBO.
AFW – Steam Driven Pump Room	NUMARC 87-00, 2.7.1(2) and 7.2.4, Appendix F and H	Condition 3	Using methodology presented in appendix F of the NUMARC 87-00. The equipment continued to perform its intended function.

6. Containment Isolation

A review of plant containment isolation valves was performed to ensure that containment integrity is provided during the SBO event. NUMARC 87-00, Section 7.2.5 defines "containment integrity" as the capability for valve position indication and closure of containment isolation valves independent of the preferred class 1E power supplies. The containment isolation valves requiring this capability are valves that may be in the open position at the onset of an SBO. Acceptable means of position indication includes local mechanical indication, DC-powered indication and AAC-powered indication. All station containment isolation valves were identified by performing a review of the plant design bases. Table 4 includes a list of containment isolation valves, detailed information about each of the valves and the reasoning for acceptance to satisfy NUMARC 87-00 requirements.

Based on this review, it is concluded that under SBO conditions, containment integrity is accomplished

No plant or procedure changes are required to implement a 16 hour coping strategy.

Table 4, Containment Isolation Valves
Page 1 of 8

System	Valve Numbers	Valve Operator	Primary Actuation Mode	Secondary Actuation Mode	Valve position			ESF Actuation Signal	Power Source (Train)	Valve Size (in.)	Valve Type	Applicable steps of NUMARC 87-00, section 7.2.5 & other references
					Normal	Post-Accident	Failure					
AF	AFB-UV035	Motor	R	R	C	O	FAI	AFAS-2	PH (B)	6	Gate	Primary and secondary and act as containment boundary. Lack of isolation would not result in breach of containment. Normal leakages from primary to secondary would be limited. Water level in secondary would reduce any release associated with normal leakage though these pathways. Special application of closed- loop system Example, Refer to step 1.4.
	AFE-V080	None	A	A	C	O	NA	None	NA	6	Check	
	AFBPSV0107	None	A	A	C	C	NA	None	NA	¾X1	Relief	
	AFAPSV0109	None	A	A	C	C	NA	None	NA	¾X1	Relief	
	AFA-UV037	Motor	R	R	C	O	FAI	AFAS-2	PK (A)	6	Gate	
	AFE-V079	None	A	A	C	O	NA	None	NA	6	Check	
	AFC-UV036	Motor	R	R	C	O	FAI	AFAS-1	PK (C)	6	Gate	
	AFBPSV0106	None	A	A	C	C	NA	None	NA	¾X1	Relief	
	AFAPSV0108	None	A	A	C	C	NA	None	NA	¾X1	Relief	
	AFB-UV034	Motor	R	R	C	O	FAI	AFAS-1	PH (B)	6	Gate	
CH CVCS	CHA-UV506	Pneumatic	A	R, M	O	C	C	CSAS	IA PK(A)	1	Globe	Exempt; refer to step 1 (5)
	CHB-UV505	Pneumatic	A	R	O	C	C	CSAS	IA PK(B)	1	Globe	
	CHA-UV560	Pneumatic	A	R	O or C	C	C	CIAS	IA PK(A)	3	Globe	AOV valve would fail close.
	CHB-UV561	Pneumatic	A	R, M	O or C	C	C	CIAS	IA PK(B)	3	Globe	
	CHE-V494	None	A	A	O or C	C	NA	None	NA	1 ½	Check	Exempt; refer to step 1 (3)
	CHA-UV580	Pneumatic	A	R, M	O or C	C	C	CIAS	IA PK(A)	1 ½	Gate	Exempt; refer to step 1 (5)
	CHA-UV715	Solenoid	A	R	C	C	C	CIAS	PK (A)	½	Globe	
	CHA-UV516	Pneumatic	A	R	O	C	C	CIAS SIAS	IA PK(A)	2	Globe	
	CHB-UV523	Pneumatic	A	R, M	O	C	C	CIAS	IA PK(B)	2	Globe	
	CHB-UV924	Solenoid	A	R	C	C	C	CIAS	PK (B)	½	Globe	
	CHE-VM70	None	A	A	C	O or C	NA	None	NA	3	Check	Exempt; refer to step 1 (3)
	CHA-HV524	Motor	R	M	LO	LO	FAI	None	PH (A)	2	Globe	Exempt; refer to step 1 (5)
	CHE-V854	Hand	M	M	C	C	NA	None	NA	¾	Globe	
	CHE-V835	None	A	A	O	O or C	NA	None	NA	1 ½	Check	
	CHB-HV255	Motor	R	M	O	O or C	FAI	None	PH (B)	1 ½	Globe	
CL ILRT	MCLEU58 MCLEU62B MCLEU62C	NA	NA	NA	C	C	NA	None	NA	8 ¾ ¾	Flange	Passive device. No impact due to SBO.
CP Purge	CPB-UV005A	Solenoid	A	R	C	C	C	CIAS CPIAS	PK (B)	8	B'fly	Failure of AC power would result in closure of these valves.
	CPA-UV004A	Solenoid	A	R	C	C	C	CIAS CPIAS	PK (A)	8	B'fly	
	CPA-UV004B	Solenoid	A	R	C	C	C	CIAS CPIAS	PK (A)	8	B'fly	

Table 4, Containment Isolation Valves
Page 2 of 8

System	Valve Numbers	Valve Operator	Primary Actuation Mode	Secondary Actuation Mode	Valve position: Normal	Valve position: Post-Accident	Valve position: Failure	ESF Actuation Signal	Power Source (Train)	Valve Size (in.)	Valve Type	Applicable steps of NUMARC 87-00, section 7.2.5 & other references
CP Purge	CPB-UV005B	Solenoid	A	R	C	C	C	CIAS CPIAS	PK (B)	8	B'fly	Failure AC power would result in closure of these valves.
	CPB-UV003A	Motor	A	R	LC	C	FAI	CIAS CPIAS	PH (B)	42	B'/fly	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (See Note 1)
	CPA-UV002A	Motor	A	R	LC	C	FAI	CIAS CPIAS	PH (A)	42	B'/fly	
	CPA-UV002B	Motor	A	R	LC	C	FAI	CIAS CPIAS	PH (A)	42	B'/fly	
	CPB-UV003B	Motor	A	R	LC	C	FAI	CIAS CPIAS	PH (B)	42	B'/fly	
DW	DWE-V061 DWE-V062	Hand	M	M	LC	C	NA	None	NA	2	Globe	Exempt; refer to step 1 (4) and (5)
FP	FPE-V089	Hand	M	M	LC	C	NA	None	NA	6	Gate	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (See Note 1)
	FPE-V090	None	A	A	C	C	NA	None	NA	6	Check	Exempt; refer to step 1 (3)
GA (N2)	GAE-V015	None	A	A	O	C	NA	None	NA	1	Check	
	GAA-UV002	Solenoid	A	R	O	C	C	CIAS	PK (A)	1	Globe	Exempt; refer to step 1 (5)
	GAE-V011	None	A	A	C	C	NA	None	NA	1	Check	
	GAA-UV001	Solenoid	A	R	C	C	C	CIAS	PK (A)	1	Globe	
GR RTD Vent	GRA-UV001	Motor	A	R	O	C	FAI	CIAS	PH (A)	1	Globe	
	GRB-UV002	Solenoid	A	R	O	C	C	CIAS	PK (B)	1	Globe	
HC Rad. Mon.	HCB-UV044	Solenoid	A	R	O	O or C	C	CIAS	PK (B)	1	Globe	
	HCA-UV045	Solenoid	A	R	O	O or C	C	CIAS	PK (A)	1	Globe	
	HCB-UV047	Solenoid	A	R	O	O or C	C	CIAS	PK (B)	1	Globe	
	HCA-UV046	Solenoid	A	R	O	O or C	C	CIAS	PK (A)	1	Globe	
HC Press. Mon.	HCA-HV074	Solenoid	R	R	O	O	O	None	PK (A)	¾	Globe	
	HCB-HV075	Solenoid	R	R	O	O	O	None	PK (B)	¾	Globe	
	HCC-HV076	Solenoid	R	R	O	O	O	None	PK (C)	¾	Globe	
	HCD-HV077	Solenoid	R	R	O	O	O	None	PK (D)	¾	Globe	
HP H2 Control	HPB-UV002	Motor	A	R	C	O or C	FAI	CIAS	PH (B)	2	Globe	
	HPB-UV004	Motor	A	R	C	O or C	FAI	CIAS	PH (B)	2	Globe	
	HPB-HV008A	Solenoid	R	R	C	O or C	C	None	PK (B)	1	Globe	
	HPA-V002	None	A	A	C	O or C	NA	None	NA	2	Check	Exempt; refer to step 1 (3)
	HPA-UV005	Motor	A	R	C	O or C	FAI	CIAS	PH (A)	2	Globe	Exempt; refer to step 1 (5)
	HPA-HV007B	Solenoid	R	R	C	O or C	C	None	PK (A)	1	Globe	
	HPA-UV0023	Solenoid	A	R	C	O or C	F C	CIAS	PK (A)	½" U1 1" U2 & 3	Globe	
	HPB-V004	None	A	A	C	O or C	NA	None	NA	2	Check	
	HPB-UV006	Motor	A	R	C	O or C	FAI	CIAS	PH (B)	2	Globe	
	HPB-HV008B	Solenoid	R	R	C	O or C	C	None	PK (B)	1	Globe	
	HPA-UV001	Motor	A	R	C	O or C	FAI	CIAS	PH (A)	2	Globe	

