RC1	Revise EN-IS-123 to reduce the limit for electrical superintendent approval for work on energized equipment from 240 volts to 50 volts. (CA-29)	Maint	04/28/12
CC4/ Extent /OP2B / OP5AD / OP5AE / OP5T	Using the SAT process, initiate a TEAR and perform a needs analysis on the need for initial and continuing training in the use of EN-WM-104 for qualitative and quantitative risk assessment and their relationship to the work planning process described by EN-WM-104 and the use of prejob briefs described in EN-HU-102 and EN-HU-105. Identify the correct population and establish schedule for training. If training is not recommended, develop a schedule of recommended actions and return to CARB for approval. (CA-30)	Training	01/26/12
CC4/ Extent / OP5A / OP5AE	Based on results of Training needs analysis for EN-WM-104 training, determine scope and schedule for effectiveness review. (CA-31)	Maint	02/15/12
CC2/CC4/ Extent / OP2B /OP5AE	Provide information sharing to Maintenance supervisors and superintendents on the use of use of EN-WM-104 for qualitative and quantitative risk assessment and its relationship to EN-WM-105. (CA-32)	Maint	11/17/11
CC1/ CC2/ CC4 /OP4A / OP5A / OP5D	Revise EPS-E-10 to include all outage and on-line maintenance on these 125 volt DC panels and breakers. Include critical steps and consideration of IPTE. Clarify Plant impact to make clear the potential for train failure and Plant trip and remove Notes which provide instructions in lieu of actual procedure steps. Instructions should account for the fact that the physical layout and construction of the increases the chance of error during maintenance. (CA-33)	Maint	02/28/12
CC2/ Extent/ OP4A /OP5A / OP5D	Revise or cancel other Maintenance EPS (Emergency Power System) procedures that have not been revised since the 2007 Entergy transition, which now contain outdated references and which do not conform to Entergy standards of completeness. (CA-34)	Maint	03/31/12

CC2/ Extent/ OP4A / OP5D	Quarantine any Maintenance EPS procedures that have not been revised recently and are considered out of date. (CA-35)	Maint	11/17/11
CC2/ CC4/ Extent / OP5D	Develop a plan to prioritize and eliminate outdated references, workarounds, tribal knowledge and human performance traps in all Maintenance procedures and which includes plans to improve Maintenance worker ownership of procedure quality.(CA-36)	Maint	11/28/11
CC2/ CC4/ Extent / OP5D	Complete the plan to eliminate outdated references, workarounds, tribal knowledge and human performance traps in all Maintenance procedures and which includes plans to improve Maintenance worker ownership of procedure quality. (CA-37)	Maint	12/31/12
CC4/ Extent	Reconsider the existence of an emerging trend in NRC violations with a cross cutting aspect in procedure compliance (H4b) based on situations that have been identified since the evaluation of CR-PLP-2011-2397. Issue a follow up condition report if required to evaluate a new recognized trend. (CA-38)	Licensing	01/31/12
RC1/CC3/ LOW	Verify that completed actions to address weaknesses in management oversight of work activities assigned from the evaluation of CR-PLP-2011-4522 (CA-11 through CA-13) that include the development, instruction and use of WILL sheets and the review for formal training, have addressed concerns identified for this evaluation. Develop follow up corrective actions and return to CARB for approval if CR-PLP-2011-4522 results are not satisfactory. (CA-39)	Maint	02/28/12

RC1 / OP2B	Submit a training evaluation action request (TEAR) to improve PLP staff knowledge of the meaning of a Condition Adverse to Quality (CAQ). Specifically, provide direction to PLP staff on the definitions of "Nuclear Safety", "Industrial Safety", "Equipment Reliability" and "Procedure Adherence". If the training needs analysis results in a finding of no training is necessary, then arrange to have this accepted or overridden by the corrective action review board (CARB). This corrective action is to remain open until the completion of the training needs analysis. (Refer to Recovery Plan WT-PLP-2011-366 CA199, and CA238) (CA 65)	CA&A	12/29/11
RC1 / OP2B	Develop and implement WILL sheets on the 8 attributes of a strong safety culture. (Close Recovery Plan WT-PLP-2011-366 CA401) (CA-50)	ISHP	12/18/11
RC1	Coordinate a third party safety culture assessment, (Close Recovery Plan WT-PLP-2011-366 CA397) (CA-51)	NSA	2/28/12
RC1	Create and implement a WILL sheet specific to observing trip risk activities (Close Recovery Plan WT-PLP-2011-366 CA75) (CA-52)	Maint	12/8/11
RC1	Revise on-line scope add form to include statement that appropriate risk and risk mitigators have been added to appropriate schedule. (Close Recovery Plan WT-PLP-2011-366 CA408) (CA-53)	PS&O	12/23/11
RC1	Perform a causal analysis, which should include a review of previous 12 months RCEs, significant ACEs, NRC findings, Cross-cut issues, AFIs, etc. Apply special focus on O&Ps. Use of 95-001/002/003 inspection manuals (Close Recovery Plan WT-PLP-2011-366 CA90) (CA-54)	CA&A	12/23/11
RC1	CRG and DPICS to ensure that the keyword "Stop When Unsure" is applied all CR's written regarding failure to complete a task based the work being stopped because either: a. the workers are unsure, b. the task is not correct as written, c. the task cannot be completed as written, d. the replacement components are different, d. the scope of the work changes, e. the workers are directed to stop by Supervision/Management/Engineering. CRG and DPICS to ensure appropriate follow-up actions are assigned. (CA-55)	GMPO	1/8/2012

RC1	At the T-5 Critical Evolutions Meeting (CEM) and the T-2 meeting, Members validate the rigor and correctness of the Risk Analysis associated with evolutions identified by EN-FAP-WM-002. For work packages that do not have adequate Risk Analysis as determined by the members, a CR will be generated with the keyword "Risk Management" applied and appropriate actions created. (CA-56)	GMPO	1/8/2012
RC1, CC3, CC4	Create an annual CBT to re-affirm employee understanding of and commitment to Entergy Accountability, Behavioral and Procedure Use standards. Create an accompanying Job Familiarization Guide for use with new employees. Ensure created materials reference this CR and require CARB approval for removal from site curriculum. (CA-57)	Training	3/9/12
Extent	Submit the LER for the identified conditions within the 60-day time period. (CA-02)	Licensing	11/22/11
Enhance ment	Request EN-IS-123 clarification of the EN-OP-102 requirement for a Shift manager face-to-face meeting with workers when work on energized equipment without tagging is involved. (CA-40)	Maint	11/30/11
Enhance ment	Request EN-WM-104 clarification for disposition of completed risk assessments as records or incorporation into work order packages. (CA-41)	Maint	11/30/11
Other	Perform Learning Opportunity Review per EN-QV-112, "Learning Opportunity Review Process" (CA-42)	QA	12/15/11
Other	Locate the actual root cause evaluation record for CPAL-97-1493 and initiate additional corrective actions to address issues not addressed by this corrective action plan. (CA-43)	Maint	11/30/11
Other	Arrange with CA&A to have referenced actions from CR-PLP-2011-4835 and CR-PLP-2011-4522 appropriately linked in PCRS to this corrective action plan. (CA-44)	Maint	11/30/11

CC2/ CC3/ CC4/ LOW	Verify completion of CERT Team Report 18 recommended actions as identified in LO-WTPLP-2011-0366 which address procedure use, procedure quality and management oversight (CA-45)	NSA	03/15/12
EFR	Obtain an LO document number and assign effectiveness review actions to verify that actions to preclude recurrence have been successful (CA-46)	Maint	11/30/11
OE	Prepare and issue internal Entergy fleet OE summary (CA-13)	OE	10/26/11
OE	Prepare and issue external OE summary (CA-16)	Maint	10/26/11

Effectiveness Review Plan

LO-PLPLO-2011-00061

CAPR1/ RC1 Reinforce and institutionalize Entergy Standards for Procedure Compliance, Accountability, and Unacceptable Behaviors via face to face communications from the COO through Individual Contributor Levels.

CAPR2/RC1 Implement, and ensure compliance with, Entergy Risk Management procedures EN-WM-104 and EN-FAP-WM-002.

	Action	Resp. Dept	Due Date
Method:	Focused self assessment by non-Palisades (PLP) personnel of Palisades procedure adherence with respect to promoting a sensitive risk culture	**GMPO**	6/20/2012 for first assessment
Attributes:	Risk Management Work Practices Management Oversight Management Intrusiveness		
Success:	Non PLP personnel self assessment confirms that Palisades has properly institutionalized the applicable work oversight and methodology combined with institutionalized knowledge of work practice expectations		
Timeliness:	Approximately every 6 months for 2 years.		

References

Documents reviewed

Documents used in this evaluation which are not identified directly in the body of the report as they are used are identified as footnotes at the end of each report section.

Team Members

Chuck Sherman - Sponsor/ RP
Brad O'Donnell - Electrical Maintenance
Mark Floyd - Training
Brian Meredith - System Engineering
Maggie Koyo - System Engineering
Ted Berry - Training
Paul Johnson - HU/ IS
George Stieber - Operations
Richard Swanson - Contractor
Al Baerren - Maintenance

Attachments

Attachment 1 - Event Time Line from **EA-PSA-SDP-D11-2-11-07**

Attachment 2 - Failure Modes Analysis

Attachment 3 - Failure Modes Chart

Attachment 4 - Barrier Analysis

Attachment 5 - Change Analysis

Attachment 6 - Safety Culture Evaluation

Attachment 7 - O&P Evaluation Checklist

Attachment 8 - Maintenance Crew Statements

Attachment 9 - Why Staircase

Attachment 1: Event Timeline Chart and Narrative

This attachment contains the following:

- Event timeline in chart format (Table A01-1)
- Event timeline in narrative format

Table A01-1: Event Timeline Chart

Friday 9/23 1607	Saturday 9/24 2218	Sunday 9/25 1109	Sunday 9/25 1500	Sunday 9/25 1506	Sunday 9/25 1506	Sunday 9/25 1506	Sunday 9/25 1506	Sunday 9/25 1506
Electrical maintenance restoring breaker 72-123 (Emergency Airlock ED-123)	Battery chargers #1 ED-15 and #2 ED-16 initially in-service	Temp mod 31973 Installed. (Temp power for breaker 72-121 (generator exciter field breaker control) from 72-127 (test cabinets))	Electrical maintenance removed 4 dc panel ED-11-2 breakers (72-119,72-120,72-121,72-123)	While removing bus bar, short occurred in dc panel ED-11-2	MSIS (2/4 logic low SG pressure) due to loss of preferred ac buses EY-10 and EY-30	Right channel SIAS (2/4 logic low PZR pressure) due to loss of preferred ac buses EY-10 and EY-30	AFAS (2/4 logic low S/G level) due to loss of preferred ac buses EY-10 and EY-30	Right channel CIS/CHR (2/4 logic, RIAX-1805/RIAX-1807) due to loss of preferred ac buses EY-10 and EY-30. Left channel containment isolation valves closed due to loss of power
Control room alarm: EK-0316 GEN FIELD FORCING/OVER EXCITATION cycling on/off		FWP air compressor C-903B cross-tied supplying plant air system		Shunt trip breaker 72-01 opened de-energizing dc buses ED-10R and ED-10L	MSIVs CV-0510 and CV-0501 and E-50B MFRV CV-0703 closed on MSIS, and E-50A MFRV CV-0701 closed due to loss of power to EY-10 and EY-30	IE bus EA-13 de-energized, no power to C-903B FWP air compressor (was cross-tied supplying plant air). Closed MV-CA320 to isolate FWP from instrument air. C-2A instrument air compressor was in "sleep" mode and started	Turbine driven AFW pump P-8B starts (CV-0522B failed open due to loss of ED-11-1). AFW flow control valves CV-0727 and CV-0749 fail full-open. Flow imbalance develops between SGs due to differential in dome pressures (no flow indication available)	PCP controlled bleedoff valves CV-2083 and CV-2099 close due to CHR/loss of power, directing flow to primary system drain tank T-74 in containment (5 gpm)
Multiple containment isolation valves position indication lost				Dc panels ED-11-1 and ED-11-2, and preferred ac buses EY-10 and EY-30 de-energized	All ADVs CV-0779, CV-0780, CV-0781, and CV-0782 fail closed/inoperable (quick open and normal operation) due to loss of preferred ac panel EY-10 (LCO 3.7.4)	In service PZR level control channel A fails, charging pumps P-55A and P-55B in service (93 gpm), and letdown orifices CV-2003, CV-2004,CV- 2005 close (0 letdown),PZR heaters de-energize	AFW pump P-8C starts (AFAS) supplying 165 gpm to each SG. Loss of EY-10 causes low suction pressure trip signal which prevents P-8A operation.)	PCS unidentified leakage > 1 gpm for PCP controlled bleedoff isolation (LCO 3.4.13.A.1, B.1, B.2)
Entered ONP-7.1 (72-119 failure caused loss of service air and CV-1221 FWP building cross-tie to fail open)				Preferred ac panel EY-10 inoperable LCO 3.8.9.B (LCO 3.0.3) Preferred ac panel EY-30 inoperable LCO 3.8.9.B (LCO 3.0.3)	MSSVs lift on both SGs	In service PZR pressure control channel A fails, spray valves CV-1057 and CV-1059 fail closed, no spray available	Inverter #1 ED-06 input breaker to EY-10, 72-37 tripped (LCO 3.8.7.A)	Right channel CHP alarm (2/4 logic,PSX-1801/PSX-1803) due to loss of EY-10 and EY-30 panels, no actuation (actuation logic requirements not met)
				Reactor trip (2/4 logic RPS) due to loss of preferred ac buses EY-10 and EY-30	Turbine trip (from reactor trip), generator breakers do not open due to loss of dc panel D-11-1	Operators enter EOP-1.0 Standard Post-Trip Actions	Battery charger #1 ED-15, output breaker closed but charger not operating	Dc bus ED-10R inoperable (LCO 3.8.9.6) Dc bus ED-10L inoperable (LCO 3.8.9.6)

