

**ST-HL-AE-5084**

**ATTACHMENT 6**

**0POP04-AE-0001**

**LOSS OF ANY 13.8KV OR 4.16KV BUS**

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HOUSTON LIGHTING AND POWER COMPANY  
SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION  
PLANT PROCEDURES MANUAL

OPOP04-AE-0001 REV. 2

LOSS OF ANY 13.8 KV OR 4.16 KV BUS

DEPARTMENT PROCEDURE

SAFETY RELATED (Q)

  
PLANT OPERATIONS MANAGER

9-15-93  
DATE APPROVED

9-24-93  
DATE EFFECTIVE

USAGE CONTROL: In Hand Controlling Station Only

LIST OF ATTACHMENTS:

STI -93-011721-19

- o Addendum 1, Sequencer Loading Verification
- o Addendum 2, Local Operator Actions In Response To A Loss of Electrical Power
- o Addendum 3, Loss of Offsite Power (LOOP) Recovery
- o Addendum 4, Restoring Power To Auxiliary Bus 1J(2J)
- o Addendum 5, Restoring Power To Auxiliary Bus 1F(2F)
- o Addendum 6, Restoring Power To Auxiliary Bus 1G(2G)
- o Addendum 7, Restoring Power To Auxiliary Bus 1H(2H)
- o Addendum 8, Restoring Power To Standby Bus 1F(2F)
- o Addendum 9, Restoring Power To Standby Bus 1G(2G)
- o Addendum 10, Restoring Power To Standby Bus 1H(2H)
- o Addendum 11, Transfer ESF Busses To The Emergency Transformer
- o Addendum 12, Response To Loss Of Train A And Train C 4.16 KV ESF Busses
- o Addendum 13, Restoring Power To Bus 1D1(2D1)
- o Addendum 14, Restoring Power To Bus 1D2(2D2)

This procedure is applicable in all Modes.

PURPOSE

- 1) This procedure provides guidance for operator response to a loss of power to any 13.8 KV or 4.16 KV bus except 1K(2K), 1L(2L) and 1M during all plant modes including no mode conditions.
- 2) This procedure provides guidance for operator response to a loss of all AC power during modes 1 through 4 as directed by OPOP05-EO-EC00, LOSS OF ALL AC POWER.
- 3) This procedure provides guidance for operator response to a loss of all AC power during modes 5, 6 and no mode.

SYMPTOMS

Loss of power to any 4.16 KV ESF Bus E1A(E2A), E1B(E2B), or E1C(E2C).  
Loss of power to either 4.16 KV Bus 1D1(2D1) or 1D2(2D2).  
Loss of power to any 13.8 KV STBY Bus 1F(2F), 1G(2G), or 1H(2H).  
Loss of power to any 13.8 KV AUX Bus 1F(2F), 1G(2G), 1H(2H), or 1J(2J).

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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CAUTION

IF an RCP is tripped AND a Reactor Trip does NOT occur, THEN the Reactor SHALL be tripped.

1 VERIFY All AC ESF Busses - ENERGIZED

PERFORM the following:

- a. IF any 4.16 KV ESF bus is NOT energized, THEN START its respective STBY DG.
  - b. IF any 4.16 KV ESF bus is NOT energized AND its respective STBY DG is running, THEN PERFORM the following:
    - 1) VERIFY "4KV BUS O/C LOCKOUT" indicating lamp on applicable BSMP (CPO03) NOT illuminated.
    - 2) IF no bus lockout condition exist, THEN manually CLOSE the diesel generator output breaker.
  - c. IF any running STBY DG Fuel Oil Storage Tank is being recirculated, THEN SECURE the recirculation within 30 minutes of STBY DG start per OPOP02-FO-0001, FUEL OIL STORAGE AND TRANSFER.
  - d. IF any ESF bus can NOT be energized, THEN TAKE manual control of its respective SG PORV(s) to conserve PORV hydraulic pressure.
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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
2	CHECK ECW Status: <ul style="list-style-type: none"><li>o ECW pumps - RUNNING</li><li>o ECW pumps discharge isolation valve - OPEN</li></ul>	<p><u>IF</u> any STBY DG is running <u>AND</u> its associated ECW loop is <u>NOT</u> in service, <u>THEN</u>:</p> <ul style="list-style-type: none"><li>a. START ECW pump.</li><li>b. OPEN ECW pump discharge isolation valve.</li><li>c. <u>IF</u> an ECW pump can <u>NOT</u> be started <u>OR</u> its discharge isolation valve can <u>NOT</u> be opened, <u>THEN</u>:<ul style="list-style-type: none"><li>1) TRIP associated STBY DG.</li><li>2) TRIP associated essential chillers.</li></ul></li></ul> <p>-----</p>
3	VERIFY All AC ESF Busses - ENERGIZED FROM OFFSITE POWER	<p><u>IF</u> any 4.16 KV ESF bus is energized from its STBY DG, <u>THEN</u> PERFORM the following:</p> <ul style="list-style-type: none"><li>a. DISPATCH an Operator to monitor for fuel oil leakage from the high pressure injectors on loaded STBY DGs.</li><li>b. <u>IF</u> leakage is detected, <u>THEN</u> DIRECT Maintenance to isolate the affected injector(s).</li><li>c. VERIFY sequencer loading per Addendum 1.</li></ul> <p>-----</p>
4	VERIFY No RCS Dilution In Progress: <ul style="list-style-type: none"><li>o BTRS</li><li>o Reactor Makeup System</li><li>o Letdown Demineralizer</li></ul>	<p>STOP any RCS dilutions in progress.</p> <p>-----</p>

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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NOTE

Due to CP010 voltage instrumentation being powered from various power supplies, it may be necessary to contact the other unit or Load Dispatcher to determine actual bus/offsite power availability.

- |   |   |   |
|---|---|---|
| 5 | CHECK Offsite Power Available To 13.8 KV Switchgear | PERFORM the following:  |
|   | o Unit AUX XFMR - AVAILABLE                         | a. CONTACT Load Dispatcher to report Unit's condition and request assistance. |
|   | OR  |   |
|   | o Affected Unit's STBY XFMR - AVAILABLE             | b. DISPATCH an operator to perform Addendum 2.                                |
|   | OR  |   |
|   | o Other Unit's STBY XFMR - AVAILABLE                | c. PERFORM Addendum 3.  |
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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
6	VERIFY CL-ACW Pump Status - ANY PUMP RUNNING	PERFORM the following:  a. START at least one CL-ACW pump.  b. <u>IF</u> a CL-ACW pump can <u>NOT</u> be started, <u>THEN</u> DISPATCH an operator to perform the following:  1) VERIFY MCC 1G5(2G5) energized.  2) <u>IF</u> MCC 1G5(2G5) is <u>NOT</u> energized, <u>THEN</u> Manually START BOP DG and LOAD MCC 1G5(2G5), REFER TO OPOPO2-DE-0003, BALANCE OF PLANT DIESEL GENERATOR. (29 ft TGB South of 4.16 KV SWGR Rm)  3) ENSURE IA emergency cooling water pump isolation valves open. (29 ft TGB NE of CNDSR)  o "1(2)-AC-0105 CL-ACW INLET TO" "IA EMER COOLING WATER PUMP"  o "1(2)-AC-0108 CL-ACW OUTLET" "FROM IA EMER COOLING WATER" "PUMP"  4) START "INST AIR EMERGENCY COOLING WATER PUMP". (29 ft TGB NE of CNDSR)  5) CLOSE "1(2)-AC-0096 CL-ACW I.A. #11(21) SUPP HEADER ISOLATION" (29 ft TGB NE of CNDSR)  6) ENSURE "INSTRUMENT AIR COMPRESSOR NO. 12(22)" running.  7) GO TO Procedure Step 8. -----
7	DISPATCH An Operator To Ensure At Least One IA Or SA Compressor Is Running (29 ft TGB)	

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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NOTE

- o IF the cause for loss of power to any bus is due to a bus fault as determined by a review of relay flags on CP010 and associated switchgear AND CAN NOT be isolated, THEN power restoration to that bus SHALL NOT be attempted.
- o WHEN the cause for loss of power to a bus has been isolated, THEN it may be necessary to reset the bus lockout for power restoration to that bus.
- o Any tripped relays or other protective devices reset during bus restoration should be documented to assist in troubleshooting.
- o The sequence of restoring AUX busses was selected to ensure optimum availability of switchyard metering and RCPs.

8	VERIFY 13.8 KV Auxiliary Bus 1J(2J) - ENERGIZED	PERFORM Addendum 4.
9	VERIFY 13.8 KV Auxiliary Bus 1F(2F) - ENERGIZED	PERFORM Addendum 5.
10	VERIFY 13.8 KV Auxiliary Bus 1G(2G) - ENERGIZED	PERFORM Addendum 6.
11	VERIFY 13.8 KV Auxiliary Bus 1H(2H)- ENERGIZED	PERFORM Addendum 7.
12	VERIFY 13.8 KV Standby Bus 1F(2F) - ENERGIZED	PERFORM Addendum 8.
13	VERIFY 13.8 KV Standby Bus 1G(2G) - ENERGIZED	PERFORM Addendum 9.
14	VERIFY 13.8 KV Standby Bus 1H(2H) - ENERGIZED	PERFORM Addendum 10.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
15	VERIFY All AC ESF Busses - ENERGIZED	PERFORM the following:  a. IF the associated STBY DG will <u>NOT</u> start <u>AND</u> 13.8 KV Emergency Bus 1L(2L) is energized, <u>THEN</u> ENERGIZE ONE 4.16 KV ESF bus per Addendum 11.  b. IF LESS THAN two 4.16 KV ESF Busses are energized, <u>THEN</u> DISPATCH an Operator with keys to Relay Room 202 to open all relay cabinet doors.  c. IF Train A <u>AND</u> Train C 4.16 KV ESF Busses are de-energized, <u>THEN</u> PERFORM Addendum 12. -----
16	VERIFY 4.16 KV Bus 1D1(2D1) - ENERGIZED	PERFORM Addendum 13. -----
17	VERIFY 4.16 KV Bus 1D2(2D2) - ENERGIZED	PERFORM Addendum 14. -----
18	CHECK Normal Letdown - IN SERVICE	PERFORM the following:  a. IF normal letdown is required <u>AND</u> Train C 4.16 KV ESF Bus is available, <u>THEN</u> RESTORE normal letdown per OPOP02-CV-0004, CHEMICAL AND VOLUME CONTROL SYSTEM SUBSYSTEM.  b. IF normal letdown is required <u>AND</u> Train C 4.16 KV ESF Bus is <u>NOT</u> available, <u>THEN</u> ESTABLISH excess letdown per OPOP02-CV-0004, CHEMICAL AND VOLUME CONTROL SYSTEM SUBSYSTEM.  c. IF RHR is in service <u>AND</u> letdown is required, <u>THEN</u> ENSURE Low Pressure Letdown System in service. -----

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
19	CHECK CL-ACW System - AT LEAST ONE PUMP RUNNING	PERFORM the following: a) START at least one CL-ACW pump. b) <u>IF</u> a CL-ACW pump can <u>NOT</u> be started, <u>THEN</u> GO TO Procedure Step 21. -----
20	DISPATCH An Operator To:  o ENSURE "INST AIR EMERGENCY COOLING WATER PUMP" secured (29 ft TGB NE of CNDSR)  o ENSURE "1(2)-AC-0096 CL-ACW I.A. #11(21) SUPP HEADER ISOLATION" open (29 ft TGB NE of CNDSR)	
21	CHECK Condensate System For Proper System Operation, REFER TO OPOP02-CD-0001, CONDENSATE SYSTEM.	
22	CHECK OL-ACW System - AT LEAST ONE PUMP RUNNING	<u>IF</u> power is available to any OL-ACW pump, <u>THEN</u> PLACE at least one OL-ACW pump in service per OPOP02-OC-0001, OPEN LOOP AUXILIARY COOLING SYSTEM. -----
23	CHECK Circulating Water System - AT LEAST THREE CIRCULATING WATER PUMPS RUNNING	<u>IF</u> less than three circulating water pumps are running, <u>THEN</u> ENSURE proper system operation per OPOP02-CW-0001, CIRCULATING WATER SYSTEM PUMP OPERATION. -----
24	DISPATCH An Operator To Perform The Following:  a. ENSURE proper MAB Chilled Water System operation per OPOP02-CH-0002, MECHANICAL AUXILIARY BUILDING CHILLED WATER SYSTEM  b. ENSURE proper RCB Chilled Water System operation per OPOP02-CH-0003, RCB CHILLED WATER SYSTEM	
25	CHECK RCB Chilled Water System - ALIGNED TO RCFC'S	<u>WHEN</u> RCB Chilled Water System is available, <u>THEN</u> TRANSFER RCFC cooling to RCB chilled water. -----



STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
26	CHECK Train A 4.16 KV ESF Bus - ENERGIZED FROM STBY BUS 1F(2F)	PERFORM the following:  a. <u>IF</u> STBY DG 11(21) is supplying Train A 4.16 KV ESF Bus <u>AND</u> STBY Bus 1F(2F) is energized, <u>THEN</u> :  1) TRANSFER Train A 4.16 KV ESF Bus to STBY Bus 1F(2F) per OPOP02- DG-0001, EMERGENCY DIESEL GENERATOR #11(21).  2) SHUTDOWN the STBY DG per OPOP02- DG-0001, EMERGENCY DIESEL GENERATOR #11(21).  b. <u>IF</u> 13.8 KV Emergency Bus 1L(2L) is supplying Train A 4.16 KV ESF Bus <u>AND</u> STBY Bus 1F(2F) is energized, <u>THEN</u> CONSULT Plant Management for normal ESF power restoration. ----- PERFORM the following:  a. <u>IF</u> STBY DG 12(22) is supplying Train B 4.16 KV ESF Bus <u>AND</u> STBY Bus 1G(2G) is energized, <u>THEN</u> :  1) TRANSFER Train B 4.16 KV ESF Bus to STBY Bus 1G(2G) per OPOP02- DG-0002, EMERGENCY DIESEL GENERATOR #12(22).  2) SHUTDOWN the STBY DG per OPOP02- DG-0002, EMERGENCY DIESEL GENERATOR #12(22).  b. <u>IF</u> 13.8 KV Emergency Bus 1L(2L) is supplying Train B 4.16 KV ESF Bus <u>AND</u> STBY Bus 1G(2G) is energized, <u>THEN</u> CONSULT Plant Management for normal ESF power restoration. -----
27	CHECK Train B 4.16 KV ESF Bus - ENERGIZED FROM STBY BUS 1G(2G)	



STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
28	CHECK Train C 4.16 KV ESF Bus - ENERGIZED FROM STBY BUS 1H(2H)	PERFORM the following:  a. IF STBY DG 13(23) is supplying Train C 4.16 KV ESF Bus <u>AND</u> STBY Bus 1H(2H) is energized, <u>THEN</u> :  1) TRANSFER Train C 4.16 KV ESF Bus to STBY Bus 1H(2H) per OPOP02- DG-0003, EMERGENCY DIESEL GENERATOR #13(23).  2) SHUTDOWN the STBY DG per OPOP02- DG-0003, EMERGENCY DIESEL GENERATOR #13(23).  b. IF 13.8 KV Emergency Bus 1L(2L) is supplying Train C 4.16 KV ESF Bus <u>AND</u> STBY Bus 1H(2H) is energized, <u>THEN</u> CONSULT Plant Management for normal ESF power restoration. ----- WHEN power becomes available to Train A <u>OR</u> Train C 4.16 KV ESF Bus(es), <u>THEN</u> DISPATCH an operator to:  a. ENERGIZE the respective NSSS inverter(s) per OPOP02-AE-0004, 120 VAC ESF VITAL DISTRIBUTION POWER SUPPLIES.  b. ENERGIZE any DC loads previously de-energized by Addendum 12, Table 1. -----
29	CHECK Channel I And IV 7.5 KVA NSSS Inverters - ENERGIZED	
30	PLACE SFPC IN Service Within 2.5 Hours Of Loss Of SFPC:  a. SFPC heat exchanger(s) - CCW ALIGNED  b. SFPC pump(s) - RUNNING	a. ALIGN CCW to the SFPC HX. ----- b. START SFPC pump(s) per OPOP02-FC-0001, SPENT FUEL POOL COOLING AND CLEANUP SYSTEM. -----

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
31	TAKE Appropriate Action per Technical Specifications	
32	CHECK All 13.8 KV And 4.16 KV Busses - ENERGIZED	PERFORM the following:  a. CONTACT Load Dispatcher to report Unit's condition.  b. <u>WHEN</u> any source of power becomes available, <u>THEN</u> REPEAT applicable steps. -----
33	RESTORE Normal Electrical Distribution Breaker Alignment As Plant Conditions Permit	
34	DISPATCH An Operator To Check All Sequencer Main Supply Breakers - ON	NOTIFY operator to close any sequencer main supply breaker previously opened in Addendum 12, RNO Steps 20 or 21. -----
35	GO TO Appropriate Plant Procedure As Determined By Unit Or Shift Supervisor	

- END -

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REFERENCES

- 1) 5Z109Z42117, ESF Load Seq. Act. Train A
- 2) 5Z109Z42118, ESF Load Seq. Act. Train B
- 3) 5Z109Z42119, ESF Load Seq. Act. Train C
- 4) 5Z109Z42124, Control Room HVAC Emergency Operation
- 5) OPOP02-AE-0001, AC Electrical Distribution Breaker Lineup
- 6) OPOP02-RC-0004, Operation of Reactor Coolant Pump
- 7) OPOP02-RH-0001, Residual Heat Removal System Operation
- 8) OPOP02-FC-0001, Spent Fuel Pool Cooling and Cleanup System
- 9) OPOP02-DG-0001, Emergency Diesel Generator #11(21)
- 10) OPOP02-DG-0002, Emergency Diesel Generator #12(22)
- 11) OPOP02-DG-0003, Emergency Diesel Generator #13(23)
- 12) OPOP02-DB-0003, Balance of Plant Diesel Generator
- 13) OPOP02-DB-0004, Emergency Lighting Diesel Generator
- 14) OPOP02-DB-0005, Technical Support Center Diesel Generator
- 15) OPOP02-OC-0001, Open Loop Auxiliary Cooling System
- 16) OPOP02-AC-0001, Closed Loop Auxiliary Cooling Water
- 17) OPOP02-CW-0001, Circulating Water System Pump Operation
- 18) OPOP02-SA-0001, Service Air
- 19) OPOP02-IA-0001, Instrument Air

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- 20) OPOP02-CD-0001, Condensate System
  - 21) OPOP03-ZG-0003, Secondary Plant Startup
  - 22) OPOP02-CH-0002, Mechanical Auxiliary Building Chilled Water System
  - 23) OPOP02-CH-0003, RCB Chilled Water System
  - 24) OPOP02-FO-0001, Fuel Oil Storage And Transfer
  - 25) OPOP02-CV-0004, Chemical Volume And Control System
  - 26) OPOP02-AE-0004, 120 VAC ESF Vital Distribution Power Supplies
  - 27) OPOP02-EE-0001, ESF (Class 1E) DC Distribution System
  - 28) Notice of Violation 498/8854-02, LCTS 8802063-936
  - 29) Technical Specification 3.8.1.1 and 3.8.1.2
  - 30) SPR 91-0110/LER 1-91-009, LCTS 9100370-936
  - 31) ST-HL-AE-3509, "Loss of All Alternating Current Power" - Responses to NRC Questions, LCTS 9100474-936
  - 32) ST-HL-AE-3729, "Loss of All Alternating Current Power" - Responses to NRC Questions, LCTS 91-00039-936
  - 33) Battery Calculation - EC 5008 - Class 1E Batteries, Chargers and Inverters
  - 34) SPR 88-0106/LER 1-88-026, LCTS 8800875-936
  - 35) USQE 91-0024, Rev. 0
  - 36) DBD Diesel Generator System, 5Q159MB1023
  - 37) DBD 4.16 KV AC Power System, 4E519EB1108
  - 38) UFSAR Chapter 8
  - 39) FHB HVAC System Description, TPNS Number 5V129VD0116
  - 40) NRC Information Notice 91-54, Foreign Experience Regarding Boron Dilution
  - 41) ST-HS-HS-16520, "Action Item in Response to SER Confirmatory Items"
  - 42) 5Q159MB1023, Standby Diesel Generator Design Basis Document (Operator Actions)
  - 43) ST-HL-AE-14250, Station Blackout- Trip Report, LCTS 9100384-936
  - 44) ST-HL-AE-3847, Blackout Rule - Response to SER Confirmatory Actions, LCTS 9100946-936

ADDENDUM 1  
SEQUENCER LOADING VERIFICATION

PAGE 1 OF 1

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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- 1    VERIFY the following equipment -                      Manually LOAD equipment on ESF bus.  
      LOADED ON ESF BUS

Component	Mode II		
	TRAIN		
	A	B	C
480V LC feeder breakers			
CCPs			
RCFCs			
CCW pumps			
AFW pumps			
Essential Chill Water pumps			
EAB HVAC fans			
Control Room HVAC fans			
FHB HVAC fans			
Essential chillers (150 ton)			
Essential chillers (300 ton)			

- 2    RESET ESF load sequencers
- 3    RETURN TO Procedure Step 4

ADDENDUM 2LOCAL OPERATOR ACTIONS IN RESPONSE  
TO A LOSS OF ELECTRICAL POWER

PAGE 1 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	VERIFY BOP DG - RUNNING AND SUPPLYING MCC 1G5(2G5) (29 ft TGB S of 4.16 SWGR Rm)	Manually START BOP DG and LOAD on MCC 1G5(2G5), REFER TO OPOP02-DB-0003, BALANCE OF PLANT DIESEL GENERATOR. (29 ft TGB S of 13.8 KV SWGR Rm)
2	VERIFY "BOP EMERGENCY DG RM EXHAUST FAN FN017" - STOPPED (29 ft TGB on ZLP-169 outside 13.8 KV SWGR Rm)	STOP "BOP EMERGENCY DG RM EXHAUST FAN FN017".
3	VERIFY IA emergency cooling water pump isolation valves open. (29 ft TGB NE of CNDSR)  o "1(2)-AC-0105" "CL-ACW INLET TO" "IA EMER COOLING" "WATER PUMP"  o "1(2)-AC-0108" "CL-ACW OUTLET FROM" "IA EMER COOLING" "WATER PUMP"	OPEN emergency cooling water pump isolation valves.
4	START IA emergency cooling water pump. (29 ft TGB NE of CNDSR)  "INST AIR EMERGENCY" "COOLING WATER PUMP"	
5	CLOSE "1(2)-AC-0096 CL-ACW I.A. #11(21) SUPP HEADER ISOLATION" (29 ft TGB NE of CNDSR)	



ADDENDUM 2LOCAL OPERATOR ACTIONS IN RESPONSE  
TO A LOSS OF ELECTRICAL POWER

PAGE 2 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
6	VERIFY "INSTRUMENT AIR COMPRESSOR NO. 12(22)" - RUNNING (29 ft TGB)	START "INSTRUMENT AIR COMPRESSOR NO. 12(22)". -----
7	CLOSE condensate recirc valve FV-7022 from "1(2)-CD-FIC-7022 COND RECIRC VLV FV-7022 AUTO/MANUAL CONTROL STATION". (29 ft TGB SE Corner)	
8	VERIFY deaerator high level dump valves bypass valves - CLOSED (29 ft TGB S of CNDSR 13/23)  o "1(2)-FW-0486 DEAERATOR STOR TANK" "#2 DUMP CONT VLV BYPASS VLV"  o "1(2)-FW-0487 DEAEKATOR STOR TANK" "#1 DUMP CONT VLV BYPASS VLV"	CLOSE deaerator high level dump valve(s) bypass valve(s).  -----
9	VERIFY condenser vacuum breakers - OPEN (55 ft TGB E of CNDSR)  o "1(2)-CR-MOV-0023" "CONDENSER #11(21)" "VACUUM BREAKER"  o "1(2)-CR-MOV-0024" "CONDENSER #12(22)" "VACUUM BREAKER"  o "1(2)-CR-MOV-0025" "CONDENSER #13(23)" "VACUUM BREAKER"	OPEN condenser vacuum breaker(s).  -----
10	VERIFY TSC DG - RUNNING AND SUPPLYING LC 1W(2W) (East yard)	Manually START TSC DG and LOAD LC 1W(2W), REFER TO OPOP02-DB-0005, TECHNICAL SUPPORT CENTER DIESEL GENERATOR. -----



