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October 31, 2023

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

Serial No. 23-284
VCS-LIC/JB R0
Docket No. 50-395
License No. NPF-12

DOMINION ENERGY SOUTH CAROLINA (DESC)
VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
REGULATORY CONFERENCE SUPPORTING DOCUMENTATION; (EA-23-093)

On October 4, 2023, DESC received Inspection Report 05000395/2023090 (Reference 1) documenting the preliminary significance determination of a finding and associated Apparent Violation (AV) 05000395/2023002-01 (EA-23-093). The inspection report states that NRC assessed the preliminary significance of the finding based on the best available information at the time of the NRC Significance and Enforcement Review Panel on September 13, 2023. By letter dated October 10, 2023 (Reference 2), DESC requested a regulatory conference to present additional information for consideration prior to NRC making a final significance determination for the finding.

The purpose of this letter is to provide information in support of the planned regulatory conference. Specifically, Attachment 1 provides a summary of the Apparent Violation, the direct cause, actions taken to date, and actions under development. Attachment 2 provides amplifying risk determination information which was not available to the NRC Significance and Enforcement Review Panel on September 13, 2023.

Should you have any questions, please contact Mr. Michael Moore, Manager, Nuclear Station Licensing, at (803) 345-4752.

Sincerely,

Eric S. Carr
President – Nuclear Operations and Chief Nuclear Officer
Dominion Energy

References:

1. Letter from L. B. Suggs (NRC) to E. S. Carr (DESC), "Virgil C. Summer Nuclear Station - NRC Inspection Report 05000395/2023090 and Preliminary Yellow Finding and Apparent Violation," dated October 4, 2023.
2. Letter from E. S. Carr to NRC Document Control Desk, "Dominion Energy South Carolina (DESC), Virgil C. Summer Nuclear Station (VCSNS) Unit 1, Request for Regulatory Conference," dated October 10, 2023.

Attachments:

1. Summary of Apparent Violation, Direct Cause, and Actions Taken and Under Development
2. V.C. Summer 'A' EDG 2022 Significance Determination

Commitments contained in this letter: None

cc: G. J. Lindamood – Santee Cooper
L. Dudes – NRC Region II
D. E. Dumbacher – NRC Region II
G. Miller – NRC Project Manager
NRC Resident Inspector

SUMMARY OF APPARENT VIOLATION, DIRECT CAUSE, AND ACTIONS TAKEN AND UNDER DEVELOPMENT

Apparent Violation 05000395/2023002-01

A self-revealed finding that has preliminarily been determined to be Yellow (substantial safety significance) and associated Apparent Violation (AV) of Title 10 of the Code of Federal Regulations Part 50, Appendix B, Criterion XVI, "Corrective Action," was identified when the licensee failed to identify and correct a condition adverse to quality for the Emergency Diesel Generator (EDG) fuel oil system that left the system vulnerable to piping cracks and eventually resulted in the failure of the 'A' EDG during testing on November 2, 2022. Specifically, inspectors determined that, based on the failure history of the EDGs and VCSNS's documented conclusions that attributed pipe cracks to prior maintenance events, VCSNS had sufficient information to identify the existence of a condition adverse to quality related to the design of the EDG fuel oil system.

November 2022 EDG Fuel Oil Leak

VCSNS understands that the Emergency Diesel Generators (EDGs) are risk significant equipment that require a high sensitivity to identification and correction of availability and reliability concerns. The station acknowledges the performance deficiency documented in the AV, has implemented short-term corrective actions to ensure EDG operability, and is working on planned long-term actions.

The direct cause of the 'A' EDG event on November 2, 2022, was a circumferential crack at the root of the last engaged male fuel oil pipe nipple thread. The crack propagated through-wall 140 degrees during a 24-hour surveillance run on November 2, 2022. VCSNS is currently performing a Root Cause Evaluation (RCE) to determine the organizational, process, and material aspects of the event.

Immediately following the November 2, 2022 event, the failed fuel oil pipe was replaced on the 'A' EDG. The EDG was then retested satisfactorily and returned to operable status on November 3, 2022. The associated fuel oil piping was replaced on the 'B' EDG on March 14, 2023. No fuel oil leaks have occurred on either EDG since the November 2, 2022 event.

VCSNS is currently pursuing an EDG fuel oil piping design change to improve the design margin of the system. Additionally, corrective actions will be assigned to correct any organization, equipment, and process issues identified in the RCE.

Attachment 2

V.C. SUMMER 'A' EDG 2022 SIGNIFICANCE DETERMINATION

Virgil C. Summer Nuclear Station (VCSNS) Unit 1
Dominion Energy South Carolina, Inc. (DESC)

REPORT

VC SUMMER A EDG 2022 SIGNIFICANCE DETERMINATION

PREPARED FOR

Dominion Energy
5000 Dominion Boulevard
Glen Allen, VA, 23060

Project #: 1FJJ35029
Date: October 17, 2023
Report # 35029-RPT-02, Revision 0

PREPARED BY

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Report #	*35029-RPT-02*	*Revision #*	*0*	*Total Pages*	*263*

Safety Class: (NQAPM)	☐ Safety Related		☐ Augmented Quality	☒ Non-Safety Related
Canadian Project Requirements (CQAPM)	☐ N/A	☐ N299.1	☐ N299.2	☐ N299.3
	☐ N299.4		☐ N286	☐ N286.7

☐ Preliminary ☒ Final

Client:	Dominion Energy		
Project No.	1FJJ35029		
Project Title:	VC Summer Inverter LAR PRA Support		
Report Title:	VC Summer EDG SDP Support		
Preparer:	PRINT NAME	SIGNATURE/DATE	
	Franklin Hope		2023.10.17 14:29:09-04'00'
Reviewer:	PRINT NAME	SIGNATURE/DATE	
	Meredith Blue		Digitally signed by Meredith Blue DN: C=US, E=mblue@jensenhughes.com, O=Jensen Hughes, CN=Meredith Blue Date: 2023.10.17 14:47:56-04'00'
Review Method:	☒ Design Review	☐ Alternate Calculation (attached)	☐ Testing (attached)
Review Type:	☒ Independent (Safety Related, Augmented, ASME)		☐ Peer Review
Does calculation contain unverified assumptions?		☒ No ☐ Yes	
Approver:	PRINT NAME	SIGNATURE/DATE	
	Francisco Joglar		Digitally signed by Francisco Joglar Date: 2023.10.17 15:42:08-04'00'

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Software Used:	*Verification + Approval Basis:*	*Software Analysis Type:*
☒ Yes ☐ N/A	☒ ASwL ☐ CASwL ☐ Project Specific (Attach Results) ☐ N/A ☐ Other (Attach justification and results)	If work is being performed under the authority of the CQAPM complete the checkboxes below **Probabilistic Risk Analysis** ☐ Yes ☐ No (If Yes, QF 4-201.4 Section A.1 only) **Design + Analytical Analyses** ☐ Yes ☐ No (If Yes, QF 4-201.4 Section A.1 & A.2 Required) ☒ N/A

Software Name	*Version*	*ASwL, CASwL Rev. # (if applicable)*	*Computer SN:/Name (or ID)*
FRANX	4.4	41	FHOPE5492
HRACalculator	5.1	41	MBLUE
CAFTA	6.0b	41	FHOPE5492
FTREX	2.0.0.1	41	FHOPE5492

Description of Revision

Initial Issuance

Notes

None

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Revision Record Summary

Revision	Revision Summary
0	Initial Issuance

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1.0 Introduction

V.C. Summer Nuclear Station (VCSNS) Condition Report 1211780 (Ref. 1) documents a condition where a small fuel oil leak developed at a fitting located above the #7 cylinder on Emergency Diesel Generator (EDG) A. Subsequently, the Nuclear Regulatory Commission (NRC) documented an apparent violation for which the NRC has not yet reached a preliminary significance determination (Ref. 2) as of the initiation of this report effort. The NRC noted that the licensee will be given an additional opportunity to provide additional information prior to the final significance determination unless the NRC review concludes that the finding has very low safety significance (i.e., green).

The apparent violation from the NRC inspection report states the following:

> *A self-revealed finding with significance to be determined (Pending) and associated AV of Title of the Code of Federal Regulations (10 CFR) Part 50, Appendix B, Criterion XVI, "Corrective Action," was identified when the licensee failed to identify and correct a condition adverse to quality for the EDG fuel oil system that left the system vulnerable to premature piping cracks and eventually resulted in the failure of the 'A' EDG during testing on November 2, 2022. Specifically, inspectors determined that, based on the failure history of the EDGs and the licensee's documented conclusions that attributed pipe cracks to prior maintenance events, the licensee had sufficient information to identify the existence of a condition adverse to quality related to the design of the EDG fuel oil system. This condition caused threaded fuel oil piping connections to be vulnerable to maintenance activities that over torqued, strained, or impacted the piping. Despite the challenge to maintain leak-tight connections and repeat occurrences of cracked piping, no significant changes were made to maintenance practices, procedures or system design, and the licensee continued to reactively monitor for leakage even after vulnerabilities were identified.*

A preliminary quantification to assess the risk impact of the condition was performed. During the cutset reviews performed for this quantification, it was identified that the quantification was overly conservative because many of the core damage sequences involved station blackout conditions where the model did not consider all of the mitigating equipment credited in the Loss of All ESF AC Power Emergency Operating Procedure (Ref. 3). Since the Fukushima-Daiichi nuclear accident in 2011, the US nuclear industry has invested significant resources in developing Diverse and Flexible Coping Strategies (FLEX) to mitigate a beyond design basis (BDB) event. The BDB strategies at VCSNS previously have not been included in the PRA model but are being introduced in this evaluation to provide a more realistic estimate of risk for this significance determination. The FLEX and B.5.b equipment and strategies discussed in this report are interchangeably referred to as BDB equipment and strategies since their regulatory function exists to comply with 10 CFR 50.155, Mitigation of Beyond Design Basis Events. In addition to the BDB strategy modeling, additional risk-reduction model refinements are included in this evaluation. However, these changes are relatively minor compared to the introduction of credit for BDB strategies.

Figure 1-1 and Figure 1-2 show the credited FLEX electrical strategies for establishing battery charging. As discussed in Section 5.1.2.2, the 80 kW Portable Diesel Generators, XEG0100, XEG0107, and XEG0108, are not credited in this analysis. Figure 1-3 and Figure 1-4 show the credited strategies for feeding the Steam Generators with water.

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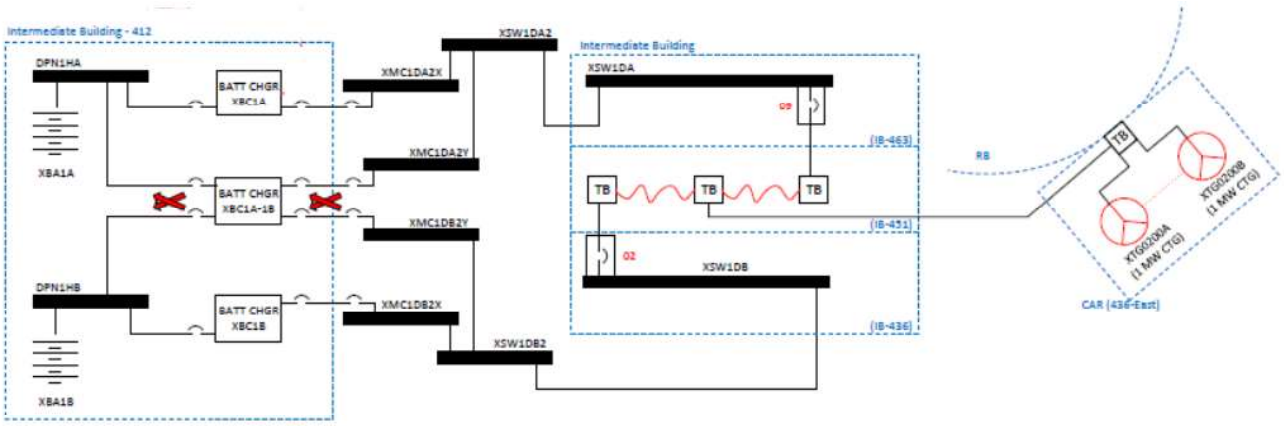

Figure 1-1 – Credited FLEX Electrical Strategy Using Combustion Turbine Generators

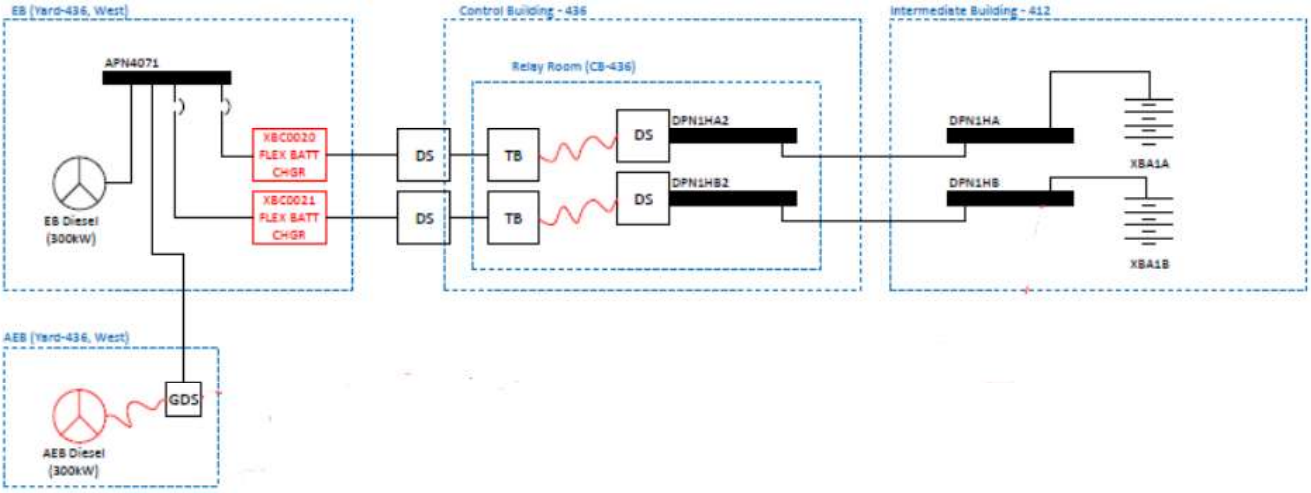

Figure 1-2 – Credited FLEX Electrical Strategies Using EB/AEB 300kW Diesel Generators

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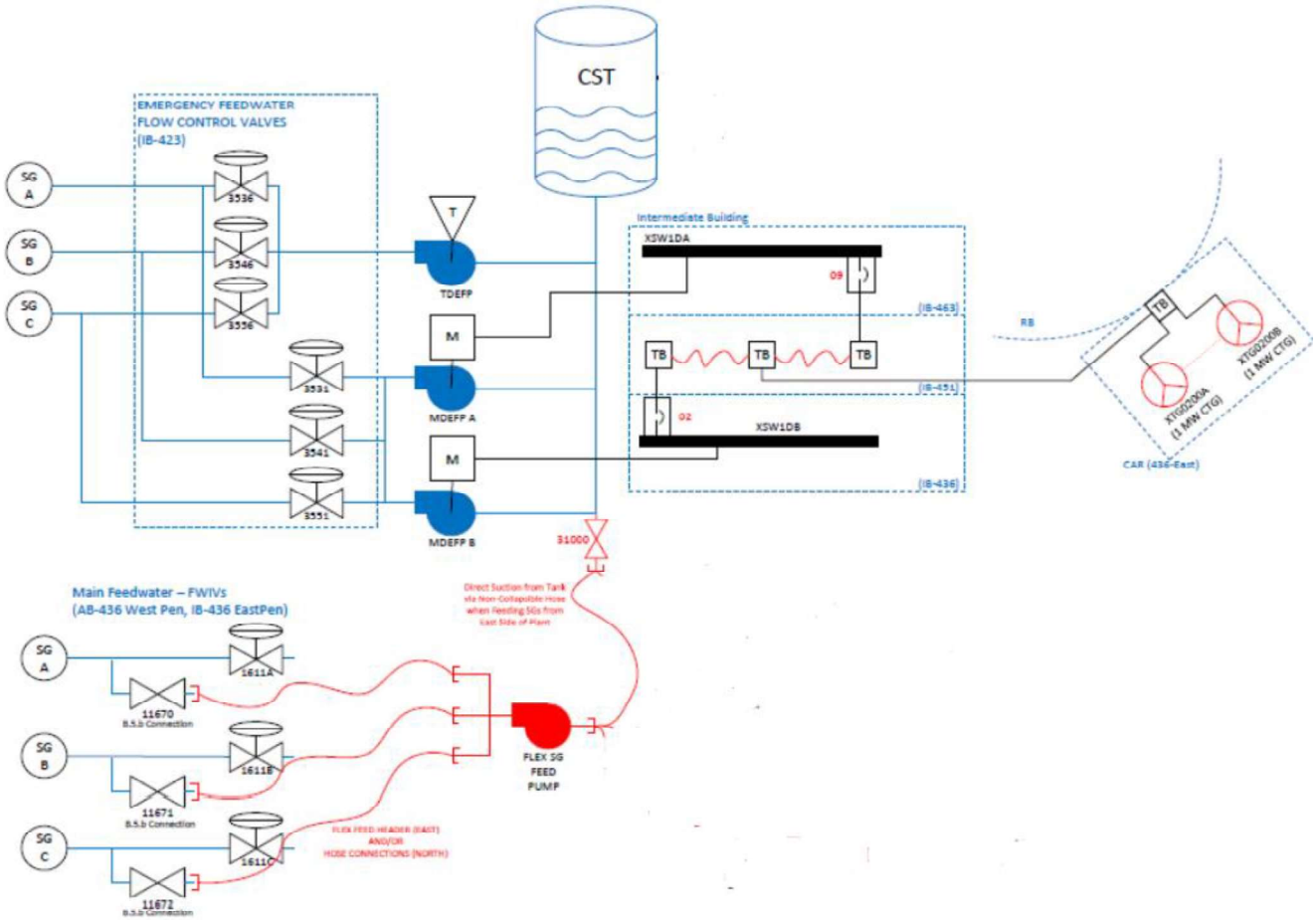

Figure 1-3 – Credited FLEX Decay Heat Removal Strategies using Combustion Turbine Generators OR FLEX SG Feed Pump

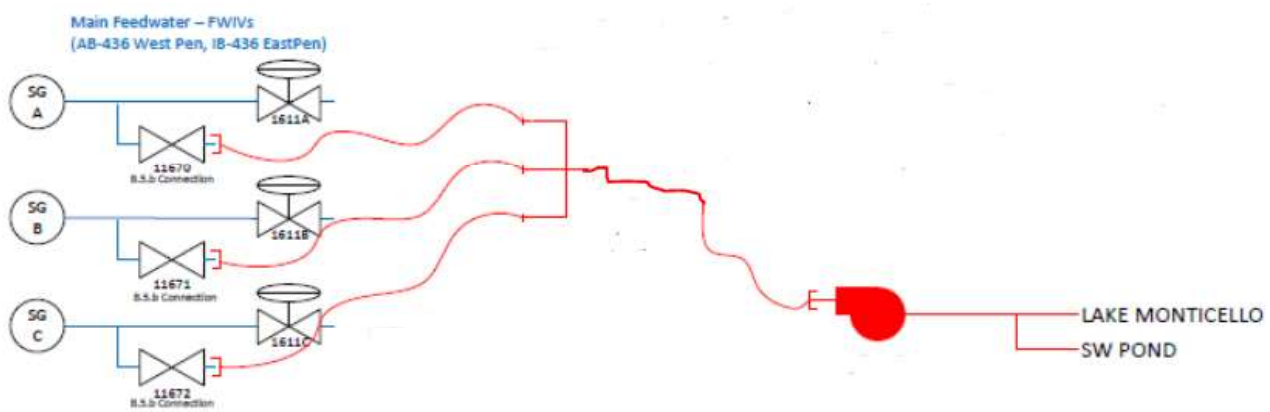

Figure 1-4 – Credited B.5.b Pumper Truck Decay Heat Removal Strategies

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2.0 Purpose + Scope

The purpose of this report is to update the VCSNS Fire PRA model to include mitigation strategies used in Emergency Operating Procedure (EOP)-6.0, Loss of All ESF AC Power (Ref. 3), and adjust the model to calculate the risk increase associated with the EDG A fuel oil leak documented in CR 1211780. The current PRA accident sequence and success criteria has not yet been updated to reflect revisions made to EOP-6.0 in support of compliance with post-Fukushima upgrades associated with 10 CFR 50.155. The VCSNS post-fire procedures are symptom-based procedures where Operations works through both the Emergency Operating Procedures and the Fire Abnormal Operating Procedures as necessary during and following a fire in the plant.

Additional refinements to reduce the calculated conditional increase in risk are also included in the scope of this report.

3.0 Assumptions and Limitations

The following assumptions and limitations were used to complete thisanalysis:

- The model updates documented in this report are specific to the Significance Determination Process (SDP) evaluation and do not represent updates to the Fire PRA model of record (MOR).
- The Fire PRA model used as a starting point for this evaluation is the model developed in support of PRA evaluation VC-22-00011 on March 23, 2023. This model includes fire modeling database (FMDB) updates through March 23, 2023, and was updated with current PC-CKS data (pulled June 28, 2023). Since the revision of FMDB used for the March 23, 2023 PRA evaluation, CR11271561 was written to evaluate the need to change the fire zone AB01.01.03 transient fire storage influence factor in accordance with DC0780B-001 and NUREG/CR-6850. This evaluation is not complete and is not included in the quantification. However, the results of the evaluation are not necessary to support this application as zone AB01.01.03 has a Conditional Core Damage Probability (CCDP) on the order of 10^{-7} with minimal PRA targets assigned to the zone. Any potential increase in fire scenario frequency will not materially impact the results due to the extremely low CCDP.
- The exposure time for the ΔCDF and ΔLERF calculation is assumed to be 169 days per Section 2.5 of the RASP Manual (Ref. 17) based on a log of the 'A' EDG run hours in 2022 provided from the EDG system engineer (Ref. 18). The exposure time was calculated by summing the run hours from when the EDG was secured on 11/2/2022 back until there was a total of 24 run hours. This calculation is in tab "A EDG Run Time" of Attachment C (Ref. 19). Therefore, the exposure time was from 5/17/2022 to 11/2/2022 which is 169 days. The NRC SPAR analysis documented in Ref. 21 used a slightly lower exposure time of 162 days.
- The identified minor EDG A fuel oil leakage is postulated to increase as the diesel run time increases such that the EDG is assumed to fail after six hours of run time. The diesel was secured after 365 min (6.08 hr) of operation on 11/2/2022 after Operations staff witnessed increasing leakage from 90 mL/min to 200 mL/min. The diesel generator was still functioning at 365 min when it was secured and tagged out for repair (Ref. 1). Although six hours of run time is assumed, the diesel would have been able to continue functioning past the six hours. The NRC SPAR analysis documented in Ref. 21 assumed a longer diesel run time of nine hours during the last interval of the exposure window.
- Failure data for FLEX system combustion turbine generators (CTGs), diesel generators and diesel-driven pumps is obtained from PWROG-18042-NP (Ref. 5) as recommended by the NRC staff (Ref. 6). Common cause failure data is obtained from INL/EXT-21-62940 (Ref. 7) for equipment with no prior CCF data

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derived, which is also consistent with the NRC staff recommendation for FLEX data treatment (Ref. 6). The mission time of FLEX equipment is assumed to be 15 hours unless the equipment is used throughout the entire coping time or designed to start automatically on a loss of offsite power (e.g., EB diesel generator) where a 24 hour mission time is used. FLEX equipment is only credited for sequences where the SBO condition occurs six hours following a loss of offsite power. A 15 hour mission time represents the run time of BDB equipment if the equipment is staged and connected to the plant within three hours following the Station Blackout initiation.