Table A01-1: Event Timeline Chart

Sunday 9/25 1515	Sunday 9/25 1517	Sunday 9/25 1527	Sunday 9/25 1531	Sunday 9/25 1537	Sunday 9/25 1542	Sunday 9/25 1544	Sunday 9/25 1549	Sunday 9/25 1555
MSSVs open and then operate (throttle/close/open) to maintain SG pressure PCS Tave 544°F	Operator jumpered relay 487u (Y-phase) to open generator output breakers 25F7 and 25H9	Enter EOP-9.0 Functional Recovery Procedure (due to <3 out of 4 preferred ac buses available)	Operator observed high E-50A level (90%). Order given to isolate CV-0522B (steam to AFW pump P-8B) per EOP Supplement 19 (LCO 3.7.5)	Per EOP-9.0, enter ONP-24.1 and ONP-24.3 due to loss of preferred ac buses EY-10 and EY-30	Isolated RV-2006 letdown relief by placing letdown orifice stop valves CV-2003, CV-2004, and CV-2005 to close	NCO closed P-8C AFW flow control valve CV-0737A to isolate flow to E-50A, continue supplying 165 gpm to E-50B via CV-0736A	Restored 1E bus EA-13 (lost on SIAS at 1506) and reenergized associated PZR heaters	Observed PZR level >62.8% (LCO 3.4.9.A). Actual PZR level 78%
	1A bus EA-21 de-energized. Primary coolant pumps P-50A and P-50C stop, P-50B and P-50D remain in service	PZR level 62%	~1530 Entered ONP-2.3 Loss of DC Power (time not verified)	PZR pressure peaks high 2200 psig. PZR level 71%	Charging 73 gpm, 0 gpm letdown, 5 gpm PCP controlled bleedoff to primary system drain tank T-74			
				Realigned PZR pressure control to B channel to enable spray, pressure begins lowering				
				Realigned PZR level control and heater control select switch to B channel. Letdown orifices open and RV-2006 (letdown heat exchanger inlet safety relief) lifts due to CV-2009 (letdown containment isolation) being closed on CHR/loss of power. 1D bus EA-12 PZR backup heaters reenergize				
				Charging pumps P-55A and P-55B in service (73 gpm charging,108 gpm letdown relieving to quench tank) 5 gpm PCP controlled bleedoff to PSDT				

Table A01-1: Event Timeline Chart

Sunday 9/25 1557	Sunday 9/25 1602	Sunday 9/25 1603	Sunday 9/25 1609	Sunday 9/25 1615	Sunday 9/25 1621	Sunday 9/25 1630	Sunday 9/25 1639	Sunday 9/25 1646
Electricians report no faults on dc buses ED-10L and ED-10R. Reenergized ED-10L and ED-10R by closing breaker 72-01 (ED-10L and ED-10R now operable)	Charging pump P-55B suction relief RV-2096 lifting to the equipment drain tank T-80. The tank overfilled causing floor drains to backup on the 590' Auxiliary Bldg (order sent to isolate P-55B)	Steam to P-8B turbine isolated by closing CV-0522B. 0 AFW flow to E-50A. Still supplying 165 gpm to E-50B via P-8C and flow control valve CV-0736A	CV-0736A closed to isolate flow from AFW pump P-8C to E-50B, no AFW flow to either SG at this time	SG E-50A MSSVs lift, E-50B MSSVs throttle open. MSSVs then operate (throttle/close/open) to maintain SG pressure Tave 544°F	Entered ONP-7.1 "Loss of Instrument Air (due to loss of all instrument air compressors at 1557)	Charging pump P-55B suction and discharge valves closed to isolate suction relief RV-2096 leak	Restored AFW to E-50B from P-8C 150 gpm	Preferred ac bus EY-30 realigned from bypass regulator to #3 inverter ED-08 supply
Generator field breaker 341 opened when ED-11-2 reenergized	Restored power to 1E bus EA-13 and reenergized associated pressurizer heaters	PCS Tave 529°F. PZR level 85%		PZR level peaks high 101.5%				Preferred ac bus EY-10 placed on bypass regulator. EY-10 operable
Preferred ac bus EY-30 powered via bypass regulator (EY-30 now operable)								ADVs CV-0779, CV-0780, CV-0781, and CV-0782 operable due to EY-10 restored (HIC-0780A now powered), started controlling heat removal using ADVs. MSSVs close Tave 540°F
Left channel safety injection actuated when EY-30 reenergized, resulting in loss of 1E bus EA-13								
Throttled safety injection. Stopped charging pumps P-55A and P-55B. Charging flow 0, letdown flow 0, 5 gpm PCP controlled bleedoff to PSDT. PZR level 80%								
When dc restored, instrument air compressor C-2A tripped (reason unknown)								
Control room manually started instrument air compressors C-2B and C-2C								

Table A01-1: Event Timeline Chart								
Sunday 9/25 1720	**Sunday 9/25 1746**	**Sunday 9/25 1818**	**Sunday 9/25 1852**	**Sunday 9/25 1909**	**Sunday 9/25 1911**	**Sunday 9/25 1923**	**Sunday 9/25 1933**	**Sunday 9/25 2100**
Entered ONP-4.1, Containment Spurious Isolation, reset CHR	Exited EOP-9 and entered GOP-8, Power Reduction and Plant Shutdown to Mode 2 or Mode 3 $\geq$ 525°F(All 4 preferred ac buses in service)	Reset SIAS	Restored P-8B steam supply CV-0522B to AUTO (LCO 3.7.5)	Exited ONP-24.1, Loss of Y-10	Exited ONP-24.3, Loss of Y-30	ED-01, main station battery left channel, inoperable per 3.8.4.B (no connected battery charger and surveillance requirement 3.8.4.1 not met)	#3 battery charger ED-17 in service supplying ED-01 (battery chargers #2 and #3 now in service)	P-910 (main condenser vacuum pump) in-service
						#1 battery charger ED-15 inoperable per LCO 3.8.4.A.2		

Table A01-1: Event Timeline Chart					
Sunday 9/25 2330	**Sunday 9/25 2348**	**Monday 9/26 0156**	**Monday 9/26 0311**	**Monday 9/26 0441**	**Tuesday 9/27 1733**
Test started instrument air compressor C-2A satisfactorily, and then placed in AUTO (C-2B still in-service, C-2C in SLEEP mode)	PZR level <62.8% (LCO 3.4.9)	Restored P-55B charging pump to service (available)	Placed #4 battery charger ED-18 in-service and removed #2 battery charger ED-16 from service, #3 battery charger ED-17 and #4 battery charger ED-18 now in service	Main station battery ED-01 left channel operable	#1 inverter ED-06 operable, supplying preferred ac bus EY-10 (LCO 3.8.7)

Event Timeline Narrative

I. Initial Conditions (prior to event)

- 100% reactor power
- normal single charging and letdown lineup
  - Charging pump P-55A in service
  - Letdown orifice stop valve CV-2003 open
  - Primary coolant pump CBO returning to volume control tank T-54
- pressurizer T-72 pressure and level control channel A in service
- auxiliary feedwater system in normal standby lineup
- #1 battery charger ED-15 and #2 battery charger ED-16 in service
- feedwater purity air system cross-tied with and supplying the plant compressed air system

II. Electrical Equipment Conditions Concurrent with the Reactor Trip at 1506

- dc buses ED-10L and ED-10R de-energized
  - shunt trip breaker 72-01 opened
  - #1 battery charger de-energized
- dc distribution panels ED-11-1 and ED-11-2 de-energized
- #1 battery charger ED-15 failed, not supplying associated buses ED-10L and ED-10R
- #1 inverter ED-06 and #3 inverter ED-08 de-energized (ED-06 internal breaker also tripped)
- preferred ac buses EY-10 and EY-30 de-energized
- 2400v 1E bus EA-13 de-energized

III. Conditions Resulting from Loss of Power to Preferred AC Buses EY-10 and EY-30

Reactor Trip / Turbine Trip: main generator breakers 25F7 and 25H9 did not open due to loss of ED-11-2.

Main Steam Isolation Signal: both main steam isolation valves CV-0501 and CV-0510 closed and both main feedwater regulating valves CV-0701 and CV-0703 closed. CV-0701 closed as result

of loss of EY-10 and EY-30; CV-0703 closed due to MSIS.

Auxiliary Feedwater Actuation Signal: P-8A did not receive a start signal due to loss of D-11-1, but also did not run due to low suction pressure trip logic actuation on loss of EY-10. P-8C started and supplied 165 gpm to each steam generator (E-50A and E-50B). Steam driven AFW pump P-8B started due to loss of panel ED-11-2 and AFW flow control valves CV-0749 (E-50A) and CV-0727 (E-50B) failed full open. P-8B flow indication was not available. Flow distribution was dependent on SG pressures. E-50A is the steam source for P-8B, resulting in initially lower pressure, while E-50B had no steam removal path other than MSSVs.

Safety Injection Actuation Signal: Right channel SIAS only - resulted in de-energizing (load shedding) 2400V 1E bus EA-13, isolating non-critical service water header isolation valve CV-1359 and starting associated equipment including charging pump P-55B.

Containment High Radiation: Right channel CHR only – resulted in containment isolation valves closing, including letdown isolation valve CV-2009 and PCP controlled bleedoff valve C-2099. Left channel containment isolation valves also closed due to the loss of dc to their control circuits.

Containment High Pressure: Logic inputs were not sufficient for system actuation, i.e. no initiation signal was generated, alarm only.

Pressurizer Pressure Control: In service pressurizer pressure controller PIC-0101(channel A) de-energized – resulted in pressurizer spray valves CV-1057 and CV-1059 failing closed, and all available heaters energizing.

Pressurizer Level Control: In service pressurizer level controller LIC-0101(channel A) de-energized – resulted in letdown orifices closing, charging pump P-55A running at maximum speed (53 gpm) and all pressurizer heaters de-energizing. P-55C did not start due to loss of breaker control power (ED-11-1).

2400V 1E Bus EA-13: de-energized – resulted in unavailability of associated PZR heaters and FWP air compressors. Plant air compressor C-2A automatically started to restore pressure.

Atmospheric Steam Dump Valves: all ASDVs CV-0779, CV-0780, CV-0781 and CV-0782 failed closed (both normal and 'quick open') due to loss of power to controller HIC-0780A (EY-10).

Generator Output Breakers: breakers 25F7 and 25H9 failed closed and all switchyard breaker indication lost due to loss of ED-11-1. 1A bus EA-21 and 1F bus EA-23 did not transfer to startup power on turbine trip due to loss of ED-11-2. 1A bus EA-21 remained powered from #1-1 station power transformer EX-01 until operators opened the generator breakers using a jumper on relay 487u (Y phase) in control room panel EC-04. 1F bus EA-23 remained powered from #1-3 station power transformer until the generator breakers opened.

IV. Plant / Equipment Conditions and Operator Actions Following Event Initiation

Notes:

- Due to the high activity level and unavailability of some plant computer data during this event, times recorded in the Operator Log are generally correct, but may not exactly match information from other sources.
- Effects of conditions/actions described below are depicted in Appendix 1 – PCS and SG Post-Trip Behavior.

1506: Conditions noted in III above.

Main steam safety valves (MSSVs) on both steam generator headers opened and operated (throttled/closed/opened) to maintain SG pressures and lower PCS temperature and pressure. (MSSVs opened due to ASDVs failing closed and MSIVs closing on MSIS.)

Operators entered EOP-1.0 Standard Post-Trip Actions.

1515: Due to there being no steaming path available, PCS temperature rose to 544°F resulting in MSSVs opening further and PCS temperature, pressure and level lowering. PCS temperature continued lowering primarily due to relatively cold (87°F) AFW being supplied to the steam generators (690 gpm total).

AFW pump P-8B flow control valves CV-0727 and CV-0749 failed full open. The flow delivered to each SG was dependent on piping losses and SG pressure differences. SG pressures were initially both ~930 psig. However, E-50A's pressure lowered more than E-50B's (possibly due to varying MSSV characteristics), resulting in significantly more cool AFW flow to E-50A, which further lowered its pressure. By 1530 total AFW flows (P-8B +P-8C) to the SGs were 502 gpm to E-50A and 195 gpm to E-50B. This flow imbalance contributed to over-filling E-50A.

1517: Power Control verified main generator breakers 25F7 and 25H9 were closed (failed to open on turbine trip). Operators installed a jumper on relay 487u (Y phase) in control room panel EC-04 to open the breakers per EOP-1.0. Opening the generator breakers de-energized 4160v 1A bus EA-21, stopping primary coolant pumps P-50A and P-50C. PCPs P-50B and P-50D remained in service, maintaining forced circulation with one operating pump in each PCS/SG loop.

1527: Operators entered EOP-9.0 Functional Recovery Procedure due to less than 3 preferred AC buses being available. (Pressurizer level 62%)

1531: Operator observed high SG E-50A water level (90%) and an NPO was directed to isolate steam to P-8B per EOP Supplement 19 Alternate Auxiliary Feedwater Methods, i.e. manually closing steam supply valve CV-0522B. Both SG levels had been observed approximately equal (35% – 40%) during EOP-1.0 verbal verifications (1515). Operators entered ONP-2.3 Loss of DC Power.

1537: Operators first addressed safety function MVAE-DC-1 due to it being jeopardized (acceptance criteria not being met). Per MVAE-DC-1 operators entered ONP 24.1 Loss of Preferred AC Bus Y-10 and ONP-24.3 Loss of Preferred AC Bus Y-30 to recover the buses.

Operator observed high PCS pressure (2200 psia) due to loss of power to pressurizer pressure controller channel A which failed spray valves CV-1057 and CV-1059 closed. Operator placed pressurizer pressure control channel B in service, lowered pressure in manual mode and then placed the controller in auto mode. PZR spray valves then remained available for pressure control.

Operator also noted loss of power to pressurizer level controller channel A and placed channel B and pressurizer heater select channel B in service. This resulted in letdown orifice stop valves CV-2003, CV-2004 and CV-2005 opening and charging pump P-55A speed lowering from 53 gpm to 33 gpm, and restored bus 1D pressurizer heater availability. Opening the letdown orifice valves resulted in letdown relief valve RV-2006 opening, due to CV-2009 having closed on CHR. RV-2006 directed letdown flow (108 gpm, 560 gal total) to quench tank T-73 in containment, and resulted in relief valve 2006 discharge high temperature annunciator EK-0702 alarming. (Pressurizer level 71%)

1542: Operator closed letdown orifice stop valves CV-2003, CV-2004 and CV-2005 to isolate letdown flow per ARP-4 Annunciator Response Procedure Primary System Volume Level Pressure Scheme EK-07 (C-12).

At this time charging flow was 73 gpm with 0 letdown and 5 gpm PCP bleedoff flow, resulting in 68 gpm PCS net inventory addition. When the density change from charging temperature to PCS temperature is considered this gives a 90 gpm effective charging rate or 1.36%/minute pressurizer level rise rate (90 gpm / 66.16 g/% = 1.36%/m). (Pressurizer volume gal / % indicated level = 66.16 g/% per surveillance procedure DWO-1 Operator's Daily/Weekly Items Modes 1, 2, 3, and 4 Rev 80.)

1544: Operator closed CV-0737A, isolating P-8C AFW flow to steam generator E-50A. P-8C flow to E-50B continued at 165 gpm, and P-8B flow continued at 380 gpm to E-50A and 0 gpm to E-50B.

1549: Operators restored power to 2400v 1E bus EA-13 per SOP-30 Station Power and reenergized associated pressurizer heaters.

1555: Operator logged pressurizer level high (>62.8%) (actual level 78%). Due to PCS temperature continuing to lower, the observed level rate of rise was less than would be observed if temperature was stable. Changing PCS temperature one degree has the effect of changing PCS water volume 74.43 gallons (per DWO-1). (Note: Per PZR pressure/level recorder LPIR-0101B, pressurizer level exceeded 62.8% at 1528.)

1557: Operator aligned preferred ac bus EY-30 to be supplied from instrument ac bus EY-01 via the bypass regulator. Energizing EY-30 resulted in Left channel safety injection actuation which de-energized (load shed) 2400V 1E bus EA-13 and started associated equipment. P-55C did not start due to panel ED-11-1 being de-energized.