## ADDENDUM 2

LOCAL OPERATOR ACTIONS IN RESPONSE  
TO A LOSS OF ELECTRICAL POWER

PAGE 3 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
11	(UNIT 1 ONLY) VERIFY Lighting DG - STARTED AND SUPPLYING MCC 12K3 (Lighting DG SWBD ZLP-672 S yard)	Manually START Lighting DG and LOAD MCC 12K3, REFER TO 1POPO2-DB-0004, EMERGENCY LIGHTING DIESEL GENERATOR.
12	VERIFY seal water to SGFPs - ISOLATED <ul style="list-style-type: none"> <li>"1(2)-CD-0326 SGFP SEAL INJ ISOL" (TGB 29 ft SE in Overhead)</li> <li>"1(2)-CD-0254 SGFP #11(21) SEAL" "WATER 1(2)-CD-PV-7134 ISOL VALVE" (SGFP 11(21) N End)</li> <li>"1(2)-CD-0329 SGFP #12(22) SEAL" "WATER 1(2)-CD-PV-7135 ISOL VALVE" (SGFP 12(22) N End)</li> <li>"1(2)-CD-0327 SGFP #13(23) SEAL" "WATER 1(2)-CD-PV-7136 ISOL VALVE" (SGFP 13(23) N End)</li> </ul>	ISOLATE seal water.
13	VERIFY feedwater booster pump suction valves - CLOSED <ul style="list-style-type: none"> <li>"1(2)-FW-427 FWBP #11(21) SUCTION" "ISOL VLV" (Above FWBP 11(21))</li> <li>"1(2)-FW-430 FWBP #12(22) SUCTION" "ISOL VLV" (Above FWBP 12(22))</li> <li>"1(2)-FW-432 FWBP #13(23) SUCTION" "ISOL VLV" (Above FWBP 13(23))</li> </ul>	CLOSE feedwater booster pump suction valves
14	VERIFY Main turbine and SGFP turbines - ON TURNING GEAR	WHEN turbine(s) come to rest, THEN: <ul style="list-style-type: none"> <li>a. ENSURE SGFPs main oil pumps running.</li> <li>b. ENSURE the turbines on the turning gear.</li> </ul>
15	NOTIFY Control Room of addendum completion	

ADDENDUM 3

## LOSS OF OFFSITE POWER (LOOP) RECOVERY

PAGE 1 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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NOTE

IF offsite power becomes available during performance of this addendum, THEN Addendums 2 and 3 are NOT required to be completed AND immediate transition to Procedure Step 5 SHALL be made.

1	VERIFY MSIVs - CLOSED	CLOSE MSIVs.
2	VERIFY running RCFC(s) - COOLING WATER TRANSFERRED TO CCW	TRANSFER cooling water to CCW.
3	CHECK RCS temperature - GREATER THAN 200 °F	IF RCP seal injection flow is <u>NOT</u> required, <u>THEN</u> GO TO Addendum Step 6.
4	CHECK VCT status - <ul style="list-style-type: none"><li>o GREATER THAN 25%</li><li>o MAKEUP AVAILABLE</li></ul>	PERFORM the following: <ul style="list-style-type: none"><li>a. ENSURE charging pump suction aligned to RWST.</li><li>b. IF charging pump suction can <u>NOT</u> be aligned to RWST, <u>THEN</u> DISPATCH an operator to open "1(2)-CV-MOV-0112C RWST TO CHG PUMP SUCTION ISOL". (10 ft MAB CHG pump valve Rm 044)</li></ul>

ADDENDUM 3

## LOSS OF OFFSITE POWER (LOOP) RECOVERY

PAGE 2 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
5	CHECK RCP seal injection flow - BETWEEN 6 AND 8 GPM ON EACH RCP	PERFORM the following:  a. ENSURE at least one CCP running.  b. <u>IF</u> a CCP can <u>NOT</u> be started <u>THEN</u> :  1) CHECK power available to PDP.  2) <u>IF</u> power is <u>NOT</u> available to PDP, <u>THEN</u> GO TO Addendum Step 7.  3) OPEN PDP recirculation valve to 100%  4) CLOSE "FLOW CONT HCV-0218"  5) START PDP.  6) Slowly CLOSE PDP recirculation valve to obtain the desired RCP seal injection flow.  7) GO TO Addendum Step 6.  c. ADJUST RCP seal injection flow. ..... PERFORM the following:  a. <u>IF</u> normal letdown is required <u>AND</u> Train C 4.16 KV ESF Bus is available, <u>THEN</u> RESTORE normal letdown per OPOP02-CV-0004, CHEMICAL AND VOLUME CONTROL SYSTEM SUBSYSTEM.  b. <u>IF</u> normal letdown is required <u>AND</u> Train C 4.16 KV ESF Bus is <u>NOT</u> available, <u>THEN</u> ESTABLISH excess letdown per OPOP02-CV-0004, CHEMICAL AND VOLUME CONTROL SYSTEM SUBSYSTEM.  c. <u>IF</u> RHR is in service <u>AND</u> letdown is required, <u>THEN</u> ENSURE Low Pressure Letdown System in service. .....
6	CHECK normal letdown - IN SERVICE	

ADDENDUM 3

## LOSS OF OFFSITE POWER (LOOP) RECOVERY

PAGE 3 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
7	VERIFY the FHB HVAC supply relief dampers - OPEN	OPEN the FHB HVAC supply relief dampers.
8	CHECK Main Turbine Lube Oil System status - AC OR DC LUBE OIL PUMP RUNNING	<u>IF</u> lube oil system is required, <u>THEN</u> START one pump.
9	VERIFY All AC ESF Busses - ENERGIZED	PERFORM the following:  a. <u>IF</u> any 4.16 KV ESF bus can <u>NOT</u> be energized from its STBY DG <u>AND</u> 13.8 KV Emergency Bus 1L(2L) is energized, <u>THEN</u> ENERGIZE ONE 4.16 KV ESF bus per Addendum 11.  b. <u>IF</u> Train A <u>AND</u> Train C 4.16 KV ESF Busses are de-energized, <u>THEN</u> PERFORM Addendum 12.
10	CHECK offsite power - AVAILABLE	PERFORM the following:  a. MAINTAIN stable plant conditions.  b. <u>WHEN</u> offsite power becomes available to 13.8 KV bus(es), <u>THEN</u> GO TO Procedure Step 8.
11	GO TO Procedure Step 8	

ADDENDUM 4

## RESTORING POWER TO AUXILIARY BUS 1J(2J)

PAGE 1 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	DISPATCH an operator to ensure any non-running CARS pump switch(es) - IN THE OFF POSITION (29 ft TGB)	
2	PLACE the following equipment in PULL TO LOCK: <ul style="list-style-type: none"><li>o Circulating Water Pump 14(24)</li><li>o Condensate Pump 13(23)</li><li>o Feedwater Booster Pump 13(23)</li><li>o MSR DRIP Pump 12A(22A)</li><li>o MSR DRIP Pump 12B(22B)</li><li>o RCP 1D(2D)</li></ul>	
3	CHECK Unit AUX XFMR - AVAILABLE	GO TO Addendum Step 5.
4	RESTORE power to AUX Bus 1J(2J) <ul style="list-style-type: none"><li>a. VERIFY the following breakers open:<ul style="list-style-type: none"><li>o "STBY XFMR 1(2) TO" "AUX BUS 1J(2J) SPLY" "ST-0170(ST-0270)"</li><li>o "STBY XFMR 2(1) TO" "AUX BUS 1J(2J) SPLY" "ST-0190(ST-0290)"</li></ul></li><li>b. CLOSE "UAT TO AUX BUS 1J(2J) SPLY P-0150(P-0250)" breaker</li><li>c. VERIFY AUX Bus 1J(2J) - ENERGIZED</li><li>d. GO TO Addendum Step 10</li></ul>	<ul style="list-style-type: none"><li>a. OPEN breaker(s).</li><li>b. GO TO Addendum Step 5.</li><li>c. GO TO Addendum Step 5.</li></ul>

ADDENDUM 4  
RESTORING POWER TO AUXILIARY BUS 1J(2J)

PAGE 2 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

5 CHECK affected Unit's STBY XFMR -  
AVAILABLE

GO TO Addendum Step 7.

6 RESTORE power to AUX Bus 1J(2J)

a. VERIFY the following  
breakers open:

a. OPEN breaker(s).

o "STBY XFMR 2(1) TO"  
"AUX BUS 1J(2J) SPLY"  
"ST-0190(ST-0290)"

o "UAT TO AUX"  
"BUS 1J(2J) SPLY"  
"P-0150(P-0250)"

b. CLOSE "STBY XFMR 1(2) TO AUX  
BUS 1J(2J) SPLY ST-0170  
(ST-0270)" breaker

b. GO TO Addendum Step 7.

c. VERIFY AUX BUS 1J(2J) -  
ENERGIZED

c. GO TO Addendum Step 7.

d. GO TO Addendum Step 10



ADDENDUM 4

RESTORING POWER TO AUXILIARY BUS 1J(2J)

PAGE 3 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

7	CONTACT other Unit to verify their STBY XFMR - AVAILABLE	GO TO Addendum Step 9.
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8	RESTORE power to AUX Bus 1J(2J)	
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a.	VERIFY the following breakers open:	
----	--	--

a.	OPEN breaker(s).
----	------------------

o	"STBY XFMR 1(2) TO" "AUX BUS 1J(2J) SPLY" "ST-0170(ST-0270)"
---	--

o	"UAT TO AUX" "BUS 1J(2J) SPLY" "P-0150(P-0250)"
---	---

b.	CLOSE "STBY XFMR 2(1) TO AUX BUS 1J(2J) SPLY ST-0190 (ST-0290)" breaker	
----	---	--



ADDENDUM 4

## RESTORING POWER TO AUXILIARY BUS 1J(2J)

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
9	VERIFY AUX Bus 1J(2J) - ENERGIZED	<p>PERFORM the following:</p> <p>a. DISPATCH an operator to:</p> <ol style="list-style-type: none"><li>1) ENSURE the BOP DG is running and supplying MCC 1G5(2G5), REFER TO OPOP02-DB-0003, BALANCE OF PLANT DIESEL GENERATOR.</li><li>2) ENSURE "BOP EMERGENCY DG RM EXHAUST FAN FN017" stopped. (29 ft TGB ZLP-169 outside 13.8 KV SWGR Rm)</li><li>3) ENSURE TSC DG is running and supplying LC 1W(2W), REFER TO OPOP02-DB-0005, TECHNICAL SUPPORT CENTER DIESEL GENERATOR.</li><li>4) (UNIT 1 ONLY) ENSURE Lighting DG is running and supplying MCC 12K3, REFER TO 1POP02-DB-0004, EMERGENCY LIGHTING DIESEL GENERATOR.</li></ol> <p>b. RETURN TO Procedure Step 9.</p> <p>-----</p>

ADDENDUM 4

## RESTORING POWER TO AUXILIARY BUS 1J(2J)

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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- |    |  |  |
|----|--|--|
| 10 | <p>DISPATCH an operator to perform the following:</p> <ul style="list-style-type: none"><li>a. SHUTDOWN the BOP DG and TRANSFER MCC 1G5(2G5) to LC 1U(2U) per OPOP02-DB-0003, BALANCE OF PLANT DIESEL GENERATOR.</li><li>b. START the "BOP EMERGENCY DG RM EXHAUST FAN FN017"<br/>(29 ft TGB on ZLP-169 outside the 13.8 KV SWGR Rm)</li><li>c. OPEN TGB battery room door and START:<br/><br/>"TGB BATTERY RM EX FAN"<br/>"FN013 11A(21A)"<br/><br/>OR<br/><br/>"TGB BATTERY RM EX FAN"<br/>"FN014 11B(21B)"<br/><br/>(ZLP-170 outside 4.16 KV SWGR RM)</li><li>d. TRANSFER LC 1W(2W) to 13.8 KV Bus 1J(2J) and SHUTDOWN the TSC DG per OPOP02-DB-0005, TECHNICAL SUPPORT CENTER DIESEL GENERATOR.</li><li>e. (UNIT 1 ONLY) TRANSFER MCC 12K3 to LC 12L and SHUTDOWN the lighting DG per 1POPO2-DB-0004, EMERGENCY LIGHTING DIESEL GENERATOR.</li></ul> |  |
|----|--|--|