- The installed diesel-driven air compressor is not credited as a bounding conservative simplification in the FPRA model. Therefore, operation of Steam Generator Power Operated Relief Valves (PORVs) is assumed to occur locally.
- Based on the MAAP analysis performed for this evaluation (Ref. 11), the success criteria and HRA timing are based on Operators feeding a single Steam Generator. The procedure guidance instructs Operators to perform a symmetric cooldown and feed all three Steam Generators, but only one of the three Steam Generators is required for success.
- The BDB Steam Generator Feed strategies include procedural guidance for multiple connection points. Only the primary connection point is modeled for simplicity. Likewise, only the CST suction source connection is modeled for the FLEX SG Feed pump. The manual valves and check valves (where installed) at the connection are modeled as a source of potential failure. In reality, Operators could reposition hoses at one of the alternate connection points if the primary connection is not available.
- The human failure event developed for the FLEX SG Feed Pump is assumed to be applicable to the Pumper Truck strategy. Both strategies involve staging a portable pump to inject water into the same feedwater connection. The suction of the FLEX SG Feed Pump is assumed to be connected to the CST, while the suction of the Pumper Truck is connected to either the lake or the fire main. These connections and Steam Generator depressurization strategies have similar procedural actions and guidance such that the development of two separate HFEs is not necessary. The MAAP analysis documented in Ref. 11 demonstrates that there is 5.5 hours available to depressurize and deliver feedwater to the Steam Generators using either strategy. Therefore, minor differences in deployment times would not materially impact the human error probability result since significant margin exists between the deployment time and the limiting time at which feedwater is required. This bounding timing is developed based on an assumed loss of TDEFW initially at the onset of the station blackout.
- Following declaration of an ELAP, FSP-5.0 instructs operators to refer to FSP-20.1, Vital Area Emergency Ventilation to establish ventilation to critical areas. The FSP-20.1 procedure involves initially opening doors to provide natural ventilation followed by deployment of fans for forced ventilation. Control Room ventilation is screened from the Fire PRA model of record and is not included in the FLEX modeling since indication required to support operator actions for low pressure SG feed is assumed to be obtained locally using portable gauges. When repowering plant equipment using the CTGs, the existing Fire PRA model of record ventilation logic is included in the FLEX modeling. Ventilation is not modeled to support the low pressure SG feed strategies, since pumps are staged outside and indication can be obtained locally.
- Testing unavailability and maintenance unavailability of FLEX equipment are assumed to be 1% each per year. According to the FLEX equipment owner, the Combustion Turbine Generators are sent to the original equipment manufacturer for about three weeks every three years for maintenance. Preventative maintenance tasks, such as periodic start-up of BDB equipment, does not impact the ability of BDB equipment to perform its required function. Supporting Requirement DA-C11 for HLR-DA-C (Ref. 15) states

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that when using data on maintenance and testing durations to estimate unavailabilities, only include activities that could leave the component unable to perform its function when demanded. Because the BDB equipment is portable in nature, testing and maintenance activities typically do not impact the availability of the equipment. This assumption has an insignificant effect on the analysis results since the run failure rates using data in PWROG-18042 (Ref. 5) dominate the unreliability results, being an order of magnitude greater than the assumed testing and maintenance unavailability over the assumed mission times.

- Beyond Design Basis equipment is only credited for Station Blackout sequences. The VCSNS procedure for loss of decay heat removal, EOP-15 (FR-H.1) (Ref. 20), provides procedural guidance under non-Station Blackout conditions to establish feed to the Steam Generators using Beyond Design Basis equipment if EFW has failed. A MAAP run (Ref. 11) demonstrates that the FR-H.1 action to establish Steam Generator feed using BDMG-5.0 is feasible if FR-H.1 entry conditions occurred for sequences where 7.2kV ESF power was available from XSW1DB but EFW is lost when EDG A fails at six hours (i.e., sequences where power to Train B is available but failures of EFW occur randomly or due to fire damage). When EFW is lost at six hours, the EOP-15 entry conditions are met at 7.3 hours and the feed and bleed condition is reached at 9.1 hours. Therefore, almost two hours are available for operators to work through EOP-15 and implement BDMG-5.0. However, no credit is applied in the model for this strategy as a conservatism.

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4.0 Methodology

4.1 FIRE PRA INPUT

The input files for this evaluation are obtained from the quantification associated with design change VC-22-00011 performed in March 2023 (file folder shown in Figure 4-1). These files were edited as described in this report except for the PC-CKS data tables were completely replaced (PCCKS_FXPRA_EXPORT_2023-09-01_1518.mdb).

Filename	Compressed ...	Original Size	Compr...	File Type	Modified Date
..					
Auxillary Fire Files				Local Disk	
FIRE_CUTSETS_CDF				Local Disk	
FIRE_CUTSETS_LERF				Local Disk	
@8c_flag.caf	826	3,747	78%	CAFTA Fault Tree	2023-03-28 AM 11:42:50
@8c_losprec.caf	9,099	38,642	76%	CAFTA Fault Tree	2023-03-28 AM 11:42:52
@8ca.caf	202,474	880,255	77%	CAFTA Fault Tree	2023-03-28 AM 11:42:20
@8ca.rr	1,522,904	28,430,336	95%	CAFTA Database	2023-03-29 PM 03:15:30
flag_8ca_Fire-VCSummer.flg	546	2,480	78%	FLG File	2023-03-28 AM 11:42:40
FRANX-TABLES-03-23-2023.mdb	1,001,646	12,148,736	92%	Microsoft Access ...	2023-03-29 PM 03:02:08
PCCKS_FXPRA_EXPORT_2023-03-27.MDB	580,434	4,337,664	87%	Microsoft Access ...	2023-03-28 PM 08:19:46
R_8c.txt	4,393	29,332	85%	Text Document	2023-03-28 AM 11:42:42
R_8ca-VCSummer_FIRE.recv	2,009	7,461	73%	RECV File	2023-03-28 AM 11:42:42
SetScenarioFrequencies_20190924.txt	23,326	89,318	74%	Text Document	2019-09-25 AM 10:28:52
VCS FMDB Rev_03-23-2023.accdb	36,705,588	299,556,864	88%	Microsoft Access ...	2023-03-30 AM 09:34:32
VCS_CDF+LERF_HRA_Dep_09-20-2019.recv	26,372	193,475	86%	RECV File	2023-03-28 AM 11:42:46
VCS-8ca_FRANX_status_panel.cfg	276	851	68%	CFG File	2023-03-28 AM 11:42:48
VCS-8ca-CDF.franx	54,803,691	989,532,160	94%	FRANX	2023-03-30 PM 04:29:24
VCS-8ca-CSA.flg	30	42	29%	FLG File	2023-03-28 AM 11:42:48
VCS-8ca-LERF.franx	54,838,621	987,729,920	94%	FRANX	2023-03-30 PM 04:34:54

Figure 4-1 - Input Fire PRA Files (VCS-RA.009R0 - VC-22-00011 03-23-2023.zip)

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4.2 RISK ASSESSMENT

4.2.1 Overall Risk Assessment Process

The risk assessment activities included the following steps and depicted in Figure 4-2 :

- Research existing modeling in the Fire PRA CAFTA model and determine a strategy to support the modeling of EOP-6.0, Loss of All ESF AC Power, strategies to mitigate SBO core damage sequences.
- Perform circuit analysis, as necessary to support modeling in the Fire PRA. It is noted that PC-CKS maintains both the circuit analysis results and the cable routing associated with the selected cables to be included in the Fire PRA.
- Confirm routing of cables previously not included in the Fire PRA. If necessary, update PC-CKS with additional raceway-fire zone routing to ensure that fire scenarios are appropriately mapped in the Fire Modeling Database (FMDB).
- Update the Fire PRA CAFTA and FRANX model based upon the inputs from PC-CKS and FMDB. In addition, perform the necessary quantifications to support the evaluation in accordance with the acceptance criteria.
- Based on the quantification results, perform cutset reviews to confirm modeling and additional opportunities to refine the Fire PRA model.
- Document the results.

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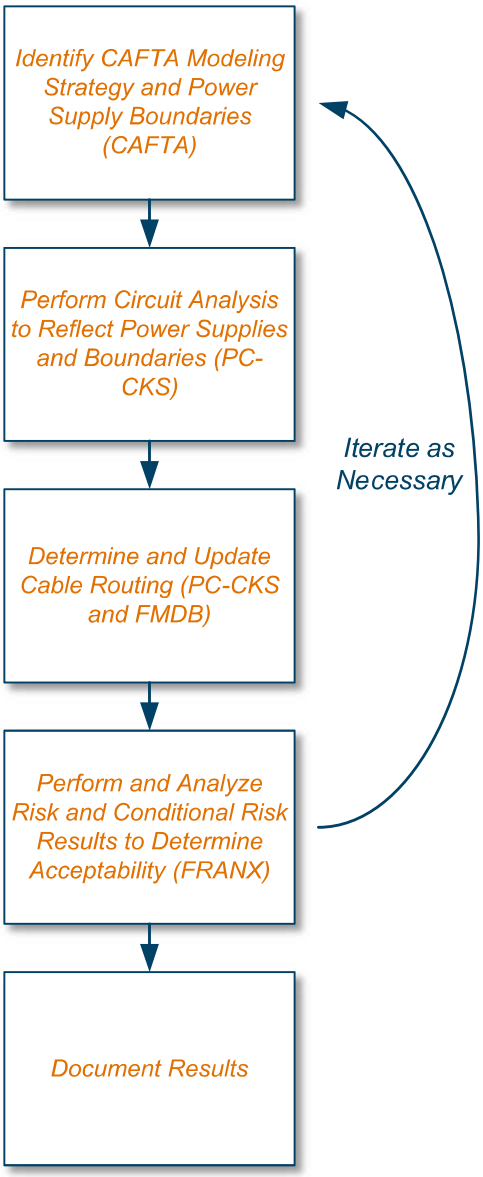

Figure 4-2 - Risk Assessment Process

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4.2.2 Risk Metrics and Acceptance Criteria

Figure 4-3 summarizes the acceptance criteria for SDP risk assessments based on the guidance provided in NRC Inspection Manual 0609 (specifically Definition 0609-04.02 and Exhibit 1) (Ref. 4). Inspection findings are assigned a color representing the safety significance of the finding. In Figure 4-3, the terms "increase in CDF (/yr)" and "increase in LERF(/yr)" refer to the increase in the SDP exposure delta risk increase that results from the degraded condition.

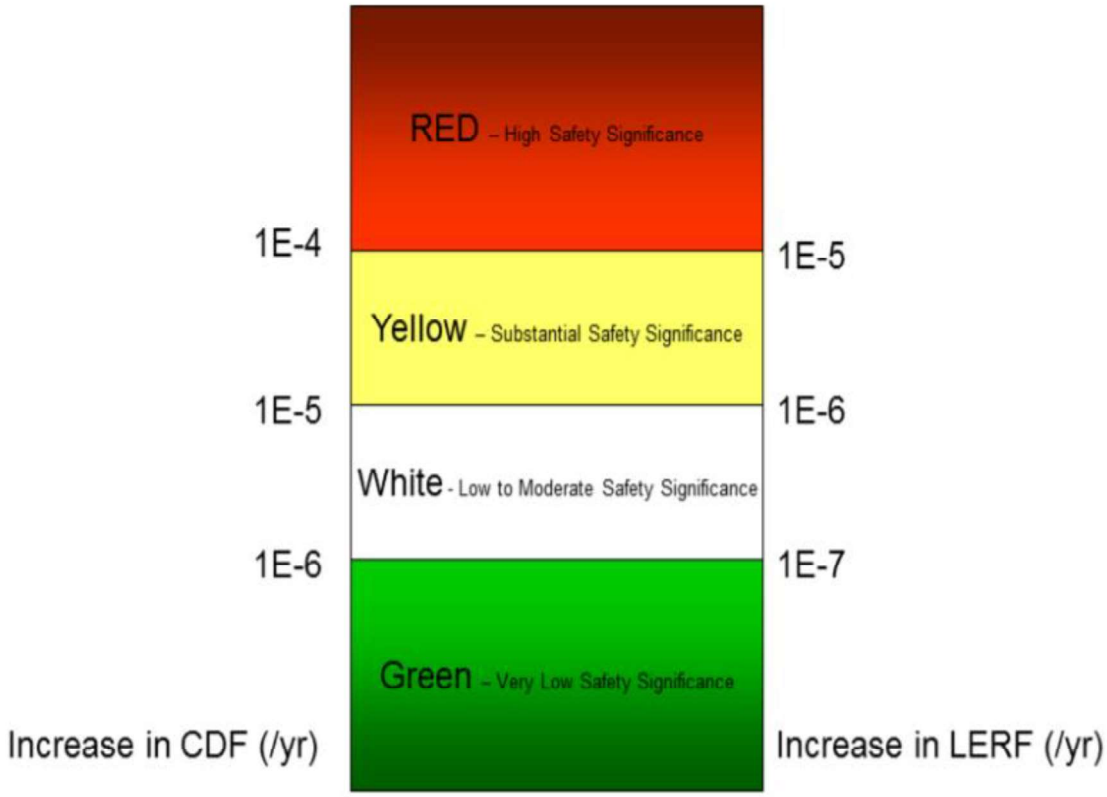

Figure 4-3 - Quantitative Significance of SDP Inspection Findings

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5.0 Discussion

5.1 FIRE PRA CAFTA MODEL UPDATES

5.1.1 Modeling the Diesel Fuel Oil Leak

The risk increase of the diesel fuel oil leak condition can be estimated by breaking up the Diesel Generator A fail-to-run basic event into a short and long term event as shown in Figure 5-1 and Figure 5-2. The mission time of the early Diesel Generator A failure, Basic Event DG-EDG-SFR-XEG1A, is adjusted from 24 hours to six hours, while the new basic event, DG-EDG-SFR-XEG1A-24H, mission time is assigned the remaining 18 hours. The quantification is performed by setting basic event DG-EDG-SFR-XEG1A-24H to a 1.0 failure probability.

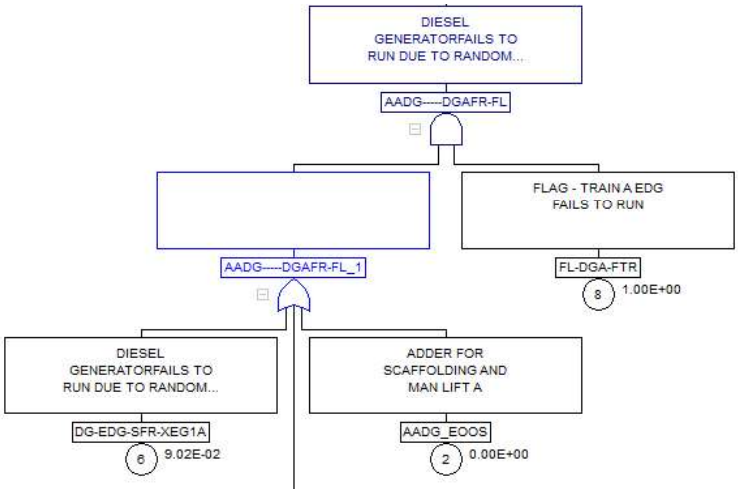

Figure 5-1 – MOR Diesel Generator A Fail-to-Run Logic

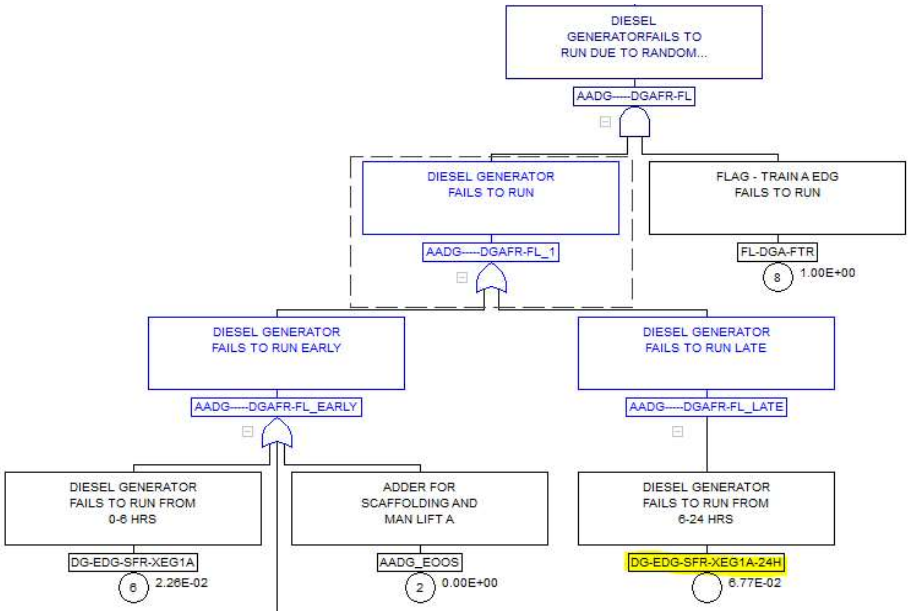

Figure 5-2 – Modified SDP Model Diesel Generator A Fail-to-Run Logic

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5.1.2 BDB Strategy CAFTA Model Update

The Fire PRA CAFTA model @8ca.caf was updated to allow credit for the BDB strategies which are found in EOP-6.0. The modeling of the BDB strategies for this application is targeted to only address internal fire sequences where Emergency Feedwater and 7.2kV ESF power is initially available, but a postulated failure of EDG A several hours into the event results in station blackout conditions. The reduction in decay heat associated with the delayed onset of the SBO allows enough time for Operators to deploy BDB equipment such that simplified modeling with conservative bounding conditions can be assumed, such as no credit for RCS cooldown via SG depressurization, deep load shed, etc. These simplifications allow for the BDB strategy credit to be inserted into the model without having to restructure the Station Blackout Event Tree. If the BDB strategies are credited in a future model update, revisions to the event tree are recommended.

5.1.2.1 MAAP Analysis

Credit for BDB strategies is being applied to post-fire sequences where EDG A is postulated to fail six hours following a fire-induced loss of offsite power where 7.2kV ESF power and Emergency Feedwater are initially available and the RCS is intact (i.e., no LOCA). MAAP cases have been developed to establish the limiting timing for which Steam Generator feed must be reestablished under these conditions. In the worst case scenario, the following conditions apply:

- Fire occurs and 7.2kV Switchgear 1DB fails
- 7.2kV Switchgear 1DA is energized via EDG A (offsite power not available due to fire)
- Only MDEFW Pump A is available (TDEFW fails due to random, fire or maintenance unavailability)
- Feedwater Fails (Not credited in the Fire PRA)
- EFW is lost at t = 6 hours when EDG A is postulated to fail to continue running
- For this worst-case scenario, MAAP cases LOOP-EFW-Case2-A and LOOP-EFW-Case2-B demonstrate that core damage can be prevented if SG feed is restored by t = 12 hours. The FLEX logic in the model is conditioned to require availability of either MDEFW Pump A or the TDEFW Pump to ensure that FLEX credit is only applied to scenarios where the loss of the Diesel Generator A at six hours causes the loss of EFW in the model. No further analysis is provided to demonstrate the additional time that would be available if TDEFW was successful at the onset of SBO conditions, as six hours is more than sufficient time to stage and implement the BDB strategies for SG feed.

For sequences where EFW is not available initially or EDG A fails to start or initially run, the postulated later failure of EDG A caused by the fuel oil leak would have no impact on the sequence.

For sequences where 7.2kV Switchgear 1DB is energized, the entry conditions for EOP-6.0 would not be met. It is possible to use some of the BDB strategies according to the instructions in EOP-15.0 if not in SBO conditions. However, no credit is applied for BDB strategies in the Fire PRA model for non-SBO sequences.

For these reasons, FLEX credit in the model is applied to fire scenarios where the offsite power supply can be impacted, such as large turbine building fires, and fire scenarios where both 7.2kV Switchgear 1DB and the offsite power feed to 7.2kV Switchgear 1DA can be impacted.

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5.1.2.2 SBO Plant Response to Loss of EFW

If EDG A is assumed to fail at six hours resulting in SBO conditions, Operators would enter EOP-6.0, Loss of All ESF AC Power. Prior to any declaration of Extended Loss of AC Power (ELAP), Step 4 of EOP-6.0 instructs operators to verify Emergency Feedwater (EFW) flow to the Steam Generators. If EFW has failed due to loss of Turbine Driven EFW (TDEFW), the response not obtained action for Step 4 instructs Operators to enter Beyond Design Basis Mitigating Guideline (BDMG)-4.0, Manual Operation of the TDEFW Pump, if the TDEFW pump is not working. The initial caution in BDMG-4.0 states that BDMG-5.0, Manually Depressurize SGS and Use Low Pressure Water Source, should be used if the TDEFW Pump is not functioning and cannot be restored. BDMG-5.0 contains instructions to locally depressurize the Steam Generators and use a pumper truck or FLEX SG Feed Pump to feed the Steam Generators using the Condensate Storage Tank (CST), Fire Service Header, Service Water Pond or Monticello Reservoir as a suction source for the pump. If EFW is initially available when Operators reach Step 4 of EOP-6.0 and is subsequently lost, the reference page of EOP-6.0 instructs Operators to perform Attachment 10, Low Pressure Feedwater, where the FLEX SG Feed Pump or a pumper truck is deployed to feed the Steam Generators.