Operators verified SI throttling criteria met and stopped both operating charging pumps P-55A and P-55B to stop PCS inventory addition. Charging and letdown flows = 0, 5 gpm PCP bleedoff to primary system drain tank T-74 continues. (Pressurizer level 80%)

Electricians reported buses ED-10L and ED-10R fault free. Operator closed shunt trip breaker 72-01 reenergizing Left channel dc buses ED-10L, ED-10R, ED-11-1, ED-11-2 from battery ED-01. Generator field breaker 341 automatically opened when ED-11-2 was reenergized. Instrument air compressor C-2A tripped for an unknown reason when dc power was restored. Operator manually started compressors C-2B and C-2B. The brief loss of air compressor had no noticeable effect.

1602: NPO reported charging pump P-55B suction relief valve RV-2096 lifting and not reseating, equipment drain tank T-80 full and floor drains backing up on the auxiliary building 590 elevation. Control room directed closing pump suction and discharge valves to isolate P-55B and its suction relief. Water discharged from the relief was from concentrated boric acid tanks T-53A and T-53B.

Operators restored power to 1E bus EA-13 and reenergized associated pressurizer heaters.

1603: Auxiliary operator reported steam supply valve to P-8B turbine CV-0522B manually closed per EOP Supplement 19. AFW flow to and steam flow from E-50A = 0. AFW flow to E-50B continued at 165 gpm and steam flow from E-50B was controlled by associated MSSVs. PCS heat removal rate was reduced and PCS temperature stopped lowering and started rising. The

PCS heatup rate was 1°F/m, resulting in PZR level rising 1.125%/m. (Tave 529°F, PZR level 85%)

1609: Operator closed CV-0736A, isolating AFW flow to E-50B, slightly raising the PCS heatup rate. There was no AFW to either SG at this time and steam was only being removed from E-50B via MSSVs throttling.

1615: MSSVs on both steam generator headers opened due to PCS temperature rising to 544°F. PZR level peaked at 101.5% and then lowered as PCS temperature lowered. (Note: There was no PCS inventory addition since 1557. The PZR level rise was entirely due to PCS heatup from 529°F to 544°F.) After opening, the MSSVs remained partially open, effectively controlling PCS Tave 540°F until the ASDVs were placed in service.

1621: Operators entered ONP-7.1 Loss of Instrument Air and placed C-2B and C-2C in service. Compressor C-2A tripped during electrical bus restoration as previously noted.

1630: Charging pump P-55B suction and discharge valves reported closed, isolating suction relief valve leakage.

1639: Operator restored 150 gpm AFW flow to E-50B using P-8C.

1646: After confirming no faults on preferred ac bus EY-10, #3 inverter ED-08 was aligned to supply EY-30 and EY-10 was powered from instrument ac bus EY-01 via the bypass regulator. All preferred ac buses were now available.

All 4 ADVs were available when EY-10 was restored, and operators began using them for PCS temperature control. MSSVs fully closed. (Tave 539°F)

1720: Operators entered ONP-4.1 Containment Spurious Isolation and operator reset CHR.

1746: Operators exited EOP-9.0 and entered GOP-8 Power Reduction and Plant Shutdown to Mode 2 or Mode 3 $\geq$ 525°F.

1818: Operators reset SIAS and restored non-critical service water per SOP-15 Service Water System.

1852: Operators restored AFW pump P-8B steam supply CV-0522B to AUTO per EOP Supplement 19.

1933: Placed #3 battery charger ED-17 in service supplying station battery ED-01. #2 and #3 battery chargers ED-16 and ED-17 in service.

2348: Pressurizer level lowered to 62% and continued lowering due to PCP bleedoff.

09/26/11, 0311: Placed #4 battery charger ED-18 in service supplying station battery ED-02. Battery chargers #3 ED-17 and #4 ED-18 in service.

09/27/11, 1733: Placed #1 inverter ED-06 in service supplying #1 preferred ac bus EY-10.

Acronyms

AFAS	Auxiliary Feedwater Actuation Signal
AFW	Auxiliary Feedwater
ASDV	Atmospheric Steam Dump Valve
CAS	Compressed Air System
CBO	Controlled Bleedoff
CHP	Containment High Pressure
CHR	Containment High Radiation
CIS	Containment Isolation Signal
CVCS	Chemical and Volume Control System
FWP	Feedwater Purity
MFRV	Main Feedwater Regulating Valve
MSIS	Main Steam Isolation Signal
MSIV	Main Steam Isolation Valve
MSSV	Main Steam Safety Valve
NCO	Nuclear Control Operator
NPO	Nuclear Plant Operator
PCP	Primary Coolant Pump
PCS	Primary Coolant System
PSDT	Primary System Drain Tank
PZR	Pressurizer
RPS	Reactor Protective System
SG	Steam Generator
SI	Safety Injection
SIS	Safety Injection Actuation Signal
VCT	Volume Control Tan

Attachment 2 - Failure Modes Analysis

Problem Statement: Electrical Power was lost to DC Bus ED-10L and ED-10R

Failure Modes	Supporting Evidence	Refuting Evidence	Assumptions	Additional Information	Conclusion
Simultaneous manual opening of: [Bkr 72-18 (Battery No. 1 ED-1) or 72-01 (Isolation Breaker To DC Battery No. 1 ED-1)] **AND** Bkr 72-11 (Charger No. 3 ED-17) **AND** Bkr 72-15 (Charger No. 1 ED-15)	Power to 125 VDC Bus ED10-L & R was lost.	There was no reported observation of individuals opening these breakers. The breakers would have to have been opened simultaneous with the shorting event observed during the ED-11-2 work.	None	None	It is extremely unlikely these events could be coordinated to occur at the same time. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in ED-08 (Inverter No. 3) or in its connected power feed cabling.	Power to 125 VDC Bus ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	Upon restoration, ED-08 (Inverter No. 3) was reported to be operating normally.	It is extremely unlikely that a short would spontaneously occur in ED-08 (Inverter No. 3) or it's connected power feed cable simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred internally	Power to 125 VDC Bus ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance	The short caused Bkr 72-18 (Battery No. 1 ED-1)	None	It is extremely unlikely that a short would spontaneously occur in spare

to spare breaker 72-11 (no connected load or cabling)		work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.		breaker 72-11 simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in ED-17 (Battery Charger No. 3) or in its connected power feed cabling.	Power to 125 VDC Bus ED10-L & R was lost.	At the time of the event, ED-17 (Battery Charger No. 3) was in standby with it's breaker 72-12 (Charger NO. 3 ED-17) OPEN. Therefore, a short in ED-17 could not have affected 125 VDC Bus ED10-L & R as it was not electrically connected.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	Upon restoration, ED-17 (Battery Charger No. 3) was reported to be operating normally.	It is extremely unlikely that a short would spontaneously occur in ED-17 (Battery Charger No. 3) or it's connected power feed cable simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in P-81A (DC Primary Coolant Pump Oil Lift Pump) or in its connected power feed cabling.	Power to 125 VDC Bus ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	None	It is extremely unlikely that a short would spontaneously occur in P-81A (DC Primary Coolant Pump Oil Lift Pump) or it's connected power feed cable simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in P-81C (DC Primary Coolant Pump Oil Lift Pump) or in its connected power	Power to 125 VDC Bus ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	None	It is extremely unlikely that a short would spontaneously occur in P-81C (DC Primary Coolant Pump Oil Lift Pump) or in its connected power feed cable simultaneously with the electrical arc caused by the

feed cable.		to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.			loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in ED-11-1 (125 VDC Panel) or any of the loads connected to this panel.	Power to 125 VDC Bus ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	None	It is extremely unlikely that a short would spontaneously occur in ED-11-1 (125 VDC Panel) or any of the loads connected to this panel simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in ED-11-2 (125 VDC Panel) or any of the loads connected to this panel.	Power to 125 VDC Bus ED10-L & R was lost. Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	None	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation. After the event, Bkr 72-37 (Inverter No.1 ED-06 Power Supply Breaker) was found tripped. Per the Inverter vendor, capacitors on the feed side of the Inverter would have fed a connected fault. The vendor concurred that it was reasonable to conclude that Bkr 72-37 could have tripped from the current produced by	Based on inspection post event, Bkr 72-18 (Battery No. 1 ED-1) was found CLOSED, but breaker 72-01 (Isolation Breaker To Dc Battery No. 1 ED-1) was discovered TRIPPED. Per Dwg. E-8 Sh. 1, Breaker 72-01 (Isolation Breaker To Dc Battery No. 1 ED-1) is	This Failure Mode has a high probability as being the cause of the loss of electrical Power to DC Bus ED-10L and ED-10R.

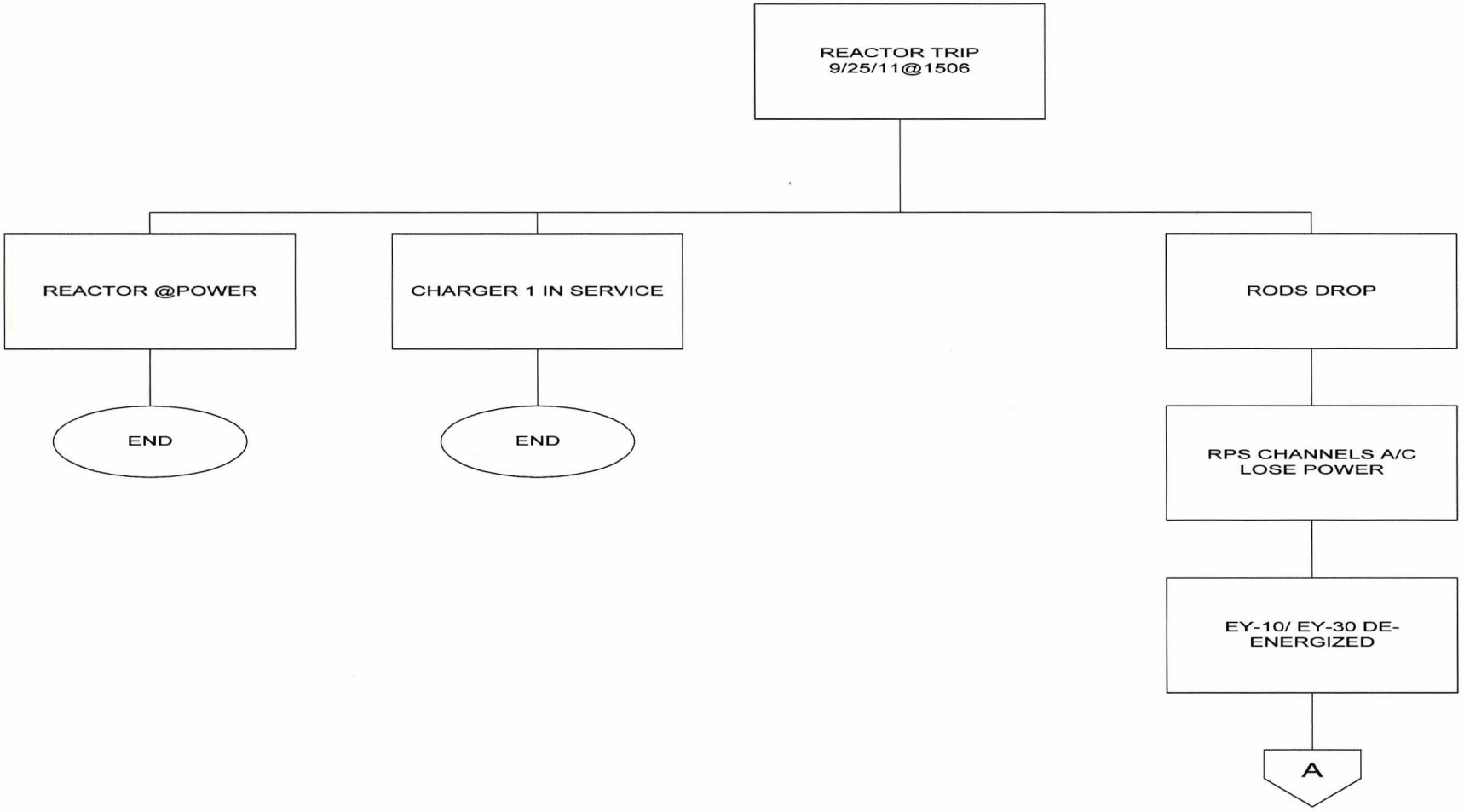
			the Inverter capacitors. Located between ED-10R (125 VDC Bus) and ED-11-2 (125 VDC Panel) is fuse FUZ/D11-2 (Feeder Fuse To Relay In Panel ED-11A). This fuse was found intact. The assumption is that it is reasonable to expect that the fault current contributed by ED-06 (Inverter No. 1) would trip Bkr 72-37 and not fuse FUZ/D11-2. Note that for the stated failure mode, all of the fault current would have passed through fuse FUZ/D11-2, and this fuse was found intact.	identified as a Non-Automatic shunt trip breaker, that is this breaker would not incorporate a magnetic or thermal automatic trip feature. As has been discovered, this breaker does in fact contain a magnetic automatic trip feature.	
A (+) to (-) short occurred in ED-15 (Battery Charger No. 1) or in its connected power feed cabling.	Power to 125 VDC Buss ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	Upon restoration, ED-15 (Battery Charger No. 1) was reported to be operating normally.	It is extremely unlikely that a short would spontaneously occur in ED-15 (Battery Charger No. 1) or it's connected power feed cable simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred internally to spare breaker 72-16 (no connected load or cabling)	Power to 125 VDC Buss ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to	None	It is extremely unlikely that a short would spontaneously occur in spare breaker 72-16 simultaneously with the electrical arc caused by the loss of physical control of the copper bar