- |    |                            |  |
|----|----------------------------|--|
| 11 | RETURN TO Procedure Step 9 |  |
|----|----------------------------|--|

ADDENDUM 5

## RESTORING POWER TO AUXILIARY BUS 1F(2F)

PAGE 1 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	DISPATCH an operator to ensure any non-running CARS pump switch(es) - IN THE OFF POSITION (29 ft TGB)	
2	PLACE the following equipment in PULL TO LOCK: <ul style="list-style-type: none"><li>o Circulating Water Pump 11(21)</li><li>o Condensate Pump 11(21)</li><li>o Feedwater Booster Pump 11(21)</li><li>o CL-ACW Pump 12(22)</li><li>o MSR DRIP Pump 11A(21A)</li><li>o MSR DRIP Pump 11B(21B)</li><li>o RCP 1A(2A)</li><li>o MAB Supply Fan 11A(21A)</li><li>o MAB Supply Fan 11B(21B)</li><li>o MAB Exhaust Fan 11A(21A)</li><li>o MAB Chill Water Pump 11A(21A)</li></ul>	
3	CHECK Unit AUX XFMR - AVAILABLE	GO TO Addendum Step 7. -----

ADDENDUM 5

## RESTORING POWER TO AUXILIARY BUS 1F(2F)

PAGE 2 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
4	RESTORE power to AUX Bus 1F(2F)	
a.	VERIFY "AUX TO STBY BUS 1F(2F) TIE T-0120(T-0220)" breaker - OPEN	a. OPEN breaker. -----
b.	CLOSE "UAT TO AUX BUS 1F(2F) SPLY P-0120(P-0220)" breaker	b. GO TO Addendum Step 7. -----
c.	VERIFY AUX BUS 1F(2F) - ENERGIZED	c. GO TO Addendum Step 7. -----
5	VERIFY STBY Bus 1F(2F) - ENERGIZED	PERFORM the following: a. ENSURE the following breakers open: o "STBY XFMR 1(2) TO" "STBY BUS 1F(2F) SPLY" "ST-0120(ST-0220)" o "STBY XFMR 2(1) TO" "STBY BUS 1F(2F) SPLY" "ST-0140(ST-0240)" o E1A(E2A) "SPLY BKR" b. CLOSE "AUX TO STBY BUS 1F(2F) TIE T-0120(T-0220)" breaker. -----
6	GO TO Addendum Step 15	

ADDENDUM 5

## RESTORING POWER TO AUXILIARY BUS 1F(2F)

PAGE 3 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

- |    |   |  |
|----|---|--|
| 7  | CHECK Affected Unit's STBY XFMR - AVAILABLE               | GO TO Addendum Step 12.  |
| 8  | VERIFY STBY Bus 1F(2F) - ENERGIZED                        | PERFORM the following:<br>a. ENSURE the following breakers open:<br>o "STBY XFMR 2(1) TO"<br>"STBY BUS 1F(2F) SPLY"<br>"ST-0140(ST-0240)"<br>o "AUX TO STBY"<br>"BUS 1F(2F) TIE"<br>"T-0120(T-0220)"<br>o E1A(E2A) "SPLY BKR"<br>b. CLOSE "STBY XFMR 1(2) TO STBY BUS 1F(2F) SPLY ST-0120(ST-0220)" breaker.<br>c. IF STBY Bus 1F(2F) is <u>NOT</u> energized, <u>THEN</u> GO TO Addendum Step 12. |
| 9  | CLOSE "AUX TO STBY BUS 1F(2F) TIE T-0120(T-0220)" breaker | GO TO Addendum Step 12.  |
| 10 | VERIFY AUX Bus 1F(2F) - ENERGIZED                         | GO TO Addendum Step 12.  |
| 11 | GO TO Addendum Step 15                                    |  |

ADDENDUM 5

## RESTORING POWER TO AUXILIARY BUS 1F(2F)

PAGE 4 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

- |    |   |  |
|----|---|--|
| 12 | CONTACT other unit to verify their STBY XFMR - AVAILABLE  | GO TO Addendum Step 15.  |
| 13 | VERIFY STBY Bus 1F(2F) - ENERGIZED                        | -----<br>PERFORM the following:<br><br>a. ENSURE the following breakers open:<br><br>o "STBY XFMR 1(2) TO"<br>"STBY BUS 1F(2F) SPLY"<br>"ST-0120(ST-0220)"<br><br>o "AUX TO STBY"<br>"BUS 1F(2F) TIE"<br>"T-0120(T-0220)"<br><br>o E1A(E2A) "SPLY BKR"<br><br>b. CLOSE "STBY XFMR 2(1) TO STBY BUS 1F(2F) SPLY ST-0140 (ST-0240)" breaker.<br><br>c. <u>IF</u> STBY Bus 1F(2F) is <u>NOT</u> energized, <u>THEN</u> GO TO Addendum Step 15.<br>----- |
| 14 | CLOSE "AUX TO STBY BUS 1F(2F) TIE T-0120(T-0220)" breaker |  |
| 15 | VERIFY 4.16 KV ESF Bus E1A(E2A) - ENERGIZED               | <u>IF</u> STBY Bus 1F(2F) is energized, <u>THEN</u> ENERGIZE 4.16 KV Bus E1A(E2A) <u>AND</u> 480V ESF LCs.<br>-----  |

ADDENDUM 5

## RESTORING POWER TO AUXILIARY BUS 1F(2F)

PAGE 5 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
16	VERIFY AUX Bus 1F(2F) - ENERGIZED	RETURN TO Procedure Step 10.

NOTE

- o RCP 1A(2A) bearing oil lift pump is powered from MCC 1J1(2J1) via LC 1J1(2J1). LC 1J1(2J1) is normally supplied from AUX bus 1H(2H) and may be locally cross-tied to be supplied from AUX bus 1F(2F) via LC 1J2(2J2).
- o RCP 1D(2D) bearing oil lift pump is powered from MCC 1K1(2K1) via LC 1K1(2K1). LC 1K1(2K1) is normally supplied from AUX bus 1G(2G) and may be locally cross-tied to be supplied from AUX bus 1F(2F) via LC 1K2(2K2).

17 CHECK RCP status - AT LEAST ONE RUNNING.

PERFORM the following:

- a. IF RCP 1D(2D) operation is required AND power is available to AUX bus 1J(2J), THEN:
  - 1) ENSURE LC 1K1(2K1) energized.
  - 2) START RCP 1D(2D) as directed by the Unit/Shift Supervisor per OPOP02-RC-0004, REACTOR COOLANT PUMP OPERATION.
- b. IF RCP 1A(2A) operation is required, THEN:
  - 1) ENSURE LC 1J1(2J1) energized.
  - 2) START RCP 1A(2A) as directed by the Unit/Shift Supervisor per OPOP02-RC-0004, REACTOR COOLANT PUMP OPERATION.

18 RETURN TO Procedure Step 10



ADDENDUM 6

## RESTORING POWER TO AUXILIARY BUS 1G(2G)

PAGE 1 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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1	DISPATCH an operator to ensure any non-running CARS pump switch(es) - IN THE OFF POSITION (29 ft TGB)	
---	---	--

2	PLACE the following equipment in PULL TO LOCK:	
---	--	--

- \_\_\_ o Feeder Breaker to 4.16 KV XFMR 1D1(2D1)
- \_\_\_ o Circulating Water Pump 12(22)
- \_\_\_ o Condensate Pump 12(22)
- \_\_\_ o Feedwater Booster Pump 12(22)
- \_\_\_ o CL-ACW Pump 11(21)
- \_\_\_ o CL-ACW Pump 13(23)
- \_\_\_ o RCP 1B(2B)
- \_\_\_ o MAB Main Supply Fan 11C(21C)
- \_\_\_ o MAB Main Exhaust Fan 11B(21B)
- \_\_\_ o MAB Chill Water Pump 11B(21B)
- \_\_\_ o MAB Chill Water Pump 11C(21C)
- \_\_\_ o MAB Chill Water Pump 11D(21D)
- \_\_\_ o RCB Chill Water Pump 11C(21C)

3	CHECK Unit AUX XFMR - AVAILABLE	
---	---------------------------------	--

GO TO Addendum Step 7.  
-----

ADDENDUM 6

## RESTORING POWER TO AUXILIARY BUS 1G(2G)

PAGE 2 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
4	RESTORE power to AUX Bus 1G(2G)	
	a. VERIFY "AUX TO STBY BUS 1G(2G) TIE BKR T-0140(T-0240)" - OPEN	a. OPEN breaker. -----
	b. CLOSE "UAT TO AUX BUS 1G(2G) SPLY P-0140(P-0240)" breaker	b. GO TO Addendum Step 7. -----
	c. VERIFY AUX Bus 1G(2G) - ENERGIZED	c. GO TO Addendum Step 7. -----
5	VERIFY STBY Bus 1G(2G) - ENERGIZED	PERFORM the following: a. ENSURE the following breakers open: o "STBY XFMR 1(2) TO" "STBY BUS 1G(2G) SPLY" "ST-0160(ST-0260)" o "STBY XFMR 2(1) TO" "STBY BUS 1G(2G) SPLY" "ST-0180(ST-0280)" o E1B(E2B) "SPLY BKR" b. CLOSE "AUX TO STBY BUS 1G(2G) TIE BKR T-0140(T-0240)". -----
6	GO TO Addendum Step 15	

ADDENDUM 6  
RESTORING POWER TO AUXILIARY BUS 1G(2G)

PAGE 3 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

7 CHECK affected Unit's STBY XFMR -  
AVAILABLE

GO TO Addendum Step 12.

8 VERIFY STBY Bus 1G(2G) - ENERGIZED

PERFORM the following:

a. ENSURE the following breakers open:

- o "STBY XFMR 2(1) TO"  
"STBY BUS 1G(2G) SPLY"  
"ST-0180(ST-0280)"
- o "AUX TO STBY"  
"BUS 1G(2G) TIE BKR"  
"T-0140(T-0240)"
- o E1B(E2B) "SPLY BKR"

b. CLOSE "STBY XFMR 1(2) TO STBY BUS  
1G(2G) SPLY ST-0160 (ST-0260)"  
breaker.

c. IF STBY Bus 1G(2G) is NOT  
energized, THEN GO TO Addendum  
Step 12.