Also prior to the ELAP declaration, Step 13 of EOP-6.0 instructs operators to locally verify APN4071 is energized from the Electrical Building (EB) or Auxiliary Electrical Building (AEB) installed Diesel Generators and to stage the FLEX Combustion Turbine Generators. The next step, Step 14, contains the ELAP declaration criteria, which is to check if AC power is expected to be restored within two hours. Once the ELAP declaration is made, Operators use FLEX Support Procedure (FSP)-5.0 to initiate load shedding and strategies to restore ESF battery charging using either the FLEX Combustion Turbine Generators (CTGs), or the Electrical Building (EB) or Auxiliary Electrical Building (AEB) installed Diesel Generators via APN4071. After the ELAP declaration, FSP-5.0 instructs Operators to energize both CTGs and start a MDEFW pump if EFW is lost.

If using the BDMGs, the Critical Equipment Operations List, Attachment XXII of BDMG-5.0, provides Operators a priority of electrical power sources which can be used to isolate or vent the Safety Injection Accumulators and to charge one of the Station Battery Banks, XBA1A, XBA1B or XBA1X. The 80 kW Portable Diesel Generators, XEG0100, XEG0107, and XEG0108 are listed as equipment which can be used for this task. The FLEX procedures provide similar guidance in FSP-8.0 and FSP-10.0, but no direct guidance exists to instruct Operations to use the FLEX 80 kW Portable Diesel Generators with EMP-100.013 or EMP-100.016 to maintain battery charging. Therefore, no credit is applied in the model for XEG0100, XEG0107, or XEG0108.

According to ERP-113 (Ref. 12), fuel is available from the Diesel Fuel Oil Storage Tanks (2 × 53,000 gallons), Auxiliary Boiler Fuel Oil Storage Tank (500,000 gallons) and Fleet Maintenance Fuel Oil Storage Tank (8000 gallons). Two CTGs running concurrently draws a maximum consumption of 220 gallons/hour and has a maximum refuel interval of every three hours. A 650-gallon capacity fuel cube is dedicated to support CTG operation. The 300kW EB/AEB Diesel Generators are each equipped with a 19-hour supply of fuel (Ref. 13). Modeling of refueling is addressed in Appendix E using the EPRI 3002013018 (Ref. 16) guidance.

In summary, the modified SBO FPRA response model credits three FLEX methods of restoring SG feed if the TDEFW pump fails:

- Energizing an installed MDEFW pump via two of two CTGs.
- Staging and connecting the portable FLEX SG Feed pump.
- BDMG-5.0 strategy of using one of the two pumper trucks.

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The modified SBO FPRA response model credits two FLEX methods of charging station batteries to prevent depletion:

- One of two EB/AEB diesel generators can repower a DC bus.
- One of two CTGs can energize a battery charger via a 7.2kV ESF switchgear.

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5.1.2.3 FLEX Model Update

The FLEX/BDB strategy modeling is applied to the Station Blackout sequences under the EFT and EFC events in the SBO event tree (see Figure 5-3). For the sequences where EFW is available for the initial six hours following by SBO conditions occurring when EDG A fails at six hours, event EFT is modified to add the BDB strategies under gate EFT.

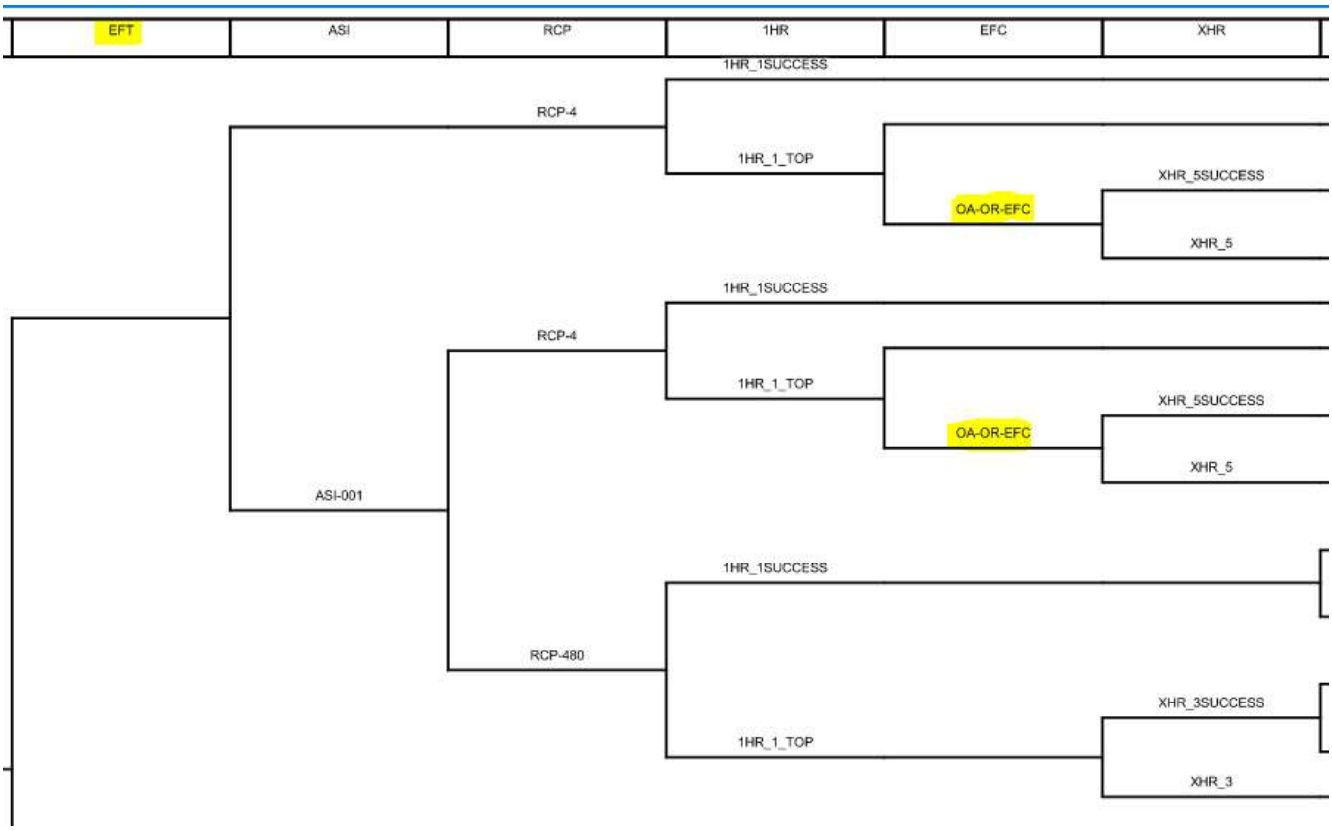

Figure 5-3 – Station Blackout Event Tree

The top gate logic for events EFT and OA-OR-EFC and subsequent logic for each BDB strategy under the top events are shown in Figure 5-4 through Figure 5-9. The change log for CAFTA edits to incorporate this logic is found in the excel file VCS EDG SDP.xlsx.

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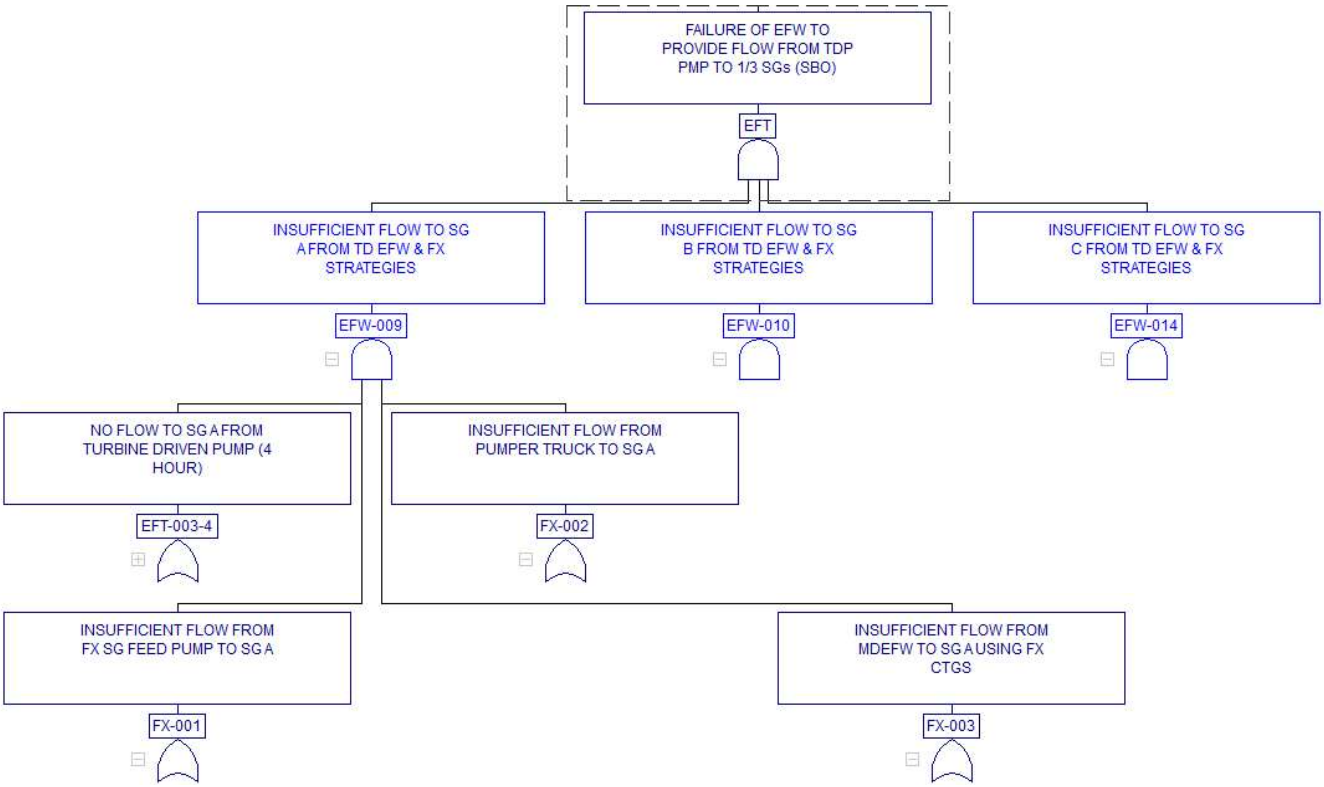

Figure 5-4 – Top Event "EFT" Logic

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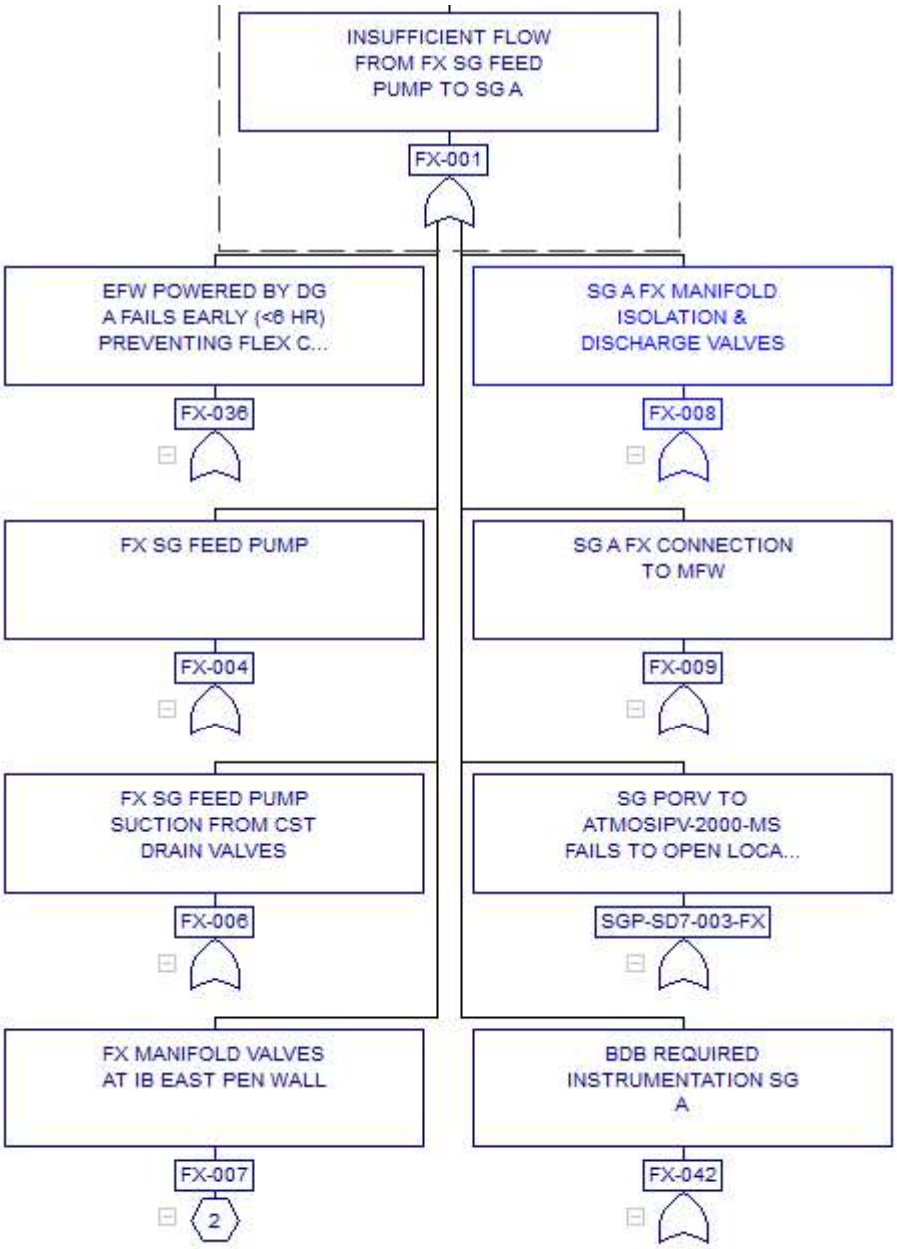

Figure 5-5 – FLEX SG Feed Pump Logic

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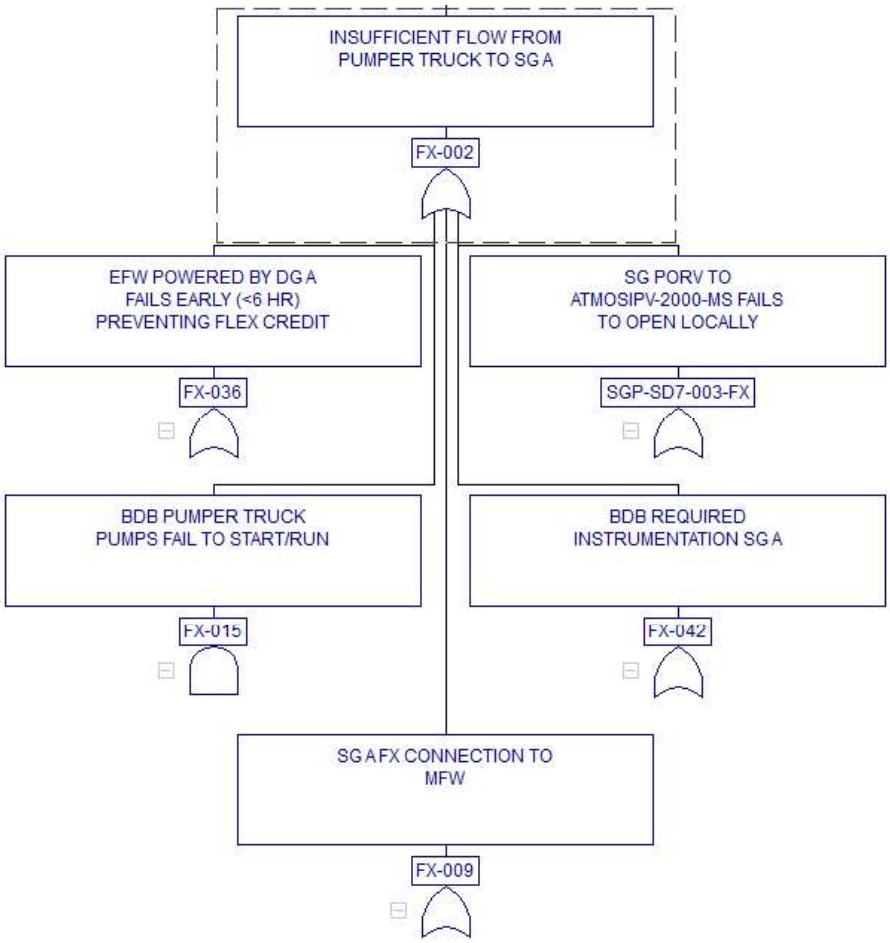

Figure 5-6 – BDB Pumper Truck Logic

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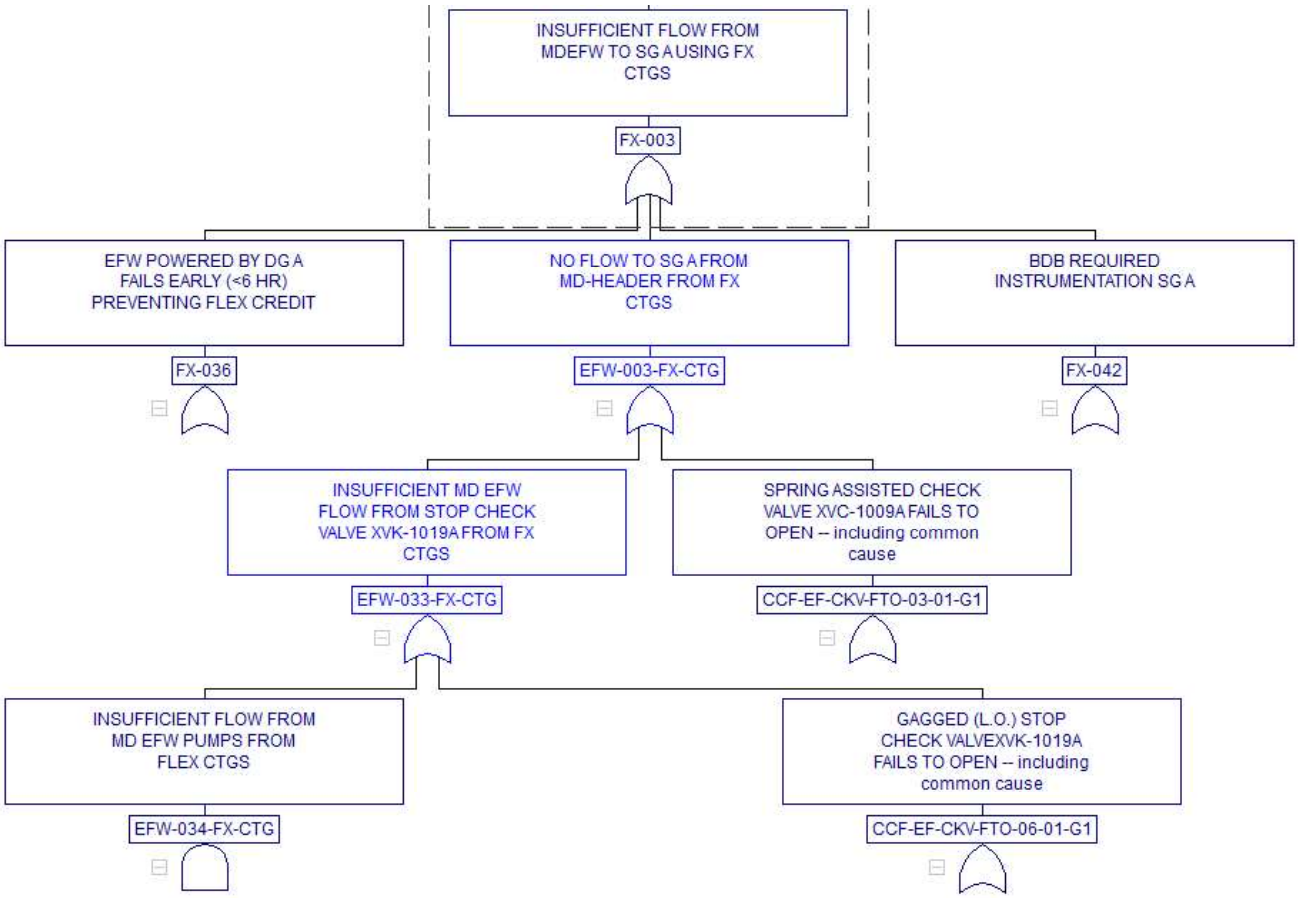

Figure 5-7 – MDEFW Pump Power by FLEX CTGs Logic

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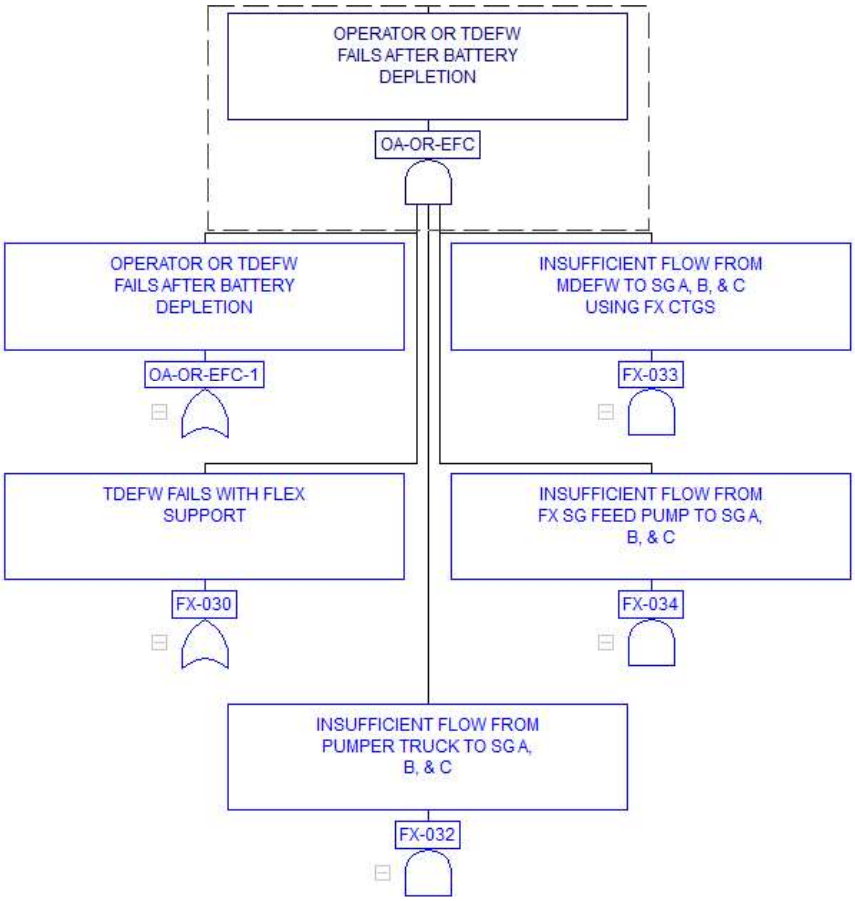

Figure 5-8 – Top Event "OA-OR-EFC" Logic*

*Top Event OA-OR-EFC previously represented failure to continue TDEFW following battery depletion (assumed at four hours). The event now represents failure to feed the steam generators after four hours, with or without battery depletion, although the gate description has not been renamed.