Table 4, Containment Isolation Valves

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System	Valve Numbers	Valve Operator	Primary Actuation Mode	Secondary Actuation Mode	Valve position: Normal	Valve position: Post-Accident	Valve position: Failure	ESF Actuation Signal	Power Source (Train)	Valve Size (in.)	Valve Type	Applicable steps of NUMARC 87-00, section 7.2.5 & other references
HP H2 Control	HPA-UV003	Motor	A	R	C	O or C	FAI	CIAS	PH (A)	2	Globe	Exempt; refer to step 1 (5)
	HPA-HV007A	Solenoid	R	R	C	O or C	C	None	PK (A)	1	Globe	
	HPA-UV0024	Solenoid	A	R	C	O or C	F C	CIAS	PK (A)	½" U1 1" U2 & 3	Globe	
IA	IAE-V021	None		A	O	C	NA	None	NA	2	Check	Exempt; refer to step 1 (3)
	IAA-UV002	Solenoid	A	R	O	C	C	CSAS	PK (A)	2	Globe	Exempt; refer to step 1 (5)
	IAE-V073	None	A	A	C	C	NA	None	NA	3	Check	Exempt; refer to step 1 (3)
	IAE-V072	Hand	M	M	LC	C	NA	None	NA	3	Globe	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (see note 1)
NC	NCE-V118	None	A	A	O	C	NA	None	NA	10	Check	Exempt; refer to step 1 (3)
	NCB-UV401	Motor	A	R	O	C	FAI	CSAS	PH (B)	10	B'Fly	Exempt; refer to step 1 (4)
	NCB-UV403	Motor	A	R	O	C	FAI	CSAS	PH (B)	10	B'Fly	
	NCA-UV402	Motor	A	R	O	C	FAI	CSAS	PH (A)	10	B'Fly	
	NCE-PSV0617	Safety	A	M	C	C	C	None	NA	¾ x 1	Relief	Inside containment - outer isolation UV-402 would be closed. The SBO would not result in lifting
PC	PCE-V071	Hand	M	M	LC	C	NA	None	NA	4	Gate	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (see note 1)
	PCE-V070	Hand	M	M	LC	C	NA	None	NA	4	Gate	
	PCE-V075	Hand	M	M	LC	C	NA	None	NA	4	Gate	
	PCE-V076	Hand	M	M	LC	C	NA	None	NA	4	Gate	
RD	RDA-UV023	Motor	A	R	O	C	FAI	CIAS	PH (A)	3	Gate	Although the inner valves remain open, outer valve, (UV024) would close to safe position when AC power is lost. Single failure does not apply see Q/A 101 Appendix I
	RDB-UV024	Pneumatic	A	R	O	C	C	CIAS	IA PK(B)	3	Gate	Fails close on loss of power
	RDB-UV407	Solenoid	A	R	C	C	FC	CIAS	PK (B)	½	Globe	Exempt; refer to step 1 (3)
SG Feedwater	SGB-UV132 SGB-UV137 SGA-UV174 SGA-UV177	Hydraulic	A	R	O	C	C	MSIS	Accumulator	24	Gate	Valves are exempt since the SG tubes provide the pressure boundary between primary and secondary and act as containment boundary. Lack of isolation would not result in breach of containment. Normal leakages from primary to secondary would be limited. Water level in secondary would reduce any release as a result of normal leakage though this pathway. Special application of closed- loop system Step 1 item 4.
	SGE-V003 SGE-V006 SGE-V007 SGE-V005	None	A	A	O	C	NA	None	NA	24	Check	
	SGE-V652 SGE-V653 SGE-V642 SGE-V693	None	A	A	O	C	C	None	NA	8	Check	
	SGB-UV130 SGB-UV135	Pneumatic	A	R	O	C	O or C(e)	MSIS	IA GA PK(B)	8	Gate	

Table 4, Containment Isolation Valves
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System	Valve Numbers	Valve Operator	Primary Actuation Mode	Secondary Actuation Mode	Valve position			ESF Actuation Signal	Power Source (Train)	Valve Size (in.)	Valve Type	Applicable steps of NUMARC 87-00, section 7.2.5 & other references
					Normal	Post-Accident	Failure					
SG Feedwater	SGB-HV200	Solenoid	A	R	C	C	FC	CIAS MSIS	PK (B)	¾	Plug	Valves are exempt since the SG tubes provide the pressure boundary between primary and secondary and act as containment boundary. Loss of isolation would not result in breach of containment. Normal leakages from primary to secondary would be limited. Water level in secondary would reduce any release as a *result of normal leakage though this pathway. Special application of* closed- loop system Step 1 item 4.
	SGA-UV172 SGA-UV175	Pneumatic	A	R	O	C	O or C(e)	MSIS	IA GA PK(A)	8	Gate	
	SGB-HV201	Solenoid	A	R	C	C	FC	CIAS MSIS	PK (B)	¾	Plug	
SG Main Steam	SGE-UV170 SGE-UV171 SGE-UV180 SGE-UV181	Hydraulic	A	R	O	C	C	MSIS	Accumulator	28	Gate	
	SGE-PSV691 SGE-PSV692 SGE-PSV694 SGE-PSV695	Safety	A	NA	C	C	C	None	NA	6	Safety	
	SGE-PSV575 SGE-PSV576 SGE-PSV557 SGE-PSV558	Safety	A	NA	C	C	C	None	NA	6	Safety	
	SGE-PSV574 SGE-PSV577 SGE-PSV556 SGE-PSV559	Safety	A	NA	C	C	C	None	NA	6	Safety	
	SGE-PSV573 SGE-PSV578 SGE-PSV555 SGE-PSV560	Safety	A	NA	C	C	C	None	NA	6	Safety	
	SGE-PSV572 SGE-PSV579 SGE-PSV554 SGE-PSV561	Safety	A	NA	C	C	C	None	NA	6	Safety	
	SGA-UV134 SGA-UV138	Motor	A	R	C	O/C	FAI	AFAS-1 AFAS-2	PK (A)	6	Gate	
	SGA-UV134A SGA-UV138A	Solenoid	A	R	C	O/C	FC	AFAS-1 AFAS-2	PK (A)	1	Globe	
	SGA-HV184 SGB-HV178 SGB-HV185 SGA-HV179	Pneumatic	R	M	C	O/C	FC	None(d)	Accumulator IA PK (A, B, C, D)	12	Globe	
	SGE-UV169 SGE-UV183	Pneumatic	A	R	C	C	FC	MSIS	PK (A, B)	4	Gate	
	SGA-UV1133 SGA-UV1134	Solenoid	A	R	O	C	C	MSIS	PK (A)	1	Globe	

Table 4, Containment Isolation Valves
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System	Valve Numbers	Valve Operator	Primary Actuation Mode	Secondary Actuation Mode	Valve position Normal	Valve position Post-Accident	Valve position Failure	ESF Actuation Signal	Power Source (Train)	Valve Size (in.)	Valve Type	Applicable steps of NUMARC 87-00, section 7.2.5 & other references
SG Main Steam	SGB-UV1135A SGB-UV1135B SGB-UV1136A SGB-UV1136B	Solenoid	A	R	O	C	C	MSIS	PK(B)	1	Globe	Valves are exempt since the SG tubes provide the pressure boundary between primary and secondary and act as containment boundary. Loss of isolation would not result in breach of containment. Normal leakages from primary to secondary would be limited. Water level in secondary would reduce any release as a result of normal leakage though this pathway. Special application of closed- loop system Step 1 item 4.
	SGE-V603 SGE- V611	Hand	M	M	LC	C	NA	None	NA	1	Globe	
SG Blowdown Sample	SGA-UV211	Solenoid	A	R	O	C	FC	MSIS AFAS-1 AFAS-2 SIAS	PK (A)	½	Plug	
	SGB-UV228	Solenoid	A	R	O	C	FC		PK (B)	½	Plug	
	SGA-UV204	Solenoid	A	R	O	C	FC	MSIS AFAS-1 AFAS-2 SIAS	PK (A)	½	Plug	
	SGB-UV219	Solenoid	A	R	O	C	FC		PK (B)	½	Plug	
	SGB-UV226	Solenoid	A	R	O	C	FC	MSIS AFAS-1 AFAS-2 SIAS	PK (B)	½	Plug	
	SGA-UV227	Solenoid	A	R	O	C	FC		PK(A)	½	Plug	
	SGA-UV220	Solenoid	A	R	O	C	FC	MSIS AFAS-1 AFAS-2 SIAS	PK(A)	½	Plug	
	SGB-UV221	Solenoid	A	R	O	C	FC		PK (B)	½	Plug	
	SGB-UV224	Solenoid	A	R	O	C	FC	MSIS AFAS-1 AFAS-2 SIAS	PK (B)	½	Plug	
	SGA-UV225	Solenoid	A	R	O	C	FC		PK (A)	½	Plug	
	SGB-UV222	Solenoid	A	R	O	C	FC	MSIS AFAS-1 AFAS-2 SIAS	PK (B)	½	Plug	
	SGA-UV223	Solenoid	A	R	O	C	FC		PK (A)	½	Plug	
SG Blowdown	SGA-UV500P	Pneumatic	A	R	O	C	FC	MSIS AFAS-1 AFAS-2 SIAS	IA PK (A)	6	Gate	
	SGB-UV500Q	Pneumatic	A	R	O	C	FC		IA PK (B)	6	Gate	
	SGE-V293	Hand	M	M	LC	C	NA	None	NA	1	Globe	