9 CLOSE "AUX TO STBY BUS 1G(2G) TIE BKR  
T-0140(T-0240)"

ADDENDUM 6

## RESTORING POWER TO AUXILIARY BUS 1G(2G)

PAGE 4 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

10	VERIFY AUX Bus 1G(2G) - ENERGIZED	GO TO Addendum Step 12.
----	-----------------------------------	-------------------------

11	GO TO Addendum Step 15	-----
----	------------------------	-------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

12	CONTACT other unit to verify their STBY XFMR - AVAILABLE	GO TO Addendum Step 15.
----	---	-------------------------

13	VERIFY STBY Bus 1G(2G) - ENERGIZED	-----
----	------------------------------------	-------

PERFORM the following:

a. ENSURE the following breakers open:

- o "STBY XFMR 1(2) TO"  
"STBY BUS 1G(2G) SPLY"  
"ST-0160(ST-0260)"

- o "AUX TO STBY"  
"BUS 1G(2G) TIE BKR"  
"T-0140(T-0240)"

- o ElB(E2B) "SPLY BKR"

b. CLOSE "STBY XFMR 2(1) TO STBY BUS  
1G(2G) SPLY ST-0180(ST-0280)"  
breaker.c. IF STBY Bus 1G(2G) is NOT  
energized, THEN GO TO Addendum  
Step 9.  
-----

OPOP04-AE-0001

LOSS OF ANY 13.8 KV OR 4.16 KV BUS

REV. 2

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ADDENDUM 6

RESTORING POWER TO AUXILIARY BUS 1G(2G)

PAGE 5 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
14	CLOSE "AUX TO STBY BUS 1G(2G) TIE BKR T-0140(T-0240)"	
15	VERIFY 4.16 KV ESF Bus E1B(E2B) - ENERGIZED	IF STBY Bus 1G(2G) is energized, <u>THEN</u> ENERGIZE 4.16 KV Bus E1B(E2B) <u>AND</u> 480V ESF LCs. -----
16	RETURN TO Procedure Step 11	

ADDENDUM 7

## RESTORING POWER TO AUXILIARY BUS 1H(2H)

PAGE 1 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	PLACE the following equipment in PULL TO LOCK: <ul style="list-style-type: none"><li>o Feeder Breaker to 4.16 KV XFMR 1D2(2D2)</li><li>o Circulating Water Pump 13(23)</li><li>o Startup Feed Pump 14(24)</li><li>o RCP 1C(2C)</li><li>o RCB Chill Water Pump 11B(12B)</li><li>o RCB Chill Water Pump 11C(12C)</li><li>o MAB Exhaust Fan 11C(21C)</li><li>o Containment Normal Purge Supply Fan 11A(21A)</li></ul>	
2	CHECK Unit AUX XFMR - AVAILABLE	GO TO Addendum Step 6.
3	RESTORE power to AUX Bus 1H(2H) <ul style="list-style-type: none"><li>a. VERIFY "AUX TO STBY BUS 1H(2H) TIE BKR T-0130(T-0230)" - OPEN</li><li>b. CLOSE "UAT TO AUX BUS 1H(2H) SPLY P-0130(P-0230)" breaker</li><li>c. VERIFY AUX BUS 1H(2H) - ENERGIZED</li></ul>	<ul style="list-style-type: none"><li>a. OPEN breaker.</li><li>b. GO TO Addendum Step 6.</li><li>c. GO TO Addendum Step 6.</li></ul>



ADDENDUM 7

## RESTORING POWER TO AUXILIARY BUS 1H(2H)

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
4	VERIFY STBY Bus 1H(2H) - ENERGIZED	PERFORM the following:  a. ENSURE the following breakers open:  o "STBY XFMR 1(2) TO" "STBY BUS 1H(2H) SPLY" "ST-0130(ST-0230)"  o "STBY XFMR 2(1) TO" "STBY BUS 1H(2H) SPLY" "ST-0150(ST-0250)"  o E1C(E2C) "SPLY BKR"  b. CLOSE "AUX TO STBY BUS 1H(2H) TIE BKR T-0130(T-0230)". -----
5	GO TO Addendum Step 14	

ADDENDUM 7

## RESTORING POWER TO AUXILIARY BUS 1H(2H)

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

6 CHECK Affected Unit's STBY XFMR -  
AVAILABLE

GO TO Addendum Step 11.

7 VERIFY STBY Bus 1H(2H) - ENERGIZED

PERFORM the following:

a. ENSURE the following breakers open:

- o "STBY XFMR 2(1) TO"  
"STBY BUS 1H(2H) SPLY"  
"ST-0150(ST-0250)"
- o "AUX TO STBY"  
"BUS 1H(2H) TIE BKR"  
"T-0130(T-0230)"
- o E1C(E2C) "SPLY BKR"

b. CLOSE "STBY XFMR 1(2) TO STBY BUS  
1H(2H) SPLY ST-0130(ST-0230)"  
breaker.

c. IF STBY Bus 1H(2H) is NOT  
energized, THEN GO TO Addendum  
Step 11.

8 CLOSE "AUX TO STBY BUS 1H(2H) TIE BKR  
T-0130(T-0230)" breaker

GO TO Addendum Step 11.

ADDENDUM 7

## RESTORING POWER TO AUXILIARY BUS 1H(2H)

PAGE 4 OF 5

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
9	VERIFY AUX Bus 1H(2H) - ENERGIZED	GO TO Addendum Step 11.
10	GO TO Addendum Step 14	

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

11	CONTACT other unit to verify their STBY XFMR - AVAILABLE	GO TO Addendum Step 14.
12	VERIFY STBY Bus 1H(2H) - ENERGIZED	PERFORM the following:  a. ENSURE the following breakers open:  o "STBY XFMR 1(2) TO" "STBY BUS 1H(2H) SPLY" "ST-0130(ST-0230)"  o "AUX TO STBY" "BUS 1H(2H) TIE BKR" "T-0130(T-0230)"  o E1C(E2C) "SPLY BKR"  b. CLOSE "STBY XFMR 2(1) TO STBY BUS 1H(2H) SPLY ST-0150 (ST-0250)" breaker.  c. IF STBY Bus 1H(2H) is NOT energized, THEN GO TO Addendum Step 14.

ADDENDUM 7

## RESTORING POWER TO AUXILIARY BUS 1H(2H)

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
13	CLOSE "AUX TO STBY BUS 1H(2H) TIE BKR T-0130(T-0230)"	
14	VERIFY 4.16 KV ESF Bus E1C(E2C) - ENERGIZED	IF STBY Bus 1H(2H) is energized, <u>THEN</u> ENERGIZE 4.16 KV Bus E1C(E2C) <u>AND</u> 480V ESF LCs. -----
15	RETURN TO Procedure Step 12	

ADDENDUM 8  
RESTORING POWER TO STANDBY BUS 1F(2F)

PAGE 1 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	CHECK AUX Bus 1F(2F) - ENERGIZED	GO TO Addendum Step 3. -----
2	RESTORE power to STBY Bus 1F(2F)	
	a. VERIFY the following breakers open:	a. OPEN breaker(s).
	o "STBY XFMR 1(2) TO" "STBY BUS 1F(2F) SPLY" "ST-0120(ST-0220)"	
	o "STBY XFMR 2(1) TO" "STBY BUS 1F(2F) SPLY" "ST-0140(ST-0240)"	
	o E1A(E2A) "SPLY BKR"	
	b. CLOSE "AUX TO STBY BUS 1F(2F) TIE T-0120(T-0220)" breaker	b. GO TO Addendum Step 3. -----
	c. VERIFY STBY Bus 1F(2F) - ENERGIZED	c. GO TO Addendum Step 3. -----
	d. GO TO Addendum Step 7	

ADDENDUM 8

## RESTORING POWER TO STANDBY BUS 1F(2F)

PAGE 2 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

3 CHECK affected Unit's STBY XFMR -  
AVAILABLE

GO TO Addendum Step 5.

4 RESTORE power to STBY Bus 1F(2F)

a. VERIFY the following  
breakers open:

a. Open breaker(s).

o "STBY XFMR 2(1) TO"  
"STBY BUS 1F(2F) SPLY"  
"ST-0140(ST-0240)"

o "AUX TO STBY"  
"BUS 1F(2F) TIE"  
"T-0120(T-0220)"

o E1A(E2A) "SPLY BKR"

b. CLOSE "STBY XFMR 1(2) TO STBY  
BUS 1F(2F) SPLY ST-0120  
(ST-0220)" breaker

b. GO TO Addendum Step 5.

c. VERIFY STBY Bus 1F(2F) -  
ENERGIZED

c. GO TO Addendum Step 5.

d. GO TO Addendum Step 7



ADDENDUM 8  
RESTORING POWER TO STANDBY BUS 1F(2F)

PAGE 3 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

- |       |   |   |
|-------|---|---|
| 5     | CONTACT other unit to verify their STBY XFMR - AVAILABLE                    | RETURN TO Procedure Step 13.  |
| ----- |   |   |
| 6     | RESTORE power to STBY Bus 1F(2F)  |   |
|       | a. VERIFY the following breakers open:                                      | a. OPEN breaker(s).   |
|       | o "STBY XFMR 1(2) TO"<br>"STBY BUS 1F(2F) SPLY"<br>"ST-0120(ST-0220)"       |   |
|       | o "AUX TO STBY"<br>"BUS 1F(2F) TIE"<br>"T-0120(T-0220)"                     |   |
|       | o E1A(E2A) "SPLY BKR"   |   |
| ----- |   |   |
|       | b. CLOSE "STBY XFMR 2(1) TO STBY BUS 1F(2F) SPLY ST-0140 (ST-0240)" breaker |   |
| 7     | VERIFY 4.16 KV ESF Bus E1A(E2A) - ENERGIZED                                 | IF STBY Bus 1F(2F) is energized, THEN ENERGIZE 4.16 KV Bus E1A(E2A) AND 480V ESF LCs. |
| ----- |   |   |
| 8     | RETURN TO Procedure Step 13   |   |

ADDENDUM 9

## RESTORING POWER TO STANDBY BUS 1G(2G)

PAGE 1 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	CHECK AUX Bus 1G(2G) - ENERGIZED	GO TO Addendum Step 3.
2	RESTORE power to STBY Bus 1G(2G)	
	a. VERIFY the following breakers open:	a. OPEN breaker(s).
	o "STBY XFMR 1(2) TO" "STBY BUS 1G(2G) SPLY" "ST-0160(ST-0260)"	
	o "STBY XFMR 2(1) TO" "STBY BUS 1G(2G) SPLY" "ST-0180(ST-0280)"	
	o E1B(E2B) "SPLY BKR"	
	b. CLOSE "AUX TO STBY BUS 1G(2G) TIE BKR T-0140(T-0240)"	b. GO TO Addendum Step 3.
	c. VERIFY STBY Bus 1G(2G) - ENERGIZED	c. GO TO Addendum Step 3.
	d. GO TO Addendum Step 7	

ADDENDUM 9

## RESTORING POWER TO STANDBY BUS 1G(2G)

PAGE 2 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

\_\_\_ 3 CHECK affected Unit's STBY XFMR -  
AVAILABLE

GO TO Addendum Step 5.

\_\_\_ 4 RESTORE power to STBY Bus 1G(2G)

\_\_\_ a. VERIFY the following  
breakers open:

a. Open breaker(s).

\_\_\_ o "STBY XFMR 2(1) TO"  
"STBY BUS 1G(2G) SPLY"  
"ST-0180(ST-0280)"

\_\_\_ o "AUX TO STBY"  
"BUS 1G(2G) TIE BKR"  
"T-0140(T-0240)"

\_\_\_ o E1B(E2B) "SPLY BKR"

\_\_\_ b. CLOSE "STBY XFMR 1(2) TO STBY  
BUS 1G(2G) SPLY ST-0160  
(ST-0260)"

b. GO TO Addendum Step 5.

\_\_\_ c. VERIFY STBY Bus 1G(2G) -  
ENERGIZED

c. GO TO Addendum Step 5.