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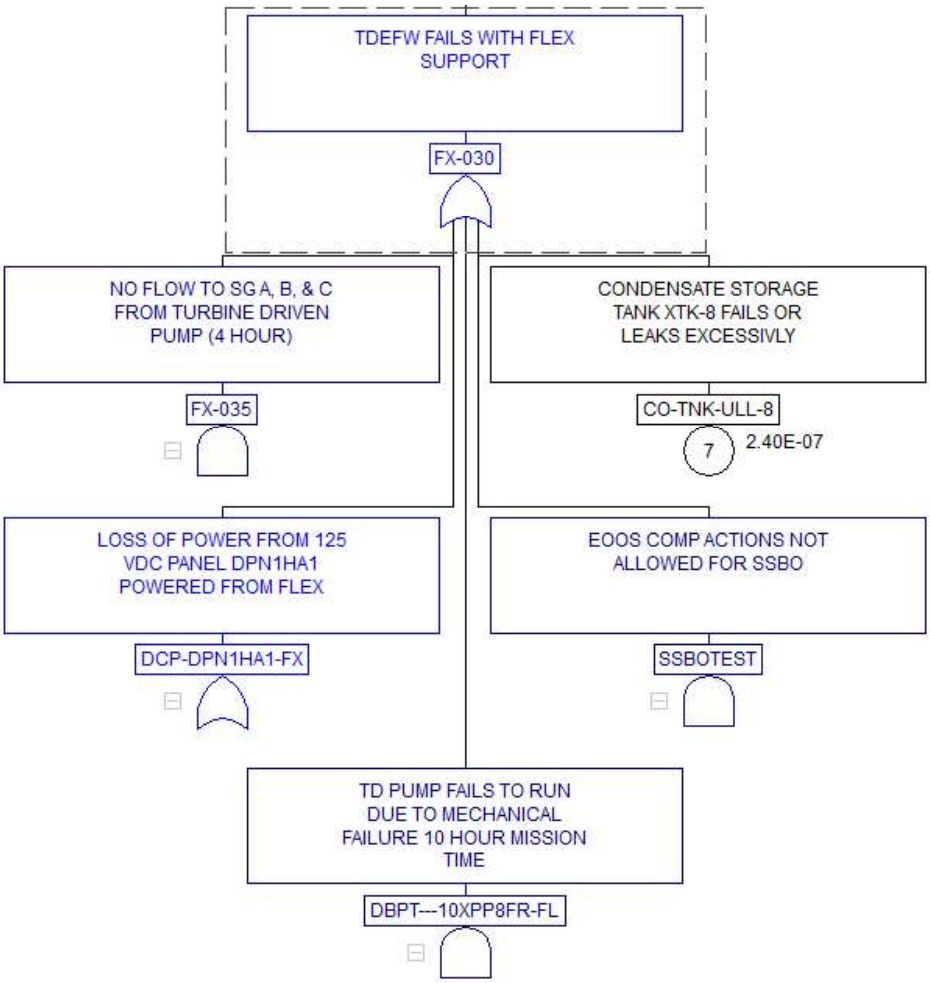

Figure 5-9 – TDEFW with FLEX Battery Charging Logic

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Table 5-1 below also identifies the Component-to-BE FRANX table (i.e., the functional state and basic events associated with the update) additions to support modeling of the BDB strategies in the Fire PRA. The cables associated with the AEB Diesel Generator are included in the EB Diesel Generator circuit analysis, so the XEG00103 component is also assigned to the XEG00102 basic events.

Table 5-1 - FRANX Component-to-BE Table Additions

Component	ToEvent	ToType	Notes
APN04071;ENERGIZED;ENERGIZED	ACP-BAC-FOP-APN4071	0	Added on 9/5/2023
XBC00020;ON;ON	RABCI-XBC0020FAB	0	Added on 9/5/2023
XBC00021;ON;ON	RABCI-XBC0021FAB	0	Added on 9/5/2023
XEG00103;OFF;STANDBY;ON	DG-FX-SFS-XEG00103	0	Added on 9/5/2023
XEG00103;OFF;STANDBY;ON	DG-FX-SFR-XEG00103	0	Added on 9/5/2023
XEG00103;OFF;STANDBY;ON	DG-FX-SFS-XEG00102	0	Added on 9/5/2023
XEG00103;OFF;STANDBY;ON	DG-FX-SFR-XEG00102	0	Added on 9/5/2023
XSW1DA-U09;OPEN;CLOSED	ES-CBK-FTC-XSW1DA-U09	0	Added on 9/5/2023
XSW1DB-U02;OPEN;CLOSED	ES-CBK-FTC-XSW1DB-U02	0	Added on 9/5/2023

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5.1.3 Other CAFTA Model Updates

During the initial Fire PRA cutset reviews, a conservatism was identified where the high pressure recirculation human failure event (HFE) related to establishing high pressure recirculation did not credit the action in Step 4 of EOP-2.2 for Operators to ensure that the RHR sump isolation valves are open. The HFE "OAR4-F" was adjusted to include this step and added to the RHR sump isolation valve logic as a backup to the automatic suction swap from the RWST to the sumps. See Appendix E for the Human Reliability Analysis updates.

5.1.4 Circuit Analysis Updates

The new component-to-BE table entries shown in Table 5-1 contain six new components that did not previously appear in the VCSNS cable routing and circuit analysis database, PC-CKS. Additionally there were two packages for DPN1HA2 & DPN1HB2 that were updated to include the FLEX cables. Circuit analysis for the following components has been performed and populated into the PC-CKS forms to support quantification.

- APN04071;ENERGIZED;ENERGIZED, 480V Main Distribution Panel DG Backed
- XBC00020;ON;ON, FLEX EB Battery Charger, Train A
- XBC00021;ON;ON, FLEX EB Battery Charger, Train B
- XEG00103;OFF;STANDBY;ON, EB Diesel Generator*
- XSW1DA-U09;OPEN;CLOSED, Switchgear, Train A
- XSW1DB-U02;OPEN;CLOSED, Switchgear, Train B

*The XEG00103 circuit analysis also contains cables required for XEG00102, AEB Diesel Generator

See Appendix C for the circuit analysis packages developed in support of this update.

5.1.5 Fire Modeling Database Updates

The updates made to the VCSNS fire modeling database, FMDB, involved two primary tasks: 1) refinement of fire scenarios located within the turbine building and 2) assigning new raceway and equipment targets to existing fire scenarios within the control and intermediate buildings. Adjustments made to tblIgnitionTargets were focused on fire scenarios involving the raceway and equipment targets included below in Table 5-2.

Table 5-2 - Targets within the scope of the FMDB Update

Compartment	Target
CB06	FX E 7A;1
CB06	FX E 8B;1
CB06	XDS00257
CB06	XDS00258

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Compartment	Target
CB12	FX E 3X#3;2
IB17	FX M 3XB;1
IB17	XBT00107
IB20	FX M 2XA;2
IB22.02	FX M 3XB;2
IB25.06.02	FX M 1X#3;2
TB01.01	TB D 3J;1
TB01.01	TB D 19J;2
TB01.01	TB D 22M;2
TB01.02	IPS05841
TB01.02	TB D 3J;2
TB01.02	TB D 19j;1
TB01.02	TB D 22M;1
TB01.02	TB D 25J;1
TB01.02	XVM02809A
TB01.02	XVM02809D

5.1.5.1 Fire Scenario Refinement

Fire scenarios located within the turbine building at elevations 412' and 436' (fire compartments TB01.01 and TB01.02) and associated with the raceway and equipment targets provided in Table 5-2 were refined based on a combination of walkdown inspections and drawing reviews. For this analysis, a walkdown review of the VC Summer plant was completed on September 6th, 2023, to provide insight into the existing fire scenarios from which the targets could be removed. For ignition sources that were not found or inspected during the walkdown, drawings were reviewed to enable further fire scenario refinement.

Fire Compartments: TB01.01 and TB01.02

Table tblIgnitionTargets was updated to remove fire scenarios where the targets were identified to not be within the ZOI of the ignition source. The deleted scenarios are presented in Table D-2 in Appendix D with a comment in the field "TrgtComment" providing the basis for removal.

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Fire Compartment: TB01.03

Table tblIgnitionTargets was updated to append the target to scenario mapping for the targets in the turbine building, included in Table D-3 in Appendix D, for all fire scenarios sources with an equipment type of either "TGH" or "TGO".

5.1.5.2 New Raceway and Equipment Targets

New targets were primarily mapped to the existing fire scenarios based on a combination of 1) the new target location on drawings and 2) inspections during the September 6th, 2023, walkdown. The mapping of the new raceways, conduits and endpoints to each ignition source and a comment supporting this mapping is listed in Table D-3 of Appendix D.

Once the new targets were mapped to the appropriated scenarios, the FMDB was updated as follows:

- Table tblTargets was updated manually to add the new required targets. This update was performed using a cable routing download from PC-CKS as of September 21, 2023, to ensure that targets added to FMDB were also in PC-CKS, and that target IDs were the same in both databases. Note that:
  - No changes were made to the existing data in tblTargets. The table was only updated to append new targets.
  - For these newly added targets, the MapToScenario checkbox was checked as these targets were mapped to transient and fixed ignition sources in tblIngitionTargets.
  - The ViaCCDP field was not updated because it is out of the scope of this quantification. In addition, using the existing ViaCCDP values can be assumed to be conservative because all the model changes done for this application are resulting in lower CCDPs. Therefore, using the previous model results bounds the risk contribution of cable fires and junction boxes. These values should be updated in the next VCSNS Fire PRA update.
- Table tblIgnitionTargets was updated to append the target to scenario mapping presented in Table D-3 of Appendix D.
- Table tblScenarioTable was updated to append the transient mapping presented in Table D-4 of Appendix D. Note that this table only maintains transient mapping (i.e., not fixed ignition sources mapping).
- Table tblEquipmentCount was updated to include equipment XBT00107.

Targets located in the control and intermediate buildings were added to tblTargets (if not already existing in the FMDB) and the appropriate fire scenarios were appended to tblIgnitionTargets as shown in Table D-3 of Appendix D. For the fire compartments in the control and intermediate buildings, there were no fire scenarios removed from the database. Note that some targets included in Table 5-2 were located in fire compartments prescribed with full compartment burnout. As a result, the following targets shown in Table 5-3 below were appended only to table tblTargets:

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Table 5-3 - Targets Located in Compartments with Full Burnout

Compartment	Target
CB08.03	FX E 3X#3;1
CB08.03	FX E 3X#2;1
CB22	FX E 4X#3;3
CB23	FX E 4X#2;2
IB16	XBT00105
IB16	XBT00106
IB16	FX M 2XA;1
IB25.05.01	FX M 1X#2;2
IB25.05.02	FX M 1X#2;3
IB25.06.01	FX M 1X#3;1
IB25.06.01	FX M 1X#2;4

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5.2 FIRE QUANTIFICATION AND RISK ANALYSIS

5.2.1 Fire PRA Quantification Results

Fire PRA quantification was performed using CAFTA 6.0b, FRANX 4.4 with the FTREX 2.0.0.1 64 bit quantification engine. The CAFTA/FRANX model was quantified to re-baseline the model and then the flag file was altered to set basic event DG-EDG-SFR-XEG1A-24H to true to quantify the conditional risk impact of the condition being analyzed over the exposure time. The ΔCDF and ΔLERF results are provided in Table 5-4 for an exposure time of 169 days.

Table 5-4 – Fire Quantification and Delta Risk Results

	CDF	*ΔCDF 169 Days*	*LERF*	*ΔLERF 169 Days*
Baseline	4.45E-05	-	2.19E-06	-
Conditional Risk	4.92E-05	2.19E-06	2.60E-06	1.90E-07

The dominant ΔCDF cutsets involved fire scenarios located in the turbine building (~87%) and were primarily associated with combinations of human failure events associated with Loss of Offsite Power (non-SBO) sequences:

- Failure to manually establish Emergency Feedwater given fire damage to automatic actuation and subsequent failure to manually align Train B pumps necessary to implement feed and bleed.
- Failure to manually align Train B pumps necessary to implement feed and bleed if fire failures of the feedwater isolation signal result in overfill of the Steam Generator and failure of the TDEFW pump.
- RCP seal LOCAs caused by random failure of Alternate Seal Injection and human failures to maintain RCP seal injection by aligning the Train B and C Charging Pumps on loss of power from Train A .

The SBO sequences which appeared in the ΔCDF cutsets involved:

- Failure to declare ELAP or deploy FLEX equipment with subsequent failure to manually control TDEFW following battery depletion.
- Combinations of random failures of FLEX equipment and human failures.

One source of uncertainty for the risk evaluation is the assumed timing of the diesel failure. Figure 5-10 shows how the timing of core damage is affected by the diesel generator run time if EFW fails immediately at the onset of station blackout occurring when the diesel generator fails. The MAAP results show that the time to core

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damage is significantly extended, primarily due to reductions in decay heat, when the onset of station blackout is delayed.

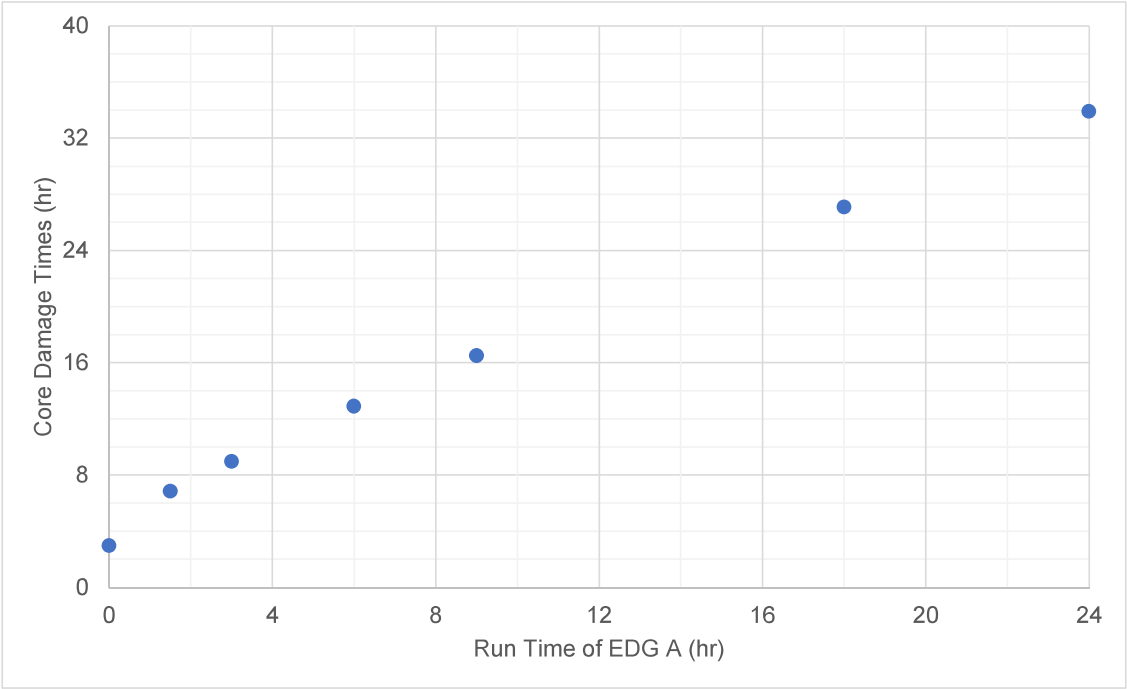

Figure 5-10 – Core Damage Time with No SG Feed vs. SBO Initiation Time after Loss of Offsite Power

As decay heat reduces with time, the available time increases for implementation of Beyond Design Basis strategies for decay heat removal. The time to stage and operate BDB equipment for each decay heat removal strategy is conservatively assumed to be roughly two hours. If the Station Blackout occurs immediately, there will be some delay for Operations to work through procedures to initiate deployment of BDB strategies. Therefore, 2 to 2.5 hours is a reasonable time for which Operations can be expected to be able to deploy the BDB decay heat removal strategies. Several MAAP runs were performed to identify limiting times to reestablish feed to the Steam Generators if a total loss of EFW occurs at various Diesel Generator A failure times when the Station Blackout is postulated to occur. The results of the MAAP runs are presented in Figure 5-11.

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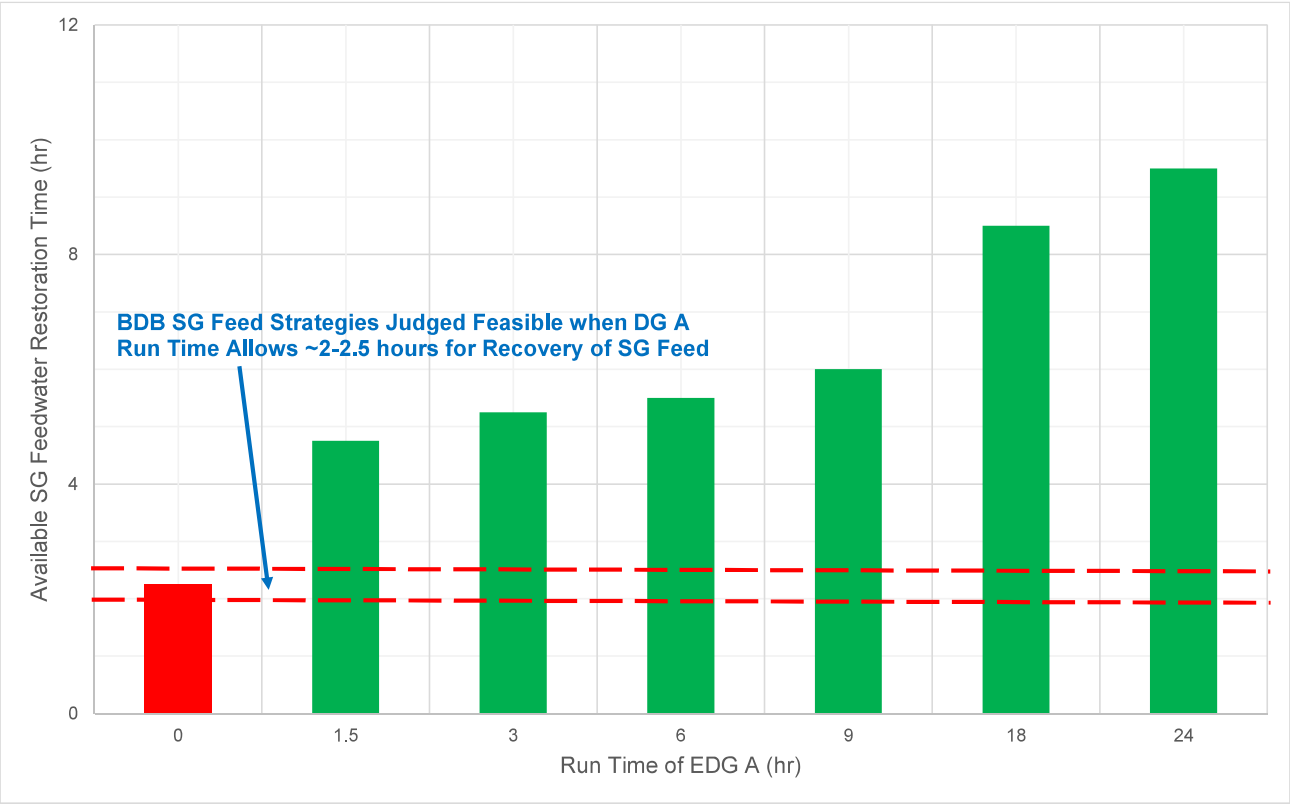

Figure 5-11 – Available SG Feed Restoration Time vs. SBO Initiation Time

The exponential nature of reactor decay heat results in available times for SG feedwater restoration that quickly exceed the required time to deploy BDB equipment. BDB SG Feed Strategies, which require about 2.5 hrs to reliably execute are judged to become feasible to prevent core damage when EDG run time is ~1 hour following a loss of offsite power. Because the BDB strategies are considered feasible at ~1 hr, there is high confidence that the assumed six hour EDG A run time is not a critical assumption to the risk assessment.

Additionally, the insights from the Station Blackout MAAP results show that significant conservatisms may exist in this risk analysis which are related to the assumption documented in Section 3.0 which states that no credit is taken for BDB equipment mitigating non-SBO sequences. The VCSNS procedure for loss of decay heat removal, EOP-15 (FR-H.1) (Ref. 20), provides procedural guidance under non-Station Blackout conditions to establish feed to the Steam Generators using Beyond Design Basis equipment if EFW has failed. The MAAP results for time available to establish BDB decay heat removal strategies once FR.H-1 entry conditions occur are presented in two separate figures. The time available to prevent the feed and bleed condition is presented in Figure 5-12, while the time available to prevent core damage is presented in Figure 5-13.