Table 4, Containment Isolation Valves
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System	Valve Numbers	Valve Operator	Primary Actuation Mode	Secondary Actuation Mode	Valve position			ESF Actuation Signal	Power Source (Train)	Valve Size (in.)	Valve Type	Applicable steps of NUMARC 87-00, section 7.2.5 & other references
					Normal	Post-Accident	Failure					
SG Blowdown	SGB-UV500R	Pneumatic	A	R	O	C	FC	MSIS AFAS-1 AFAS-2 SIAS	IA PK (B)	6	Gate	Valves are exempt since the SG tubes provide the pressure boundary between primary and secondary and act as containment boundary. Loss of isolation would not result in breach of containment. Normal leakages from primary to secondary would be limited. Water level in secondary would reduce any release as a result of normal leakage though this pathway. Special application of closed- loop system Step 1 Item 4.
	SGA-UV500S	Pneumatic	A	R	O	C	FC		IA PK (A)	6	Gate	
	SGE-V294	Hand	M	M	LC	C	NA	None	NA	1	Globe	
SI HPSI	SIE-V113	None	A	A	C	O	NA	None	NA	3	Check	Exempt; refer to step 1 (3)
	SIB-UV616	Motor	A	R, M	C	O	FAI	SIAS	PH (B)	2	Globe	Exempt; refer to step 1 (5)
	SIA-UV617	Motor	A	R, M	C	O	FAI	SIAS	PH (A)	2	Globe	
	SIE-V123	None	A	A	C	O	NA	None	NA	3	Check	Exempt; refer to step 1 (3)
	SIB-UV626	Motor	A	R, M	C	O	FAI	SIAS	PH (B)	2	Globe	Exempt; refer to step 1 (5)
	SIA-UV627	Motor	A	R, M	C	O	FAI	SIAS	PH (A)	2	Globe	
	SIE-V133	None	A	A	C	O	NA	None	NA	3	Check	Exempt; refer to step 1 (3)
	SIB-UV636	Motor	A	R, M	C	O	FAI	SIAS	PH (B)	2	Globe	Exempt; refer to step 1 (5)
	SIA-UV637	Motor	A	R, M	C	O	FAI	SIAS	PH (A)	2	Globe	
	SIE-V143	None	A	A	C	O	NA	None	NA	3	Check	
	SIB-UV646	Motor	A	R, M	C	O	FAI	SIAS	PH (B)	2	Globe	
	SIA-UV647	Motor	A	R, M	C	O	FAI	SIAS	PH (A)	2	Globe	
SI Containment Spray	SIA-V164	None	A	A	C	O	NA	None	NA	10	Check	Exempt; refer to step 1 (3)
	SIA-UV672	Motor	A	R	LC	O	FAI	CSAS	PH (A)	8	Gate	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (See Note 1)
	SIB-V165	None	A	A	C	O	NA	None	NA	10	Check	Exempt; refer to step 1 (3)
	SIB-UV671	Motor	A	R	LC	O	FAI	CSAS	PH (B)	8	Gate	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (See Note 1)
SI LPSI	SIE-V114	None	A	A	C	O	NA	None	NA	12	Check	Exempt; refer to step 1 (3)
	SIB-UV615	Motor	A	R, M	C	O	FAI	SIAS	PH (B)	12	Globe	ESF, required for mitigation of event. Part of extended containment boundary.
	SIE-V124	None	A	A	C	O	NA	None	NA	12	Check	Exempt; refer to step 1 (3)
	SIB-UV625	Motor	A	R, M	C	O	FAI	SIAS	PH (B)	12	Globe	ESF, required for mitigation of event. Part of extended containment boundary.
	SIE-V134	None	A	A	C	O	NA	None	NA	12	Check	Exempt; refer to step 1 (3)
	SIA-UV635	Motor	A	R, M	C	O	FAI	SIAS	PH (A)	12	Globe	ESF, required for mitigation of event. Part of extended containment boundary.
	SIE-V144	None	A	A	C	O	NA	None	NA	12	Check	Exempt; refer to step 1 (3)
	SIA-UV645	Motor	A	R, M	C	O	FAI	SIAS	PH (A)	12	Globe	ESF, required for mitigation of event. Part of extended containment boundary.
SI Recirc	SIA-UV673	Motor	A	R, M	C	O	FAI	RAS	PH (A)	24	B'Fly	
	SIA-UV674	Motor	A	R, M	C	O	FAI	RAS	PH (A)	24	B'Fly	
	SIA-PSV151	Safety	A	NA	C	C	C	None	NA	¾	Safety	Exempt; refer to step 1 (5)
	SIA-UV708	Solenoid	A	R	C	C	C	CIAS	PK (A)	½	Globe	

Table 4, Containment Isolation Valves
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System	Valve Numbers	Valve Operator	Primary Actuation Mode	Secondary Actuation Mode	Valve position: Normal	Valve position: Post-Accident	Valve position: Failure	ESF Actuation Signal	Power Source (Train)	Valve Size (in.)	Valve Type	Applicable steps of NUMARC 87-00, section 7.2.5 & other references
SI Recirc	SIB-UV675	Motor	A	R, M	C	O	FAI	RAS	PH (B)	24	B'Fly	ESF, required for mitigation of event. Part of extended containment boundary.
	SIB-UV676	Motor	A	R, M	C	O	FAI	RAS	PH (B)	24	B'Fly	
	SIB-PSV140	Safety	A	NA	C	C	C	None	NA	¾	Safety	Exempt; refer to step 1 (5)
SI SDC	SID-UV654	Motor	R	R	LC	O or C	FAI	None	PK (D)	16	Gate	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (See Note 1)
	SIB-UV656	Motor	R	M	LC	O or C	FAI	None	PH (B)	16	Gate	
	SIB-HV690	Motor	R	M	LC	O or C	FAI	None	PH (B)	10	Globe	
	SIB-PSV189	Safety	A	NA	C	C	C	None	NA	6	Safety	Not expect to lift for this event
	SIC-UV653	Motor	R	R	LC	O or C	FAI	None	PK (C)	16	Gate	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (See Note 1)
	SIA-UV655	Motor	R	M	LC	O or C	FAI	None	PH (A)	16	Gate	
	SIA-HV691	Motor	R	M	LC	O or C	FAI	None	PH (A)	10	Globe	
	SIA-PSV179	Safety	A	NA	C	C	C	None	NA	6	Safety	Not expected to lift for this event
SI Fill & Drain	SIA-UV682	Pneumatic	A	R	C	C	C	SIAS	IA PK(A)	2	Globe	Exempt; refer to step 1 (5)
	SIE-V463	Hand	M	M	LC	C	NA	None	NA	2	Globe	
	SIE-PSV474	Safety	A	NA	C	C	C	None	NA	¾	Safety	
SI Long Term Recirc	SIA-V523	None	A	A	C	O	NA	None	NA	3	Check	Exempt; refer to step 1 (3)
	SIC-HV321	Motor	R	M	LC	O	FAI	None	PK (C)	3	Globe	ESF, required for mitigation of event. Part of extended containment boundary
	SIB-V533	None	A	A	C	O	NA	None	NA	3	Check	Exempt; refer to step 1 (3)
	SID-HV331	Motor	R	M	LC	O	FAI	None	PK (D)	3	Globe	Procedurally locked closed. Exempt; step 1 (1). NUMARC 87-00, Q/A 100 in Appendix I and Appendix J Q/A 7.1 (See Note 1)
SS	SSA-UV204	Solenoid	A	R	C	C	C	CIAS	PK (A)	⅜	Plug	Exempt; refer to step 1 (5)
	SSB-UV201	Solenoid	A	R	C	C	C	CIAS	PK (B)	⅜	Plug	
	SSA-UV205	Solenoid	A	R	C	C	C	CIAS	PK (A)	⅜	Plug	
	SSB-UV202	Solenoid	A	R	C	C	C	CIAS	PK (B)	⅜	Plug	
	SSA-UV203	Solenoid	A	R	C	C	C	CIAS	PK (A)	⅜	Plug	
	SSB-UV200	Solenoid	A	R	C	C	C	CIAS	PK (B)	⅜	Plug	
WC	WCE-V039	None	A	A	O	C	NA	None	NA	10	Check	Exempt; refer to step 1 (3)
	WCB-UV063	Motor	A	R	O	C	FAI	CIAS	PH (B)	10	Gate	Exempt; refer to step 1 (4)
	WCB-UV061	Motor	A	R	O	C	FAI	CIAS	PH (B)	10	Gate	
	WCA-UV062	Motor	A	R	O	C	FAI	CIAS	PH (A)	10	Gate	
Air locks (L-1, L-3)	CZCNM01 CZCNM02	NA	M	M	C	C	NA	None	NA	N/A	N/A	Passive, not required to be evaluated
Equipment Hatch (L-2)	CZCNM03	NA	M	M	C	C	NA	None	NA	N/A	N/A	
Fuel Transfer Tube	MPCEU53	NA	NA	NA	C	C	NA	None	NA	36	Flange	
Electrical Penetrations	EXXXZ01 thru EXXXZ91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Table 4, Containment Isolation Valves

Note 1: The handweels for these valves are chained and locked, if valve is motor operated, the motors do not have a mechanical lock, therefore the lock is provided at source of power (breakers are physically locked by a mechanical device).

NA	not applicable		MSIS	main steam isolation signal
O	open		CSAS	containment spray actuation signal
C	closed		CPIAS	containment purge isolation actuation signal
A	automatic		AFAS	AFW actuation signal
R	remote operation		SIAS	safety injection actuation signal
M	manual local operation		RAS	recirculation actuation signal
DU	data currently unavailable		CIAS	containment isolation actuation signal
LO	locked open		IA	Instrument air system
LC	locked closed		PK	125 VDC Power, Class 1E
FO	fail open		PH	120/480 VAC Power, Class 1E
FC	fail closed		GA	Service Gas, Nitrogen
FAI	fail-as-is			

7. Reactor Coolant Inventory Loss

Sources of expected reactor coolant inventory loss during the SBO event include RCS leakage (11 gpm per TS 3.4.14) and losses due to RCP seal leakage (25 gpm/RCP per NUMARC 87-00). Analysis of the RCS during SBO indicates that expected rates of reactor coolant inventory loss do not result in the core uncovering in the first hour or the subsequent 15 hours of coping using AAC power source. Analysis further indicates that RCS makeup systems beyond those currently available under DBEs are not required. Sufficient head exists to maintain core cooling under natural circulation.

SBO scenarios conditions were simulated with the CENTS code. The analysis supports a determination of the plant's capability to cope for up to 16 hours under SBO conditions. The analysis presented here is initiated from hot full power conditions (3990 MW_t) with the TS 3.4.14 maximum allowed RCS leakage of 11 gpm. Onset of SBO conditions are assumed to immediately cause RCP, turbine, and reactor trips, and failure of the RCP seals resulting in an additional leakage of 25 gpm/RCP. The following is a brief description of assumptions used for analysis the design bases SBO event.