\_\_\_ d. GO TO Addendum Step 7

ADDENDUM 9  
RESTORING POWER TO STANDBY BUS 1G(2G)

PAGE 3 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

- |   |   |   |
|---|---|---|
| 5   | CONTACT other unit to verify their<br>STBY XFMR - AVAILABLE                       | RETURN TO Procedure Step 14.  |
| <hr style="border-top: 1px dashed black;"/> |   |   |
| 6   | RESTORE power to STBY Bus 1G(2G)  |   |
| <hr style="border-top: 1px dashed black;"/> |   |   |
|   | a. VERIFY the following<br>breakers open:   | a. OPEN breaker(s).   |
|   | o "STBY XFMR 1(2) TO"<br>"STBY BUS 1G(2G) SPLY"<br>"ST-0160(ST-0260)"             |   |
|   | o "AUX TO STBY"<br>"BUS 1G(2G) TIE BKR"<br>"T-0140(T-0240)"                       |   |
|   | o E1B(E2B) "SPLY BKR"   |   |
| <hr style="border-top: 1px dashed black;"/> |   |   |
|   | b. CLOSE "STBY XFMR 2(1) TO STBY<br>BUS 1G(2G) SPLY ST-0180<br>(ST-0280)" breaker |   |
| <hr style="border-top: 1px dashed black;"/> |   |   |
| 7   | VERIFY 4.16 KV ESF Bus E1B(E2B) -<br>ENERGIZED                                    | IF STBY Bus 1G(2G) is energized, THEN<br>ENERGIZE 4.16 KV Bus E1B(E2B) AND 480V<br>ESF LCs. |
| <hr style="border-top: 1px dashed black;"/> |   |   |
| 8   | RETURN TO Procedure Step 14   |   |

ADDENDUM 10  
RESTORING POWER TO STANDBY BUS 1H(2H)

PAGE 1 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	CHECK AUX Bus 1H(2H) - ENERGIZED	GO TO Addendum Step 4. -----
2	PLACE the Startup Steam Generator Feed Pump 14(24) in PULL TO LOCK	
3	RESTORE power to STBY Bus 1H(2H)	
a.	VERIFY the following breakers open:	a. OPEN breaker(s). -----
o	"STBY XFMR 1(2) TO" "STBY BUS 1H(2H) SPLY" "ST-0130(ST-0230)"	
o	"STBY XFMR 2(1) TO" "STBY BUS 1H(2H) SPLY" "ST-0150(ST-0250)"	
o	ELC(E2C) "SPLY BKR"	
b.	CLOSE "AUX TO STBY BUS 1H(2H) TIE BKR T-0130(T-0230)" breaker	b. GO TO Addendum Step 4. -----
c.	VERIFY STBY Bus 1H(2H) - ENERGIZED	c. GO TO Addendum Step 4. -----
d.	GO TO Addendum Step 8	

ADDENDUM 10  
RESTORING POWER TO STANDBY BUS 1H(2H)

PAGE 2 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

- |          |  |                                    |
|----------|--|------------------------------------|
| _____ 4  | CHECK affected Unit's STBY XFMR - AVAILABLE                              | GO TO Addendum Step 6.<br>-----    |
| _____ 5  | RESTORE power to STBY Bus 1H(2H)   |                                    |
| _____ a. | VERIFY the following breakers open:                                      | a. Open breaker(s).<br>-----       |
| _____ o  | "STBY XFMR 2(1) TO"<br>"STBY BUS 1H(2H) SPLY"<br>"ST-0150(ST-0250)"      |                                    |
| _____ o  | "AUX TO STBY"<br>"BUS 1H(2H) TIE BKR"<br>"T-0130(T-0230)"                |                                    |
| _____ o  | ELC(E2C) "SPLY BKR"  |                                    |
| _____ b. | CLOSE "STBY XFMR 1(2) TO STBY BUS 1H(2H) SPLY ST-0130 (ST-0230)" breaker | b. GO TO Addendum Step 6.<br>----- |
| _____ c. | VERIFY STBY Bus 1H(2H) - ENERGIZED                                       | c. GO TO Addendum Step 6.<br>----- |
| _____ d. | GO TO Addendum Step 8  |                                    |



ADDENDUM 10

## RESTORING POWER TO STANDBY BUS 1H(2H)

PAGE 3 OF 3

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Each STBY XFMR is capable of carrying TWO fully loaded STBY busses and ONE fully loaded AUX bus per winding.

- |   |   |   |
|---|---|---|
| 6 | CONTACT other unit to verify their STBY XFMR - AVAILABLE                    | RETURN TO Procedure Step 15.  |
| 7 | RESTORE power to STBY Bus 1H(2H)  | -----   |
|   | a. VERIFY the following breakers open:                                      | a. OPEN breaker(s).   |
|   | o "STBY XFMR 1(2) TO"<br>"STBY BUS 1H(2H) SPLY"<br>"ST-0130(ST-0230)"       |   |
|   | o "AUX TO STBY"<br>"BUS 1H(2H) TIE BKR"<br>"T-0130(T-0230)"                 |   |
|   | o E1C(E2C) "SPLY BKR"   | -----   |
|   | b. CLOSE "STBY XFMR 2(1) TO STBY BUS 1H(2H) SPLY ST-0150 (ST-0250)" breaker |   |
| 8 | VERIFY 4.16 KV ESF Bus E1C(E2C) - ENERGIZED                                 | IF STBY Bus 1H(2H) is energized, <u>THEN</u> ENERGIZE 4.16 KV Bus E1C(E2C) <u>AND</u> 480V ESF LCs. |
| 9 | RETURN TO Procedure Step 15   | -----   |

ADDENDUM 11

## TRANSFER ESF BUSSES TO THE EMERGENCY TRANSFORMER

PAGE 4 OF 4

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

- |   |  |  |
|---|--|--|
| 6 | CLOSE the 4.16 KV normal supply breaker to the selected ESF bus                          |  |
| 7 | CLOSE the 480 V ESF LC feeder breakers from the selected ESF bus.                        |  |
| 8 | RESTORE equipment to the selected ESF bus as deemed appropriate by Unit/Shift Supervisor |  |
| 9 | RETURN TO Procedure Step or Addendum Step in effect                                      |  |

ADDENDUM 12RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 1 OF 14

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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NOTE

- o IF the loss of Train A AND Train C 4.16 KV ESF Busses is expected to last LESS THAN two hours, THEN performance of this Addendum is NOT required.
- o IF the loss of Train A AND Train C 4.16 KV ESF Busses is expected to last GREATER THAN OR EQUAL TO two hours, THEN this addendum SHALL be performed within thirty minutes after event initiation to ensure adequate battery capacity for safe shutdown instrumentation.

- |   |  |  |
|---|--|--|
| 1 | Expected duration of loss of power to Train A and Train C 4.16 KV ESF Busses<br>- GREATER THAN OR EQUAL TO TWO HOURS | RETURN TO Procedure Step or Addendum Step in effect. |
| 2 | CHECK status of 4.16 KV ESF Bus<br>ElB(E2B) - ENERGIZED FROM<br>STBY DG 12(22)                                       | GO TO Addendum Step 25.                              |
| 3 | ENSURE the following 4.16 KV ESF<br>normal supply breakers - OPEN  | OPEN 4.16 KV normal supply breakers                  |
|   | o ElA(E2A) "SPLY BKR"  |  |
|   | o ElB(E2B) "SPLY BKR"  |  |
|   | o ElC(E2C) "SPLY BKR"  |  |

ADDENDUM 12RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
4	<p>OPEN feeder breaker from STBY bus to ONE de-energized ESF bus</p> <p>o E1A(E2A) - "STBY BUS 1F(2F)" "TO XFMR E1A(E2A)" "BKR SW - NORM"</p> <p>OR</p> <p>o E1C(E2C) - "STBY BUS 1H(2H)" "TO XFMR E1C(E2C)" "BKR SW - NORM"</p>	
5	<p>OPEN feeder breaker from STBY Bus 1G(2G) to 4.16 KV ESF Bus E1B(E2B)</p> <p>o E1B(E2B) - "STBY BUS 1G(2G)" "TO XFMR E1B(E2B)" "BKR SW - NORM"</p>	
6	<p>OPEN motor operated disconnects from STBY bus to the selected de-energized ESF bus</p> <p>o E1A(E2A) - "STBY BUS 1F(2F) TO" "XFMR E1A(E2A)" "DISC SW - NORM"</p> <p>OR</p> <p>o E1C(E2C) - "STBY BUS 1H(2H) TO" "XFMR E1C(E2C)" "DISC SW - NORM"</p>	<p>DISPATCH operator to open motor operated disconnects to the selected de-energized ESF bus from STBY bus, REFER TO OPOPO2-AE-0001, AC ELECTRICAL DISTRIBUTION BREAKER LINUP (located next to associated ESF transformer)</p> <p>o "E1A(E2A) MOTOR OPERATED DISCONNECT" "FROM STBY BUS 1F(2F)"</p> <p>OR</p> <p>o "E1C(E2C) MOTOR OPERATED DISCONNECT" "FROM STBY BUS 1H(2H)"</p>
7	<p>OPEN motor operated disconnects from STBY Bus 1G(2G) to 4.16 KV ESF Bus E1B(E2B)</p> <p>o E1B(E2B) - "STBY BUS 1G(2G) TO" "XFMR E1B(E2B)" "DISC SW - NORM"</p>	<p>DISPATCH operator to open motor operated disconnect to the 4.16 KV ESF Bus E1B(E2B) from STBY bus, REFER TO OPOPO2-AE-0001, AC ELECTRICAL DISTRIBUTION BREAKER LINUP (located next to E1B(E2B) ESF transformer)</p> <p>o "E1B(E2B) MOTOR OPERATED DISCONNECT" "FROM STBY BUS 1G(2G)"</p>

ADDENDUM 12

RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 3 OF 14

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
8	<p>VERIFY emergency feeder breaker from Bus 1L(2L) to the selected de-energized 4.16 KV ESF bus - OPEN</p> <p>o E1A(E2A) - "EMER BUS 1L(2L)" "TO XFMR E1A(E2A)" "BKR SW - EMER"</p> <p>OR</p> <p>o E1C(E2C) - "EMER BUS 1L(2L)" "TO XFMR E1C(E2C)" "BKR SW - EMER"</p>	<p>OPEN emergency feeder breaker from 1L(2L) to the selected 4.16 KV ESF bus</p>
9	<p>VERIFY emergency feeder breaker from Bus 1L(2L) to 4.16 KV ESF Bus E1B(E2B) - OPEN</p> <p>o E1B(E2B) - "EMER BUS 1L(2L)" "TO XFMR E1B(E2B)" "BKR SW - EMER"</p>	<p>-----</p> <p>OPEN emergency feeder breaker from 1L(2L) to 4.16 KV ESF Bus E1B(E2B)</p>
10	<p>VERIFY emergency transformer supply breaker "EMER XFMR TO BUS 1K/1L(2K/2L) SPLY" - IN PULL TO LOCK</p>	<p>-----</p> <p>PLACE "EMER XFMR TO BUS 1K/1L(2K/2L) SPLY" in PULL TO LOCK.</p>

ADDENDUM 12RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
11	CLOSE motor operated disconnects from Emergency Bus 1L(2L) to the selected de-energized ESF bus	DISPATCH operator to close motor operated disconnects to the selected de-energized ESF bus from the emergency transformer (located next to associated ESF transformer.)
	o E1A(E2A) - "EMER BUS 1L(2L) TO" "XFMR E1A(E2A)" "DISC SW - EMER"	o "E1A(E2A) MOTOR OPERATED DISCONNECT" "FROM EMERGENCY BUS 1L(2L)"
	OR	OR
	o E1C(E2C) - "EMER BUS 1L(2L) TO" "XFMR E1C(E2C)" "DISC SW - EMER"	o "E1C(E2C) MOTOR OPERATED DISCONNECT" "FROM EMERGENCY BUS 1L(2L)"
12	CLOSE motor operated disconnects from Emergency Bus 1L(2L) to 4.16 KV ESF Bus E1B(E2B)	DISPATCH operator to close the motor operated disconnect to 4.16 KV ESF Bus E1B(E2B) from the emergency transformer (located next to associated ESF transformer.)
	o E1B(E2B) - "EMER BUS 1L(2L) TO" "XFMR E1B(E2B)" "DISC SW - EMER"	o "E1B(E2B) MOTOR OPERATED DISCONNECT" "FROM EMERGENCY BUS 1L(2L)"



ADDENDUM 12RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

- |    |  |  |
|----|--|--|
| 13 | PLACE the following equipment for the selected de-energized ESF bus in PULL TO LOCK: |  |
|    | o Essential chillers   |  |
|    | o Essential chill water pump   |  |
|    | o Standby emergency DG supply fan  |  |
|    | o Spent fuel cooling pump (TRAIN C ONLY)   |  |
|    | o ECW room fans  |  |
|    | o FHB exhaust and exhaust booster fans   |  |
|    | o EAB supply and return fans   |  |
|    | o CR supply, return, makeup, and recirculation fans                                  |  |
|    | o RHR pump   |  |
|    | o HHSI pump  |  |
|    | o LHSI pump  |  |
|    | o Containment spray pump   |  |
|    | o ECW pump   |  |
|    | o CCW pump   |  |
|    | o RCFCs  |  |
|    | o STBY DG output breaker   |  |
|    | o AFW pump   |  |
|    | o Centrifugal charging pump  |  |

ADDENDUM 12RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

- |    |   |  |
|----|---|--|
| 14 | CLOSE emergency feeder breaker from Bus 1L(2L) to the selected de-energized 4.16 KV ESF bus |  |
|    | o E1A(E2A) - "EMER BUS 1L(2L)"<br>"TO XFMR E1A(E2A)"<br>"BKR SW - EMER"                     |  |
|    | OR  |  |
|    | o E1C(E2C) - "EMER BUS 1L(2L)"<br>"TO XFMR E1C(E2C)"<br>"BKR SW - EMER"                     |  |
| 15 | CLOSE emergency feeder breaker from Bus 1L(2L) to 4.16 KV ESF Bus E1B(E2B)                  |  |
|    | o E1B(E2B) - "EMER BUS 1L(2L)"<br>"TO XFMR E1B(E2B)"<br>"BKR SW - EMER"                     |  |
| 16 | PLACE the synchronizing switch for STBY DG 12(22) in the ON position                        |  |
| 17 | CLOSE the 4.16 KV ESF bus normal supply breaker "SPLY BKR" to E1B(E2B)                      |  |
| 18 | PLACE the synchronizing switch for STBY DG 12(22) in the OFF position                       |  |

ADDENDUM 12  
RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 7 OF 14

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Performance of the following step will energize the selected ESF bus.