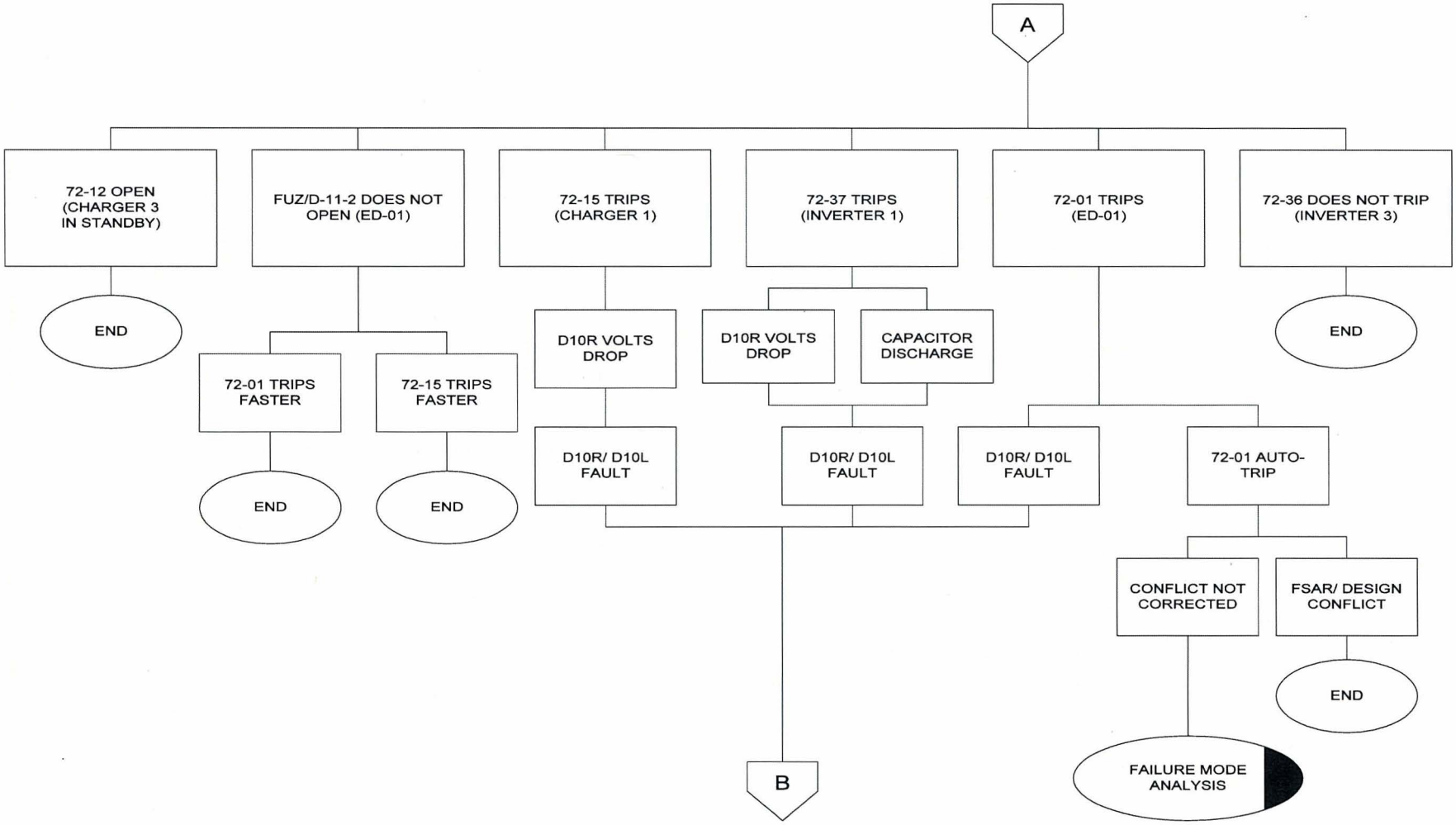
		a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	cease output operation.		being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in ED-06 (Inverter No. 1) or in its connected power feed cabling.	Power to 125 VDC Buss ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	Upon restoration, ED-06 (Inverter No. 1) was reported to be operating normally.	It is extremely unlikely that a short would spontaneously occur in ED-06 (Inverter No. 1) or it's connected power feed cable simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in EU-72 (Public Address System Inverter) or connected cabling.	Power to 125 VDC Buss ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	None	It is extremely unlikely that a short would spontaneously occur in ED-06 (Inverter No. 1) or it's connected power feed cable simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in the ED-10L (125 VDC Bus) bus work.	Power to 125 VDC Buss ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	Upon restoration, the ED-10L (125 VDC Bus) bus provided power to it's connected load without incident.	It is extremely unlikely that a short would spontaneously occur in the ED-10L (125 VDC Bus) bus work simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be

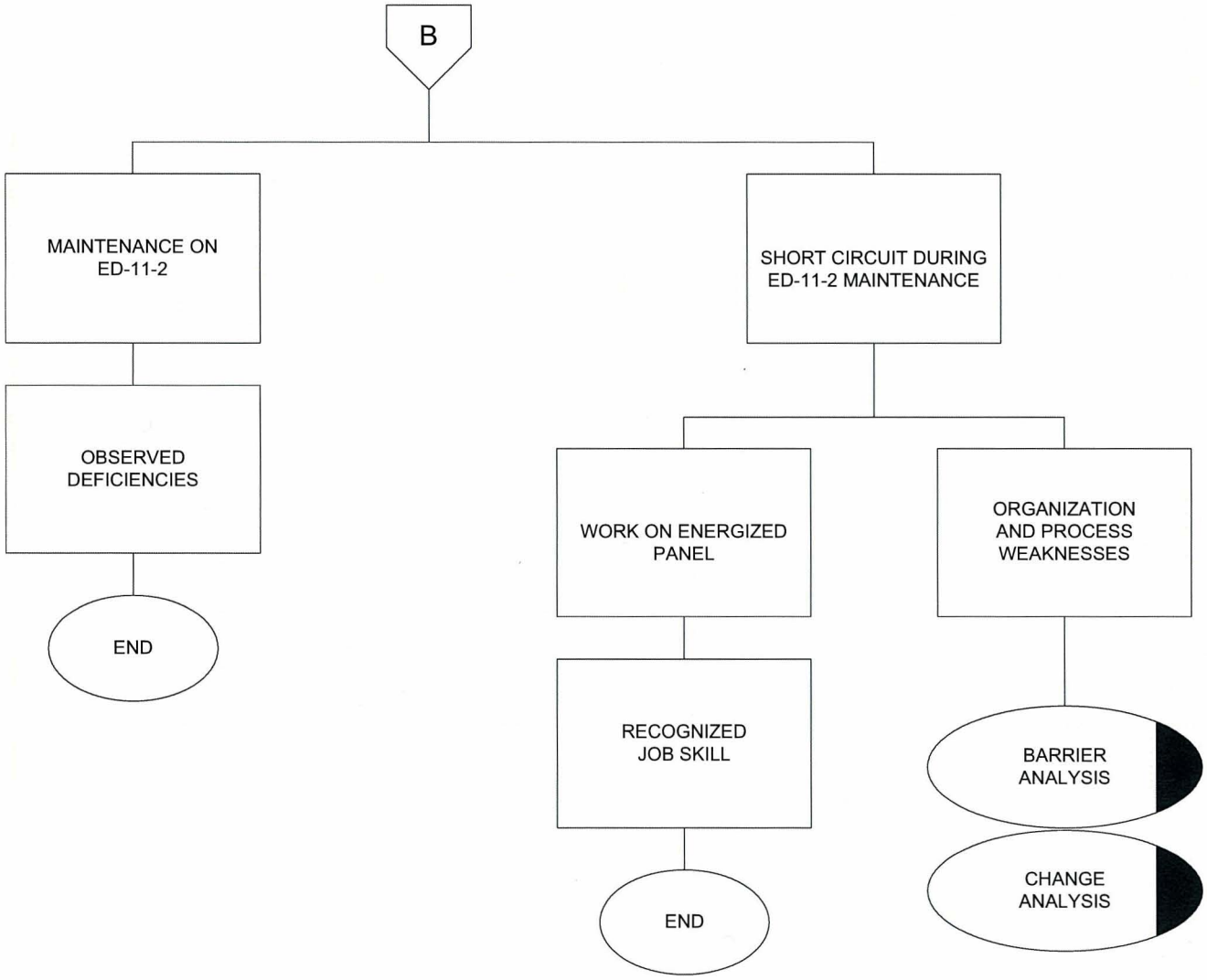
		also photographic evidence of the results of an electrical arc.			credible.
A (+) to (-) short occurred in the ED-10R (125 VDC Bus) bus work.	Power to 125 VDC Buss ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.	Upon restoration, the ED-10R (125 VDC Bus) bus provided power to it's connected load without incident.	It is extremely unlikely that a short would spontaneously occur in the ED-10R (125 VDC Bus) bus work simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.
A (+) to (-) short occurred in the ED-13 (Metering Section W/IN MN DC Dist Bus #1) ground detection circuitry.	Power to 125 VDC Buss ED10-L & R was lost.	Multiple individuals observing the Electrical Maintenance work being performed in DC Distribution Panel ED-11-2 observed an electrical arc when a piece of copper bar attached to the aluminum bus bar swung and made contact with the opposite polarity bus. There is also photographic evidence of the results of an electrical arc.	The short caused Bkr 72-18 (Battery No. 1 ED-1) to open and the short caused Battery Chargers ED-15 and ED-17 to cease output operation.		It is extremely unlikely that a short would spontaneously occur in the ED-13 (Metering Section W/IN MN DC Dist Bus #1) ground detection circuitry simultaneously with the electrical arc caused by the loss of physical control of the copper bar being worked in DC Distribution Panel ED-11-2. Therefore this Failure Mode is not considered to be credible.

Summary: The Failure Mode: A (+) to (-) short occurred in ED-11-2 (125 VDC Panel) or any of the loads connected to this panel, was considered to be the credible failure which resulted in loss of Electrical Power to DC Bus ED-10L and ED-10R. Specifically, the short was due to the contact of opposite polarity copper stand-offs, one of which was in the process of being removed by Electrical Maintenance when the fault occurred. **References: Dwg. E-8 Sh. 1 and Operators Statements regarding the Plant Trip Notes: None**

Attachment 3 - Failure Modes Chart




A
72-12 OPEN (CHARGER 3 IN STANDBY)
FUZ/D-11-2 DOES NOT OPEN (ED-01)
72-15 TRIPS (CHARGER 1)
72-37 TRIPS (INVERTER 1)
72-01 TRIPS (ED-01)
72-36 DOES NOT TRIP (INVERTER 3)
END
72-01 TRIPS FASTER
72-15 TRIPS FASTER
D10R VOLTS DROP
D10R VOLTS DROP
CAPACITOR DISCHARGE
END
END
END
D10R/ D10L FAULT
D10R/ D10L FAULT
D10R/ D10L FAULT
72-01 AUTO-TRIP
CONFLICT NOT CORRECTED
FSAR/ DESIGN CONFLICT
END
B
FAILURE MODE ANALYSIS


B
MAINTENANCE ON ED-11-2
OBSERVED DEFICIENCIES
END
SHORT CIRCUIT DURING ED-11-2 MAINTENANCE
WORK ON ENERGIZED PANEL
RECOGNIZED JOB SKILL
END
ORGANIZATION AND PROCESS WEAKNESSES
BARRIER ANALYSIS
CHANGE ANALYSIS

Attachment 4 – Barrier Analysis

GOAL	HAZARD	BARRIER	HOW BARRIER FAILED	IMPACT ON EVENT
Adequate information available to plan to plan and complete work	WO Task LTA	Work order planning	Work order plan did not include details for removal of bus bar with damaged threads and insulation of energized components. Used notes for instructions and was based on outdated procedure.	Contributing Cause 2
		Ops impact review	Indicated there was Plant trip concern which but that it was slight.	Root Cause 1
	Plant Maintenance Procedures LTA	Procedure quality	No Plant maintenance procedures included in WO plan but the procedure referenced was outdated	Contributing Cause 2
		Maintenance feedback	EPS-E-10 has been in use but no evidence of DRNs	Contributing Cause 2
	Fleet Procedures LTA	Procedure quality	HPER input that EN-IS-123 vs EN-OP-102 needs clarification per shift manager face-to-face meetings on energized equipment work	Enhancement
		Incorporation of previous comments	No evidence of previous unincorporated comments	NA

	OE References LTA	Planning development	Relevant OE30342 included in WO package	NA
	Inappropriate work scheduling	Risk assessment	Qualitative risk assessments at four points could have resulted in increased management attention and better decision making	Root Cause 1; see change analysis
		Management oversight	Managers were not intrusive, unaware and unable to control what was going on	Root Cause 1/ LOW
	Feedback to correct previously known problems	Work crew review	Crew indicated concerns identified were reported and resolved	NA
Crew develops good plan to perform work	Shift turnover LTA	Face to face review	Breaker inspection and replacement was not turned over; continued with same crew after temporary mod was installed	NA
	Crew review LTA	Opportunity to review work order package on schedule	Crew review had opportunity and identified concerns	NA
		Opportunity to resolve comments on work order package	Concerns related to drawing availability not resolved but crew continued with work	Root Cause 1 and Contributing Cause 4
	Prejob brief LTA	Use of correct PJB form	Based on interviews, EN-HU-102 was not referenced and checklists not used; in addition, during HPER, workers indicated they were not clear about how to use EN-HU-102 flowchart for selecting prejob brief level	Root Cause 1 and Contributing Cause 4
		Correct performance of PJB		

		Manager and supervisor oversight	Supervisor, duty station manager and asst maintenance manager were present at brief and should have identified failure to use checklists	Supports Contributing Cause 3 and Root Cause 1
		Use of OE	OE provided was relevant but not successfully used due to weak prejob brief	Contributing Cause 4
Crew completes work as planned	Worker skills LTA	Training and experience	During HPER discussions, workers were considered and they considered themselves trained an experienced	NA
	Response to changes LTA	Worker regroup and rebrief	Worker decisions not to stop and regroup when deciding to remove bus connectors and to change from insulation sheets to insulating gloves violated procedures and expectations	Root Cause 1 and Contributing Cause 4; see Change Analysis
	Working conditions LTA	Worker and supervisor recognition	During HPER reviews, crew indicated there were no adverse impacts from working conditions	NA
	Oversight LTA	Manager and supervisor oversight	Weaknesses in job execution not recognized and corrected even though supervisor, duty station manager and asst maintenance manager were present and able to recognize what was going on	Contributing Cause 3 and Root Cause 1

Attachment 5 - Change Analysis

ATTRIBUTE	PROBLEM SITUATION	PRIOR SITUATION	DIFFERENCES/ CHANGES	IMPACT ON EVENT
Work priority decision	Decision is made to replace 72-123	Only troubleshooting would be performed	Replacement of breaker 72-123 will involve work on energized bus of panel ED-11-2 which has EOOS orange risk factor	Weak decision making and failure to perform qualitative risk analysis support Root Cause 1
Use of insulating gloves	Insulating gloves are used to remove damaged bus connectors in panel ED-11-2	Prejob brief plan was to sheets of insulating material	There is inadequate separation between opposing phase bus connectors during repair work which increases the chance of short circuit	Failure to rebrief this change in plans reduces chances for successful completion and supports Root Cause 1
Work on damaged bus connectors	Damaged bus connectors are removed from panel ED-11-2 to repair threads	Work order plans indicate bus connectors will be repaired in the panel. Task does not include the word REMOVE.	Removal reduces chances that metal chips will fall into bus which is good; removal of connectors increases risk that errors will occur because it increases the complexity of the task	Worker do not stop to change the instructions or rebrief the next steps to be completed; supports Root Cause 1

Attachment 6 - Safety Culture Evaluation

TABLE 1 – SAFETY CULTURE COMPARISON

SAFETY CULTURE COMPONENT	DESCRIPTION	CR-PLP-2011-4822– Plant Trip During Panel ED-11-2 Maintenance
1. Decision-Making	Licensee decisions demonstrate that nuclear safety is an overriding priority.	**RC1**
2. Resources	The licensee ensures that personnel, equipment, procedures, and other resources are available and adequate to assure nuclear safety.	**RC1/ CC2**
3. Work Control	The licensee plans and coordinates work activities, consistent with nuclear safety	**RC1**
4. Work Practices	Personnel work practices support human performance.	**RC1/ CC2/ CC3**
5. Corrective Action Program	The licensee ensures that issues potentially impacting nuclear safety are promptly identified, fully evaluated, and that actions are taken to address safety issues in a timely manner, commensurate with their significance.	No safety culture weakness determined for any of the identified causes
6. Operating Experience	The licensee uses operating experience (OE) information, including vendor recommendations and internally generated lessons learned, to support plant safety.	No safety culture weakness determined for any of the identified causes
7. Self- and Independent Assessments	The licensee conducts self- and independent assessments of their activities and practices, as appropriate, to assess performance and identify areas for improvement.	No safety culture weakness determined for any of the identified causes

SAFETY CULTURE COMPONENT	DESCRIPTION	CR-PLP-2011-4822– Plant Trip During Panel ED-11-2 Maintenance
8. Environment For Raising Concerns	An environment exists in which employees feel free to raise concerns both to their management and/or the NRC without fear of retaliation and employees are encouraged to raise such concerns.	No safety culture weakness determined for any of the identified causes
9. Preventing, Detecting and Mitigating Perceptions of Retaliation	A policy for prohibiting harassment and retaliation for raising nuclear safety concerns exists and is consistently enforced.	No safety culture weakness determined for any of the identified causes
10. Accountability	Management defines the line of authority and responsibility for nuclear safety.	**RC1/CC3**
11. Continuous Learning Environment	The licensee ensures that a learning environment exists.	**RC1/CC3**
12. Organizational Change Management	Management uses a systematic process for planning, coordinating, and evaluating the safety impacts of decisions related to major changes in organizational structures and functions, leadership, policies, programs, procedures, and resources. Management effectively communicates such changes to affected personnel.	No safety culture weakness determined for any of the identified causes
13. Safety Policies	Safety policies and related training establish and reinforce that nuclear safety is an overriding priority in that.	No safety culture weakness determined for any of the identified causes

NOTES

1. Decision Making - Indicated because personnel in all parts of the Plant organization did not recognize, account for or prepare for the industrial safety and Plant operational risk involved with the panel ED-11-2 breaker maintenance. (H1a). This was described by the examples identified for RC1 and will be addressed by the corrective actions assigned to that cause and its Extent.