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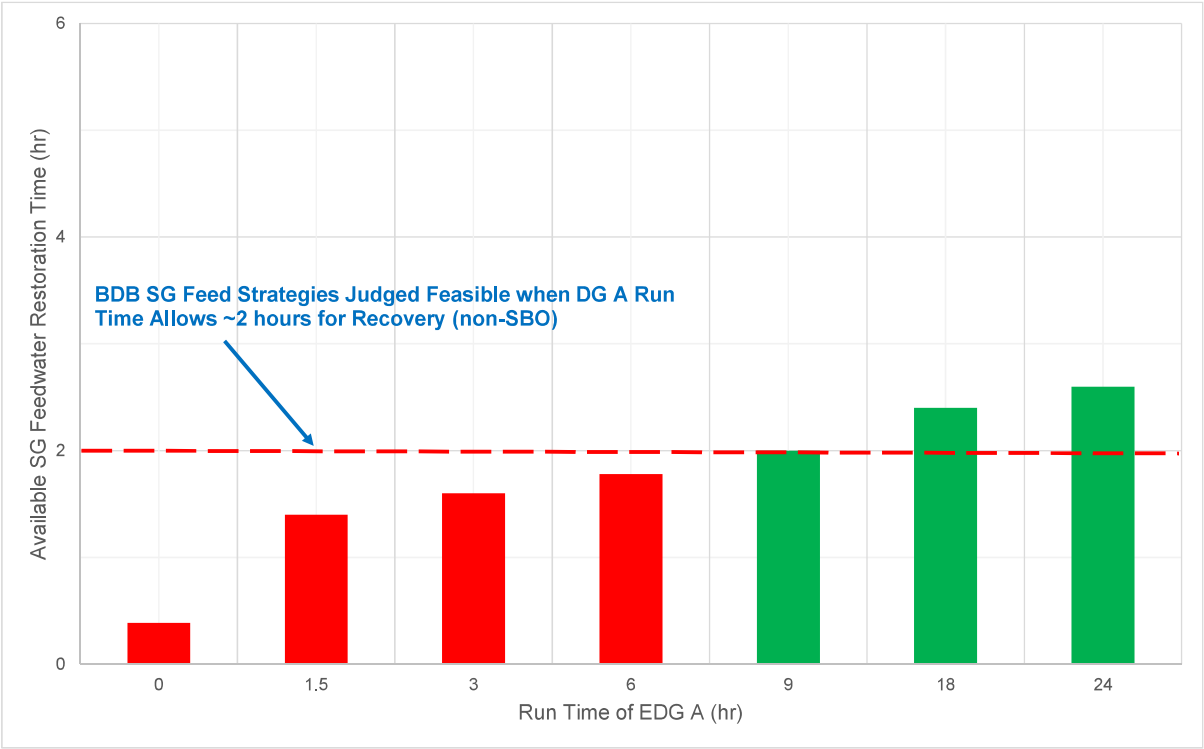

Figure 5-12 – Available SG Feed Restoration Time (F&B Constraint) vs. Loss of EFW Initiation Time

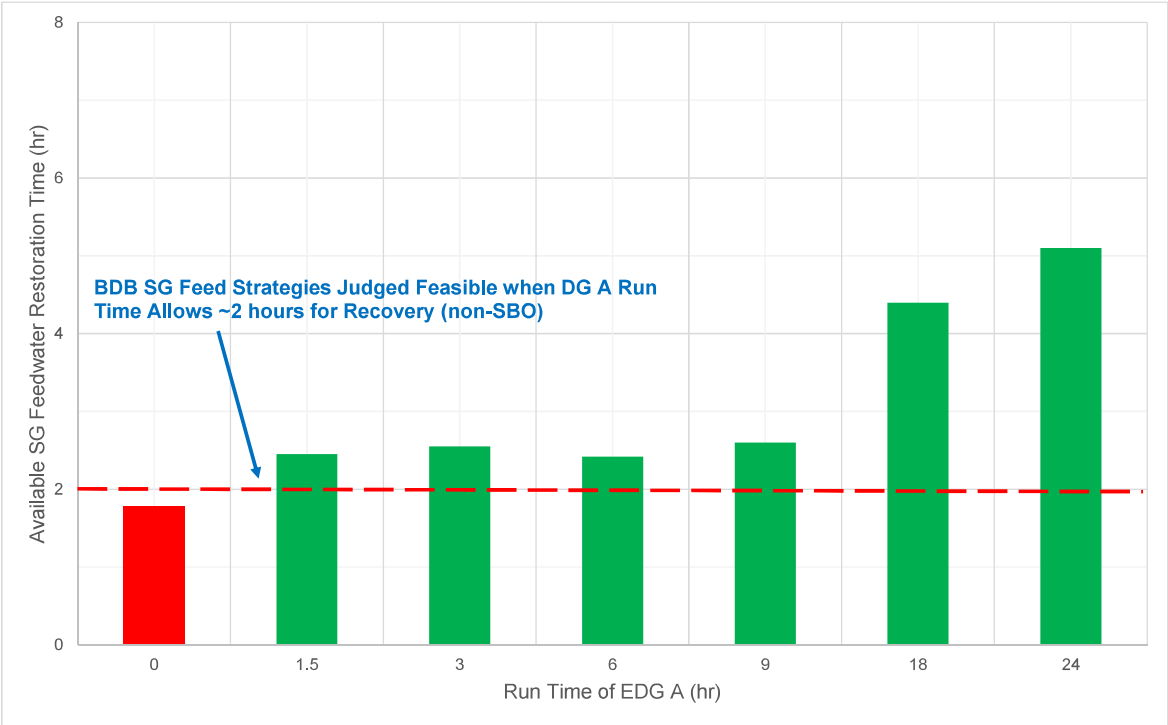

Figure 5-13 – Available SG Feed Restoration Time (Core Damage Constraint) vs. Loss of EFW Initiation Time

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BDB strategy implementation for Loss of Offsite Power events is expected to occur faster than during Station Blackout conditions since there is less equipment to deploy and ESF power remains available. These figures demonstrate that the time available to establish BDB feed to the Steam Generators is close to the assumed deployment times if the goal is to prevent the use of once-through cooling using the feed and bleed method prescribed in FR-H.1. For situations where core damage may occur due to failures preventing successful implementation of once-through cooling, it is unlikely that efforts to restore feed to the Steam Generators would be discontinued. The results presented in Figure 5-13 show that, much like the SBO cases, enough time exists to implement BDB strategies to prevent core damage if once-through cooling is not successful as long as the diesel generator would have been able to run for a short time (and EFW is available) following a loss of offsite power.

In summary, the MAAP analyses performed demonstrate that the BDB strategy credit for fire-induced SBO sequences is appropriate and significant conservatisms exist by omitting credit for BDB decay heat removal strategies for non-SBO sequences. The refinements used for the fire risk analysis likely have similar risk reduction impacts for other hazards (internal events, flood and seismic) where the Beyond Design Basis strategies have not been implemented in the risk model at this time. Additionally, the following conservatisms have been identified in the Fire PRA model which affect this evaluation:

- The MAAP analyses did not take credit for RCS cooldown via secondary side depressurization prior to initiation of SBO conditions. The RCS cooldown would likely be completed for scenarios where the diesel generator and EFW operated for 4-6 hours, which would significantly extend the time available to restore feed to the Steam Generators. A partially completed cooldown would also provide additional time available for deployment.
- The 230 kV Offsite Power Supply is assumed to be failed in almost all of the fire scenarios since only the 115 kV source is credited for most areas. Increased availability of offsite power would lessen the risk impact of loss of a diesel generator.
- Some of the cutsets associated with Station Blackout involve testing and maintenance failures of the opposite train diesel generator. However, Diesel Generator B was not taken out of service for maintenance during the exposure time according to the plant logs. No attempt has been made to refine these cutsets.
- The human failure events related to the BDB strategies use timing based on FLEX assumptions of minimum shift staffing available until later in the event since site access may be difficult for certain external events. For a scenario where a plant fire caused a loss of offsite power, access to the site would not be impeded and additional manpower would be available, resulting in an accelerated and more reliable deployment.
- The human failure events related to the BDB strategies do not take credit for DC bus load shedding and are based on bounding sequences where TDEFW fails immediately when Station Blackout conditions occur. Successful DC bus load shed would greatly extend the required time to deploy the BDB electrical strategies.
- The Fire Protection System is not credited to support BDB strategies related to implementation of BDMG-5.0. Use of the fire protection hydrants would accelerate the deployment of Steam Generator feed strategies using the Pumper Trucks.
- Assumed train alignments in the Fire PRA model bias the risk results of the condition conservatively by assuming swing train equipment alignments to Train A. Similar conservatisms may exist in the other hazard models.
- The 80 kW Portable Diesel Generators are not credited in this analysis.

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5.3 COMBINED HAZARD RISK ASSESSMENT RESULTS

5.3.1 Results by Hazard

The ΔCDF and ΔLERF results are provided in Table 5-5 for an exposure time of 169 days, based on input from NOTEBK-PRA-VCS-RA.013 (Ref. 19). Only the Fire PRA model includes credit for Beyond Design Basis equipment. Applying the same credit to the Internal Events/Internal Flood and Seismic PRA models would likely result in significant additional reduction in ΔCDF and ΔLERF results.

Table 5-5 –Quantification and Delta Risk Results

	FPIE/ Int-Flood	*Fire*	*Seismic*	*Total*
Baseline CDF	2.72E-06	4.45E-05	3.51E-05	-
Conditional CDF	4.43E-06	4.92E-05	4.06E-05	-
ΔCDF (169 days)	7.93E-07	2.19E-06	2.51E-06	5.49E-06
Baseline LERF	4.26E-07	2.19E-06	3.26E-06	-
Conditional LERF	8.93E-07	2.60E-06	3.27E-06	-
ΔLERF (169 days)	2.16E-07	1.90E-07	3.68E-09	4.10E-07

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6.0 Conclusions + Recommendations

Using Dominion's Internal Events/Internal Flood and Seismic PRA models, as well as a detailed fire risk analysis result in the ΔCDF of 5.49E-06/yr and ΔLERF of 4.10E-07/yr for the significance of the subject finding. Sufficient evidence exists to categorize the finding as white significance based on the additional level of detail available in these analyses.

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7.0 References

The following references were used in the development of this report:

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6. NRC Letter, Updated Assessment of Industry Guidance for Crediting Mitigating Strategies in Probabilistic Risk Assessments, May 6, 2022, ML22014A084
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19. NOTEBK-PRA-VCS-RA.013, Rev. 0, Dominion Quantification Input to VCS EDG Fuel Oil Leak SDP
20. EOP-15, FR-H.1, Response to Loss of Secondary Heat Sink, Rev. 18.
21. Virgil C. Summer Nuclear Station – NRC Inspection Report 05000395/2023090 and Preliminary Yellow Finding and Apparent Violation, October 4, 2023 (ML23268A467).

Refer to circuit analysis packages listed in Appendix C of this report for drawings and references used to perform the circuit analysis.

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Appendix A - CAFTA Model Changes

See excel file VCS EDG SDP.xlsx.

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Appendix B - PRA Data Development

See excel file VCS EDG SDP.xlsx

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Appendix C - Circuit Analysis Updates

The following pages contain circuit analysis packages that were updated and entered into PC-CKS to support quantifications. Additionally there were two packages for DPN1HA2:ENERGIZED:ENERGIZED & DPN1HB2:ENERGIZED ENERGIZED that were updated to include the FLEX connection cables.

- APN04071;ENERGIZED;ENERGIZED, 480V Distribution Panel, Train A & B
- XBC00020;ON;ON, Flex EB Battery Charger, Train A
- XBC00021;ON;ON, Flex EB Battery Charger, Train B
- XEG00103;OFF;STANDBY;ON, Diesel Generator, Train A & B
- XSW1DA-U09;OPEN;CLOSED, Switchgear, Train A
- XSW1DB-U02;OPEN;CLOSED, Switchgear, Train B

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Appendix D - Cable Routing and FMDB Update

Cable routing was obtained from PC-CKS as of September 1, 2023 to support use in the Fire PRA quantification. Refinements were made to the existing routing information, based upon cables associated with the inverter bypass circuit that did not contain full routing to transient zones in FMDB.

Table C-1 contains fire zone additions made to PC-CKS in support of the analysis.

Table D-1 – Cable Routing Updates

ID	TOEVENT	Cable	Raceway	Zone
FH K 37X	APN04071:Energized:Energized	FH K 37X	FH K 37X#1;9999	YD01
FH K 37X	APN04071:Energized:Energized	FH K 37X	FH K 37X#2;9999	YD01
FH K 37X	APN04071:Energized:Energized	FH K 37X	XET04021	YD01
FH K 38X;ECR50793C	APN04071:Energized:Energized	FH K 38X;ECR50793C	FH K 38X#2;9999	YD01
FH K 38X;ECR50793C	APN04071:Energized:Energized	FH K 38X;ECR50793C	FH K 38X#1;9999	YD01
FH K 38X;ECR50793C	APN04071:Energized:Energized	FH K 38X;ECR50793C	XPN05393	YD01
FH K 38X;ECR50793C	APN04071:Energized:Energized	FH K 38X;ECR50793C	XLB00001	YD01
FH K 44X	APN04071:Energized:Energized	FH K 44X	FH K 44X#1;9999	YD01
FH K 44X	APN04071:Energized:Energized	FH K 44X	FH K 44X#2;9999	YD01
FH K 44X	APN04071:Energized:Energized	FH K 44X	IUQ79200	YD01
FH K 45X	APN04071:Energized:Energized	FH K 45X	FH K 45X#1;9999	YD01
FH K 45X	APN04071:Energized:Energized	FH K 45X	FH K 45X#2;9999	YD01
FH K 45X	APN04071:Energized:Energized	FH K 45X	IUQ79201	YD01
FH K 87X	APN04071:Energized:Energized	FH K 87X	FH K 87X#1;9999	YD01
FH K 87X	APN04071:Energized:Energized	FH K 87X	FH K 87X#2;9999	YD01
FH K 87X	APN04071:Energized:Energized	FH K 87X	XET04024	YD01

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Table D-1 – Cable Routing Updates

ID	TOEVENT	Cable	Raceway	Zone
FH K 87X	APN04071:Energized:Energized	FH K 87X	XET04025	YD01
FH K 88X	APN04071:Energized:Energized	FH K 88X	FH K 88X#1;9999	YD01
FH K 88X	APN04071:Energized:Energized	FH K 88X	FH K 88X#2;9999	YD01
FH K 88X	APN04071:Energized:Energized	FH K 88X	XET04025	YD01
FH K 88X	APN04071:Energized:Energized	FH K 88X	APN05987	YD01
FX K 1X	APN04071:Energized:Energized	FX K 1X	FX K 1X#1;9999	YD01
FX K 1X	APN04071:Energized:Energized	FX K 1X	FX K 1X#2;9999	YD01
FX K 3X	APN04071:Energized:Energized	FX K 3X	FX K 3X#1;9999	YD01
FX K 3X	APN04071:Energized:Energized	FX K 3X	FX K 3X#2;9999	YD01
FX K 6X	APN04071:Energized:Energized	FX K 6X	FX K 6X;9999	YD01
FX K 6X	APN04071:Energized:Energized	FX K 6X	XX -10461X;9999	YD01
FX K 6X	APN04071:Energized:Energized	FX K 6X	XX -10460X;9999	YD01
FX K 6X	APN04071:Energized:Energized	FX K 6X	XX -10462X;9999	YD01
FX K 6X	APN04071:Energized:Energized	FX K 6X	XDS00256	YD01
FX K 10X	APN04071:Energized:Energized	FX K 10X	FX K 10X;9999	YD01
FX K 10X	APN04071:Energized:Energized	FX K 10X	XDS00256	YD01
FX K 10X	APN04071:Energized:Energized	FX K 10X	XPN05611	YD01
FX E 7A	DPN1HA2:Energized:Energized	FX E 7A	FX E 7A;9999	YD01
FX E 7A	DPN1HA2:Energized:Energized	FX E 7A	XDS00257	YD01
FX E 8B	DPN1HB2:Energized:Energized	FX E 8B	FX E 8B;9999	YD01
FX E 8B	DPN1HB2:Energized:Energized	FX E 8B	XDS00258	YD01
FX E 1X	XBC00020:On:On	FX E 1X	FX E 1X#1;9999	YD01
FX E 1X	XBC00020:On:On	FX E 1X	FX E 1X#2;9999	YD01

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Table D-1 – Cable Routing Updates

ID	TOEVENT	Cable	Raceway	Zone
FX E 1X	XBC00020:On:On	FX E 1X	FX E 1X#3;9999	YD01
FX E 1X	XBC00020:On:On	FX E 1X	FX E 1X#4;9999	YD01
FX E 1X	XBC00020:On:On	FX E 1X	FX E 1X#5;9999	YD01
FX E 1X	XBC00020:On:On	FX E 1X	XDS00254	YD01
FX E 3X	XBC00020:On:On	FX E 3X	FX E 3X#1;9999	YD01
FX E 3X	XBC00020:On:On	FX E 3X	FX E 3X#2;9999	YD01
FX E 3X	XBC00020:On:On	FX E 3X	FX E 3X#3;9999	YD01
FX E 3X	XBC00020:On:On	FX E 3X	XDS00254	YD01
FX E 2X	XBC00021:On:On	FX E 2X	FX E 2X#5;9999	YD01
FX E 2X	XBC00021:On:On	FX E 2X	FX E 2X#1;9999	YD01
FX E 2X	XBC00021:On:On	FX E 2X	FX E 2X#2;9999	YD01
FX E 2X	XBC00021:On:On	FX E 2X	FX E 2X#3;9999	YD01
FX E 2X	XBC00021:On:On	FX E 2X	FX E 2X#4;9999	YD01
FX E 2X	XBC00021:On:On	FX E 2X	XDS00255	YD01
FX E 4X	XBC00021:On:On	FX E 4X	FX E 4X#1;9999	YD01
FX E 4X	XBC00021:On:On	FX E 4X	FX E 4X#2;9999	YD01
FX E 4X	XBC00021:On:On	FX E 4X	FX E 4X#3;9999	YD01
FX E 4X	XBC00021:On:On	FX E 4X	XDS00255	YD01
FH J 2X;ECR50870A	XEG00103:Off/Standby:On	FH J 2X;ECR50870A	FH J 2X#1;9999	YD01
FH J 2X;ECR50870A	XEG00103:Off/Standby:On	FH J 2X;ECR50870A	FH J 2X#2;9999	YD01
FH J 2X;ECR50870A	XEG00103:Off/Standby:On	FH J 2X;ECR50870A	XET04025	YD01

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Table D-1 – Cable Routing Updates

ID	TOEVENT	Cable	Raceway	Zone
FH J 2X;ECR50870A	XEG00103:Off/Standby:On	FH J 2X;ECR50870A	XPN05392	YD01
FH J 4X	XEG00103:Off/Standby:On	FH J 4X	FH J 4X;9999	YD01
FH J 4X	XEG00103:Off/Standby:On	FH J 4X	XX - 9981X;9999	YD01
FH J 4X	XEG00103:Off/Standby:On	FH J 4X	XET04025	YD01
FH J 6X	XEG00103:Off/Standby:On	FH J 6X	XPN05605	YD01
FH J 7X	XEG00103:Off/Standby:On	FH J 7X	XX - 9983X;9999	YD01
FH J 7X	XEG00103:Off/Standby:On	FH J 7X	XET04025	YD01
FH J 7X	XEG00103:Off/Standby:On	FH J 7X	XET04021	YD01
FH J 8X;ECR50793C	XEG00103:Off/Standby:On	FH J 8X;ECR50793C	FH J 8X;9999	YD01
FH J 8X;ECR50793C	XEG00103:Off/Standby:On	FH J 8X;ECR50793C	XX -10482X;9999	YD01
FH J 8X;ECR50793C	XEG00103:Off/Standby:On	FH J 8X;ECR50793C	XPN05397	YD01
FH J 8X;ECR50793C	XEG00103:Off/Standby:On	FH J 8X;ECR50793C	XPN05392	YD01
FH J 9X	XEG00103:Off/Standby:On	FH J 9X	FH J 9X;9999	YD01
FH J 9X	XEG00103:Off/Standby:On	FH J 9X	XPN05606	YD01
FH K 76X	XEG00103:Off/Standby:On	FH K 76X	FH K 76X#1;9999	YD01
FH K 76X	XEG00103:Off/Standby:On	FH K 76X	FH K 76X#2;9999	YD01
FH K 76X	XEG00103:Off/Standby:On	FH K 76X	XDS00259	YD01
FH K 76X	XEG00103:Off/Standby:On	FH K 76X	XET04025	YD01
FH K 84X	XEG00103:Off/Standby:On	FH K 84X	XDS00260	YD01
FH K 84X	XEG00103:Off/Standby:On	FH K 84X	XDS00253	YD01
FH K 85X	XEG00103:Off/Standby:On	FH K 85X	FH K 85X#1;9999	YD01

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Table D-1 – Cable Routing Updates

ID	TOEVENT	Cable	Raceway	Zone
FH K 85X	XEG00103:Off/Standby:On	FH K 85X	FH K 85X#2;9999	YD01
FH K 85X	XEG00103:Off/Standby:On	FH K 85X	XDS00253	YD01
FH K 85X	XEG00103:Off/Standby:On	FH K 85X	XET04025	YD01
FX M 1X	XSW1DA-U09:Open:Closed	FX M 1X	FX M 1X#2;9999	IB25.05.02
FX M 1X	XSW1DA-U09:Open:Closed	FX M 1X	FX M 1X#3;9999	IB25.06.02
FX M 1X	XSW1DA-U09:Open:Closed	FX M 1X	FX M 1X#1;9999	IB25.05.01
FX M 1X	XSW1DA-U09:Open:Closed	FX M 1X	XBT00104	YD02.02
FX M 1X	XSW1DA-U09:Open:Closed	FX M 1X	XBT00105	IB16
FX M 2XA	XSW1DA-U09:Open:Closed	FX M 2XA	FX M 2XA;9999	IB16
FX M 2XA	XSW1DA-U09:Open:Closed	FX M 2XA	XBT00106	IB16
FX M 1X	XSW1DB-U02:Open:Closed	FX M 1X	FX M 1X#2;9999	IB25.05.02
FX M 1X	XSW1DB-U02:Open:Closed	FX M 1X	FX M 1X#3;9999	IB25.06.02
FX M 1X	XSW1DB-U02:Open:Closed	FX M 1X	FX M 1X#1;9999	IB25.05.01
FX M 1X	XSW1DB-U02:Open:Closed	FX M 1X	XBT00105	IB16
FX M 1X	XSW1DB-U02:Open:Closed	FX M 1X	XBT00104	YD02.02
FX M 3XB	XSW1DB-U02:Open:Closed	FX M 3XB	FX M 3XB;9999	IB17
FX M 3XB	XSW1DB-U02:Open:Closed	FX M 3XB	XBT00107	IB17

Table D-2 identifies the fire scenarios removed from tblIgnitionTargets and a comment supporting the decision to remove the scenario.