Decay heat used is based on ANSI/ANS-5.1 1979, final decay heat plus 2 sigma.

The CENTS code models the heat loss from the pressurizer, the reactor vessel upper head, the balance of the RCS, and from the secondary side of each SG. Modeling heat loss is conservative since it would worsen the cooldown of the RCS during first hour and maximize the phenomenon of loss of subcooling.

Only safety related systems are used to mitigate the event (HPSI, SDC system (SDCS), EWS, SPS, AFW, pressurizer vent valves, main steam safety valves (MSSVs), and ADVs).

No operator action for RCS inventory loss is assumed within the first hour of the event. The following operator actions are assumed after actuation of the AAC power source at one hour.

a. Control of cooldown using ADVs.
b. The AFW system is adjusted to maintain SG level.
c. The HPSI flow is delivered to maintain RCS inventory, subcooling, and natural circulation.
d. At 4 hours – operators adjust ADVs for approximately a 30 °F/hr cooldown and maintain pressure in the RCS using the pressurizer vent valve.

Table 5 demonstrates the capability to control RCS inventory, pressure, and temperature; and achieve SDC entry conditions at 16 hours. Figure 3 thru Figure 15 provide additional information on performance of RCS and secondary systems. It is therefore concluded that the ability to maintain adequate RCS inventory to ensure that the core can be cooled is achieved using the existing safety systems for 16 hours. The rates of coolant inventory loss under SBO

conditions do not result in core uncovery and the station can cope with a 16 hour duration SBO event.

Procedure changes for actions required to ensure RCS inventory are required to support a 16 hour coping strategy. These changes are described in Sections C and E.

Table 5
SBO Design Case (111 gpm RCS and RCP leakage) Controlled with HPSI Sequence of Events

Time, sec	Parameter	Value
0	SBO conditions arise. Total RCP seal + TS 3.4.14 max. allowed leakage assumed, gpm. Turbine / reactor trip.	- - 111 - -
10	MSSVs open.	- -
800	AFW flow is initiated as a result of on low SG level, lb_m/sec.	93
3600	Operator opens ADVs on each SG to close MSSVs and approach 570 °F T_{cold}. Operator adjusts AFW to maintain SG level/match ADV flow. HPSI pump is loaded onto the GTG-energized bus, and flow initiates (and is controlled not to exceed 126 gpm) as RCS pressure drops below shutoff head, psia.	- - - - 1715
14400	Operator opens the ADVs on each SG to initiate a ~ 30 °F/hr cooldown, and is adjusted hourly to sustain cooldown. Operator opens the pressurizer vent valve to limit the increase in subcooling.	- - - -
~ 40000	SDC entry pressure is achieved, psig.	435
~ 43000	SDC entry temperature achieved, °F.	<350
46800	Operator adjusts ADVs to terminate the cooldown.	- -
48000	Operator controls HPSI (≤ 405 gpm) to limit pressurizer level increases.	