2. Resources - Indicated because management personnel exceeded established work hours rules and failed to follow prejob brief requirements (H2b) and because work orders used for breaker maintenance did not include details appropriate for energized, high critical equipment (H2c) Concerns will be addressed by the corrective actions for RC1 and CC2.

3. Work Control - Indicated because all parts of the Plant organization did not recognize, account for or prepare for the industrial safety and Plant operational risk involved with the panel ED-11-2 breaker maintenance. (H3a) This was described by the examples identified for RC1 and will be addressed by the corrective actions assigned to that cause and its Extent.

4. Work Practices - Oversight by managers and supervisors did not result in identification and correction (H4b) of the errors and weaknesses on the part of the Maintenance work crew (H4a) involved with the breaker inspection and maintenance work that lead to this event. Based on the evidence, the Plant organization did not recognize and account for the industrial safety and Plant trip risk involved(H4c) This will be addressed by corrective actions assigned for RC1, CC2 and CC3.

5. Accountability - Managers and supervisors did not recognize the industrial safety and Plant trip risk involved with the breaker inspection and maintenance work that lead to this event and did not reinforce safety standards among themselves or with those doing the work (A1b) . result in identification and correction (H4b) of the errors and weaknesses on the part of the Maintenance work crew (H4a) involved. This concern will be addressed by corrective actions assigned for RC1 and CC3.

6. Continuous Learning Environment - Regardless of supervisor and manager training based on SOER 10-2, none of those present at the prejob brief or at the work site, identified or corrected lapses in the conduct of the prejob brief, the lack of critical steps or the failure to stop and reconsider when the job plan changed (C2a). This concern will be addressed by corrective actions assigned for RC1 and CC3.

TABLE 2 – DETAILED SAFETY CULTURE COMPONENT REVIEW

		Description	CR-PLP-2011-4822– Plant Trip During Panel ED-11-2 Maintenance
1. Decision-Making		**Licensee decisions demonstrate that nuclear safety is an overriding priority. Specifically (as applicable):**	
DM	H.1(a)	The licensee makes safety-significant or risk-significant decisions using a systematic process, especially when faced with uncertain or unexpected plant conditions, to ensure safety is maintained. This includes formally defining the authority and roles for decisions affecting nuclear safety, communicating these roles to applicable personnel, and implementing these roles and authorities as designed and obtaining interdisciplinary input and reviews on safety-significant or risk-significant decisions.	Applicable to RC1. See Note 1.
DM	H.1(b)	The licensee uses conservative assumptions in decision making and adopts a requirement to demonstrate that the proposed action is safe in order to proceed rather than a requirement to demonstrate that it is unsafe in order to disapprove the action. The licensee conducts effectiveness reviews of safety-significant decisions to verify the validity of the underlying assumptions, identify possible unintended consequences, and determine how to improve future decisions.	No safety culture weakness determined for any of the identified causes
DM	H.1(c)	The licensee communicates decisions and the basis for decisions to personnel who have a need to know the information in order to perform work safely, in a timely manner.	No safety culture weakness determined for any of the identified causes
2. Resources		**The licensee ensures that personnel, equipment, procedures, and other resources are available and adequate to assure nuclear safety. Specifically, those necessary for:**	
RES	H.2(a)	Maintaining long term plant safety by maintenance of design margins, minimization of long-standing equipment issues, minimizing preventative maintenance deferrals, and ensuring maintenance and engineering backlogs which are low enough to support safety.	No safety culture weakness determined for any of the identified causes
RES	H.2(b)	Training of personnel and sufficient qualified personnel to maintain work hours within working hours guidelines.	Applicable to RC1. See Note 2
RES	H.2(c)	Complete, accurate and up-to-date design documentation, procedures, and work packages, and correct labeling of components.	Applicable to CC2. See Note 2.
RES	H.2(d)	Adequate and available facilities and equipment, including physical improvements, simulator fidelity and emergency facilities and equipment.	No safety culture weakness determined for any of the identified causes.
3. Work Control		**The licensee plans and coordinates work activities, consistent with nuclear safety. Specifically (as applicable):**	
WC	H.3(a)	The licensee appropriately plans work activities by incorporating • risk insights; • job site conditions, including environmental conditions which may impact human performance; plant structures, systems, and components; human-system interface; or radiological safety; and • the need for planned contingencies, compensatory actions, and abort criteria.	Applicable to RC1. See Note 3.

		Description	CR-PLP-2011-4822– Plant Trip During Panel ED-11-2 Maintenance
WC	H.3(b)	The licensee appropriately coordinates work activities by incorporating actions to address: | • the impact of changes to the work scope or activity on the plant and human performance. • the impact of the work on different job activities, and the need for work groups to maintain interfaces with offsite organizations, and communicate, coordinate, and cooperate with each other during activities in which interdepartmental coordination is necessary to assure plant and human performance. • The need to keep personnel apprised of work status, the operational impact of work activities, and plant conditions that may affect work activities. • The licensee plans work activities to support long-term equipment reliability by limiting temporary modifications, operator work-arounds, safety systems unavailability, and reliance on manual actions. Maintenance scheduling is more preventive than reactive.	No safety culture weakness determined for any of the identified causes
4. Work Practices		**Personnel work practices support human performance. Specifically (as applicable):**	
WP	H.4(a)	The licensee communicates human error prevention techniques, such as holding pre-job briefings, self and peer checking, and proper documentation of activities. These techniques are used commensurate with the risk of the assigned task, such that work activities are performed safely. Personnel are fit for duty. In addition, personnel do not proceed in the face of uncertainty or unexpected circumstances.	Applicable to CC3. See Note 4.
WP	H.4(b)	The licensee defines and effectively communicates expectations regarding procedural compliance and personnel follow procedures	Applicable to CC2 and CC3. See Note 4.
WP	H.4(c)	The licensee ensures supervisory and management oversight of work activities, including contractors, such that nuclear safety is supported.	Applicable to RC1. See Note 4.
5. Corrective Action Program		**The licensee ensures that issues potentially impacting nuclear safety are promptly identified, fully evaluated, and that actions are taken to address safety issues in a timely manner, commensurate with their significance. Specifically (as applicable):**	
CAP	P.1(a)	The licensee implements a corrective action program with a low threshold for identifying issues. The licensee identifies such issues completely, accurately, and in a timely manner commensurate with their safety significance.	No safety culture weakness determined for any of the identified causes
CAP	P.1(b)	The licensee periodically trends and assesses information from the CAP and other assessments in the aggregate to identify programmatic and common cause problems. The licensee communicates the results of the trending to applicable personnel.	No safety culture weakness determined for any of the identified causes
CAP	P.1(c)	The licensee thoroughly evaluates problems such that the resolutions address causes and extent of conditions, as necessary. This includes properly classifying, prioritizing, and evaluating for operability and reportability conditions adverse to quality. This also includes, for significant problems, conducting effectiveness reviews of corrective actions to ensure that the problems are resolved.	No safety culture weakness determined for any of the identified causes
CAP	P.1(d)	The licensee takes appropriate corrective actions to address safety issues and adverse trends in a timely manner, commensurate with their safety significance and complexity.	No safety culture weakness determined for any of the identified causes
CAP	P.1(e)	If an alternative process (i.e., a process for raising concerns that is an alternate to the licensee's corrective action program or line management) for raising safety concerns exists, then it results in appropriate and timely resolutions of identified problems.	No safety culture weakness determined for any of the identified causes

		Description	CR-PLP-2011-4822– Plant Trip During Panel ED-11-2 Maintenance
6. Operating Experience		**The licensee uses operating experience (OE) information, including vendor recommendations and internally generated lessons learned, to support plant safety. Specifically (as applicable):**	
OE	P.2(a)	The licensee systematically collects, evaluates, and communicates to affected internal stakeholders in a timely manner relevant internal and external OE.	No safety culture weakness determined for any of the identified causes
OE	P.2(b)	The licensee implements and institutionalizes OE through changes to station processes, procedures, equipment, and training programs.	No safety culture weakness determined for any of the identified causes
7. Self- and Independent Assessments		**The licensee conducts self- and independent assessments of their activities and practices, as appropriate, to assess performance and identify areas for improvement. Specifically (as applicable):**	
SA	P.3(a)	The licensee conducts self-assessments at an appropriate frequency; such assessments are of sufficient depth, are comprehensive, are appropriately objective, and are self-critical. The licensee periodically assesses the effectiveness of oversight groups and programs such as CAP, and policies.	No safety culture weakness determined for any of the identified causes
SA	P.3(b)	The licensee tracks and trends safety indicators which provide an accurate representation of performance.	No safety culture weakness determined for any of the identified causes
SA	P.3(c)	The licensee coordinates and communicates results from assessments to affected personnel, and takes corrective actions to address issues commensurate with their significance.	No safety culture weakness determined for any of the identified causes
8. Environment For Raising Concerns		**An environment exists in which employees feel free to raise concerns both to their management and/or the NRC without fear of retaliation and employees are encouraged to raise such concerns. Specifically (as applicable):**	
ERC	S.1(a)	Behaviors and interactions encourage free flow of information related to raising nuclear safety issues, differing professional opinions, and identifying issues in the CAP and through self assessments. Such behaviors include supervisors responding to employee safety concerns in an open, honest, and non-defensive manner and providing complete, accurate, and forthright information to oversight, audit, and regulatory organizations. Past behaviors, actions, or interactions that may reasonably discourage the raising of such issues are actively mitigated. As a result, personnel freely and openly communicate in a clear manner conditions or behaviors, such as fitness for duty issues that may impact safety and personnel raise nuclear safety issues without fear of retaliation.	No safety culture weakness determined for any of the identified causes
ERC	S.1(b)	If alternative processes (i.e., a process for raising concerns or resolving differing professional opinions that are alternates to the licensee's corrective action program or line management) for raising safety concerns or resolving differing professional opinions exists, then they are communicated, accessible, have an option to raise issues in confidence, and are independent, in the sense that the program does not report to line management (i.e., those who would in the normal course of activities be responsible for addressing the issue raised).	No safety culture weakness determined for any of the identified causes

		Description	CR-PLP-2011-4822– Plant Trip During Panel ED-11-2 Maintenance
9. Preventing, Detecting, and Mitigating Perceptions of Retaliation		**A policy for prohibiting harassment and retaliation for raising nuclear safety concerns exists and is consistently enforced in that:**	
PDR	S.2(a)	All personnel are effectively trained that harassment and retaliation for raising safety concerns is a violation of law and policy and will not be tolerated	No safety culture weakness determined for any of the identified causes
PDR	S.2(b)	Claims of discrimination are investigated consistent with the content of the regulations regarding employee protection and any necessary corrective actions are taken in a timely manner, including actions to mitigate any potential chilling effect on others due to the personnel action under investigation.	No safety culture weakness determined for any of the identified causes
PDR	S.2(c)	The potential chilling effects of disciplinary actions and other potentially adverse personnel actions (e.g., reductions, outsourcing, and reorganizations) are considered and compensatory actions are taken when appropriate.	No safety culture weakness determined for any of the identified causes
10. Accountability		**Management defines the line of authority and responsibility for nuclear safety. Specifically (as applicable):**	
ACC	A.1(a)	(a) Accountability is maintained for important safety decisions in that the system of rewards and sanctions is aligned with nuclear safety policies and reinforces behaviors and outcomes which reflect safety as an overriding priority.	No safety culture weakness determined for any of the identified causes
ACC	A.1(b)	(b) Management reinforces safety standards and displays behaviors that reflect safety as an overriding priority.	Applicable to RC1 and CC3. See Note 5.
ACC	A.1(c)	(c) The workforce demonstrates a proper safety focus and reinforces safety principles among their peers.	No safety culture weakness determined for any of the identified causes
11. Continuous learning environment		**The licensee ensures that a learning environment exists. Specifically (as applicable):**	
CLE	C.2(a)	(a) The licensee provides adequate training and knowledge transfer to all personnel on site to ensure technical competency.	Applicable to RC1 and CC3. See Note 6.
CLE	C.2(b)	(b) Personnel continuously strive to improve their knowledge, skills, and safety performance through activities such as benchmarking, being receptive to feedback, and setting performance goals. The licensee effectively communicates information learned from internal and external sources about industry and plant issues.	No safety culture weakness determined for any of the identified causes
12. Organizational change management			
OCM	**12. Organizational change management**	**Management uses a systematic process for planning, coordinating, and evaluating the safety impacts of decisions related to major changes in organizational structures and functions, leadership, policies, programs, procedures, and resources. Management effectively communicates such changes to affected personnel.**	No safety culture weakness determined for any of the identified causes
13. Safety policies		**Safety policies and related training establish and reinforce that nuclear safety is an overriding priority in that:**	
SP	SP.4(a)	(a) These policies require and reinforce that individuals have the right and responsibility to raise nuclear safety issues through available means, including avenues outside their organizational chain of command and to external agencies, and obtain feedback on the resolution of such issues.	No safety culture weakness determined for any of the identified causes
SP	SP.4(b)	(b) Personnel are effectively trained on these policies.	No safety culture weakness determined for any of the identified causes

		Description	CR-PLP-2011-4822– Plant Trip During Panel ED-11-2 Maintenance
SP	SP.4(c)	(c) Organizational decisions and actions at all levels of the organization are consistent with the policies. Production, cost and schedule goals are developed, communicated, and implemented in a manner that reinforces the importance of nuclear safety.	No safety culture weakness determined for any of the identified causes
SP	SP.4(d)	(d) Senior managers and corporate personnel periodically communicate and reinforce nuclear safety such that personnel understand that safety is of the highest priority.	No safety culture weakness determined for any of the identified causes

Attachment 7 - Evaluation for Organization and Programmatic Issues

Include this Worksheet as an Attachment to the report. The questions are provided to promote consideration of like symptoms, not to define a specific failure mode. O&P causal factors are symptoms of the more basic causes of the event and are typically an action or condition that shaped the outcome of the situation.
For each causal factor block checked YES:

1. Ensure it is appropriately represented in the WHY Staircase as a cause or contributor.
2. In the BARRIER ANALYSIS, tie the O&P causal factors as appropriate to Barriers that failed, were weak, missing, or ineffective.
3. Summarize in the O&P section of the report how the identified Organizational & Programmatic weaknesses caused or contributed to the event and identify the Barrier which should have prevented it.