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	APN4004-EM	EC	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	APN4004-EM	EC	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	APN5016	EC	1	TB D 22M;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN5016	EC	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	APN6084	EC	1	TB D 19j;1	Target removed from ignition source since they are in different transient zones per drawing inspection on 9-18-23
TB01.02	APN8001	EC	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	APN8001	EC	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	APN8002	EC	1	IPS05841	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN8002	EC	1	TB D 3J;2	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN8002	EC	1	TB D 19j;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN8002	EC	1	TB D 22M;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN8002	EC	1	TB D 25J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN8002	EC	1	XVM02809A	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN8002	EC	1	XVM02809D	Target is not within ZOI of ignition source per drawing inspection on 9-18-23

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	APN9001	EC	1	TB D 22M;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN9002	EC	1	IPS05841	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN9002	EC	1	TB D 3J;2	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN9002	EC	1	TB D 19j;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN9002	EC	1	TB D 22M;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN9002	EC	1	TB D 25J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN9002	EC	1	XVM02809A	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	APN9002	EC	1	XVM02809D	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	DPN1HX-3-ED	EC	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	DPN1HX-3-ED	EC	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	DPN1X	EC	1	TB D 3J;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.01	DPN2X	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	RML0003	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	RML0010	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	RML0011	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	RML0011	EC	1	TB D 19J;2	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	RML0011	EC	1	TB D 22M;2	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	TB01.01-T12	TRTB	1	TB D 3J;1	Target was not in transient zone per drawing inspection. 9-6-23
TB01.01	TB01.01-T12	TRWTB	1	TB D 3J;1	Target was not in transient zone per drawing inspection. 9-6-23
TB01.02	TB01.02-T3	TRTB	1	TB D 19j;1	Target was not in transient zone per drawing inspection. 9-6-23
TB01.02	TB01.02-T3	TRWTB	1	TB D 19j;1	Target was not in transient zone per drawing inspection. 9-6-23
TB01.01	XAC0001A	PMP	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XAC0001A	ZO2	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XAC0001B	PMP	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XAC0001B	ZO2	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XAC0001C	PMP	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XAC0001C	ZO2	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	xdr0004A	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	xdr0004A	EC	1	TB D 19J;2	Target is not within ZOI of ignition source per drawing inspection on 9-18-23

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	xdr0004A	EC	1	TB D 22M;2	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	xdr0004B	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	xdr0004B	EC	1	TB D 19J;2	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	xdr0004B	EC	1	TB D 22M;2	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XFN0055	VSS	1	TB D 19j;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XFN0055	VSS	1	TB D 22M;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XFN0056B-M	EC	1	TB D 22M;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XFN0056B-M	EC	1	TB D 19j;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XMC1A1X	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XMC1B1Y	EC	1	TB D 19j;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XMC1B1Y	EC	1	TB D 22M;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPN0051A	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0051A	EC	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0051A	EC	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	XPN0051B	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0051B	EC	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0051B	EC	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0051C	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0051C	EC	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0051C	EC	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0062L	EC	1	TB D 3J;1	Target was not in transient zone per drawing inspection. 9-6-23
TB01.01	XPN0076	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPN0079	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPN0091	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0091	EC	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0091	EC	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0100	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0130	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	XPN0130	EC	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN0130	EC	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	XPN157	EC	1	TB D 19j;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XPN157	EC	1	TB D 22M;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.01	XPN5142	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPN5143	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN5143	EC	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN5143	EC	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN5144	EC	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN5144	EC	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN5144	EC	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPN5165	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPN5166	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	XPN5167	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPN5246	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPN7306	EC	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0042A	PMP	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPP0042A	ZO2	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPP0042B	PMP	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPP0042B	ZO2	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPP0042C	PMP	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPP0042C	ZO2	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPP0075A	PMP	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0075A	ZO1	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0075A	ZO2	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0075B	PMP	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0075B	ZO1	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0075B	ZO2	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	XPP0104A	PMP	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0104A	ZO1	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0104A	ZO2	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0104B	PMP	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0104B	ZO1	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.01	XPP0104B	ZO2	1	TB D 3J;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XPP0127A	PMP	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	ZO2	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	PMP	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	ZO2	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	PMP	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	ZO2	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	PMP	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	ZO2	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	PMP	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XPP0127A	ZO2	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	PMP	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	ZO2	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	PMP	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127A	ZO2	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	PMP	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	ZO2	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	PMP	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	ZO2	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	PMP	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	ZO2	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	PMP	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	ZO2	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	PMP	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	ZO2	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XPP0127B	PMP	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	ZO2	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	PMP	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0127B	ZO2	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0151A	PMP	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151A	ZO1	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151A	ZO2	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151A	PMP	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151A	ZO1	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151A	ZO2	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XPP0151B	PMP	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151B	ZO1	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151B	ZO2	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151B	PMP	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151B	ZO1	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151B	ZO2	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151C	PMP	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151C	ZO1	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XPP0151C	ZO2	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151C	PMP	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151C	ZO1	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0151C	ZO2	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023. Ignition source was screened because it is less than 5 hp
TB01.02	XPP0152	PMP	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0152	ZO2	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0152	PMP	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XPP0152	ZO2	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPP0153A	PMP	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153A	ZO1	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153A	ZO2	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	XPP0153A	PMP	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153A	ZO1	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153A	ZO2	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153A	PMP	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153A	ZO1	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153A	ZO2	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153B	PMP	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153B	ZO1	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153B	ZO2	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153B	PMP	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153B	ZO1	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153B	ZO2	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153B	PMP	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0153B	ZO1	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	XPP0153B	ZO2	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	PMP	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	ZO1	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	ZO2	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	PMP	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	ZO1	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	ZO2	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	PMP	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	ZO1	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168A	ZO2	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168B	PMP	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168B	ZO1	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168B	ZO2	1	TB D 3J;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168B	PMP	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.01	XPP0168B	ZO1	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168B	ZO2	1	TB D 19J;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168B	PMP	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168B	ZO1	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPP0168B	ZO2	1	TB D 22M;2	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.01	XPT0003-PP1	PMP	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPT0003-PP1	ZO2	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPT0003-PP2	PMP	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.01	XPT0003-PP2	ZO2	1	TB D 3J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XSR0007	EC	1	TB D 19j;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XSR0007	EC	1	TB D 22M;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XSR0008	EC	1	TB D 19j;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XSR0008	EC	1	TB D 22M;1	This ignition source was not identified close to the target per walkdown on 9/6/2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XTF01A1	PX	1	TB D 19j;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XTF01A1	PX	1	TB D 22M;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XTF1A1	PX	1	TB D 19j;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XTF1A1	PX	1	TB D 22M;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XTF5016	PX	1	TB D 19j;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	XTF5016	PX	1	TB D 22M;1	The ignition source had no targets within its ZOI per walkdown on 9-6-2023
TB01.02	XTF5829	PX	1	TB D 19j;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XTF5829	PX	1	TB D 22M;1	This ignition source was not identified close to the target per walkdown on 9/6/2023
TB01.02	XTF9001	PX	1	TB D 22M;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XTF9043-TI	PX	1	TB D 19j;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XTF9043-TI	PX	1	TB D 22M;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23
TB01.02	XVG02809A	PMP	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XVG02809A	ZO2	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	PMP	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	ZO2	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	PMP	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	ZO2	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	PMP	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	ZO2	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	PMP	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	ZO2	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	PMP	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	ZO2	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	PMP	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809A	ZO2	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	PMP	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	ZO2	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XVG02809B	PMP	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	ZO2	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	PMP	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	ZO2	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	PMP	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	ZO2	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	PMP	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	ZO2	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	PMP	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	ZO2	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	PMP	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809B	ZO2	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	PMP	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	ZO2	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	PMP	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XVG02809C	ZO2	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	PMP	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	ZO2	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	PMP	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	ZO2	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	PMP	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	ZO2	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	PMP	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	ZO2	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	PMP	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809C	ZO2	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	PMP	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	ZO2	1	IPS05841	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	PMP	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	ZO2	1	TB D 3J;2	The ignition source only has a large oil fire per walkdown on 9-6-2023

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Table D-2 – Fire Scenarios Removed from tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray	TrgtComment
TB01.02	XVG02809D	PMP	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	ZO2	1	TB D 19j;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	PMP	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	ZO2	1	TB D 22M;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	PMP	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	ZO2	1	TB D 25J;1	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	PMP	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	ZO2	1	XVM02809A	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	PMP	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02809D	ZO2	1	XVM02809D	The ignition source only has a large oil fire per walkdown on 9-6-2023
TB01.02	XVG02811-MS	EM	1	TB D 19j;1	Target is not within ZOI of ignition source per drawing inspection on 9-18-23

Table D-3 identifies the fire scenarios appended to tblIgnitionTargets all of which were added per plant walkdown review that took place on September 6th, 2023.

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Table D-3 – Fire Scenarios Appended to tblIgnitionTargets

Compartment	EquipUID	Equipment Type	Scenario	Target Tray
CB06	APN1FA	EC	1	FX E 7A;1
CB06	APN1FA	EC	1	XDS00257
CB06	APN1FB	EC	1	FX E 8B;1
CB06	APN1FB	EC	1	XDS00258
CB06	CB06-T12	CFWCAR	1	FX E 7A;1
CB06	CB06-T12	JB	1	FX E 7A;1
CB06	CB06-T12	TRCAR	1	FX E 7A;1
CB06	CB06-T12	TRWCAR	1	FX E 7A;1
CB06	CB06-T12	CFWCAR	1	XDS00257
CB06	CB06-T12	JB	1	XDS00257
CB06	CB06-T12	TRCAR	1	XDS00257
CB06	CB06-T12	TRWCAR	1	XDS00257
CB06	CB06-T13	CFWCAR	1	FX E 8B;1
CB06	CB06-T13	JB	1	FX E 8B;1
CB06	CB06-T13	TRCAR	1	FX E 8B;1
CB06	CB06-T13	TRWCAR	1	FX E 8B;1
CB06	CB06-T13	CFWCAR	1	XDS00258
CB06	CB06-T13	JB	1	XDS00258
CB06	CB06-T13	TRCAR	1	XDS00258
CB06	CB06-T13	TRWCAR	1	XDS00258
CB06	CB06-T17	CFWCAR	1	FX E 7A;1
CB06	CB06-T17	JB	1	FX E 7A;1
CB06	CB06-T17	TRCAR	1	FX E 7A;1
CB06	CB06-T17	TRWCAR	1	FX E 7A;1
CB06	CB06-T18	CFWCAR	1	XDS00257
CB06	CB06-T18	JB	1	XDS00257
CB06	CB06-T18	TRCAR	1	XDS00257

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Compartment	EquipUID	Equipment Type	Scenario	Target Tray
CB06	CB06-T18	TRWCAR	1	XDS00257
CB06	CB06-T20	CFWCAR	1	FX E 8B;1
CB06	CB06-T20	JB	1	FX E 8B;1
CB06	CB06-T20	TRCAR	1	FX E 8B;1
CB06	CB06-T20	TRWCAR	1	FX E 8B;1
CB06	CB06-T20	CFWCAR	1	XDS00258
CB06	CB06-T20	JB	1	XDS00258
CB06	CB06-T20	TRCAR	1	XDS00258
CB06	CB06-T20	TRWCAR	1	XDS00258
CB12	CB12-T1	CFWCAR	1	FX E 3X#3;2
CB12	CB12-T1	JB	1	FX E 3X#3;2
CB12	CB12-T1	TRCAR	1	FX E 3X#3;2
CB12	CB12-T1	TRWCAR	1	FX E 3X#3;2
CB12	CB12-T2	CFWCAR	1	FX E 3X#3;2
CB12	CB12-T2	JB	1	FX E 3X#3;2
CB12	CB12-T2	TRCAR	1	FX E 3X#3;2
CB12	CB12-T2	TRWCAR	1	FX E 3X#3;2
CB12	CB12-T3	CFWCAR	1	FX E 3X#3;2
CB12	CB12-T3	JB	1	FX E 3X#3;2
CB12	CB12-T3	TRCAR	1	FX E 3X#3;2
CB12	CB12-T3	TRWCAR	1	FX E 3X#3;2
CB06	DPN1HA2	EC	1	FX E 7A;1
CB06	DPN1HA2	EC	1	XDS00257
CB06	DPN1HB2	EC	1	FX E 8B;1
CB06	DPN1HB2	EC	1	XDS00258
IB17	IB17-T2	CFWPW	1	FX M 3XB;1
IB17	IB17-T2	JB	1	FX M 3XB;1
IB17	IB17-T2	TRPW	1	FX M 3XB;1
IB17	IB17-T2	TRWPW	1	FX M 3XB;1

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Compartment	EquipUID	Equipment Type	Scenario	Target Tray
IB17	IB17-T2	CFWPW	1	XBT00107
IB17	IB17-T2	JB	1	XBT00107
IB17	IB17-T2	TRPW	1	XBT00107
IB17	IB17-T2	TRWPW	1	XBT00107
IB20	IB20-T2a	CFWPW	1	FX M 2XA;2
IB20	IB20-T2a	JB	1	FX M 2XA;2
IB20	IB20-T2a	TRPW	1	FX M 2XA;2
IB20	IB20-T2a	TRWPW	1	FX M 2XA;2
IB20	IB20-T2b	CFWPW	1	FX M 2XA;2
IB20	IB20-T2b	JB	1	FX M 2XA;2
IB20	IB20-T2b	TRPW	1	FX M 2XA;2
IB20	IB20-T2b	TRWPW	1	FX M 2XA;2
IB20	IB20-T3	CFWPW	1	FX M 2XA;2
IB20	IB20-T3	JB	1	FX M 2XA;2
IB20	IB20-T3	TRPW	1	FX M 2XA;2
IB20	IB20-T3	TRWPW	1	FX M 2XA;2
IB22.02	IB22.02-T1a	CFWPW	1	FX M 3XB;2
IB22.02	IB22.02-T1a	JB	1	FX M 3XB;2
IB22.02	IB22.02-T1a	TRPW	1	FX M 3XB;2
IB22.02	IB22.02-T1a	TRWPW	1	FX M 3XB;2
IB22.02	IB22.02-T1b	CFWPW	1	FX M 3XB;2
IB22.02	IB22.02-T1b	JB	1	FX M 3XB;2
IB22.02	IB22.02-T1b	TRPW	1	FX M 3XB;2
IB22.02	IB22.02-T1b	TRWPW	1	FX M 3XB;2
IB22.02	IB22.02-T1-BD	BD	1	FX M 3XB;2
IB22.02	IB22.02-T2a	CFWPW	1	FX M 3XB;2
IB22.02	IB22.02-T2a	JB	1	FX M 3XB;2
IB22.02	IB22.02-T2a	TRPW	1	FX M 3XB;2
IB22.02	IB22.02-T2a	TRWPW	1	FX M 3XB;2

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Compartment	EquipUID	Equipment Type	Scenario	Target Tray
IB22.02	IB22.02-T2b	CFWPW	1	FX M 3XB;2
IB22.02	IB22.02-T2b	JB	1	FX M 3XB;2
IB22.02	IB22.02-T2b	TRPW	1	FX M 3XB;2
IB22.02	IB22.02-T2b	TRWPW	1	FX M 3XB;2
IB22.02	IB22.02-T2-BD	BD	1	FX M 3XB;2
IB22.02	IB22.02-T3	CFWPW	1	FX M 3XB;2
IB22.02	IB22.02-T3	JB	1	FX M 3XB;2
IB22.02	IB22.02-T3	TRPW	1	FX M 3XB;2
IB22.02	IB22.02-T3	TRWPW	1	FX M 3XB;2
IB25.06.02	IB25.06.02-T1	CFWPW	1	FX M 1X#3;2
IB25.06.02	IB25.06.02-T1	JB	1	FX M 1X#3;2
IB25.06.02	IB25.06.02-T1	TRPW	1	FX M 1X#3;2
IB25.06.02	IB25.06.02-T1	TRWPW	1	FX M 1X#3;2
TB01.03	TG	TGH	1	IPS05841
TB01.03	TG	TGO	1	IPS05841
TB01.03	TG	TGH	1	TB D 3J;1
TB01.03	TG	TGO	1	TB D 3J;1
TB01.03	TG	TGH	1	TB D 3J;2
TB01.03	TG	TGO	1	TB D 3J;2
TB01.03	TG	TGH	1	TB D 19j;1
TB01.03	TG	TGO	1	TB D 19j;1
TB01.03	TG	TGH	1	TB D 19J;2
TB01.03	TG	TGO	1	TB D 19J;2
TB01.03	TG	TGH	1	TB D 22M;1
TB01.03	TG	TGO	1	TB D 22M;1
TB01.03	TG	TGH	1	TB D 22M;2
TB01.03	TG	TGO	1	TB D 22M;2
TB01.03	TG	TGH	1	TB D 25J;1
TB01.03	TG	TGO	1	TB D 25J;1

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Compartment	EquipUID	Equipment Type	Scenario	Target Tray
TB01.03	TG	TGH	1	XVM02809A
TB01.03	TG	TGO	1	XVM02809A
TB01.03	TG	TGH	1	XVM02809D
TB01.03	TG	TGO	1	XVM02809D
CB06	XIT05904	EC	1	FX E 8B;1
CB06	XIT05904	EC	1	XDS00258
IB20	XSW1DA_3-16	EC	1	FX M 2XA;2
IB22.02	XSW1DB_1-5	EC	1	FX M 3XB;2
IB22.02	XSW1DB_6-19	EC	1	FX M 3XB;2
CB06	XTF-1FA	PX	1	FX E 7A;1
CB06	XTF-1FA	PX	1	XDS00257
CB06	XTF-1FB	PX	1	FX E 8B;1
CB06	XTF-1FB	PX	1	XDS00258

Table D-4 identifies the transient mapping appended to tblScenarioTable all of which were added per plant walkdown review that took place on September 6th, 2023.

Table D-4 – Transient Mapping Appended to tblScenarioTable

Compartment	Target Tray	Transient
CB06	FX E 7A;1	CB06-T17
CB06	FX E 7A;1	CB06-T12
CB06	FX E 8B;1	CB06-T13
CB06	FX E 8B;1	CB06-T20
IB20	FX M 2XA;2	IB20-T2a

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Compartment	Target Tray	Transient
IB20	FX M 2XA;2	IB20-T2b
IB20	FX M 2XA;2	IB20-T3
IB17	FX M 3XB;1	IB17-T2
IB22.02	FX M 3XB;2	IB22.02-T1b
IB22.02	FX M 3XB;2	IB22.02-T2a
IB22.02	FX M 3XB;2	IB22.02-T2b
IB22.02	FX M 3XB;2	IB22.02-T3
IB22.02	FX M 3XB;2	IB22.02-T1a
IB17	XBT00107	IB17-T2
CB06	XDS00257	CB06-T12
CB06	XDS00257	CB06-T18
CB06	XDS00258	CB06-T20
CB06	XDS00258	CB06-T13

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Appendix E - HRA Updates

The reports from the HRA Calculator for the events that were created or modified are provided at the end of this appendix.

FLEX Refueling Screening

Refueling of FLEX equipment may be a critical task for mitigation strategies. The guidance in Section 5.4.1 of EPRI 3002013018 (Ref. 16) provides screening criteria for these actions provided the action is feasible and reliable. The basis of the screening criteria is related to ASME/ANS RA-Sa-2009 PRA Standard (Ref. 15) supporting requirement SYA15, which allows a failure mode to be screened if the contribution to the total failure rate is less than 1 percent of the total failure rate, assuming the effect on system operation is the same.

The FLEX equipment requiring refueling for the 24 hour mission time are the Combustion Turbine Generators and the FLEX steam generator feed pumps. The EB diesel does not require refueling for 72 hours and the BDB Pumper Truck does not require refueling for 28 hours (VCS-ERP-0113, Ref. 12). The primary failure rates for FLEX equipment requiring refueling are provided in Table E-1. It is noted that these are not the full failure rate as common cause failures and alignment failures are not included in the table.

Table E-1 – FLEX Component Failure Rates

Component	Failure to Run	Failure to Start	Total Failure Rate	1% of Total Failure Rate
Combustion Turbine Generators	2.17E-1	2.88E-2	2.46E-1	2.46E-3
FLEX Steam Generator Feed Pump	2.33E-1	3.38E-2	2.67E-1	2.67E-3

All failure rates in Table E-1 are larger than the example provided in EPRI 3002013018. Thus, the refueling actions can be screened from the analysis if the refueling actions have the “reliable characteristics” listed in EPRI 3002013018. A summary of these characteristics for VC Summer is provided in Table E-2. The refueling actions for FLEX equipment have been screened from the analysis.

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Table E-2 – EPRI 3002013018 "Reliable Action" Characteristics Summary for VCS FLEX Refueling Actions

Attribute	Component	Assessment
The consequences of running out of fuel are obvious and recoverable.	Combustion Turbine Generators	MET. There is a dedicated refueling operator for the CTGs and it would be immediately obvious if the generator shut down. The loss of power would also be immediately noticed in the MCR. Refueling of the CTGs takes approximately 15 minutes once staged (FLEX Validation document Ref. 16). If the batteries have been charged by the CTGs, then recharging would have occurred for 3 hours, so there would be sufficient battery power. Operators would have several hours to restart the motor driven EFW pump. Requirements for restarting the CTGs upon loss of fuel are to restart and ensure the breakers close.
	FLEX Steam Generator Feed Pump	MET. There is a dedicated refueling operator for the FLEX SG Feed Pumps and it would be immediately obvious if the pumps shut down. SG level indication is also available in the MCR. Refueling of the FLEX SG Feed Pumps takes approximately 25 minutes (FLEX Validation document Ref. 16). There are several hours before injection to the SG is required to be recovered to prevent core damage.
The action has been demonstrated to be feasible	Combustion Turbine Engines FLEX Steam Generator Feed Pump	MET. Refueling of FLEX equipment feasibility is demonstrated in the Flex Validation document (Ref. 16).
The action is proceduralized	Combustion Turbine Engines FLEX Steam Generator Feed Pump	MET. Procedure VCS-ERP-0113, BDB FUELING OPERATIONS (Ref. 12) provides guidance for refueling operations. The procedure provides step-by-step directions with an enclosure that lists the fuel tank capacity for the diesel equipment used in SBO/ELAP scenarios. Another enclosure provides the fuel consumption rate and the maximum interval allowed for refueling.

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Attribute	Component	Assessment
The action is addressed in the training program.	Combustion Turbine Engines FLEX Steam Generator Feed Pump	MET. Training for refueling of the FLEX equipment occurs every four years in the classroom. In addition, the procedures for operation contain several pictures which is considered sufficient to support this task.
The action is not time stressed.	Combustion Turbine Engines	MET. The CTG refueling interval is 3 hours per VCS-ERP-0113 Enclosure B (Ref. 12). The earliest time the CTG could be started within this scenario is 9.25 hours after plant trip (6 hours of DG operation, 2 hours to declare ELAP (includes CTG staging), 1.25 hours for aligning and starting). Refueling equipment is staged along with the CTGs and a dedicated person is assigned for refueling. The cognitive portion occurs immediately after starting the CTGs, as the operator is directed to "Maintain fuel supply for the Turbine Generators while operating." The cue to refuel is time based and as such Tcog should be immediate but a conservative 1 minute is assumed. Refueling takes approximately 15 minutes after staging. The associated time margin is given by: TM = [(Tsw – Tdelay) – (Tcog + Texe)] / (Tcog + Texe) x 100% TM = [(735– 555) – (1+15)] / 16 x 100% = 1025% Based on the guidance in EPRI 3002013018 (Ref. 16), if the refueling action has a time margin of over 100%, it is not time stressed. Thus, this action is not time stressed.