- 19 CLOSE the 4.16 KV ESF bus normal "SPLY BKR" for the selected de-energized ESF bus.

PERFORM the following:

- a. DISPATCH an operator to open the sequencer main supply breaker for the selected de-energized ESF bus.  
  
(10 ft EAB sequencer room)
- b. ATTEMPT to close the 4.16 KV ESF bus normal "SPLY BKR" for the selected de-energized ESF bus.
- c. IF the 4.16 KV ESF bus normal supply breaker for the selected de-energized ESF bus will NOT close, THEN GO TO Addendum Step 25.

- 20 CLOSE the 480 VAC LC ESF bus normal supply breakers for the selected ESF bus

PERFORM the following:

- a. DISPATCH an operator to open the sequencer main supply breaker for the selected ESF bus.  
  
(10 ft EAB sequencer room)
- b. ATTEMPT to close the 480 VAC LC normal supply breaker for the selected ESF bus.
- c. IF the 480 VAC LC normal supply breakers for the selected ESF bus will NOT close, THEN GO TO Addendum Step 25.

ADDENDUM 12  
RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 8 OF 14

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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NOTE

IF CCP operation is required AND CCW to that CCP is in service, THEN the respective CCP may be started.

- |    |  |  |
|----|--|--|
| 21 | MONITOR STBY DG load - LESS THAN 5500 KW   | SHED loads as necessary to maintain LESS THAN 5500 KW.   |
| 22 | VERIFY the 480 VAC LCs for the selected ESF bus - ENERGIZED  | -----<br>GO TO Addendum Step 25.   |
| 23 | DISPATCH an operator to verify the 120 VAC battery chargers and 25 KVA TMI inverters on the selected ESF bus - ENERGIZED | -----<br>PERFORM the following:<br><br>a. DIRECT operator to perform the following:<br><br>1) ENSURE battery chargers for the selected ESF bus in service per OPOPO2-EE-0001, ESF (CLASS 1E) DC DISTRIBUTION SYSTEM.<br><br>2) ENSURE 25 KVA TMI inverters for the selected ESF bus in service per OPOPO2-AE-0004, 120 VAC ESF VITAL DISTRIBUTION POWER SUPPLIES.<br><br>b. <u>IF</u> the 25 KVA TMI inverters <u>AND</u> battery chargers on the selected ESF bus can <u>NOT</u> be energized, <u>THEN</u> GO TO Addendum Step 25.<br>----- |
| 24 | RETURN TO Procedure Step or Addendum Step in effect  |  |
| 25 | DISPATCH an operator to shed all large non-essential DC loads per Table 1 of this Addendum.                              |  |

ADDENDUM 12RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

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26 DISPATCH an operator to deenergize  
Channel I and Channel IV 7.5 KVA NSSS  
inverters by opening the following  
breakers:

a. "CH I INST/CONT PWR"  
"NSSS INVERTER DC PWR"  
E1A11(E2A11)/5E

b. "CH IV INST/CONT PWR"  
"NSSS INVERTER DC PWR"  
E1C11(E2C11)/5E

27 REFER TO Table 2 of this addendum for  
loads lost by shedding Channel I and  
Channel IV NSSS inverters

ADDENDUM 12  
RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 10 OF 14

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
------	--------------------------	-----------------------

CAUTION

Do NOT allow battery voltages to drop to LESS THAN 106 VDC for plant equipment protection and to allow sufficient voltage for starting diesel generators.

28 CHECK voltage on Channel I, III and IV  
of the Class 1E 125 VDC system -  
GREATER THAN 107 VDC

IF voltage on Channel I, III or IV  
decreases to LESS THAN 107 VDC, THEN  
DISPATCH an operator to open its  
associated battery output breaker to  
conserve battery should the respective  
STBY DG become available

o Channel I -

"125V BATT E1A11(E2A11) TO"  
"125V DC SWBD E1A11(E2A11)"  
E1A11(E2A11)/1B

o Channel III -

"125V BATT E1B11(E2B11) TO"  
"125V DC SWBD E1B11(E2B11)"  
E1B11(E2B11)/1B

o Channel IV -

"125V BATT E1C11(E2C11) TO"  
"125V DC SWBD E1C11(E2C11)"  
E1C11(E2C11)/1B

29 MONITOR voltage on Channel I, III and  
IV of the Class 1E 125 VDC system for  
duration of the event

DISPATCH an operator to monitor  
voltage on Channel I, III and IV of  
the 1E 125 VDC system.

30 RETURN TO Procedure Step or Addendum  
Step in effect



ADDENDUM 12  
RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 11 OF 14

TABLE 1  
DC NON ESSENTIAL LOADS

<u>DEVICE</u>	<u>POSITION</u>	<u>CHECK</u>
<u>E1A11(E2A11)</u>		
CUB 4A - "TRAIN A RX TRIP SWGR CONTROL PWR"	OPEN	_____
CUB 5C - "ESF LOAD SEQUENCER CABINET A - ZLP-801"	OPEN	_____
125V DC PANEL		
PL-39A/BKR 5 - "RCP 1A(2A) 15 KV CLASS 1E CUB A" (10 ft EAB Rm 007)	OPEN	_____
<u>E1B11(E2B11)</u>		
CUB 5B - "ESF LOAD SEQUENCER CABINET B - ZLP-802"	OPEN	_____
CUB 5C - "TRAIN B RX TRIP SWGR CONTROL PWR"	OPEN	_____
125V DC PANEL		
PL-39B/BKR 3 - "RCP 1C(2C) 15 KV CLASS 1E CUB C" (35 ft EAB Rm 213)	OPEN	_____
<u>E1C11(E2C11)</u>		
CUB 7B - "ESF LOAD SEQUENCER CABINET C - ZLP-803"	OPEN	_____
125V DC PANEL		
PL-39C/BKR 3 - "RCP 1D(2D) 15 KV CLASS 1E CUB D" (60 ft EAB Rm 319)	OPEN	_____

ADDENDUM 12  
RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 12 OF 14

TABLE 2  
LOADS LOST DUE TO INVERTER LOAD SHED

CHANNEL I NSSS 7.5 KVA INVERTER  
120 V AC Panel DP 1201

Breaker	Load and Affected Equipment
1	NSSS Process Cabinet 01A Protection Set I
2	NSSS Process Cabinet 01A Protection Set I
	PI-0514 SG A steam pressure
	PI-0524 SG B steam pressure
	PI-0534 SG C steam pressure
	PI-0544 SG D steam pressure
	FI-0510 SG A main FW flow
	FI-0520 SG B main FW flow
	FI-0530 SG C main FW flow
	FI-0540 SG D main FW flow
	LI-0571 SG A NR level
	LI-0572 SG B NR level
	LI-0573 SG C NR level
	LI-0574 SG D NR level
	PI-0505 HP turbine impulse pressure
	LR-0102 A BAT level
	PI-0455 pressurizer pressure
	LI-0465 pressurizer level
	TI-0410A RCS loop A hot leg temperature
	TI-0410B RCS loop A cold leg temperature
	TI-0411 RCS loop B differential pressure
	TI-0412A RCS loop A average temperature

ADDENDUM 12  
RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 13 OF 14

TABLE 2  
LOADS LOST DUE TO INVERTER LOAD SHED

CHANNEL I NSSS 7.5 KVA INVERTER  
120 V AC Panel DP 1201 (cont.)

Breaker	Load and Affected Equipment
2 (cont.)	TI-0412B RCS loop A OPDT setpoint
	TI-0412C RCS loop A OPDT setpoint
	FI-0867 A RHR pump discharge flow
3	NIS Channel I Control Power
	N-31 source range
	N-41 power range
4	NIS Channel I Instrument Power
	N-31 source range
	N-41 power range
5	SSPS Logic Cabinet R Input Channel I
6	SSPS Actuation Cabinet Train A
7	SSPS Logic Cabinet S Input Channel I
8	SSPS Safeguard Test Cabinet A
9	ECW ECC Servo Amplifier
10	ECW ECC Servo Amplifier
22	Communication Isolation Device

ADDENDUM 12  
RESPONSE TO LOSS OF TRAIN A AND TRAIN C  
4.16 KV ESF BUSES

PAGE 14 OF 14

TABLE 2  
LOADS LOST DUE TO INVERTER LOAD SHED

CHANNEL IV NSSS 7.5 KVA INVERTER  
120 V AC Panel DP 1204

Breaker	Load and Affected Equipment
1	NSSS Process Cabinet Protection Set IV
	LI-0112 VCT level
	TI-0130 letdown heat exchanger temperature
	LR-0106 B BAT level
	PR-0934 containment pressure
	TI-0440A RCS loop D hot leg temperature
	TI-0440B RCS loop D hot leg temperature
	TI-0441 RCS loop D differential temperature
	TI-0442A RCS loop D average temperature
	TI-0442B RCS loop D OPDT setpoint
	TI-0442C RCS loop D OPDT setpoint
	PI-0458 pressurizer pressure
	FI-0869 C RHR pump discharge flow
2	NIS Channnel IV Control Power
	N-43 power range
3	SSPS Logic Center R Input Channel IV
4	NIS Channel IV Instrument Power
	N-43 power range
5	SSPS Logic Cabinet S Input Channel IV
6	SSPS Actuation Train C
8	SSPS Safeguard Test Cabinet C
22	Communication Isolation Device

ADDENDUM 13

## RESTORING POWER TO BUS 1D1(2D1)

PAGE 1 OF 2

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	PLACE the following equipment in PULL TO LOCK: <ul style="list-style-type: none"><li>o LP HTR DRIP Pump 11(21)</li><li>o OL-ACW Pump 12(22)</li><li>o OL-ACW Pump 13(23)</li></ul>	
2	CHECK 13.8 KV AUX Bus 1G(2G) - ENERGIZED	GO TO Addendum Step 4.
3	RESTORE power to Bus 1D1(2D1) <ul style="list-style-type: none"><li>a. VERIFY "BUS 1D1(2D1) TO 1D2(2D2) TIE BKR" - OPEN</li><li>b. VERIFY "FDR BKR TO XFMR 1D1(2D1)" - CLOSED</li><li>c. VERIFY "AUX XFMR 1D1(2D1) TO BUS 1D1(2D1)" breaker - CLOSED</li><li>d. VERIFY Bus 1D1(2D1) - ENERGIZED</li><li>e. RETURN TO Procedure Step 17</li></ul>	<ul style="list-style-type: none"><li>a. OPEN breaker.</li><li>b. CLOSE breaker.</li><li>c. CLOSE breaker.</li><li>d. GO TO Addendum Step 4.</li></ul>

ADDENDUM 13

## RESTORING POWER TO BUS 1D1(2D1)

PAGE 2 OF 2

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
___ 4	CHECK Bus 1D2(2D2) - ENERGIZED	RETURN TO Procedure Step 17. -----
___ 5	RESTORE power to Bus 1D1(2D1)	
___ a.	VERIFY "FDR BKR TO XFMR 1D1(2D1)" - OPEN	a. OPEN breaker. -----
___ b.	VERIFY "AUX XFMR 1D1(2D1) TO BUS 1D1(2D1)" breaker - OPEN	b. OPEN breaker. -----
___ c.	CLOSE "BUS 1D1(2D1) TO 1D2(2D2) TIE BKR"	-----
___ 6	RETURN TO Procedure Step 17	



ADDENDUM 14  
RESTORING POWER TO BUS 1D2(2D2)