O&P Worksheet			
Potential O&P Failure Modes (Causal Factors)	**Contributed to or Caused Event?**		**RC# AC # CC#**
	YES	**NO**	
1) **OP1X - Organization to Organization Interface Weaknesses** • **Inadequate interface among Organizations** (Good organizational structure but organizations don't communicate). • **Excessive or lack of overlap in functions** (Overall structural design results in overlaps or holes between organizations)			
a) OP1A - Does there appear to be evidence of inadequate interface among organizations? Problems in this area surface in the form of a high human error rate in tasks requiring communication among different organizations. Usually this is caused by a lack of interface formality (tailgate meetings, formal interface documentation or agreements, etc.), inadequate teamwork or trust among organizations, or inadequate physical settings.		**N**	
b) OP1B – Is there evidence of excessive or lack of overlap functions between organizations? Negative performance in this block is usually caused by a lack of organizational planning resulting in an inadequate definition of job functions between one or more organizations.		**N**	
c) OP1C – Is there evidence that the required notifications were not made when the job was begun, interrupted or completed? Describes either the failure to perform the verbal communication of status when required by the process *or* the failure to design the process to require the verbal communication of status when successful implementation of the process depended upon this communication.		**N**	
d) OP1D – Is there evidence that appropriate personnel and departmental interactions were not fully considered when new processes were created during the implementation phases of the change? Changes to processes created new requirements for interaction between personnel or departments that were not considered in the implementation phase of the change.		**N**	
e) OP1E – Is there evidence that planning was not coordinated with inputs from walk-downs and task analysis? Job plan did not incorporate information gathered during field visits or task analysis concerning the steps and conditions required for successful completion of the task.		**N**	
f) OP1F – Is there evidence that planning was not coordinated with all departments involved in task Interdepartmental communication and teamwork were not supported by the planned work flow.		**N**	
2) **OP2X - Organization to Program Interface Weaknesses** • **Lack of commitment to program implementation** (organization never gets program off the ground) • **Inadequate Program monitoring or management** (organization does not monitor or manage the program effectively) • **Lack of program evaluation process** (program survives but Organization does not evaluate program, so it goes in the wrong direction) **Lack of organizational authority for program implementation** (organization starves to death because no one is protecting it)			
a) OP2A – Is there evidence of a lack of commitment to program implementation? Usually evidenced by slow program implementation. The failure is generally due to excessive program implementation requirements or a lack of management support of the program.	**Y**		**RC1/ CC4**
b) OP2B – Is there evidence of inadequate program monitoring or inadequate management skills? Indicated by a lack of program improvement over time. Usually it is caused by inadequate staffing or inadequate management skills.	**Y**		**RC1/ LOW**

O&P Worksheet			
Potential O&P Failure Modes (Causal Factors)	**Contributed to or Caused Event?**		**RC# AC # CC#**
	YES	**NO**	
c) OP2C – Is there evidence of a lack of a program evaluation process? This area is more reactive, in that a program failure occurs before action is taken. However, the same items contribute to negative performance, i.e., inadequate management practices, inadequate staffing for program implementation, or insufficient program design.		**N**	
d) OP2D – Is there evidence of a lack of organizational authority for program implementation? This code usually is associated with an insufficient budget for the program or fragmented responsibility and/or accountability for the program. Potential causes include a lack of organizational planning or a lack of management commitment to program implementation.	**Y**		**RC1**
e) OP2E – Is there evidence of unclear or complex wording or grammar in program implementation documents? Wording, grammar or symbols fail to clearly and concisely specify the required action; instructions provided for team of users fail to specify roles of each user.		**N**	
f) OP2F – Is there evidence of an omission of relevant information in program implementation documents that would have prevented an event from occurring (e.g. insufficient information in graphs, tables or illustration; lack of instructions or data sheet documentation requirements, etc.) Over reliance on user's training, skills or experience; lack of detail for infrequent, complex, crucial or error-prone tasks; insufficient information in graphs, tables or illustrations; lack of instructions for data sheet documentation requirements	**Y**		CC1, CC4, EOC
g) OP2G – Is there evidence of the lack of a procedure that should have been written but does not exist? The process meets administrative requirements for having a procedure, but no procedure has been written.		**N**	
h) OP2H – Is there evidence that policy guidance or management expectations were not well defined or understood by personnel involved in performing the task? Personnel exhibited a lack of understanding of existing policy and/or expectations, or policy/expectations were not defined.	**Y**		
i) OP2I – Is there evidence that job standards were not adequately defined or communicated? Measurement of effectiveness could not be performed for specific job functions due to lack of defined standards.		**N**	
j) OP2J – Is there evidence that personnel exhibited insufficient awareness of the impact of actions on safety and reliability? Management failed to provide direction regarding safeguards against non-conservative actions by personnel concerning nuclear safety or reliability	**Y**		
k) OP2K – Is there evidence that management follow-up or monitoring of activities was ineffective in identifying shortcomings in implementation? l) Management's methods for monitoring the success of initiatives were ineffective in identifying shortcomings in the implementation.	**Y**		
m) OP2L – Is there evidence that causes of a previous event or known problem were not determined? Analysis methods failed to uncover the causal factors of consequential or non-consequential events.		**N**	
n) OP2M – Is there evidence that the effects of changes on planned schedules were not adequately addressed prior to implementation? Changes to processes which resulted in scheduled changes had effects on personnel or equipment that were not addressed in the change implementation.		**N**	
o) OP2N – Is there evidence that the job scoping process did not properly identify potential task interruptions or environment stress? Work scoping process was not effective in detecting reasonable obstructions to work flow (e.g., shift changes) or the impact of environmental conditions.		**N**	
p) OP2O – Is there evidence that the job scoping process did not identify special circumstances or conditions that may be impacted or dependent on other circumstances or conditions? Work scoping process was not effective in detecting work process elements having a dependency upon other circumstances or conditions.		**N**	
q) OP2P – Is there evidence that the field walk down input to design was less than adequate? Design change and/or field change requests as a result of inadequate field walk downs to verify actual configurations of plant components, structures and systems that interface with or affect the designs.		**N**	
3) **OP3X - Program to Program Interface Weaknesses** • **Lack of interface requirements** (no formal procedures to make sure two programs talk to each other) • **Conflicting program requirements** (conflicting actions required by two different programs) • **Inadequate interface requirements** (information required is available but program interfaces are inadequate to get it)			

O&P Worksheet			
Potential O&P Failure Modes (Causal Factors)	**Contributed to or Caused Event?**		**RC# AC # CC#**
	YES	**NO**	
a) OP3A – Is there evidence of a lack of interface requirements between two or more programs that are required to interface in that details necessary to ensure a consistent standard are not adequately covered in programmatic implementing documents? Usually this is caused by inadequate program design or an inadequate work planning process.		**N**	
b) OP3B – Is there evidence of conflicting program requirements where one program has different actions from another program for the same issue? This codes is used when different actions are required by two or more programs for the same situation. As a result, staff efficiency and accountability is negatively impacted.		**N**	
c) OP3C – Is there evidence of inadequate interface requirements in that one program specifies actions different from another program for the same issue? This code is used when actions are required by one program belonging to another program that is inadequate in perform the actions. The cause is usually inadequate program design and/or inadequate work planning processes		**N**	
4) **OP4X – Programmatic Deficiencies** • **Insufficient detail** (This is my first time doing this, how am I supposed to know what "use normal process" means?) • **Inadequate scope** ("The procedure left out all the information on the electrical cables that need to be connected") • **Excessive implementation requirements** (so many requirements that people give up and don't try to follow the procedure) • **Inadequate verification process** ("We haven't really looked at our processes and given them a 'check up' for over 15 years")			
a) OP4A – Is there evidence that there are insufficient details in a procedure to perform the task? When a program is vague regarding what is required in a particular situation, it is usually indicative of an inadequate program design or insufficient feedback for individuals using the procedure.	**Y**		**CC2**
b) OP4B – Is there evidence of inadequate job scope (omission of necessary functions) in an implementing procedure because of an inadequate program design or inadequate feedback from the field? Either inadequate program design or inadequate feedback from the field is usually taking place		**N**	
c) OP4C – Is there evidence of excessive implementation requirements that result in portions of the program being ignored by the staff due to overload? This can be caused by inadequate program design, lack of work prioritization, or inadequate staffing		**N**	
d) OP4D – Is there evidence of an inadequate verification process (single human error, high program failure rate, poor procedure quality or inadequate program design? Program breakdown by a single human error; high program failure rate, poor procedure quality. Inadequate program design		**N**	
e) OP4E – Is there evidence that there is a lack of responsibility by personnel because it is not well defined or personnel are not being held accountable? Responsibility for process elements (procedures, engineering, training, etc.) was not placed with individuals or accountability for failures of those process elements was not placed with individuals.		**N**	
f) OP4F – Is there evidence that a response to a known or repetitive problem was untimely? Corrective action for known or recurring problems was not performed at or within the proper time.		**N**	
g) OP4G – Is there evidence that needed changes to the plant were not approved or funded which resulted in a plant issue? Corrective actions for existing deficiencies that were previously identified were not approved or funded.		**N**	
h) OP4H – Is there evidence that there was not a means or process to ensure procedures and documents were of adequate quality and up to date? A process for changing procedures or other work documents to ensure quality and timeliness was nonexistent or inadequate		**N**	
i) OP4I – Is there evidence that duties were not well distributed among personnel that contributed to a problem? The work loading of individuals within a group or team did not adequately address training, experience, task frequency and duration, or other situational factors such that responsibility was inappropriately distributed.		**N**	
j) OP4J – Is there evidence that too few workers are assigned to perform a task that contributed to an issue? Job planning did not allot a realistic number of man-hours based on the scope of work described.		**N**	

O&P Worksheet			
Potential O&P Failure Modes (Causal Factors)	**Contributed to or Caused Event?**		**RC# AC # CC#**
	YES	**NO**	
k) OP4K – Is there evidence that an insufficient number of training or experienced workers were assigned to a task? Though the overall number of personnel assigned matched the planned man-hour allotment, organization methods failed to identify that personnel assigned did not have adequate experience or training to perform the work.		**N**	
l) OP4L – Is there evidence that there is a problem in perform repetitive tasks and sub tasks which contributed to a problem? Work flow plan repeated tasks or sub tasks to the detriment of successful completion of the evolution.		**N**	
m) OP4M – Is there evidence that there was a less than adequate process for a configuration change to a design document? Documentation generated as a result of a design change which renders the as-left configuration of affected components, structures and systems indeterminate.	**Y**		**CC1**
n) OP4N – Is there evidence that personnel exhibited insufficient awareness of the impact of actions on safety reliability because management failed to provide direction regarding safeguards against non-conservative actions by personnel concerning nuclear safety or reliability? Management failed to provide direction regarding safeguards against non-conservative actions by personnel concerning nuclear safety or reliability.	**Y**		Nuclear Culture Safety Assessment
o) OP4O – Is there evidence that the planning process was not coordinated with inputs from walk downs and task analysis? Job plan did not incorporate information gathered during field visits or task analysis concerning the steps and conditions required for successful completion of the task.		**N**	
p) OP4P – Is there evidence that previous industry or in-house operating experience was not effectively used to prevent problems and an event occurred because the information was not properly assimilated by the organization (missed opportunity)? Industry or in-house experience relating to a current problem existed previous to the problem, but was not assimilated by the organization (missed opportunity).		**N**	
5) **OP5X - Organizational Weaknesses** • **Inadequate function or structure** (poor internal organizational design that is missing vital functions) • **Inadequate attention to emerging problems** (organization doesn't pay attention to what is happening within it) • **Inadequate work prioritization** (organization doesn't prioritize their workloads so they waste time on unimportant things) • **Inadequate communication within the organization** (communication does not get up and down the organizational ladder) • **Inadequate job skills, work practices, or decision making** (organization had a problem because of its people)			
a) OP5A – Is there evidence of inadequate functions or structure which results in work not being performed due to a lack of organizational planning or inadequate staffing? Specific issues or work are not performed or addressed, usually due to a lack of organizational planning or inadequate staffing.	**Y**		**RC1**
b) OP5B – Is there evidence of inadequate attention to emerging problems? Repetitive organizational crises in morale, work practice, or repeat events, etc. The causes are usually associated with a lack of strong self assessment, strategic planning, and root cause processes. Additionally, inadequate vertical information flow to the decision makers in the organization and inadequate prioritization of work can contribute to a breakdown in this area.		**N**	
c) OP5C – Is there evidence of an inadequate work prioritization process? Normally associated with staff work overload, over-run of the committed budget, and increasing backlog of work items. It is usually caused by inadequate work prioritization and inadequate vertical communication of the organization=s missions and goals.	**Y**		**RC1/ CC4**
d) OP5D – Is there evidence of inadequate communication within the organization? Important issues are not being addressed or a breakdown of normal work processes has occurred. Low staff morale is usually the long term result. Common causes for this include an inadequate information flow path, lack of a teamwork type of culture, or inadequate physical settings	**Y**		**RC1**
e) OP5E – Is there evidence of inadequate job skills, work practices or decision making? Generally evidenced by low morale and excessive human error rates. Causes usually include a punitive management style, inadequate supervision, training, staff qualification, or vertical communication, and conflicting or unreasonable organizational goals.		**N**	