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Attribute	Component	Assessment
The action is not time stressed. (continued)	FLEX Steam Generator Feed Pump	MET. The FLEX SG Feed pump refueling interval is 13 hours per VCS-ERP-0113 Enclosure B (Ref. 12). The earliest time the FX Feed could be started within this scenario is conservatively estimated at 8 hours after plant trip (6 hours of DG operation, and then with failure of other feedwater sources). Refueling equipment is staged via FSP-5.0 (Ref. 10) Step 24 "REFER to VCS-ERP-0113, BDB REFUELING OPERATIONS, to supply Diesel Fuel to FLEX equipment". FSP 5.0 is entered upon ELAP declaration at 8 hours. An additional 4 hours is conservatively assumed to proceed through the FSP-5.0 (e.g., aligning CTGs and battery power). The cue to refuel is time based and as such Tcog should be immediate but a conservative 1 minute is assumed. The refueling process including staging is approximately 25 minutes (FLEX Validation document Ref. 16). The associated time margin is given by: TM = [(Tsw – Tdelay) – (Tcog + Texe)] / (Tcog + Texe) x 100% TM = [(1260 – 720) – (1+25)] / 26 x 100% = 1978% Based on the guidance in EPRI 3002013018 (Ref. 16) if the refueling action has a time margin of over 100%, it is not time stressed. Thus, this action is not time stressed.
The action is not performed in an extreme environment.	Combustion Turbine Engines FLEX Steam Generator Feed Pump	MET. These actions are performed outside in accessible areas. For internal events, fire and seismic scenarios, even inclement weather would not be considered extreme.
The action requires only simple manipulations.	Combustion Turbine Engines FLEX Steam Generator Feed Pump	MET The steps include simple electrical plug manipulations, hose routing, and local fuel pump start/stop. These are all basic manipulations within the capabilities of all plant operators.

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Attribute	Component	Assessment
There is a person dedicated to monitoring the engine-driven equipment.	Combustion Turbine Engines FLEX Steam Generator Feed Pump	MET. "The Shift Manager or designee shall initiate assignment of a team member to conduct initial fueling or refueling operations of key BDB equipment. Once assigned, this activity shall be continuous, requiring continuous monitoring for the designated refueling lead until relieved." (VCS-ERP-0113 Step 5.1.1) Deployment of fuel equipment is performed with equipment staging which would occur prior to ELAP for the CTGs. Both mechanical maintenance and chemistry personnel are familiar with fueling of FLEX equipment (EOP-6 Attachment 15, Ref. 3)
The person responsible for the refueling action is aware of the timing conditions.	Combustion Turbine Engines FLEX Steam Generator Feed Pump	MET. The person assigned to refueling is aware of the timing conditions. Enclosure B of VCS-ERP-0113 (Ref. 12) provides the fuel capacity and consumption rate along with the maximum time interval allowed prior to refueling.

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HEP-C-CTG-DEPLOY, OPERATOR FAILS TO DEPLOY AND STAGE CTGs

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	**M. Blue/JH**			**9/14/2023**
Reviewer				**9/14/2023**

HEP Summary					
	P_1	P_2	P_{cog}	P_{exe}	Total HEP
Method	CBDTM	HCR/ORE	Maximum	THERP	
HEP	6.00E-04	0.00E+00	6.00E-04	1.16E-02	1.22E-02
Distribution Type	Beta		**Variance**	1.34E-04	

RAW	FV	Risk Significant
		N/A

Identification and Definition
This scenario begins with a loss of offsite power. One diesel generator runs for 6 hours. Then, there is a station blackout. Operators proceed through EOP-6 to stage the CTGs.

Cues and Indications	
Initial Cue	EOP-6 Step 13 b
Recovery Cue	FSP-5 Step 16
Cue Comments	
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	EOP-6.0 (ECA-0.0 LOSS OF ALL ESF AC POWER) Revision: 41
Cognitive Step Number	Step 13 b
Cognitive Instruction	Have Chemistry personnel stage Combustion Turbine Generators per FSP-20.7, FLEX COMBUSTION TURBINE GENERATOR OPERATION.
Execution Procedure	FSP-20.7 (FLEX COMBUSTION TURBINE GENERATOR OPERATION) Revision: 1
Execution Instruction	
Job Performance Measure	JPM: Not Selected
Notes	

Training	
Classroom Training	

Crew Member	Included	Total Available	Required for Execution	Notes
Shift Manager	No	1	0	
Shift Supervisor	No	1	0	
Shift Engineer (STA)	No	1	0	

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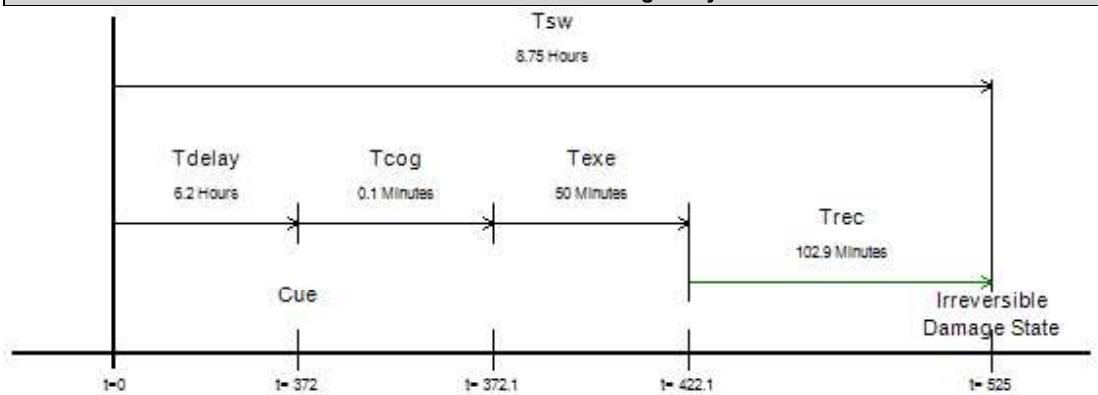
Reactor Operators	Yes	1	0	
Auxiliary Operators	Yes	1	0	
Health Physics	Yes	1	0	
Chemistry	Yes	1	1	
Mechanics	Yes	1	1	
Electricians	Yes	1	0	
I&C Maintenance	Yes	1	0	
Notes				

Operator Interview Insights
This action was discussed with operators on September 12, 2023. Representatives from Dominion included Michael Vickery and Matthew Torres. The operators verified the 75 minute execution timing and that staging of the CTGs would occur prior to ELAP declaration. It was noted that it is preferable to align the battery chargers to the EB diesel; however this is an option if that is unavailable,

Timing Analysis



T_{sw}	8.75 Hours
T_{delay}	6.2 Hours
T_{cog}	0.1 Minutes
T_{exe}	50 Minutes
Time available for cognition and recovery	103 Minutes
Time available for recovery	102.9 Minutes
SPAR-H Available time (cognitive)	103 Minutes
SPAR-H Available time (execution) ratio	3.06 Minutes
EPRI Minimum level of dependence for recovery	ZD

Notes

Tsw: 6 hours of diesel power is assumed after loss of offsite power at time 0. CTGs must be aligned and started within 4 hours after loss of all AC power to provide power for the battery chargers. Aligning the busses and starting the CTGs takes 75 minutes leaving 8.75 hours available for deploying and staging (6 hours + 4 hours - 1.25 hours = 8.75 hours). This action is also used for deploying the CTGs for MDAFW pump operation which has a longer time frame (see HEP-C-FX-CTG2).

Tdelay: EOP6 is entered upon loss of all AC power at 6 hours when the EDG fails.

Operators would begin staging the CTGs prior to ELAP declaration. During the operator interview, it was suggested that step 13 to stage the CTGs would be reached in approximately 10 minutes. 6.2 hours total delay.

Texe: From the FLEX Validation and discussion with operators, 50 minutes is assumed for assessing and deploying the CTGs.

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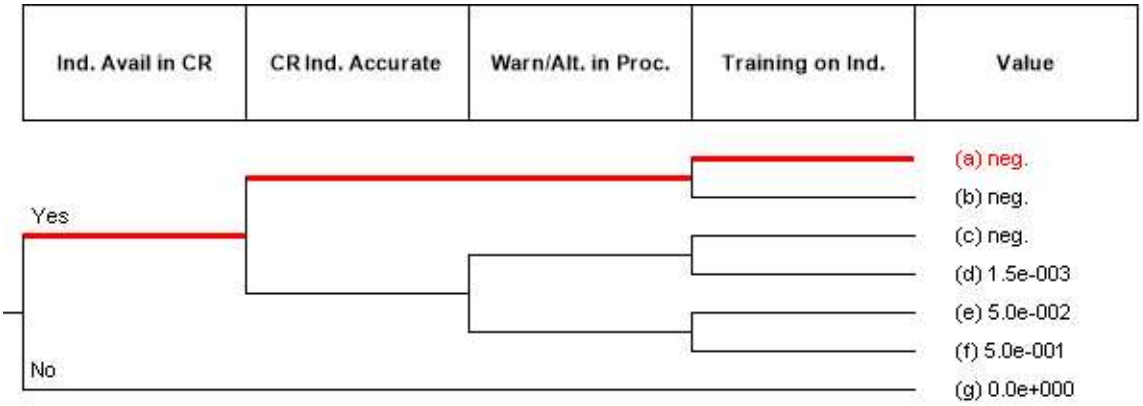
Cognitive Analysis		
Pc Failure Mechanism	**Branch**	**HEP**
Pca: Availability of Information	a	n/a
Pcb: Failure of Attention	i	n/a
Pcc: Misread/miscommunicate data	a	n/a
Pcd: Information misleading	a	n/a
Pce: Skip a step in procedure	g	6.00E-03
Pcf: Misinterpret Instructions	a	n/a
Pcg: Misinterpret decision logic	k	n/a
Pch: Deliberate violation	a	n/a
Initial Pc(without recovery credited)		6.00E-03
Notes		

Pca: Availability of Information

Notes/Assumptions:



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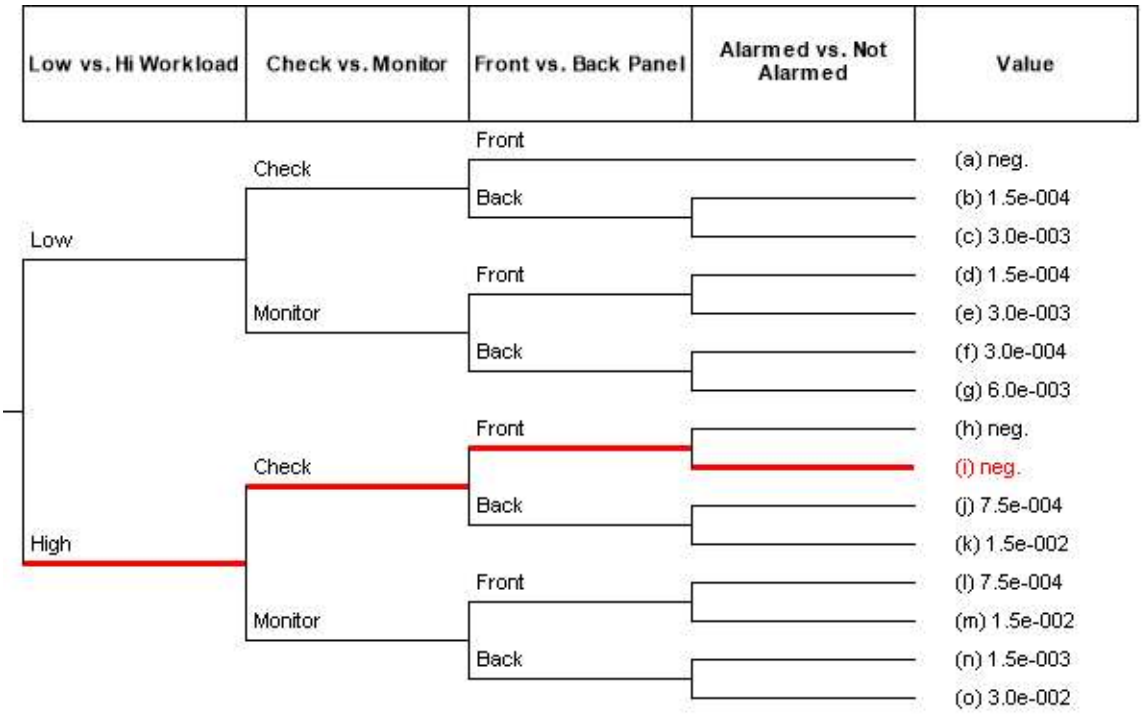
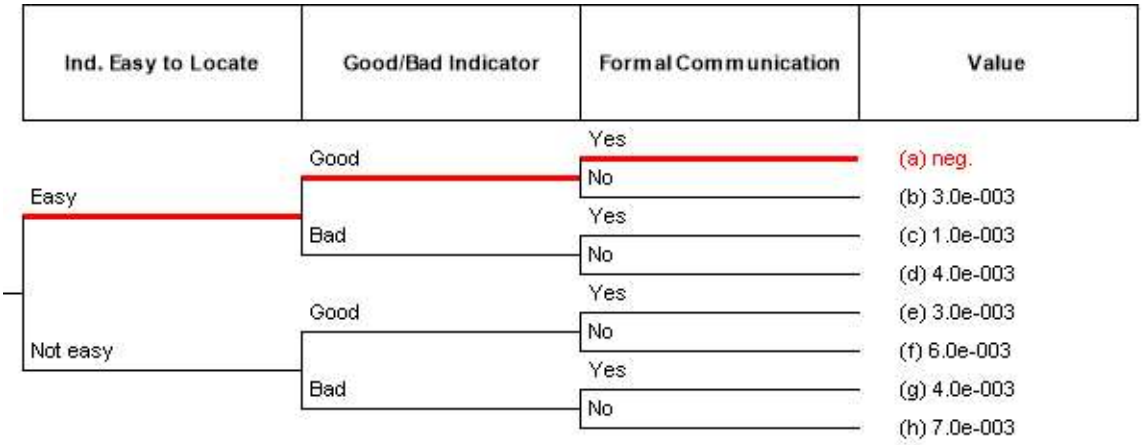
Pcb: Failure of Attention

Notes/Assumptions:



Pcc: Misread/miscommunicate data

Notes/Assumptions:



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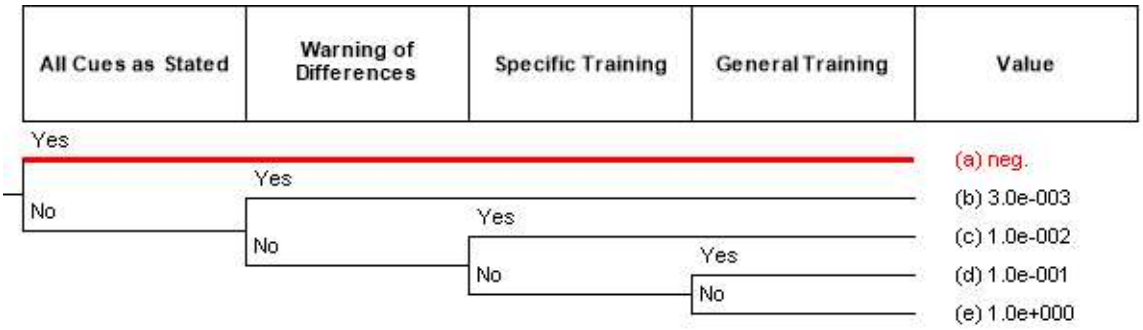
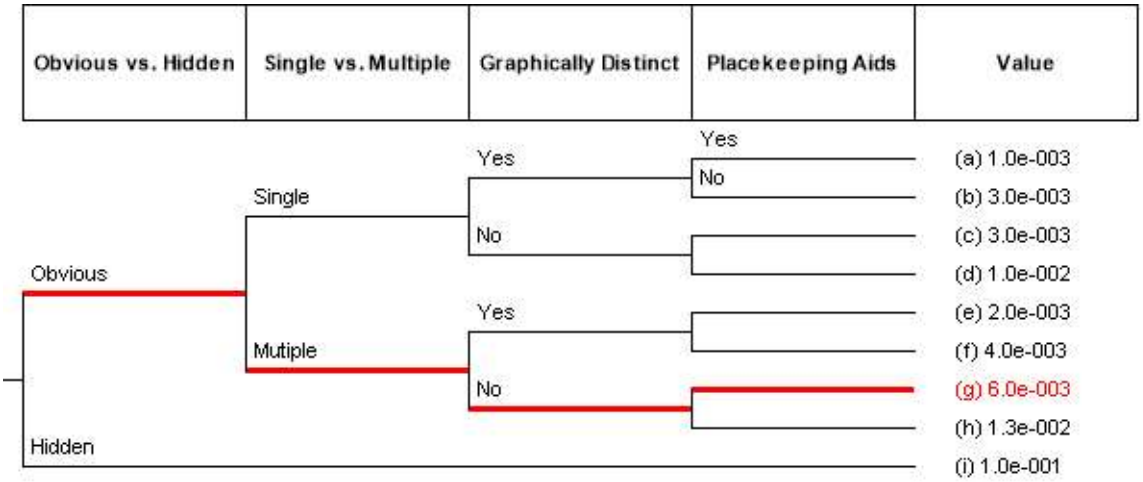
Pcd: Information misleading

Notes/Assumptions:



Pce: Skip a step in procedure

Notes/Assumptions:



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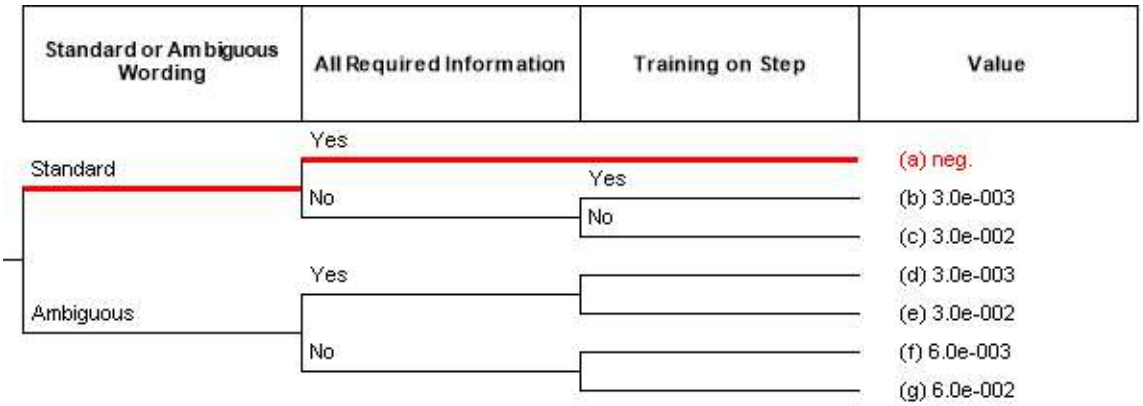
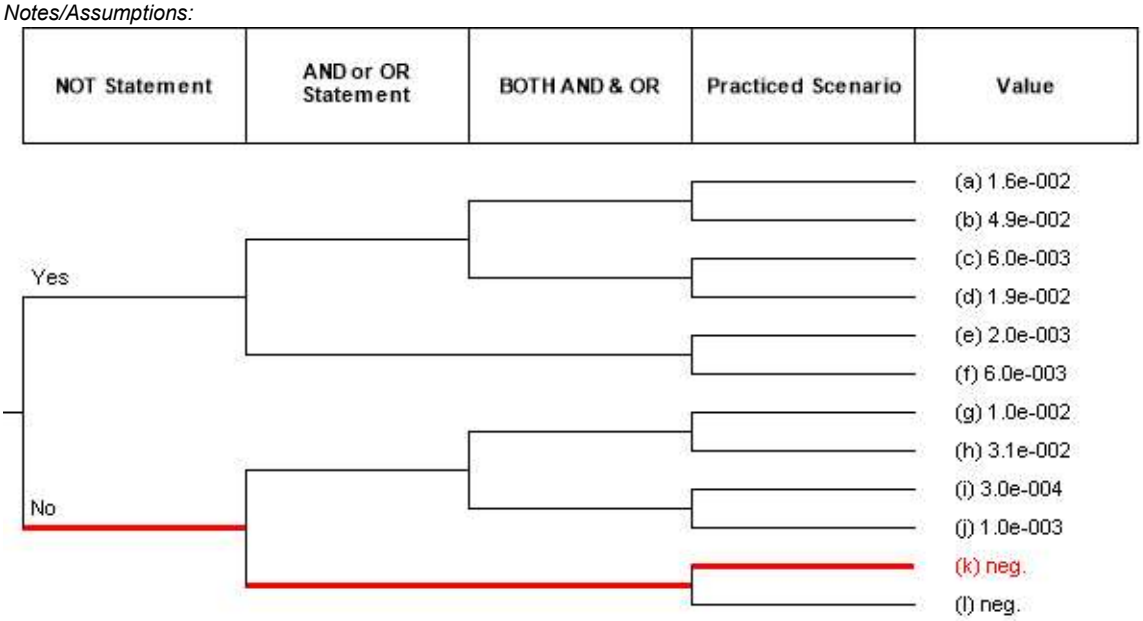
Pcf: Misinterpret Instructions

Notes/Assumptions:



Pcg: Misinterpret decision logic

Notes/Assumptions:



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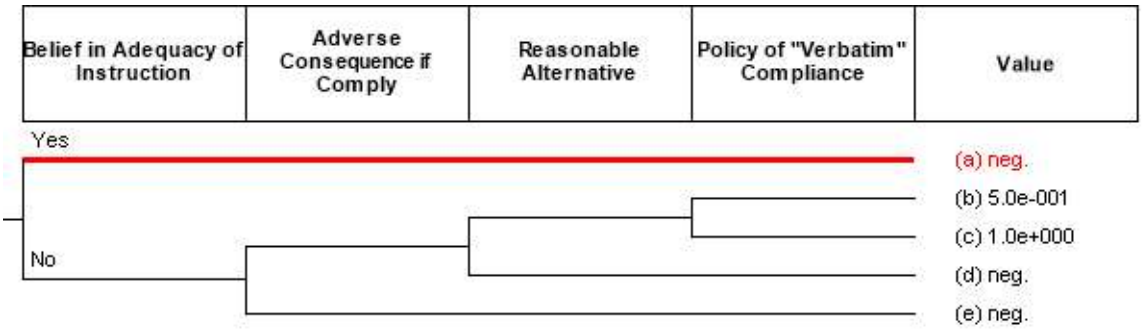
Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery											
	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-			1.00E+00		0.0
Pcb	n/a	-	-	-	-	-			1.00E+00		0.0
Pcc	n/a	-	-	-	-	-			1.00E+00		0.0
Pcd	n/a	-	-	-	-	-			1.00E+00		0.0
Pce	6.00E-03	X	-	-	-	-			1.00E-01		6.00E-04
Pcf	n/a	-	-	-	-	-			1.00E+00		0.0
Pcg	n/a	-	-	-	-	-			1.00E+00		0.0
Pch	n/a	-	-	-	-	-			1.00E+00		0.0
Final Pc (with recovery credited)											6.00E-04
Notes											

Sigma Table				
Plant Type	Response Type	LB	Sigma	UB
BWR	CP1	0.4	0.7	1
	CP2	0.2	0.58	0.96
	CP3	0.59	0.75	0.91
PWR	CP1	0.26	0.57	0.88
	CP2	0.07	0.38	0.69
	CP3		0.77	
Sigma:	5.70E-01			
HEP:	0.00E+00			
Notes/Assumptions	CP1 Event - the SBO procedure states to deploy the CTGs.			