Figure 3
Pressurizer Pressure versus Time

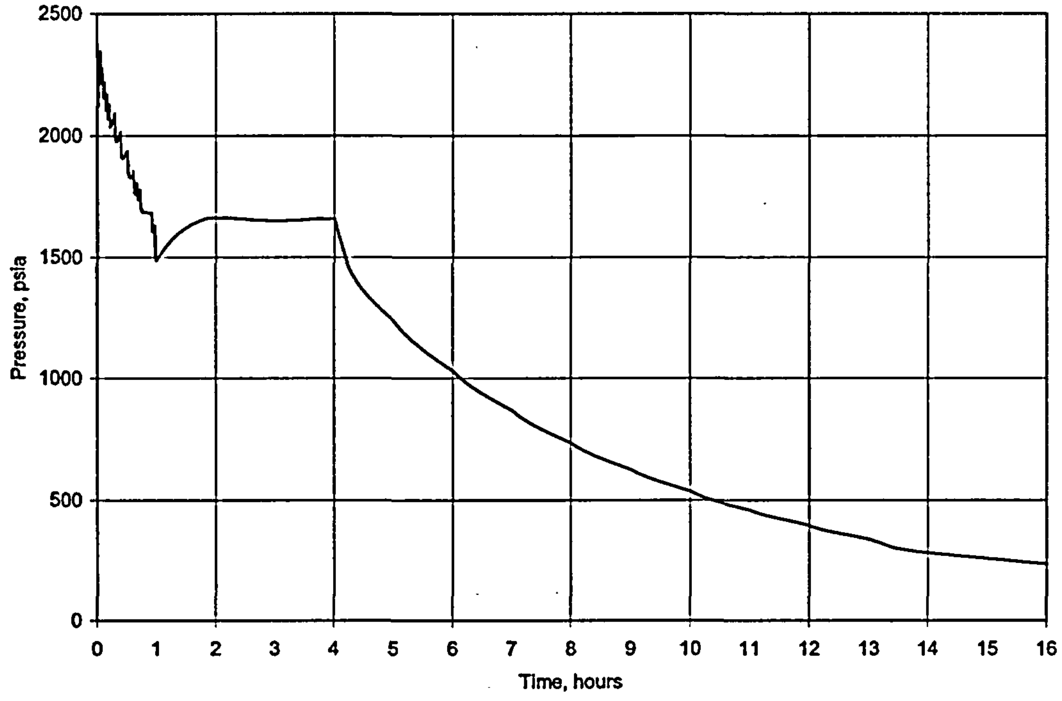


Figure 4
Level in Pressurizer versus Time

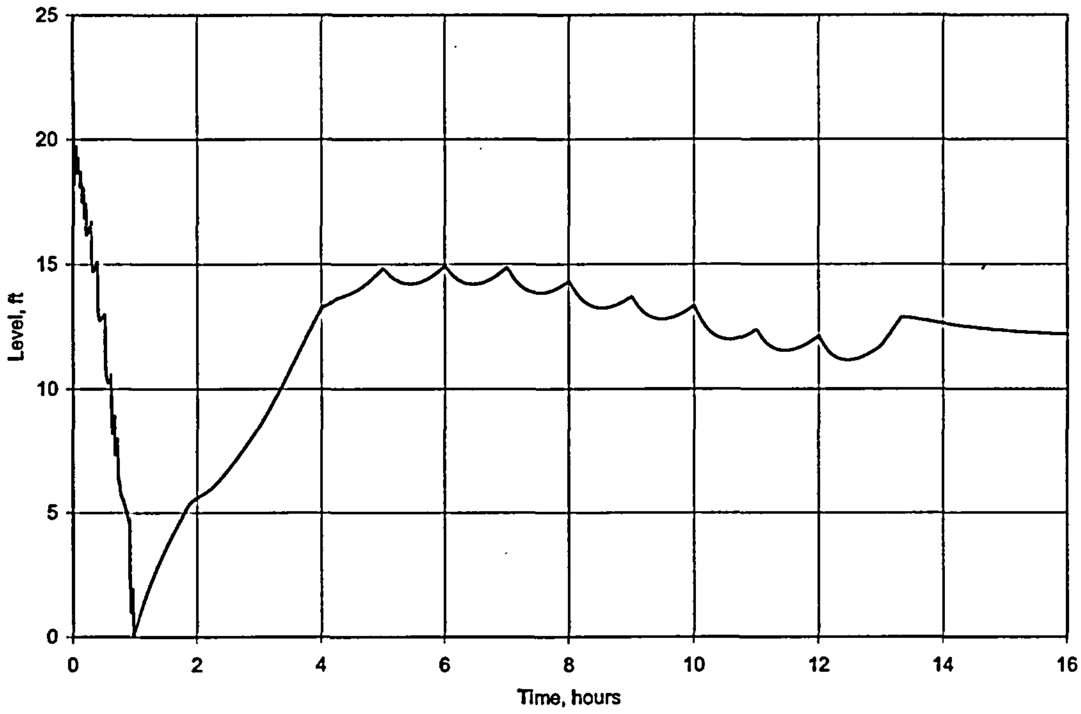


Figure 5
Subcooling in Hot Leg #1 versus Time

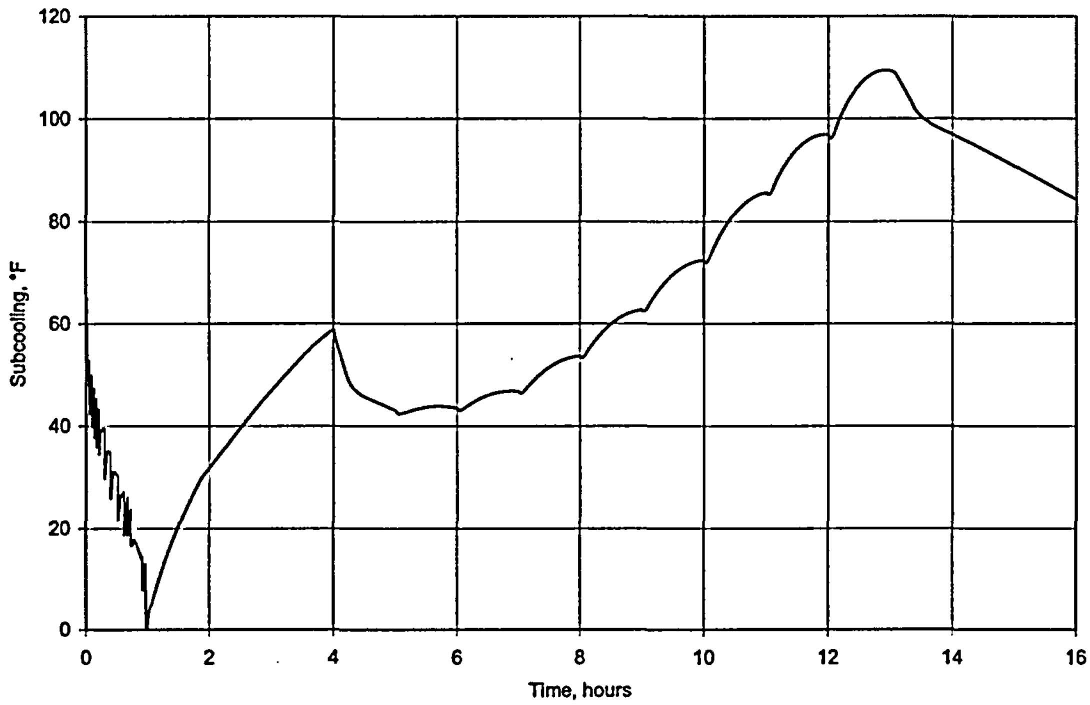


Figure 6
Subcooling in Upper Head versus Time

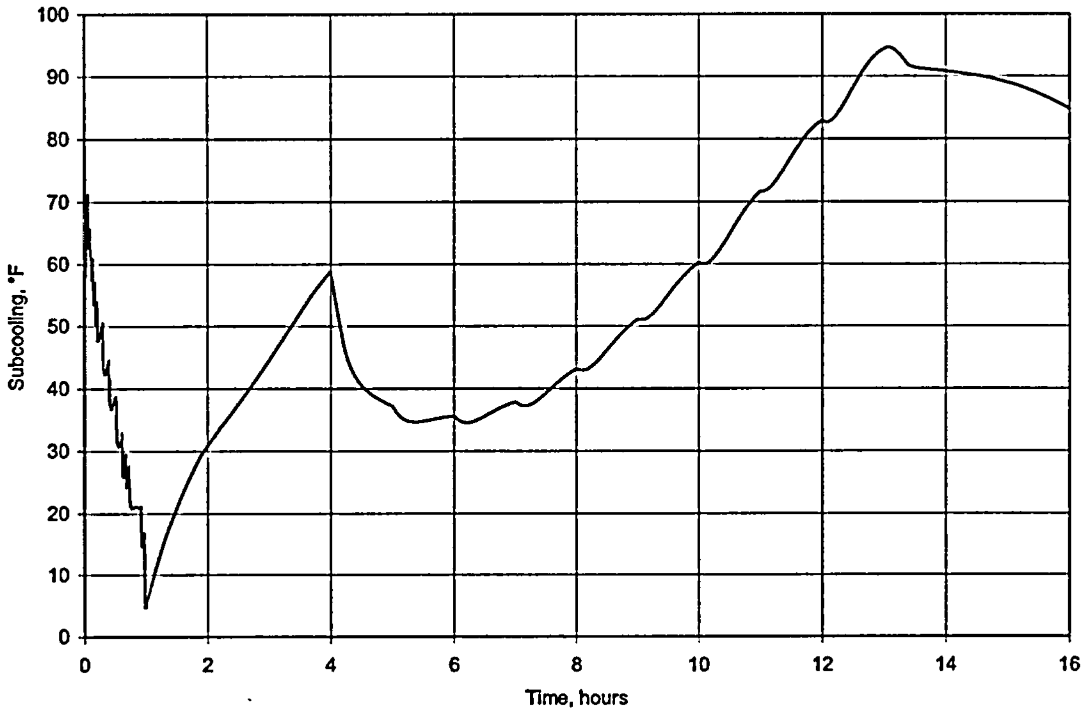


Figure 7
Temperature in Hot Leg #1 versus Time

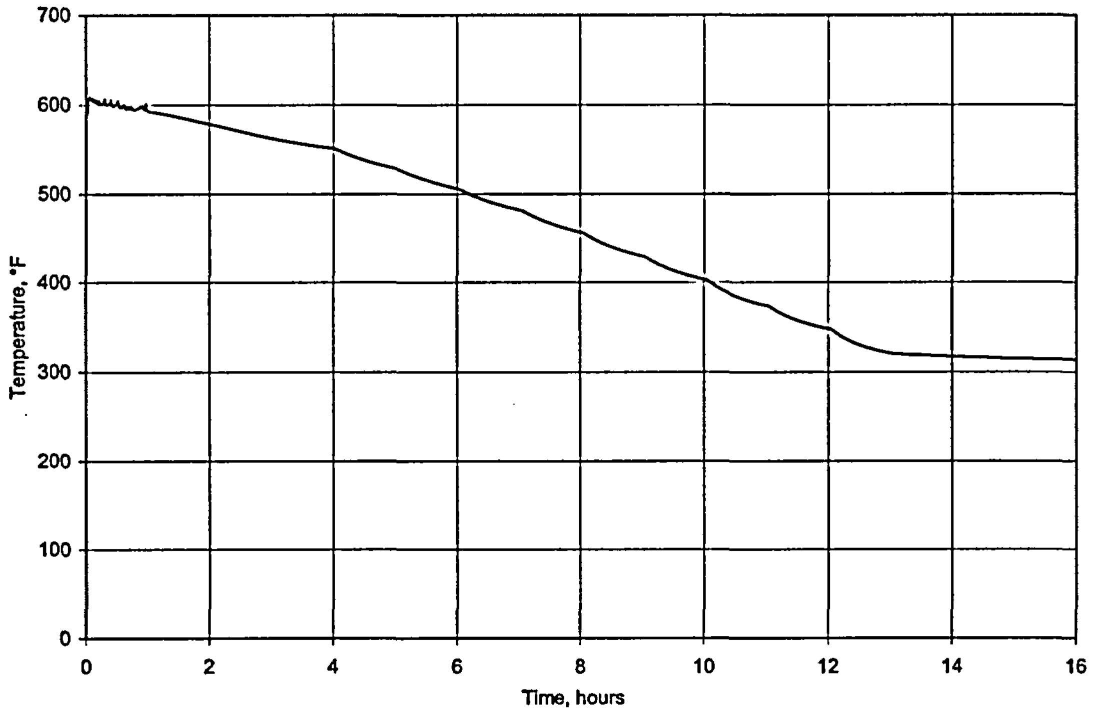


Figure 8
Total AFW Flow Rate versus Time

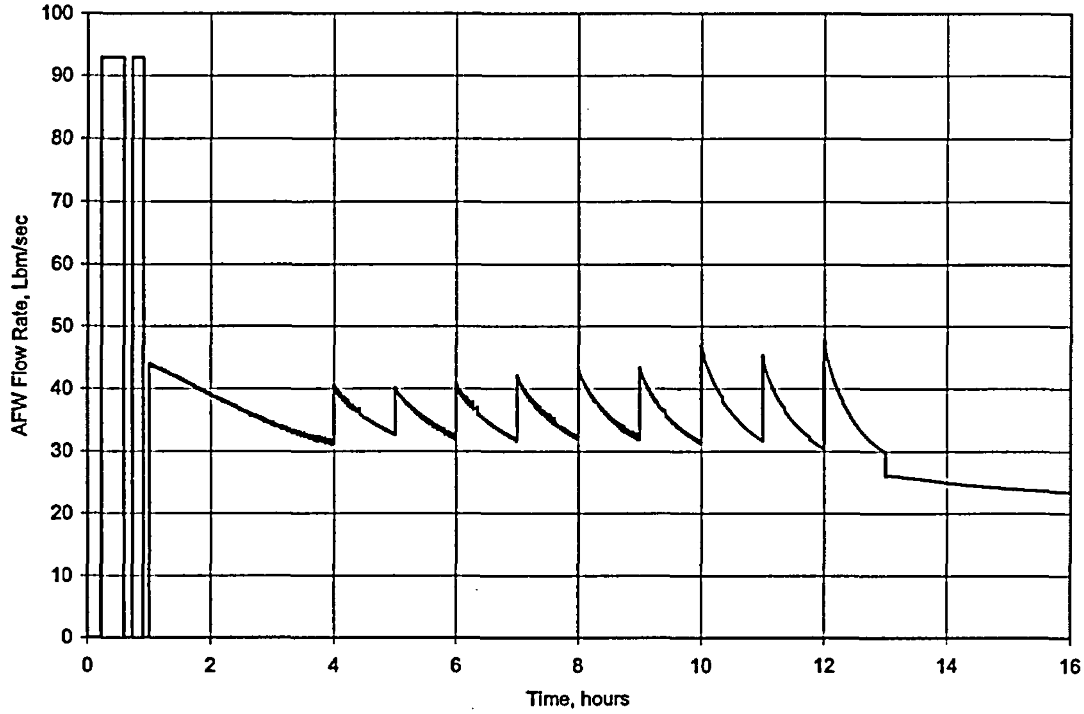


Figure 9
Total Integrated AFW Flow versus Time

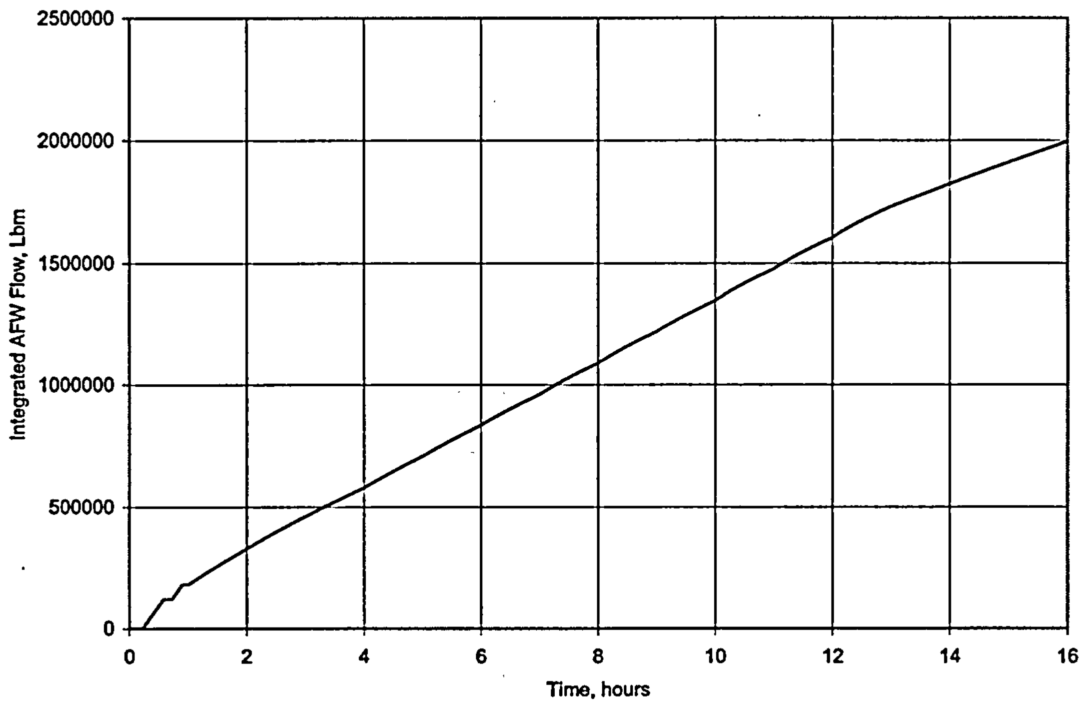


Figure 10
Pressurizer Vent Flow Rate versus Time

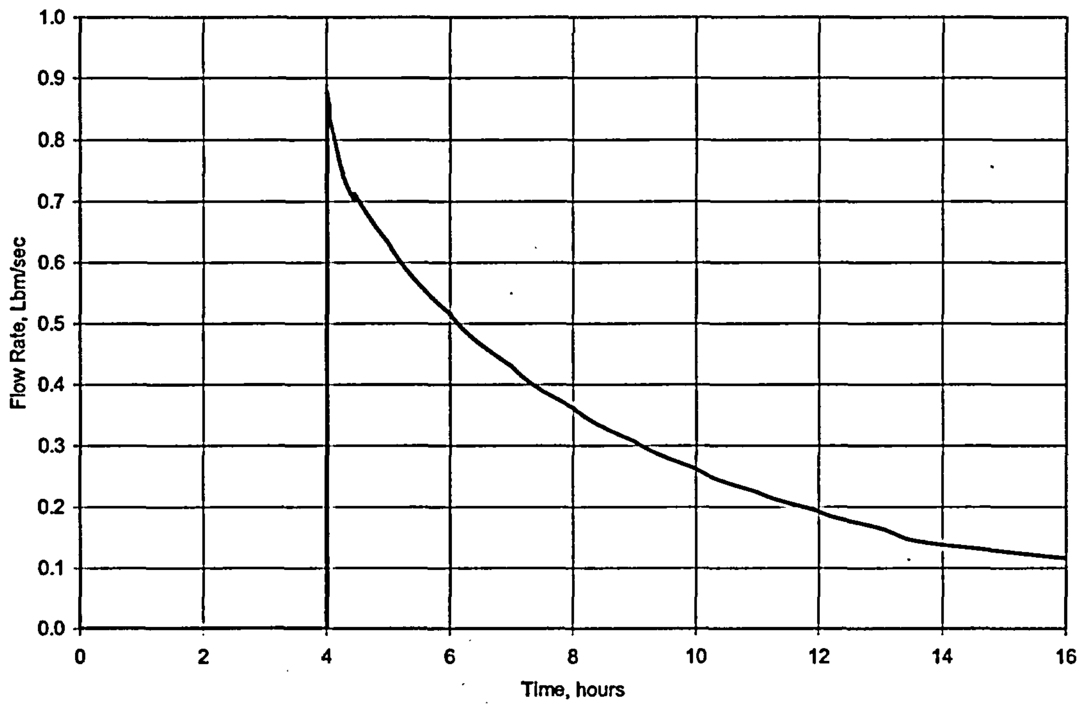


Figure 11
SG #1 Downcomer Level versus Time

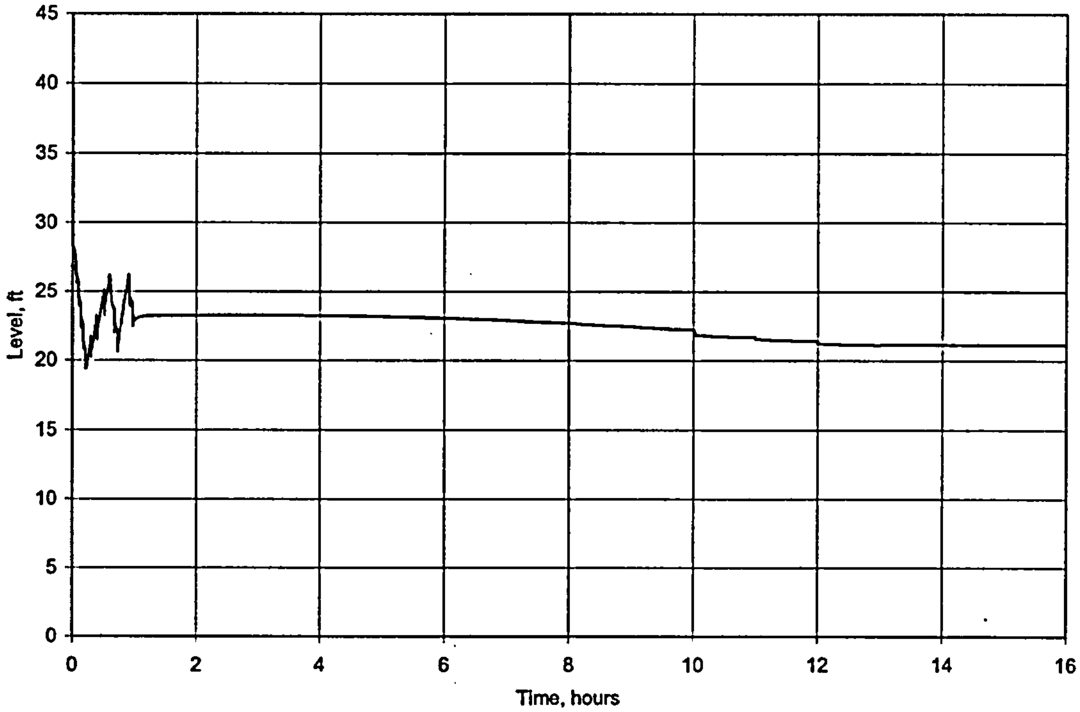


Figure 12
SG #1 Pressure versus Time

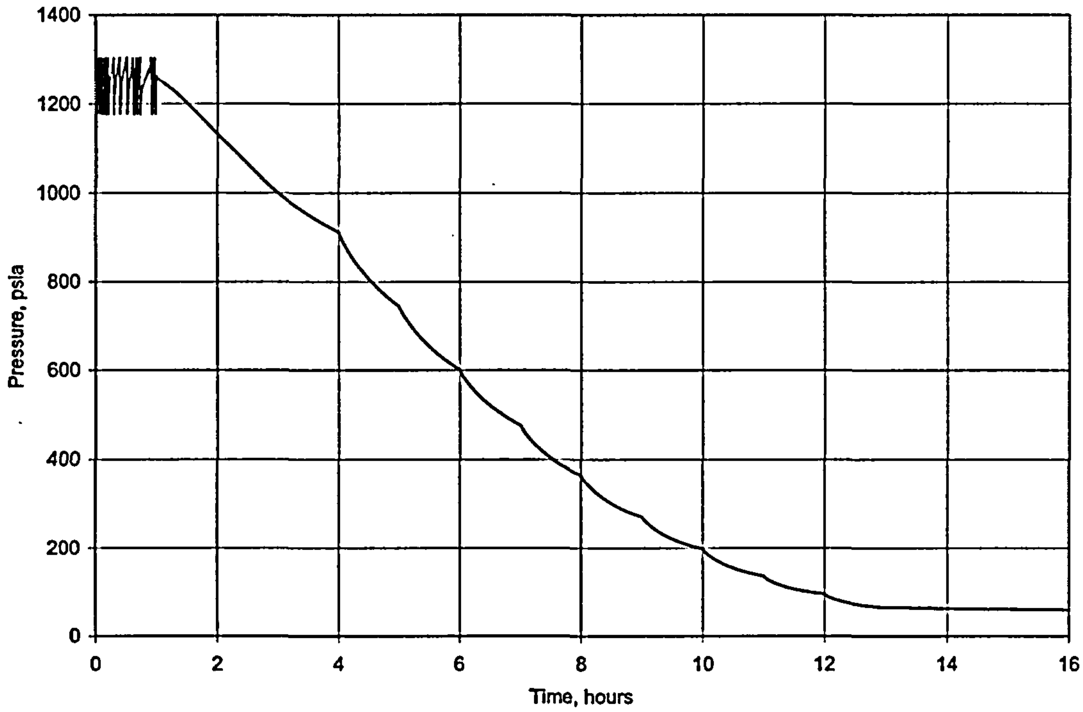


Figure 13
SG #1 Steam Dome Temperature versus Time

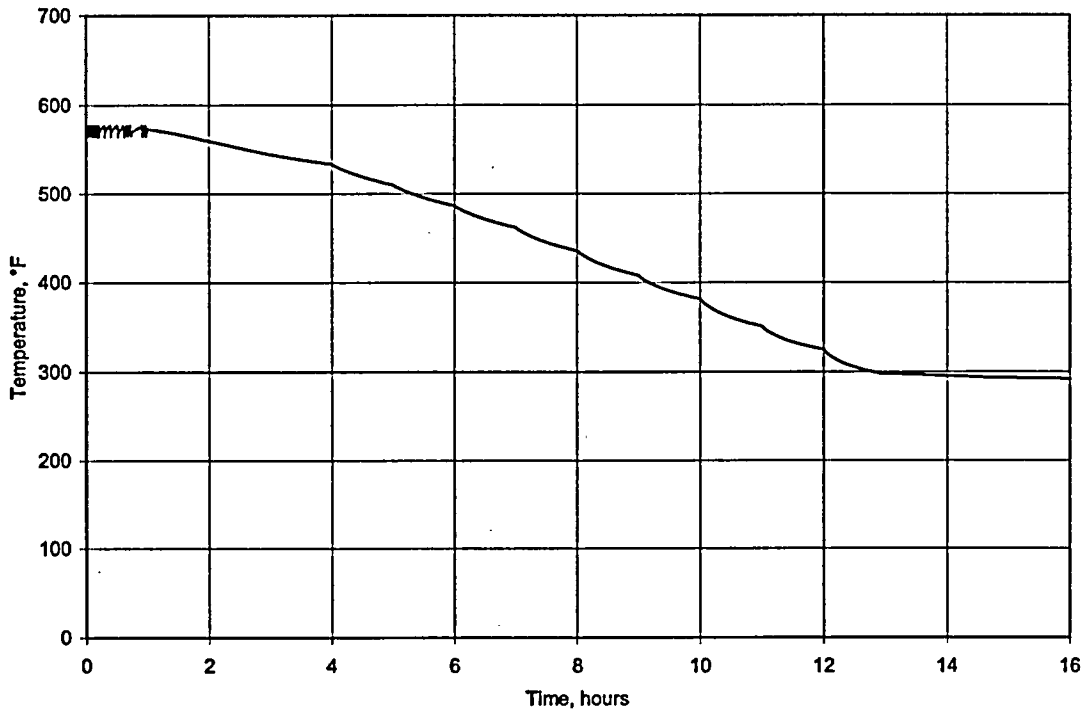


Figure 14
Total HPSI Pump Flow Rate versus Time

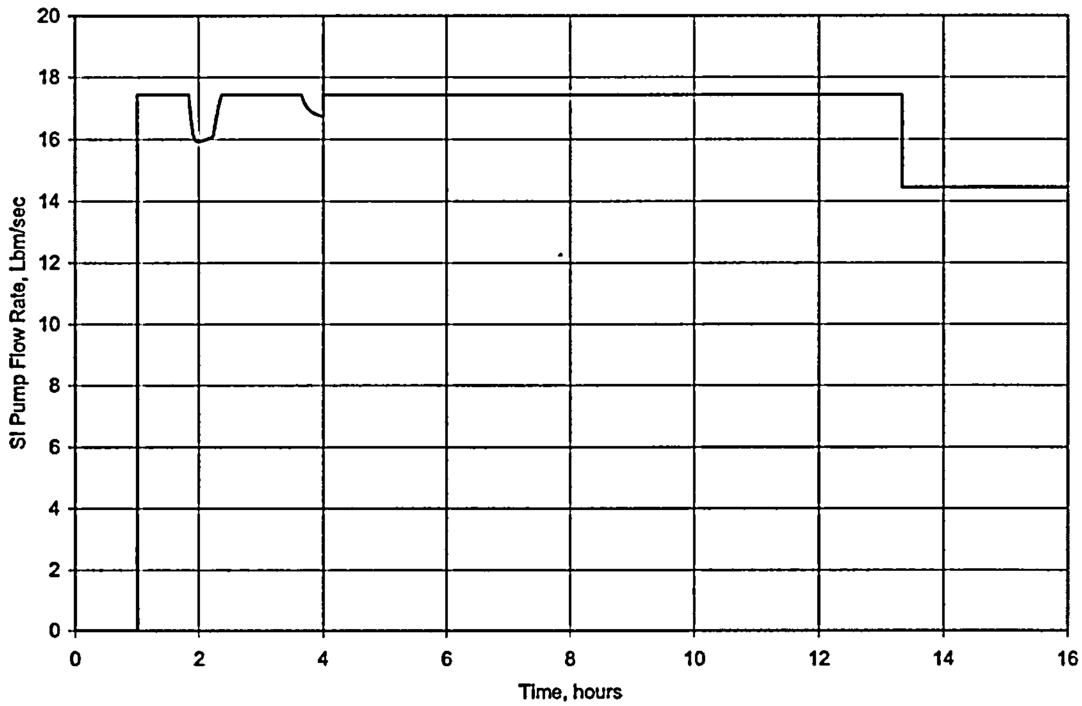
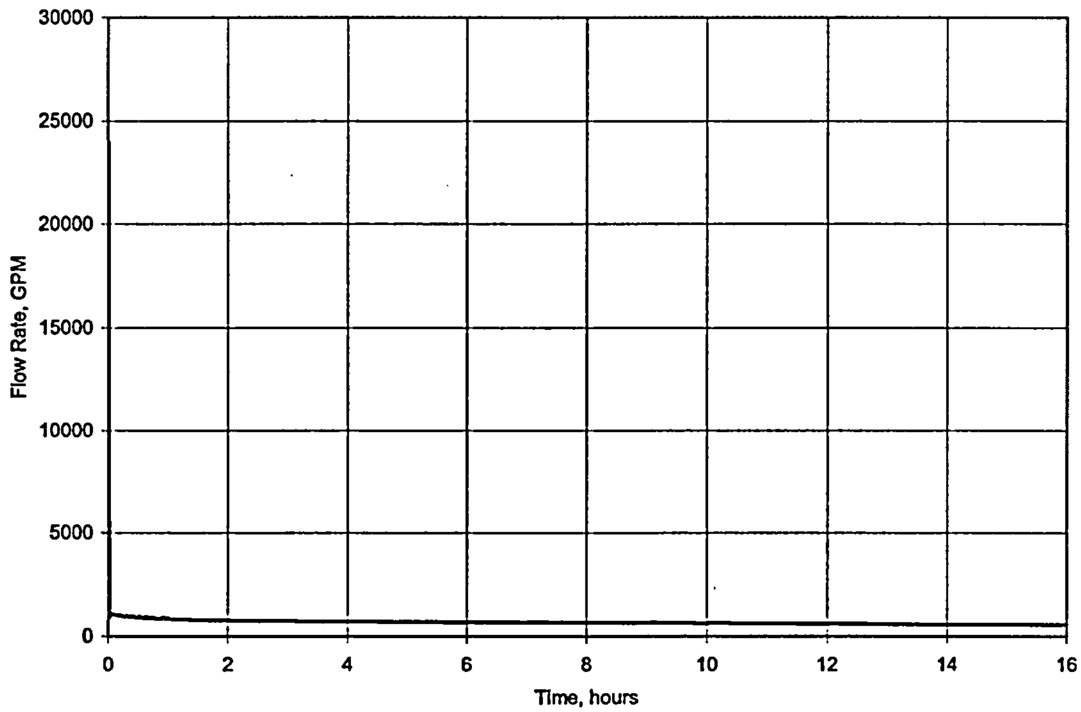


Figure 15
Hot Leg #1 Flow Rate versus Time



8. Emergency Lighting

   The emergency lighting system with eight hour battery-backed power supplies provides illuminating requirements where local manual operation is required within the power block. This lighting illuminates automatically upon a loss of AC power.