O&P Worksheet			
Potential O&P Failure Modes (Causal Factors)	**Contributed to or Caused Event?**		**RC# AC # CC#**
	YES	**NO**	
f) OP5F – Is there evidence that corrective actions for previously identified problems or event was not adequate to prevent recurrence (failed to take meaningful corrective actions for consequential or non-consequential events)? Management failed to take meaningful corrective action for consequential or non-consequential events.		**N**	
g) OP5G – Is there evidence the supervisor was not properly notified of a suspected problem? A problem requiring verbal communication with supervision arose, but was not verbally communicated to the supervisor.		**N**	
h) OP5H – Is there evidence of that pertinent information is not being properly transmitted verbally between the transmitter and the listener and vice versa? The sender failed to verbally transmit information to the listener. This requires a sender and listener to be present, and is regardless of either individual's position in management chain.		**N**	
i) OP5I – Is there evidence that there are too many administrative duties assigned to supervisory staff to properly perform supervisory activities? The administrative load on immediate supervisors adversely affected their ability to supervise ongoing activities		**N**	
j) OP5J – Is there evidence that there is insufficient supervisory resources to provide the needed supervision to plant personnel? Supervisions resource is less than that required by task analysis considering the balance of procedures, supervision and training.		**N**	
k) OP5K – Is there evidence that there is insufficient manpower to support the identified goals and objectives of the plant? Personnel are not available as required task analysis of goal/objective.		**N**	
l) OP5L – Is there evidence that sufficient resources are not provided to ensure adequate training is provided and maintained? Training resources are not available as required by task analysis.		**N**	
m) OP5M – Is there evidence that there is not adequate availability of appropriate materials and tools to do the job? A process for supplying personnel with appropriate materials or tools did not exist.		**N**	
n) OP5N – Is there evidence that there is not a means provided for ensuring adequate equipment and quality/reliability/operability for personnel equipment? A process for ensuring personnel's equipment was satisfactory did not exist.		**N**	
o) OP5O – Is there evidence that personnel selection did not ensure an appropriate match to ensure a motivation for the worker? Personnel selection processes failed to determine a mismatch between motivation and job description prior to task.		**N**	
p) OP5P – Is there evidence that tasks and individual accountability were not made clear to the worker? Tasks (and the individual accountability for the task) that were outside written guidance or training were not made clear to the worker.	**Y**		
q) OP5Q – Is there evidence that the progress and status of task is not adequately tracked by supervision? Supervision did not take the appropriate actions to monitor the task progress or status.	**Y**		**RC1**
r) OP5R – Is there evidence that there is not an appropriate level of in-task supervision planned prior to the task being performed? Supervision did not adequately assess the task for points of supervisory interaction prior to assignment to workers.		**N**	
s) OP5S – Is there evidence that direct supervisory involvement in the task interfered with the overview role of supervision? Supervision became so involved with the actual task steps that overall command and control were adversely affected		**N**	
t) OP5T – Is there evidence that emphasis on the schedule had an impact on doing a quality job and accepted standards were not met as a result of this emphasis? Accepted standards for methods were not met due to supervision's focus on completing the activity within a certain time frame.	**Y**		**RC1**
u) OP5U – Is there evidence that job performance and self checking standards were not properly communicated to the organization performing the work prior to the job being performed? Supervision failed to adequately communicate how standards for job performance and self-checking could be applied to the actual job at hand		**N**	Covered by OP5P

O&P Worksheet			
Potential O&P Failure Modes (Causal Factors)	**Contributed to or Caused Event?**		**RC# AC # CC#**
	YES	**NO**	
v) OP5V – Is there evidence that too many concurrent tasks were assigned to the worker that were beyond the individual's abilities? Supervision failed to detect that concurrent job assignments for an individual exceeded the individual's abilities.		**N**	
w) OP5W – Is there evidence that there is frequent job or task shuffling without adequate time to shift attention away from the previous task? Supervision transferred a worker from one task to another without adequate time to shift attention away from previous task.		**N**	
x) OP5X – Is there evidence that supervision did not consider the worker's need to use a higher order of skills that consider the workers talents and strengths? Supervision did not consider the worker's talents or innovative strengths that could be used to perform more challenging work.		**N**	
y) OP5Y – Is there evidence that worker assignments did not consider the worker's previous task? Supervision did not adequately assess the previous task's impact upon the worker's ability to implement the current task.		**N**	
z) OP5Z – Is there evidence that a workers assignment did not consider the worker's ingrained work patterns and necessary work patterns for successful completion of the current task? Supervision failed to assess the incompatibility between worker's ingrained work patterns and necessary work patterns for successful completion of the current task.		**N**	
aa) OP5AA – Is there evidence that there is too an infrequent contact with the workers to detect work habit and attitude changes? Supervision not aware of deviation from desired work habits/attitudes due to lack of interaction with personnel.		**N**	
bb) OP5AB – Is there evidence that supervision provides feedback on negative performance of an individual but not on positive performance? Worker's performance adversely affected by supervision's focus on negative performance feedback.		**N**	
cc) OP5AC – Is there evidence of a lack of teamwork as a result of inadequate training content? Training content did not adequately address actions individuals must take in order for the crew or team as a whole to be successful.		**N**	
dd) OP5AD – Is there evidence of a lack of evaluation of risk and consequences prior to making a change that would have an adverse impact as a result of the change? Elements of the process change were not recognized as having adverse impact or increased risk of adverse impact prior to implementing the change.	**Y**		**RC1**
ee) OP5AE – Is there evidence that personnel exhibited insufficient awareness of the impact of actions on safety and reliability? Management failed to provide direction regarding safeguards against non-conservative actions by personnel concerning nuclear safety or reliability.	**Y**		**RC1**
ff) OP5AF – Is there evidence that causes of a previous event or known problem were not determined? Analysis methods failed to uncover the causal factors of consequential or non-consequential events.		**N**	
gg) OP5AG – Is there evidence that a response to a known or repetitive problem was untimely? Corrective action for known or recurring problems was not performed at or within the proper time.		**N**	
hh) OP5AH – Is there evidence that needed changes were not approved or funded that resulted in a plant problem? Corrective actions for existing deficiencies that were previously identified were not approved or funded.		**N**	
ii) OP5AI – Is there evidence that a means was not provided to ensure procedures and documents are of adequate quality and up to date? A process for changing procedures or other work documents to ensure quality and timeliness was nonexistent or inadequate.		**N**	
jj) OP5AJ – Is there evidence that planning was not coordinated with inputs from walk downs and task analysis? Job plan did not incorporate information gathered during field visits or task analysis concerning the steps and conditions required for successful completion of the task.		**N**	

Attachment 8 - Maintenance Crew Statements

Statement #1

Date: October 5th, 2011 Event Date: September 25th, 2011
To Whom It May Concern:

I would like to start this statement by stating the fact that there have been 10 day's since the event and in that waiting period there have been lot's of speculation, misleading information, rumors, and emotional feeling's that have now affected site personnel's thoughts as well as mine. I do feel that this 10 day waiting period has been too long to clearly recall the exact event without some slight influence from conversation's and meetings on what had transpired that day. Therefore this is how the day of the event unfolded to the best of my knowledge.

Started Sunday morning 9-25-11 with turnover from nightshift on temp mod package for 72-127 we had to wait until the supervisor arrived, after supervisor arrived a prejob brief was conducted, the brief went over work instructions, critical steps, human performance tools to be used, safety concerns and was the pre job brief form that the previous shift had filled out. We went over everything that was on the pre job brief form. The brief was held with the supervisor, engineering and acting maintenance manager present, there may have been others there but I can't recall and then had a briefing with ops. The temp mod was implemented and performed without incident.

After lunch on 9-25-11 a prejob brief was performed on the three work packages for inspect and replace breakers 72-119, 72-120, 72-121 and 72-123, the prejob brief was conducted with repairmen, engineering, electrical supervisor, acting maintenance manager, the duty station manager and the NRC present. The briefing was conducted discussing detailed work instructions, safety concerns and the human performance tools to be used, however the brief was performed from memory without using a prejob briefing checklist. After the briefing everyone went out to the ED-il panel, we conducted a job site review with our yellow cards. Performed live dead live on breakers that we needed to remove sat. I determed breaker 72-120 and removed breaker, then engineering and supervisor and NRC inspected bus. I then removed breaker 72-i 19 and engineering and supervisor and NRC inspected cubicle and bus. I then removed 72-121 and engineering and supervisor and NRC inspected cubicle and bus. I then removed 72-123 and engineering and supervisor and NRC inspected cubicle and bus. 72-119 top bus bar had thread damage and the work instruction step 4.7.7 stated as needed clean and tighten bus bar connections including chasing threads and replacing fasteners, we discussed with supervisor, acting maintenance manager and engineering how to chase threads on the live bus and we were told that our work instruction step allowed us to remove bus bar stab off of the live bus because we didn't want to chase threads on a live bus and the reasons were #1 the metal shavings could short out the bus #2 we don't have an insulated thread chaser. It was discussed by repairmen how to remove the bus bar and retain positive control of the Philips head bus bar retaining screw so that it wouldn't fall into the bus, the decision was to hold the screw with an insulated screw driver and the bus bar to be held

with an insulated gloved hand. I was on the left side of _____ when he was in position to remove bus bar, he had the insulated screw driver on the retaining screw and his insulated gloved hand on the bus bar and with positive pressure on the screw to loosen, he began to loosen the screw when I saw an arc near the retaining screw and so did _____, he reacted and pulled his hands out of the panel with the thought that it was blowing up in his face, he was trying to protect his face and possibly his life, that is when the bus bars came in contact with each other and shorted out.

Statement #2

7:00AM 9-25-2011
Received a detailed turnover from C-shift of work to be performed, events that led up to this point.
Supervisor was scheduled to be in at 8:00AM so we waited until he arrived to brief the day's work.
Tried with help of engineering's help to find some kind of detail on panel construction, were not able to find any. Held brief with 3 electricians, supervisor and engineering on work for the day. Temp mod, breakers to be removed, engineering's role, etc. Installed temp mod, finished before lunch.
Lunch break Briefly talked about breaker removal and the points at which engineering would step in to evaluate and take pics etc.

Removed 72-120 breaker, Eng. evaluated and took pics. Noted gap between the copper bus bar and
breaker. With approval from supervisors and engineering checked breaker mounting screw to see if it
was loose, it was not.Removed 72-119 breaker noted the threads to the copper bar in question needed to be chased. This isthe point when it was decided that the bar needed to be removed and taken to shop for repairs.

We continued removing removing breakers 72-121 and 72-123 at the request of our supervisor. As with the other 2 breakers engineering did there evaluating as we removed them.
At this point we (electricians) dicussed how to to safely remove piece of busbar decided on the method we used. I then donned my low voltage gloves and insulated screwdriver and when I started to loosen screw is when I saw arcing and reacted.

Statement #3

Statement of events on Sunday September 25th 2011

I arrived to work at 08:00 on Sunday, and received a face to face turnover with electrical maintenance superintendent, It was discussed that we would first install a temp mod to provide alternate power to the generator voltage regulator and then the sequence of the breaker removal and install of he the DC breakers located in panel D-11-2 was discussed including the importance of insulating the positive and negative buss bar standoffs to prevent

an electrical short. The repairmen were briefed and ready to install the temp mod to provide alternate power to breaker 72-121 which provides control power to the generator voltage regulator. I then reviewed the TM to have an understanding of the work involved and had a short informal brief with the three repairmen to ensure we all understood the TM installation and what the repairmen's rolls and responsibilities would be. A briefing was then conducted in the control room with the shift manager, control room supervisor and the shift engineer to discuss our work and to establish communications with the control room in the event of an issue occurring during the work. The critical steps discussed were validating that the polarity of the DC power was the same between the temp power and the power currently feeding the voltage regulator. After the brief in the control room work commenced at the temp mod was installed
successfully at 11:00. At approximately 13:00, planning had completed the three work orders to remove and inspect the four breakers in panel D11-2. A pre-job brief was held with electrical maintenance, engineering, the acting maintenance manager, duty station manager, and the NRC to discuss the sequence of the work, safety and human performance tools to be used. It was discussed "what is the worst thing that can happen" and we discussed a short circuit event and that insulating the buss connection stabs would be the method to prevent this. After the completion of the brief, I asked around the table if anyone had any questions or concerns and no one had further input. Work shortly commenced at the D-11-2 panel after an additional brief with the control room and the work orders were taken to working. The sequence of events was to first remove breaker 72-120 and to inspect the connection points between the line side stabs of breaker 72-119 and the positive and negative bus bars and then to continue down the panel and remove breaker 72-121 and then 72-123. Upon the removal of 72-120 and a 1/16 of an inch air gap was found between the positive line stab of 72-119 and the positive buss bar stand off, this was due to a cross threaded connection screw. Breakers 72-121 and 72-123 were then removed with no additional issues found. After discussion with engineering and the repairman the decision was made to remove the positive and negative standoffs to repair the threads on the positive connection stap and then to swap the positive and negative standoffs so that breaker 72- 119 would not have a repaired mounting hole. This meant breaker 72-120 would now have the repaired hole at the connection between the negative line side stab of the breaker, this was determined because 72-120 is a spare breaker. The work instruction note stated to support or insulate the buss bar stand offs to prevent an electrical short. While it was discussed in previous briefings that insulation would be used two repairmen felt they could retain positive control of the standoff and remove it safely. This action was not discussed with me prior to removing the positive bus bar. Standing behind the work boundary I was observing _____ remove the positive bus bar when he lost control and the short occurred. At this point the plant tripped, shortly after we were asked to remove the fault from the panel D11-2 so operations could attempt to restore DC power. After the event _____ conducted a fatigue assessment and I then escorted _____ to the emergency room for fitness for dutytesting.

Statement #4

Plant tripped 9-25-11 statement date 10-5-11 Prejob brief attendance maintenance crew, supervisor, NRC, duty station manager, asst maint mgr, and two design engineers. talked about the job and what we were going to do, we removed 72-119 and found a cross threaded screw it was thought to be the smoking gun everybody that was in the brief came a crossed

the boundary to see even the shift manger, this went on for each breaker that was removed 4 total we didn't have any new buss stabs so we were going to swap the spare breaker stabs which had good holes with the breaker with the bad holes. The job was going well and the NRC left we looked at the work plan and it gave us direction to support the stab and remove it, the hot stab was then supported with a tested voltage gloves and the screw loosened an arc was seen and the stab was let go of, letting the positive stab fall into negative stab at no time did any body see the danger before us or we wouldn't have done it. My role in this job was handing tools to the teem handing tape anything that would make the job go as expected

WHY STAIRCASE

Problem statement: On September 25, 2011, at 1506, while performing maintenance activities on DC electric distribution panel D-11-2, a short circuit condition occurred resulting in reactor trip.

Why? Reactor tripped due to loss of power to two-of-four RPS channels
Why? Loss of left train DC Bus results loss of power to channels A & C

Why?1 Shunt trip breaker 72-01 opened
Why?1 Latent Design Issue

Why?2 D-11-2 short resulted in Bus trip
Why?2 Loose stab dropped causing short
Why?2 No insulation protection for bus
Why?2 Workers decided insulation was not needed
Why?2 Workers and supervision did not stop and question

Why?2.1 Workers rationalized "skill of craft"
Why?2.1 Workers did not recognize risk to themselves or to the plant
Why?2.1 Common practice to work on energized equipment
Why?2.1 Work on energized equipment considered low risk

Why?2.2 Supervision did not recognize risk and ensure insulation was in place
Why?2.2 Work not characterized as risk to workers or plant
Why?2.2 Plant EOOS assessment of risk incomplete
Why?2.2 EOOS result not questioned by management
Why?2.2 Management not always recognizing or managing risk
Why?2.2 Management not sensitive to risk
Why?2.2 Senior management has not ensured the plant culture is risk sensitive

Attachment 4

SDP Assessment of DC Panel D11-2 Fault

EA-PSA-SDP-D11-2-11-07, Revision 1

227 Pages Follow

Entergy	EA-PSA-SDP-D11-2-11-07	Revision: 1
	Date: 01/05/2012	
	Number of Pages: 152	
Title: **SDP Assessment of DC Panel D11-2 Fault**		
Approval: See signature page.		