PAGE 1 OF 2

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	PLACE the following equipment in PULL TO LOCK:  o LP HTR DRIP Pump 12(22) o LP HTR DRIP Pump 13(23) o OL-ACW Pump 11(21)	
2	CHECK 13.8 KV AUX Bus 1H(2H) - ENERGIZED	GO TO Addendum Step 4. -----
3	RESTORE power to Bus 1D2(2D2)  a. VERIFY "BUS 1D1(2D1) TO 1D2(2D2) TIE BKR" - OPEN  b. VERIFY "FDR BKR TO XFMR 1D2(2D2)" - CLOSED  c. VERIFY "AUX XFMR 1D2(2D2) TO BUS 1D2(2D2)" breaker - CLOSED  d. VERIFY Bus 1D2(2D2) - ENERGIZED  e. RETURN TO Procedure Step 18	a. OPEN breaker. ----- b. CLOSE breaker. ----- c. CLOSE breaker. ----- d. GO TO Addendum Step 4. -----

ADDENDUM 14

## RESTORING POWER TO BUS 1D2(2D2)

PAGE 2 OF 2

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
4	CHECK Bus 1D1(2D1) - ENERGIZED	GO TO Addendum Step 6. -----
5	RESTORE power to Bus 1D2(2D2)	
a.	VERIFY "FDR BKR TO XFMR 1D2(2D2)" - OPEN	a. OPEN breaker. -----
b.	VERIFY "AUX XFMR 1D2(2D2) TO BUS 1D2(2D2)" breaker - OPEN	b. OPEN breaker. -----
c.	CLOSE "BUS 1D1(2D1) TO 1D2(2D2) TIE BKR"	-----
6	VERIFY Bus 1D2(2D2) - ENERGIZED	PERFORM the following:  a. CONTACT Load Dispatcher to report loss of 480V Switchyard LC 12H2(12H1).  b. RETURN to Procedure Step 18. -----
7	NOTIFY Load Dispatcher that the normal power source to 480V Switchyard LC 12H2(12H1) - AVAILABLE FOR RESTORATION	
8	RETURN TO Procedure Step 18	

**ATTACHMENT 7**

**DESIGN AND OPERATING PARAMETERS OF THE**

**WESTINGHOUSE MODEL E STEAM GENERATOR**

**FOR THE**

**SOUTH TEXAS PROJECT**

# The Light company

Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

September 11, 1985

## Steam Generator Parameters

ST-WN-HS-90256

Dennis Cadwell  
Project Manager  
Westinghouse Electric Co.  
Pittsburg, PA.  
Telecopy Phone #: 412-829-3569

M3302

D1115 5752438

Dear Dennis:

Per your discussion with R.L. Boyer earlier today, I'm telecopying a list of HL&P questions concerning design and operating parameters of the Westinghouse Model E steam generators for the South Texas Project. According to Jack Gabrielson (HL&P), your role will be in directing these questions to the responsible Westinghouse engineer and/or department.

Westinghouse's response to these questions should also include supporting documentation that identifies how the response was obtained. Supporting documentation can be in the form of Westinghouse drawings, calculations, reports, internal memos, WCAP's, test data, etc.

Note that prior authorization must be made by HL&P, if a cost is associated with answering any of these questions.

Thank you very much for your time and cooperation on this matter. If you have any questions, please feel free to contact Roger Boyer at (713) 922-2002.

Sincerely yours,

C.R. Albury

C.R. Albury  
T&H Analysis

RLB

cc: K.K. Chitkara  
R.L. Boyer  
J.A. Gabrielson

(TELECOPY/DSG)

ATTACHMENT

Model E Steam Generator Information Request

Roger L. Boyer

and

Charles R. Albury

July 24, 1985

(SGQUEST2/DSG)

REQUIRED BY DECEMBER 1985

7. Provide the following information as a function of load for the Model E steam generator at normal operating water level. The following loads are of primary importance: 0, 5, 10, 25, 50, 75, and 100%. This information is available through Westinghouse technical literature.

- A. Shell-side fluid mass (lbm)  
This information should be submitted in the format represented by FIGURE 7.A and Table 7.A (attached).
- B. Circulation ratio  
Circulation Ratio is defined here as the mass flowrate of fluid entering the swirl vane steam separators to the mass of steam exiting the steam generator. This information should be submitted in the format represented by FIGURE 7.B and Table 7.B (attached).
- C. Feedwater leakage fraction  
This information should be submitted in the format represented by FIGURE 7.C and Table 7.C (attached).
- D. Outlet temperature (°F)  
Provide the outlet temperature at the following locations: Preheater, Mixing Region, and Tube Bundle. This information should be submitted in the format represented by FIGURE 7.D and Table 7.D (attached).
- E. Exit Quality  
Provide exit quality at the following locations: Preheater, Cold Leg, Hot Leg, U-Bend, Swirl Vane Separators, and the Steam Dryers. Identify whether static (i.e. thermodynamic) or flowing quality is given. This information should be submitted in the format represented by FIGURE 7.E and Table 7.E.
- F. Actual water level (%)  
Provide the actual water level in percent on the narrow range level span. Actual water level corresponds to a mixture level that includes bubble volume.



QUESTION 7:

Provide as a function of power the following items: secondary mass, circulation ratio, preheater leakage fraction, outlet temperature and qualities at various locations in the bundle.

RESPONSE:

Table 3 presents the information requested on page 16 and 27 of the questions. The following figures are also included which plot the indicated parameter vs percent thermal power:

- Figure 1 Secondary Mass
- Figure 2 Circulation Ratio
- Figure 3 Preheater Leakage Fraction
- Figure 4 Outlet Temperatures
- Figure 5 Outlet Qualities

Note that preheater and cold leg boiling region outlet qualities are essentially zero for the full power range and have not been plotted. The location of the outlet quantities are defined as follows:

Hot Leg Boiling:	Hot Leg at Top of Partition Plate
Cold Leg Boiling:	Cold Leg at Top of Partition Plate
U-Bend:	Top of Bundle

The unusual shape of the preheater outlet temperature is explained as follows. The minimum occurs at 40 percent power where the leakage flow out of the preheater is zero. At lower powers the inflow of saturated water from below the preheater increases rapidly increasing the preheater outlet temperature. At higher powers the increasing preheater heat load and feedwater temperature dominate and also cause the preheater exit temperature to increase

TABLE 3 FULL AND PART LOAD OPERATING CONDITIONS

R Thermal Power	Secondary Mass lbm x 10 <sup>-3</sup>	Circ. Ratio	Leakage Fraction (FRAC)	Outlet Temperature -F°			Exit Preheater	Quality Cold Leg Boiling	-R Hot Leg Boiling	U-Bend	Steam Pressure PSIA	Feed/Steam Flow lbm/hr x 10 <sup>-6</sup>	Secondary Side ΔP psi	Primary Temperature °F		Feed Temp °F
				Preheater	Mixing Region	Bundle								Hot Leg	Cold Leg	
0	209			567	567	567					1198			567.0	567.0	
20	184	13.1	-0.429	561	567	567	0	0.003	0.033	0.078	1197	0.72	2.3	579.9	565.5	307
30	173	9.3	-0.179	558	567	567	0	0.000	0.040	0.112	1198	1.11	4.0	586.2	564.8	333
40	167	7.2	-0.010	536	566	566	0	0.000	0.067	0.144	1167	1.52	5.9	592.4	564.1	352
50	159	5.8	0.132	554	565	565	0	0.000	0.085	0.182	1179	1.94	8.1	598.4	563.4	369
60	153	4.8	0.196	551	563	563	0	0.001	0.107	0.223	1162	2.37	11.1	604.2	562.6	385
70	150	4.2	0.235	549	546	562	0	0.002	0.108	0.240	1148	2.81	14.6	610.0	561.9	399
80	145	3.6	0.258	547	542	561	0	0.000	0.127	0.279	1139	3.27	18.8	615.5	561.2	413
90	141	3.1	0.272	545	538	559	0	0.001	0.153	0.321	1120	3.75	23.9	620.9	560.4	427
100	136	2.7	0.283	543	535	556	0	0.003	0.182	0.367	1101	4.24	29.8	626.1	559.7	440

$T_{NB} = 592.9^{\circ}\text{F}$

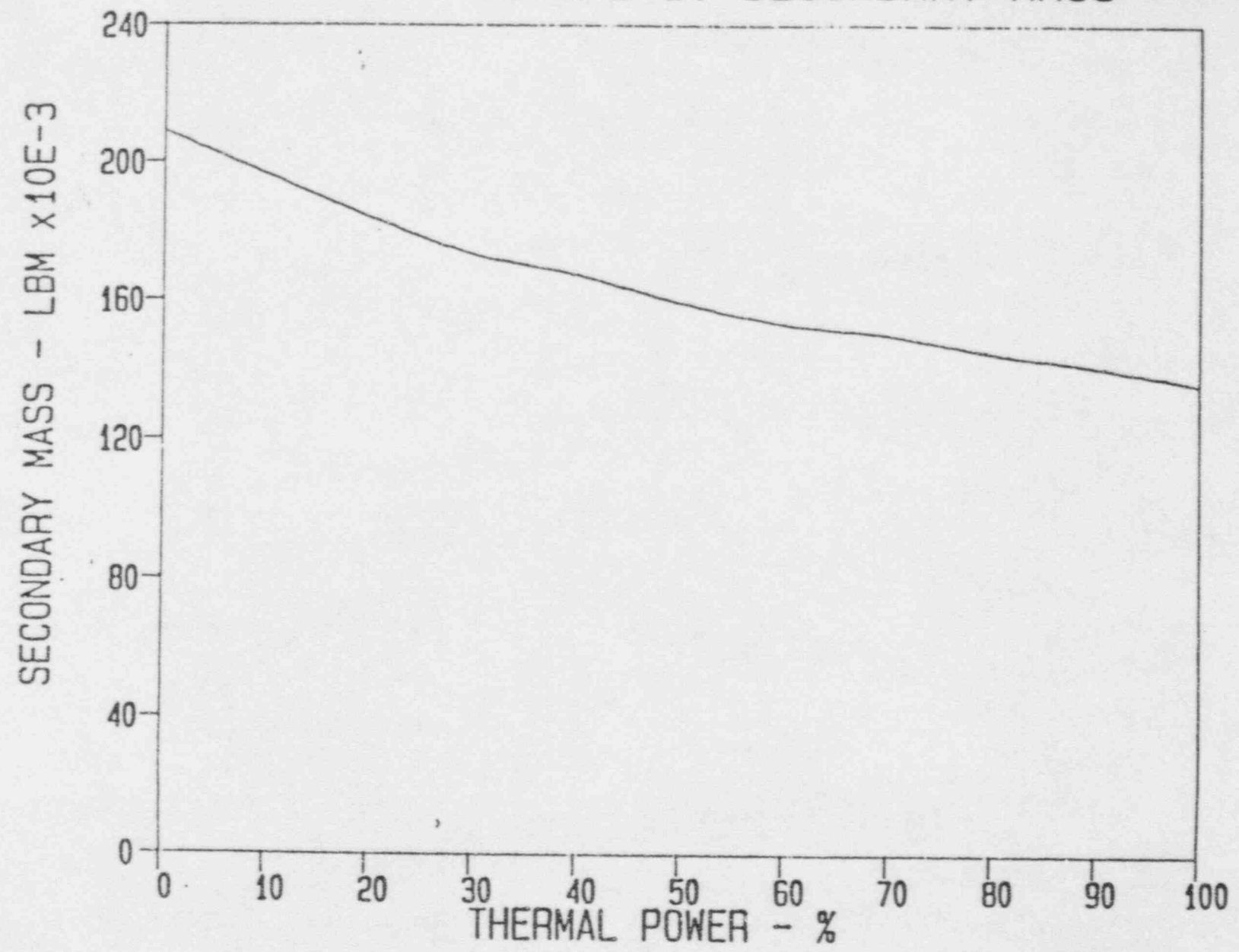
Insert this value  
for the inlet and  
outlet water temperature

$$(\text{Circulation Ratio}) = (\text{Recirc. Ratio}) + 1$$

$$\text{Circ. Ratio} = \frac{\dot{m}_R + \dot{m}_{FW}}{\dot{m}_S}$$

where  $\dot{m}_{FW} = \dot{m}_S$

FIGURE 1. SECONDARY MASS



B2