   After 1 hour, the A train essential lighting is powered by the GTGs.

   No plant or procedure changes are required to implement a 16 hour coping strategy.

9. Communications

   The primary modes of communication during an SBO are the telephone system, the plant 2-way radio system, and the sound powered phone system. The telephone system has at least a 2 hour battery capability. The 2-way radio system has a 4 hour battery system and will be transferred to the GTGs. The sound powered phone system requires no external power source to operate.

   No plant or procedure changes are required to implement a 16 hour coping strategy.

C. <u>PROCEDURES</u>

NUMARC 87-00, Section 4.2, provides guidelines for development of operating procedures for response to an SBO event. Palo Verde procedures required to support a 16 hour SBO period are as follows:

1. AC Power Restoration

   A 16 hour coping period does not impact Black-Start System Restoration. The Blackout procedure will be revised for a 16 hour coping period.

2. Severe Weather Procedures

   The Acts of Nature procedure will not be impacted by the SBO duration to 16 hours.

3. SBO Response Procedures

   a. The Blackout procedure will be revised to address the following changes for the 16-hour coping strategy:

      - Depressurize the RCS using the pressurizer vent system for RCS pressure control as an alternative to auxiliary spray.
      - Initiate a cooldown to SDC entry conditions within 4 hours.
      - Place spent fuel pool cooling in service within 8 hours.
      - Direct maintenance personnel to connect the control air system will be supplemented and place in service within 8 hours as neccessary.
      - Place SDC in service within 16 hours.

   b. The GTG operation and loading procedures will be revised for a 16 hour SBO.

c. Procedures will be developed or revised as necessary to address storage, maintenance, testing, and operation of the supplemented control air system to support 16 hours of operation of the ADVs.

d. Emergency Plan Implementing procedures will be revised to address the effects of an SBO for 16 hours. Emergency Response Organization responsibilities include connecting and operating the supplemented control air system as necessary.

4. Coldstarts

   Procedures for starting the EDGs are not impacted by the 16 hour coping period.

5. Emergency AC Power Availability

   Methods for emergency diesel generator availability are not impacted by the 16 hour coping period.

D. QUALITY ASSURANCE AND SPECIFICATION FOR NONSAFETY RELATED STATION BLACKOUT EQUIPMENT

The nonsafety related equipment added to cope with the SBO condition will meet the quality assurance requirements of Appendices A and B to Regulatory Guide (RG) 1.155 for PVNGS. Table 6 outlines the PVNGS position regarding RG 1.155.