Purpose

This engineering analysis assesses the significance of the dc panel fault and subsequent plant trip that occurred on 09/25/2011. Inadequate maintenance work instructions led to a short within dc panel ED-11-2. Contrary to intended design, the fuse between ED-11-2 and dc bus ED-10L/ED-10R failed to provide adequate protection and did not isolate the panel from the bus. This resulted in the loss of ED-10L/ED-10R and subsequent plant trip.

Conclusion

Based on reviews of the event timeline, plant design and response, operator responses, plant-specific thermal-hydraulic analyses, potential human errors and logic model quantification, the following conclusions were reached:

- Plant risk during the event increased. The increase in the conditional core damage probability given the dc panel ED-11-2 fault and subsequent plant trip is evaluated to be 4.3E-6, and is considered WHITE.
- The risk increase is driven by scenarios in which the lost train of dc power is not recovered. When combined with other failures, this could result in a loss of secondary side cooling via the steam generators, failure to refill the condensate storage tank to provide long term cooling, failure to cool down and transition to shutdown cooling, and the failure of once-through-cooling as a last resort for decay heat removal, and ultimately core damage.
- The risk increase is also comprised of scenarios in which charging pumps are not isolated in time to prevent a challenge to pressurizer safety relief valves, resulting in a potential loss of coolant accident if one or more relief valves sticks open. Failures to mitigate this consequential event can then lead to core damage.
- A stuck open pressurizer safety relief valve is classified as an above core, vapor space LOCA. For these scenarios, as long as secondary side cooling is available for decay heat removal the transient does not necessarily require high pressure safety injection to preclude core damage. If auxiliary feedwater remains available, the core survives the initial blowdown and inventory

makeup from charging is sufficient to maintain primary coolant system inventory and preclude core damage. Long term heat removal via the steam generators (or transition to shutdown cooling) then becomes a success path, even when a SRV sticks open – provided a nominal level of inventory makeup is available (e.g., via charging with SIRWT inventory conserved by terminating sprays, or via HPSI in recirculation mode once SIRWT inventory is depleted).

- Realistic and justifiable human error probabilities were used for fault-related recoveries. Use of conservative human error probabilities increases the conditional core damage probability. The increase in delta conditional core damage probability is 6.0E-06 for the event, and is still considered WHITE.
- Steam generator overfill was precluded during this event by isolating steam to the turbine driven auxiliary feedwater pump and limiting flow from AFW pump P-8C via flow control valves. Failure to do so could have resulted in steam generator overfill and the loss of the turbine driven auxiliary feedwater pump. The failure to restore the pump if needed was considered and did not contribute significantly to the risk.

Note: This engineering analysis is not a 10 CFR §50.2 design basis analysis and the results and conclusions of this analysis do not supersede those of any design basis analyses of record. The biases and degree of conservatism embodied in the methods, inputs and assumptions of this analysis may not be appropriate to support all plant activities. An appropriate level of engineering rigor commensurate with the safety significance of the topic under consideration is ensured in this analysis by conformance with all applicable Entergy procedures.

Table of Contents

1.0 PURPOSE

This engineering analysis assesses the significance of the dc panel fault and subsequent plant trip that occurred on 09/25/2011. Inadequate maintenance work instructions led to a short within dc panel ED-11-2. Contrary to intended design, the fuse between ED-11-2 and dc bus ED-10L/ED-10R failed to provide adequate protection and did not isolate the panel from the bus. This resulted in the loss of ED-10L/ED-10R and subsequent plant trip.

Specifically, this analysis evaluates the conditional core damage probability given the fault event, fault propagation, impacted components, and potential recoveries. The conditional core damage probability includes consideration of additional random component failures and recovery actions that might have been unsuccessful. This analysis addresses the dc panel ED-11-2 fault. Only the single (internal) initiating event under the conditions that occurred is evaluated. This analysis does not address accident initiators from other internal events, internal flooding, or external events (high winds, tornadoes, internal fires, etc).

2.0 CONCLUSION

Based on reviews of the event timeline, plant design and response, operator responses, plant-specific thermal-hydraulic analyses, potential human errors and logic model quantification, the following conclusions were reached:

- Plant risk during the event increased. The increase in the conditional core damage probability given the dc panel ED-11-2 fault and subsequent plant trip is evaluated to be 4.3E-6, and is considered WHITE.
- The risk increase is driven by scenarios in which the lost train of dc power is not recovered. When combined with other failures, this could result in a loss of secondary side cooling via the steam generators, failure to refill the condensate storage tank to provide long term cooling, failure to cool down and transition to shutdown cooling, and the failure of once-through-cooling as a last resort for decay heat removal, and ultimately core damage.
- The risk increase is also comprised of scenarios in which charging pumps are not isolated in time to prevent a challenge to pressurizer safety relief valves, resulting in a potential loss of coolant accident if one or more relief valves sticks open. Failures to mitigate this consequential event can then lead to core damage.
- A stuck open pressurizer safety relief valve is classified as an above core, vapor space LOCA. For these scenarios, as long as secondary side cooling is available for decay heat removal the transient does not necessarily require high pressure safety injection to preclude core damage. If auxiliary feedwater remains available, the core survives the initial blowdown and inventory makeup from charging is sufficient to maintain primary coolant system inventory and preclude core damage. Long term heat removal via the steam generators (or transition to shutdown cooling) then becomes a success path, even when a SRV sticks open – provided a nominal level of inventory makeup is available (e.g., via charging with SIRWT inventory conserved by terminating sprays, or via HPSI in recirculation mode once SIRWT inventory is depleted).
- Realistic and justifiable human error probabilities were used for fault-related recoveries. Use of conservative human error probabilities increases the conditional core damage probability. The increase in delta conditional core damage probability is 6.0E-06 for the event, and is still considered WHITE.

- Steam generator overfill was precluded during this event by isolating steam to the turbine driven auxiliary feedwater pump and limiting flow from AFW pump P-8C via flow control valves. Failure to do so could have resulted in steam generator overfill and the loss of the turbine driven auxiliary feedwater pump. The failure to restore the pump if needed was considered and did not contribute significantly to the risk.

3.0 BACKGROUND

3.1 Event Summary

On 09/25/2011, Palisades experienced an automatic reactor trip due to loss of power to 2 of 4 reactor protection system channels due to loss of power to preferred ac buses EY-10 and EY-30. Loss of power to dc bus ED-10L/ED-10R and consequently preferred ac buses EY-10 and EY-30 was the result of maintenance activities in dc panel ED-11-2. The maintenance activities caused a short in ED-11-2 and actuation of shunt trip breaker 72-01 on over-current protection. The consequence of these events was loss of power to dc buses ED-10L and ED-10R and loss of power from preferred ac buses EY-10 and EY-30.

No actual safety consequences resulted from this event. System response was as expected given a loss of one train of dc power. Right channel safety injection initiated immediately. Left channel safety injection initiated when EY-30 was placed on the bypass regulator. High and low pressure safety injection operated but did not inject since primary coolant system pressure remained above shutoff head. The opposite train of dc power remained available throughout the event.

The significant grounding event on dc panel ED-11-2 disclosed a latent coordination issue: the shunt trip breaker 72-01 opened, disconnecting the battery from the dc bus. The event also caused an internal fault in in-service #1 charger ED-15. The combination of events de-energized the dc bus resulting in loss of power to dc panels ED-11-1, ED-11-2, #1 inverter ED-06 and #3 inverter ED-08. Loss of power to the inverters resulted in loss of power to two preferred ac panels (EY-10 and EY-30). Opening of breaker 72-01 was not expected as the design for this breaker required that breaker operation only be available via remote push button.

See Attachment 01 for a detailed event time line.

3.2 Maintenance Initiating Event Summary

Breaker 72-120 was the first breaker removed from panel ED-11-2. Upon removal, a small air gap between the positive bus tie stab and the line side positive connection on breaker 72-119 was noted. An initial attempt was made to tighten the connection and close the identified air gap. The termination screw was found to be tight. The air gap was a result of a cross threaded screw, preventing the termination to be made tight. Following the removal of breakers 72-119, 72-121, and 72-123 the decision was made to remove the positive and negative copper connection stabs used to connect breakers 72-119 and 72-120 to the vertical bus; and to re-tap the damaged threads located on the copper connection stab as a result of the cross threaded screw.

As the positive copper connection stab was being removed, the repairman perceived a small arc which startled him resulting in a loss of control to the positive copper connection stand stab. The positive copper connection stab rotated downward and contacted the negative copper connection stab creating a direct short of the positive and negative dc bus within the ED-11-2 panel. Subsequently the reactor tripped following a loss of power to ED-11-2 panel.

Figures 3-1 and 3-2 below show the configuration of dc panel ED-11-2 just prior to and following the event.

Since the event was the result of a maintenance activity, personnel qualified to determine the extent of condition with respect to the fault and electrical component failures were present to carry out the recovery actions. Buses ED-10L and ED-10R were re-energized from station battery ED-01 within about 50 minutes.

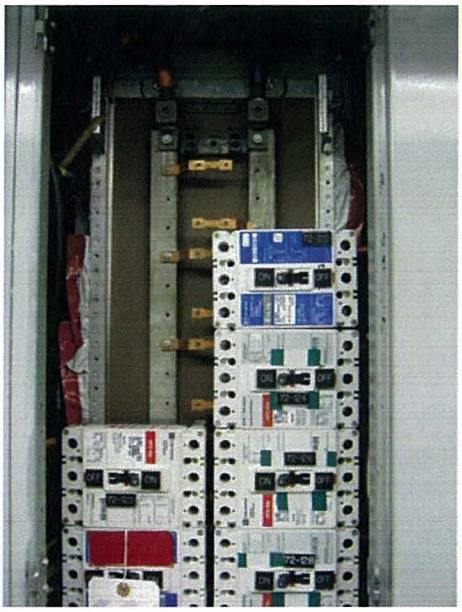


Figure 3-1: DC Panel ED-11-2 – Just Prior to Event

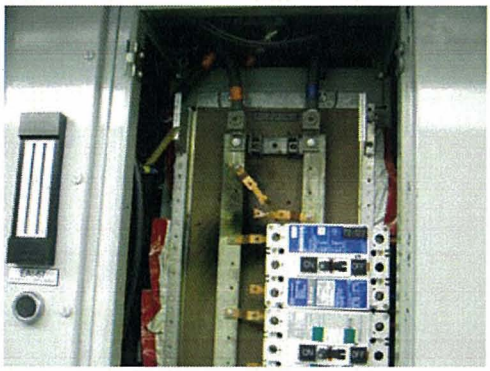


Figure 3-1: DC Panel ED-11-2 – After Fault Event

3.3 Latent Coordination Issue Summary

See Attachment 02 for a discussion of expected and actual dc breaker and fuse coordination.

3.4 Evaluation Context

The 09/25/2011 event revealed two performance deficiencies: (1) inadequate work instructions that led to a maintenance-induced dc panel fault, and (2) inadequate breaker/fuse coordination between a dc panel and bus that led to propagation of the dc panel fault to the dc bus.

A human performance deficiency (inadequate work instructions) caused a fault of sufficient magnitude to expose the latent breaker coordination deficiency. The short circuit current at the dc panel was sufficient to actuate dc breaker 72-01 internal trip function. The breaker actuation is a coordination issue since the fuse from dc panel ED-11-2 should have isolated the fault condition from dc bus ED-10L/D10-R. Actuation of breaker 72-01 removed the battery as one source of power to dc bus ED-10L/ED-10R and contributed to the total loss of power to the bus.

This analysis evaluates the risk incurred during the post-event response. The human performance deficiency created a condition in which breaker 72-01 opened. Therefore this analysis models breaker 72-01 as open (unless successfully restored). The evaluation models the reactor trip event as a direct consequence of the human performance event, by setting the transient event frequency to unity.

The consequence of the human performance deficiency alone (without the breaker coordination deficiency) would have been isolation of the dc panel from the dc bus with the bus and the remaining loads continuing to be energized. However, the active (latent) trip mechanism in breaker 72-01 resulted in disruption of the existing coordination.

Breaker 72-01 opened prior to fuse FUZ/D11-2 resulting in disconnection of battery ED-01 from bus ED-10R. Subsequently an internal fault in the in-service #1 battery charger ED-15 actuated to disconnect the panel fault from ac power supply MCC #1. Additionally the panel fault also caused at least one breaker to open: breaker 72-37 to #1 inverter ED-06 supplying preferred ac bus EY-10.

Recovery from this event required identification of the fault condition (obvious in this case) and removal of the fault and or isolation of the fault from the dc bus. Once the fault was isolated individual components (battery chargers and inverters) were assessed for operability to allow restoration of power to the dc bus.

Initially, preferred ac bus EY-30 was restored by aligning power to it from the bypass regulator (redundant to the inverter and supplied by instrument ac panel EY-01). Next, buses ED-10R & ED-10L were declared operable and re-energized from the battery by closing breaker 72-01. Once the dc bus was energized, power to preferred ac bus EY-30 was transferred back to #3 inverter ED-08 being supplied by the dc bus and power was restored to preferred ac bus EY-10 by aligning it to the bypass regulator. At this point the dc bus and both preferred ac buses were re-energized with portions of dc panel ED-11-2 not available.

3.5 Key Factors Impacting Plant Response

Based on the plant response to the ED-11-2 fault event, a review of the following factors represents an opportunity for improved operations and engineering training. The plant response and sensitivities discussed below are considered to be within the knowledge base of operations and engineering. However, the degree of sensitivity and the operational implications are worth noting here.

Identification of these factors was an indirect result of the risk assessment. Presentation here is for background purposes only. These factors underscore the complexity of the loss of dc event and provide a context for the successful operator actions during the event.

Note: all temperatures, pressures, levels and percentages are considered approximate in the discussions below.

3.5.1 Sensitivity of PZR level to PCS temperature changes

PCS temperature changes significantly impact pressurizer level.

For example, based on a PCS volume of 81,500 gallons (10,900 ft^3, FSAR Table 4-1) and the density change in water from 525°F to 544°F at 2060 psia (47.1 lbm/ft^3 to 48.3 lbm/ft^3), PCS volume changes by 109 gallons/°F. Based on volumes of 809 ft^3 and 593.7 ft^3 at levels of 57% and 42%, respectively [1], there are 107 gallons/%. This results in 1.02%/°F.

During this event from 16:03 to 16:15, PCS temperature increased from 529°F to 544°F. Even with charging and letdown isolated (charging was isolated at 15:57, with pressurizer level at ~80%; controlled bleedoff at 5 gpm), pressurizer level increased from 85% to 101.5% due to thermal expansion (see Attachment 01).

The observed increase agrees reasonably well with a prediction based the rates calculated above (i.e., 1.02%/°F and 107 gallons/%):

85% + (544°F - 529°F) * (1.02%/°F) - 5 gpm * 12 min / 107gal/% = 100%.