Table 6, Regulatory Guide 1.155 - Station Blackout Revision 0, August 1988, Compliance Table Page 1 of 4		
Regulatory Position	RG 1.155 Applicable Sections	PVNGS Position
ONSITE EMERGENCY AC POWER SOURCES	1.0	
Emergency Diesel Generator Target Reliability Levels	1.1	No exception taken
Reliability Program	1.2	No exception taken
Procedures for Restoring Emergency AC Power	1.3	No exception taken
OFFSITE POWER	2.0	No exception taken
ABILITY TO COPE WITH A SBO	3.0	
Minimum Acceptable SBO Duration Capability.	3.1	Exception taken, 16 hour coping time is based on a voluntary license condition rather than an evaluation of the factors discussed in section 3.1.
Evaluation of Plant-Specific SBO Capability	3.2	
The evaluation should be performed assuming that the SBO event occurs while the reactor is operating at 100% rated thermal power and has been at this power level for at least 100 days.	3.2.1.	Exception taken, The NSSS and secondary performance, condensate volume are calculated using the decay heat used for the 16 hour analyses discussed herein is based on the ANSI/ANS-5.1 1979 decay heat curve, plus a 2 sigma uncertainty at equilibrium.
The capability of all systems and components necessary to provide core cooling and decay heat removal following a SBO should be determined, including station battery capacity, condensate . storage tank capacity, compressed air capacity, and instrumentation and control requirements.	3.2.2	No exception taken
The ability to maintain adequate reactor coolant system inventory to ensure that the core is cooled should be evaluated, taking into consideration; shrinkage, leakage from pump seals, and inventory loss from letdown or other normally open lines dependent on ac power for isolation.	3.2.3	No exception taken – Methodology used is different than NUMARC 87-00.
The design adequacy and capability of equipment needed to cope with a SBO for the required duration and recovery period should be addressed and evaluated as appropriate for the associated environmental conditions.	3.2.4	No exception taken – Methodology used is different than NUMARC 87-00.

Table 6, Regulatory Guide 1.155 - Station Blackout Revision 0, August 1988, Compliance Table Page 2 of 4		
Regulatory Position	RG 1.155 Applicable Sections	PVNGS Position
Consideration should be given to using available non-safety-related equipment, as well as safety-related equipment; to cope with a SBO provided such equipment meets the recommendations of Regulatory Positions 3.3.3 and 3.3.4. Onsite or nearby AAC power sources that are independent and diverse from the normal Class 1E emergency ac power sources (e.g., gas turbine, separate diesel engine, steam supplies) will constitute an acceptable SBO coping capability provided an analysis is performed that demonstrates the plant has this capability from the onset of SBO until the AAC power source or sources are started and lined up to operate all equipment necessary to cope with SBO for the required duration.	3.2.5	No exception taken – It has been demonstrated that in onset of SBO, event the station can cope for duration of 1 hour without any AC sources until the AAC power sources are started and lined up to operate all equipment necessary to cope with SBO for the 16 hour required duration. Based on regulatory guidelines, it is assumed that only one of three units at the Palo Verde site would experience SBO.
Consideration should be given to timely operator actions inside or outside the control room that would increase the length of time that the plant can cope with a SBO provided it can be demonstrated that these actions can be carried out in a timely fashion.	3.2.6	No exception taken
The ability to maintain appropriate containment integrity" should be addressed. "Appropriate containment integrity" for SBO means that adequate containment integrity is ensured by providing the capability, independent of the preferred and blackout unit's onsite emergency ac power supplies, for valve position indication and closure for containment isolation valves that may be in the open position at the onset of a SBO.	3.2.7	No exception taken
Modifications To Cope with SBO.	3.3	
If, after considering load shedding to extend the time until battery depletion, battery capacity must be extended further to meet the SBO duration recommended in Regulatory Position 3.1, it is considered acceptable either to add batteries or to add a charging system for the existing batteries that is independent of both the offsite and the blacked-out unit's onsite emergency ac power systems, such as a dedicated diesel generator.	3.3.1	No exception taken. Batteries have the capacity to serve the required loads for one hour, without additional equipment or load shedding, until charging is restored from the AAC source.

Table 6, Regulatory Guide 1.155 - Station Blackout Revision 0, August 1988, Compliance Table Page 3 of 4		
Regulatory Position	RG 1.155 Applicable Sections	PVNGS Position
If the capacity of the condensate storage tank is not sufficient to remove decay heat for the SBO duration recommended in Regulatory Position 3.1, a system meeting the requirements of Regulatory Position 3.5 to resupply the tank from an alternative water source is an acceptable means to increase its capacity provided any power source necessary to provide additional water is independent of both the offsite and the blacked-out unit's onsite emergency ac power systems.	3.3.2	No exception taken. Plant CST has sufficient volume.
If the compressed air capacity is not sufficient to remove decay heat and to maintain appropriate containment integrity for the SBO duration recommended in Regulatory Position 3.1, a system to provide sufficient capacity from an alternative source that meets Regulatory Position 3.5 is an acceptable means to increase the air capacity provided any power source necessary to provide additional air is independent of both the offsite and the blacked-out unit's onsite emergency ac power systems.	3.3.3	No exception taken. The longer duration event would require addition of a supplemental control air system to aid current design of nitrogen supply for operation of the ADV. Palo Verde will be in compliance after installation of this system.
A system is required for primary coolant charging and makeup, reactor coolant pump seal cooling or injection, decay heat removal, or maintaining appropriate containment integrity specifically to meet the SBO duration recommended in Regulatory Position 3.1, the following criteria should be met: 1. The system should be capable of being actuated and controlled from the control room, or if other means of control are required, it should be demonstrated that these steps can be carried out in a timely fashion, and 2. If the system must operate at 10 minutes of a loss of all ac power, it should be capable of being actuated from the control room.	3.3.4	No exception taken.

Table 6, Regulatory Guide 1.155 - Station Blackout Revision 0, August 1988, Compliance Table
Page 4 of 4

Regulatory Position	RG 1.155 Applicable Sections	PVNGS Position
If an AAC power source is selected specifically for satisfying the requirements for SBO, the design should meet the following criteria: 1. The AAC power source should not normally be directly connected to the preferred or the blacked-out unit's onsite emergency ac power system. 2. There should be a minimum potential for common -cause failure with the preferred or the blacked-out unit's onsite emergency ac power sources. No single-point vulnerability should exist whereby a weather-related event or single active failure could disable any portion of the blacked-out unit's onsite emergency ac power sources or the preferred power sources and simultaneously fail the AAC power. 3. The AAC power source should be available in a timely manner after the onset of SBO and have provisions to be manually connected to one or all of the redundant safety buses as required. The time required for making this equipment available should not be more than 1 hour as demonstrated by test. If the AAC power source can be demonstrated by test to be available to power the shutdown buses at 10 minutes of the onset of SBO, no coping analysis is required. 4. The AAC power source should have sufficient capacity to operate the systems necessary for coping with a SBO for the time required to bring and maintain the plant in safe shutdown. 5. The AAC power system should be inspected, maintained, and tested periodically to demonstrate operability and reliability. The reliability of the AAC power system should meet or exceed 95 percent as determined in accordance with NSAC-108 or equivalent methodology.	3.3.5	No exception taken.
If a system or component is added specifically to meet the recommendations on SBO duration in Regulatory Position 3.1, system walkdowns and initial tests of new or modified systems or critical components should be performed to verify that the modifications were performed properly. Failures of added components that may be vulnerable to internal or external hazards within the design basis (e.g., seismic events) should not affect the operation of systems required for the design basis accident.	3.3.6	No exception taken.
A system or component added specifically to meet the recommendations on SBO duration in Regulatory Position 3.1 should be inspected, maintained, and tested periodically to demonstrate equipment operability and reliability.	3.3.7	No exception taken.
Procedures and Training To Cope with SBO. Procedures and training should include all operator actions necessary to cope with a SBO for at least the duration determined according to Regulatory Position 3.1.	3.4	No exception taken.
Quality Assurance and Specification Guidance for SBO Equipment That Is Not Safety-Related.	3.5	No exception taken.

E. IMPLEMENTATION

Modifications required to support a 16 hour coping period include:

- Supplement the control air system, to support operation of the ADVs for 16 hours. The gas source will be purchased, stored, and maintained per the requirements of RG 1.155.

Procedures required to be changed to support a 16 hour coping period include:

- Blackout, 40EP-9EO08, 40DP-9AP13
- GTG operation and loading, 40OP-9GT01, 55OP-0GT01, 55OP-0GT02
- Operations Support Center Actions, EPIP-02.

Schedule to implement a 16 hour coping strategy:

- Within 6 months of approval by the NRC.

REFERENCES

Reference 1 (Letters submitted to NRC by APS regarding the current SBO evaluation)

1.1 Letter 161-01842, dated April 14, 1989, D. B. Karner (APS) to USNRC, "Response to Station Blackout Rule."

1.2 Letter 161-03025, dated March 26, 1990, from W. F. Conway (APS) to USNRC, "Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3 Submittal of Supplemental Information on Station Blackout."

1.3 Letter 161-04146, dated August 31, 1991, from W. F. Conway (APS) to USNRC, "Revised Response to the Station Blackout Rule (10 CFR 50.63)".

1.4 Letter 102-02300, dated October 2, 1992, from W. F. Conway, (APS), to USNRC, " Response to NRC Comments on Periodic Testing of Alternate AC (AAC) Sources (Supplementary Safety Evaluation for Station Blackout)".

1.5 Letter 161-04684, dated March 20, 1992, from W. F. Conway, (APS), to USNRC, "Response to the NRC Station Blackout Safety Evaluation Recommendations."

1.6 Letter 102-02798, dated January 25, 1994, from W. F. Conway (APS) to USNRC, "Current Status of Station Blackout (SBO) Alternate AC Modifications."

Reference 2 (Letters from NRC to APS regarding current SBO evaluation)

2.1 Letter dated December 11, 1990, from USNRC to W. F. Conway, APS, "Clarification of Information on Station Blackout."

2.2 Letter dated February 11, 1992, from USNRC to W. F. Conway, APS, "Station Blackout Safety Evaluation PVNGS."

2.3 Letter dated July 28, 1992, from USNRC to W. F. Conway, APS, "Supplementary Safety Evaluation for Station Blackout - Palo Verde Nuclear Generating Station."

2.4 Letter dated January 4, 1993, from USNRC to W. F. Conway (APS), "Station Blackout Final Supplementary Safety Evaluation."

2.5 Letter dated April 14, 1993, from USNRC to W. F. Conway (APS), "Station Blackout Final Supplementary Safety Evaluation."

Reference 3 NUMARC 87-00, Guidelines and Technical Bases for NUMARC Initiatives Addressing SBO at Light Water Reactors.

Reference 4 Regulatory Guide 1.155: Station Blackout, Revision 0, August 1988.