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Execution Performance Shaping Factors		
Environment	Lighting	Emergency
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Special Requirements	Tools	Required
Special Requirements	Tools	Adequate
Special Requirements	Tools	Available
Complexity of Response	Execution	Complex
Equipment Accessibility (Cognitive)		
Equipment Accessibility (Execution)	CAR and Outside	Accessible

Stress	
High	
Plant Response As Expected:	Yes
Workload:	High
Performance Shaping Factors:	Negative
Notes	

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Execution Unrecovered							
Procedure		Comment				Stress Factor	Override
Step No.	Instruction / Comment	Error Type	THERP		HEP		
			Table	Item			
FSP-20.7 Step 1a	Stage the FLEX Combustion Turbine Generators for operation as follows: Pull both XTG0200A(B), FLEX COMBUSTION TURBINE GENERATOR A(B), out of their storage location to their operating position.	EOM	20-7b	2	1.3E-3	High	
		EOC	99	1	1.00E-02		
	Comment	There is a dedicated deployment location for the CTGs under the Containment Access Ramp (CAR). Deployment is to move them outside from inside opening a rollup door. Task performed by ERU personnel who are responsible for routine maintenance and testing of the equipment and are thus familiar with location and equipment,					
	Location:	CAR and Outside				Total Step HEP	5.65E-02
FSP-20.7 Step 1b	Open the Exhaust Rain Cap.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
	Location:	CAR and Outside				Total Step HEP	7.15E-02
FSP 20.7 Step 1d	Ensure each generator trailer ground is connected to the plant ground for	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		

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	each Turbine Generator to be started.						
	Location:	CAR and Outside				Total Step HEP	1.37E-01
FSP 20.7 Step 1e	Ensure each generator Neutral is connected to a separate NGR for each Turbine Generator to be started.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		
	Location:	CAR and Outside				Total Step HEP	1.37E-01
FSP 20.7 Step 1f	Ensure each NGR that is connected to a generator is connected to the plant ground	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		
	Location:	CAR and Outside				Total Step HEP	1.37E-01
FSP 20.7 Step 1g	Ensure the ground communications cable is connected between an NGR and each Turbine to be started.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		
	Location:	CAR and Outside				Total Step HEP	1.37E-01
FSP 20.7 Step 1h	Ensure the SERVICE switch is in the down (covered) position.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		
	Location:	CAR and Outside				Total Step HEP	7.85E-03
FSP 20.7 Step 1i		EOM	20-7b	2	1.3E-3	High	

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	IF the Generators will be operated in parallel, THEN ensure the communications cable between the two is connected, (GENERATOR OUTPUT on one generator goes to GENERATOR INPUT on the other generator).	EOC	20-12	13	1.30E-02		
	Location:	CAR and Outside				Total Step HEP	7.15E-02
FSP-20.7 Step 1j	Stage Portable Fuel Tank and refueling equipment for the Combustion Turbine Generator(s) per VCS-ERP-0113, ERU BDB REFUELING OPERATIONS. NOTE - Step 1.j The FLEX Portable refueling equipment must NOT be connected to the Diesel Fuel Oil Tanks until an ELAP has been declared.	EOM	20-7b	2	1.3E-3	High	

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	Comment	A fuel transfer pump is stored with the CTGs and the underground DG fuel tanks are less than 50 feet away. There is no error of commission for this step as this is just the cognition to switch to VCS-ERP-0113.					
	Location:					Total Step HEP	6.50E-03
VCS-ERP-0113 5.3.1	Deploy fuel tank/transfer equipment as described in: • VCS-ERP-0154 FX Fuel Cubes • VCS-ERP-0164 FX Fuel Transfer Pump Operation	EOM			1.3E-3	High	
	Comment	A fuel transfer pump is stored with the CTGs and the underground DG fuel tanks are less than 50 feet away. Any execution errors are negligible as there is no hooking up of the equipment in this HEP. This is just pulling out the pump and moving it less than 50 feet, No transporting with a vehicle. As this is a practiced scenario, execution errors are negligible.					
	Location:	CAR and Outside				Total Step HEP	6.50E-03
FSP-20.7 Step 1k	Turn the battery switch to ON for the Turbine(s) to be started.	EOM	20-7b	2	1.3E-3	High	
	Location:					Total Step HEP	6.50E-03
FSP 20.7 Step 1l	Ensure the thermal overload on the battery switch for the turbine(s) to be started is reset (trip lever in the up position).	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		
	Location:	CAR and Outside				Total Step HEP	7.85E-03
		EOM	20-7b	2	1.3E-3	High	

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FSP-20.7 Step 1m	Place the IGNITION toggle switch to ON (center) position for the Turbine(s) to be started.	EOC	20-12	8a	2.70E-04		
	Location:					Total Step HEP	7.85E-03
FSP-20.7 Step 1n	Verify the following displays are energized for the Turbine(s) to be started: ● Racepak. ● Woodward EasyGen 3000	EOM	20-7b	2	1.3E-3	High	
	Location:					Total Step HEP	6.50E-03
FSP-20.7 Step 1o	PULL the EMERGENCY STOP pushbutton for the Turbine(s) to be started.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		
	Location:					Total Step HEP	7.85E-03
FSP-20.7 Step 1q	Verify the Woodward EasyGen 3000 display on the turbine(s) to be started shows AUTO MODE READY.	EOM			1.3E-3	High	
	Location:					Total Step HEP	6.50E-03
FSP-20.7 Step 1r	Place the GROUP START switches in the	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		

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	GROUP START (up) position.						
	Location:					Total Step HEP	7.85E-03
FSP-20.7 Step 1s	Place the IGNITION toggle switches to OFF (down).	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		
	Location:					Total Step HEP	7.85E-03
FSP-20.7 Step 2c2	Verify the turbines start.	EOM	20-7b	2	1.3E-3	High	
	Location:					Total Step HEP	6.50E-03

Execution Recovered							
Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
FSP-20.7 Step 1a		Stage the FLEX Combustion Turbine Generators for operation as follows: Pull both XTG0200A(B), FLEX COMBUSTION TURBINE GENERATOR A(B), out of their storage location to their operating position.	5.65E-02				3.67E-04
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP-20.7 Step 1b		Open the Exhaust Rain Cap.	7.15E-02				4.65E-04

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	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP 20.7 Step 1d		Ensure each generator trailer ground is connected to the plant ground for each Turbine Generator to be started.	1.37E-01				8.87E-04
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP 20.7 Step 1e		Ensure each generator Neutral is connected to a separate NGR for each Turbine Generator to be started.	1.37E-01				8.87E-04
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP 20.7 Step 1f		Ensure each NGR that is connected to a generator is connected to the plant ground	1.37E-01				8.87E-04
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP 20.7 Step 1g		Ensure the ground communications cable is connected between an NGR and each Turbine to be started.	1.37E-01				8.87E-04

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	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP 20.7 Step 1h		Ensure the SERVICE switch is in the down (covered) position.	7.85E-03				5.10E-05
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP 20.7 Step 1i		IF the Generators will be operated in parallel, THEN ensure the communications cable between the two is connected, (GENERATOR OUTPUT on one generator goes to GENERATOR INPUT on the other generator).	7.15E-02				4.65E-04
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP-20.7 Step 1j		Stage Portable Fuel Tank and refueling equipment for the Combustion Turbine Generator(s) per VCS-ERP-0113, ERU BDB REFUELING OPERATIONS. NOTE - Step 1.j	6.50E-03				4.23E-05

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		The FLEX Portable refueling equipment must NOT be connected to the Diesel Fuel Oil Tanks until an ELAP has been declared.					
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
VCS-ERP-0113 5.3.1		Deploy fuel tank/transfer equipment as described in: • VCS-ERP-0154 FX Fuel Cubes • VCS-ERP-0164 FX Fuel Transfer Pump Operation	6.50E-03				6.50E-03
FSP-20.7 Step 1k		Turn the battery switch to ON for the Turbine(s) to be started.	6.50E-03				1.79E-09
	FSP-20.7 Step 1n	Verify the following displays are energized for the Turbine(s) to be started: ● Racepak. ● Woodward EasyGen 3000		6.50E-03	ZD	6.50E-03	
	FSP-20.7 Step 1q	Verify the Woodward EasyGen 3000 display on the turbine(s) to be started		6.50E-03	ZD	6.50E-03	

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		shows AUTO MODE READY.					
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP 20.7 Step 1l		Ensure the thermal overload on the battery switch for the turbine(s) to be started is reset (trip lever in the up position).	7.85E-03				5.10E-05
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP-20.7 Step 1m		Place the IGNITION toggle switch to ON (center) position for the Turbine(s) to be started.	7.85E-03				2.16E-09
	FSP-20.7 Step 1n	Verify the following displays are energized for the Turbine(s) to be started: ● Racepak. ● Woodward EasyGen 3000		6.50E-03	ZD	6.50E-03	
	FSP-20.7 Step 1q	Verify the Woodward EasyGen 3000 display on the turbine(s) to be started shows AUTO MODE READY.		6.50E-03	ZD	6.50E-03	

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	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP-20.7 Step 1o		PULL the EMERGENCY STOP pushbutton for the Turbine(s) to be started.	7.85E-03				3.32E-07
	FSP-20.7 Step 1q	Verify the Woodward EasyGen 3000 display on the turbine(s) to be started shows AUTO MODE READY.		6.50E-03	ZD	6.50E-03	
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP-20.7 Step 1r		Place the GROUP START switches in the GROUP START (up) position.	7.85E-03				5.10E-05
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
FSP-20.7 Step 1s		Place the IGNITION toggle switches to OFF (down).	7.85E-03				5.10E-05
	FSP-20.7 Step 2c2	Verify the turbines start.		6.50E-03	ZD	6.50E-03	
		Total Unrecovered:	8.12E-01			**Total Recovered:**	1.16E-02

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HEP-C-EBD-BAT-CHG, Operators fail to align DC Battery chargers to EB diesel in SBO

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	M. Blue/JH			9/14/2023
Reviewer				9/14/2023

HEP Summary			
	Pcog	**Pexe**	**Total HEP**
Method	CBDTM	THERP	CBDTM+THERP
Without Recovery	0.00E+00	2.25E-01	
With Recovery	0.00E+00	3.08E-04	3.08E-04
Distribution Type	Lognormal	**EF**	1.00E+01

RAW	FV	Risk Significant
		N/A

Identification and Definition
A loss of offsite power occurs at time t=0. Reactor and turbine trip are successful. One diesel generator runs for 6 hours powering the motor driven AFW pump. After 6 hours, the diesel stops running and there is a station blackout. Operators enter EOP-6. Step 14 calls for declaration of Extended Loss of AC Power (ELAP) if power is not expected to be restored within 2 hours. ELAP is conservatively assumed to be declared 2 hours later. After ELAP declaration, the operators enter procedure FSP-5.0 which instructs powering of the DC Battery chargers with the EB diesel at step 4. No other failures are assumed at the ELAP declaration for this HEP.

Cues and Indications	
Initial Cue	FSP 5 Step 4
Recovery Cue	
Cue Comments	
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	FSP-5.0 (INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING) Revision: 3
Cognitive Step Number	4
Cognitive Instruction	Locally energize DPN1HA and DPN1HB per ATTACHMENT 1, ENERGIZING DPN1HA AND DPN1HB FROM THE EB 300KW DIESEL GENERATOR.
Execution Procedure	FSP-5.0 (INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING) Revision: 3
Execution Instruction	Attachment 1

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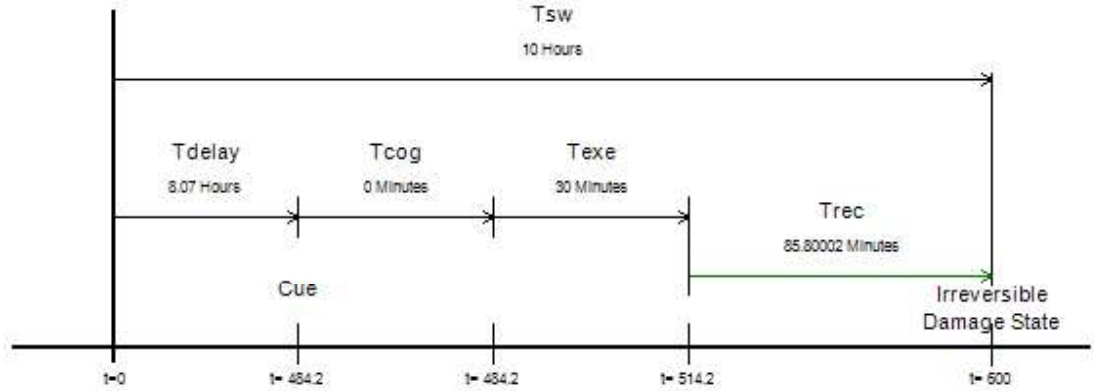
Job Performance Measure	JPM: Not Selected
Other Procedures	EOP-6.0 (ECA-0.0 LOSS OF ALL ESF AC POWER) Revision: 41
Notes	

Crew Member	Included	Total Available	Required for Execution	Notes
Shift Manager	No	1	0	
Shift Supervisor	No	1	0	
Shift Engineer (STA)	No	1	0	
Reactor Operators	Yes	1	1	
Auxiliary Operators	Yes	1	0	
Health Physics	Yes	1	0	
Chemistry	Yes	1	0	
Mechanics	Yes	1	1	
Electricians	Yes	1	0	
I&C Maintenance	Yes	1	0	
Notes				

Analyst Notes
Execution only action. Cognitive portion is ELAP declaration (HEP-C-ELAPDECLARE)

Operator Interview Insights
This action was discussed with operators on September 12, 2023. Representatives from Dominion included Michael Vickery and Matthew Torres. The operators verified the 30 minute execution time. It was noted that this is the preferred method for providing power to the batteries as it is faster than aligning the CTGs.

Timing Analysis



T_{sw}	10 Hours
T_{delay}	8.07 Hours
T_{cog}	0 Minutes
T_{exe}	30 Minutes
Time available for cognition and recovery	85.80002 Minutes
Time available for recovery	85.80002 Minutes

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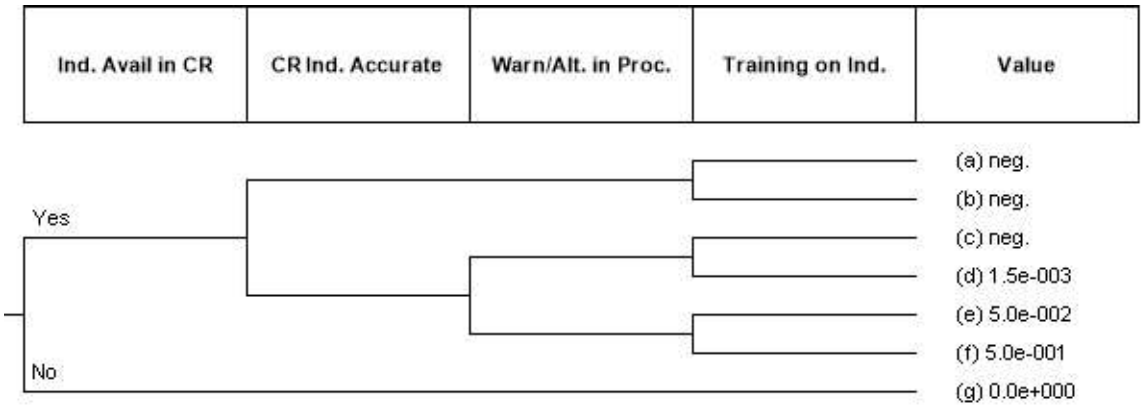
SPAR-H Available time (cognitive)	85.80002 Minutes
SPAR-H Available time (execution) ratio	3.86 Minutes
EPRI Minimum level of dependence for recovery	ZD
Notes	
Loss of offsite power occurs at time t=0. SBO is assumed to occur at time t=6 hours. Tdelay: 6 hours of DG power prior to ELAP + 2 hours for ELAP declaration. An additional .07 hours (~4 minutes) is assumed to proceed through FSP-5 to step 4. This HEP does not apply to scenarios with Diesel failures in the first 6 hours. The two hour delay for ELAP declaration is from the FLEX validation document (TECHNICAL REPORT TR00080-007, VCS Unit 1 FLEX Validation Document, REVISION 1). Tsw: FSP-5.0: (ELAP) Load shed must be complete within 4 hours if chargers are not supplied within 3 hours. 4 hours is assumed for maximum time to align battery chargers without load shedding. 4 hours is the design basis coping time for a station blackout (SOP-512). Tcog: N/A execution only action Texe: 30 minutes from operator interview and FLEX validation report.	

Cognitive Analysis		
Pc Failure Mechanism	**Branch**	**HEP**
Pca: Availability of Information		n/a
Pcb: Failure of Attention		n/a
Pcc: Misread/miscommunicate data		n/a
Pcd: Information misleading		n/a
Pce: Skip a step in procedure		n/a
Pcf: Misinterpret Instructions		n/a
Pcg: Misinterpret decision logic		n/a
Pch: Deliberate violation		n/a
Initial Pc(without recovery credited)		0.00E+00
Notes		

Pca: Availability of Information

Notes/Assumptions:



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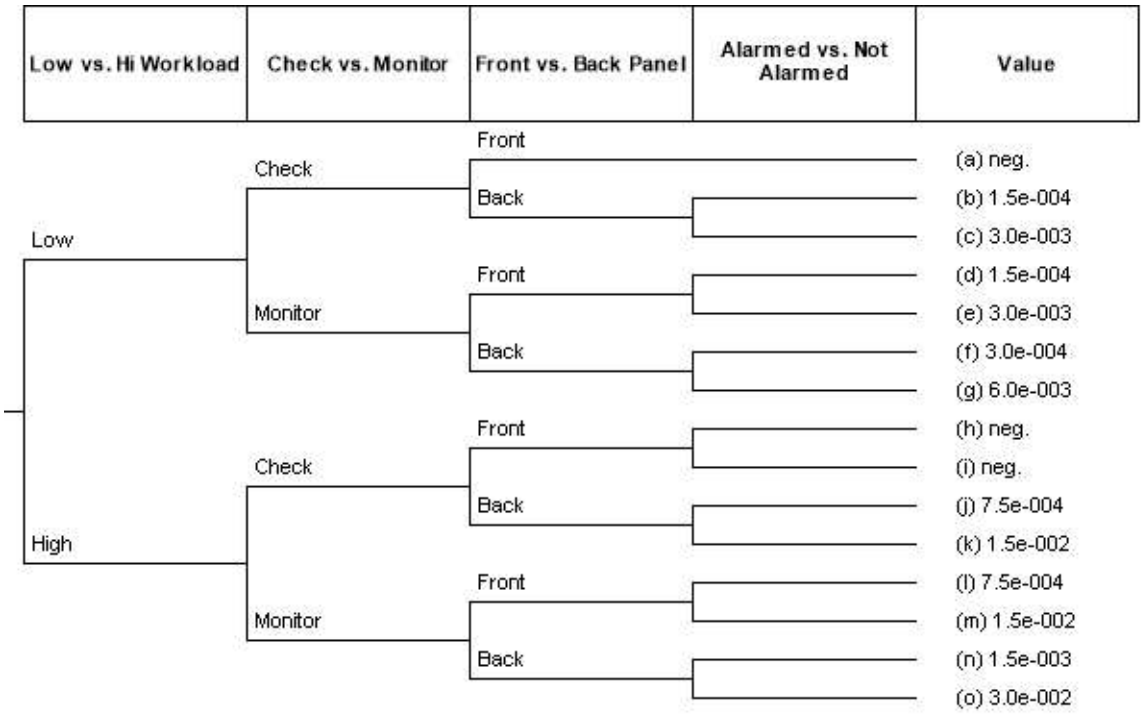
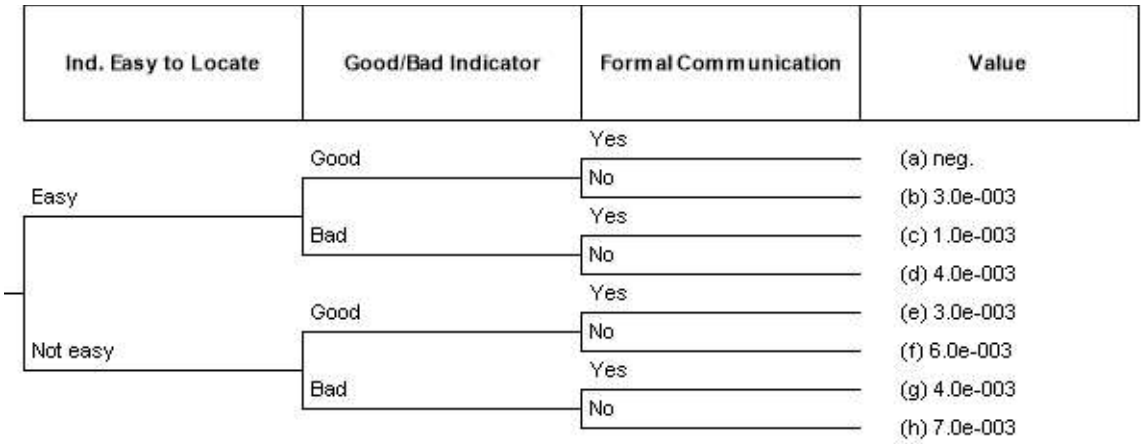
Pcb: Failure of Attention

Notes/Assumptions:



Pcc: Misread/miscommunicate data

Notes/Assumptions:



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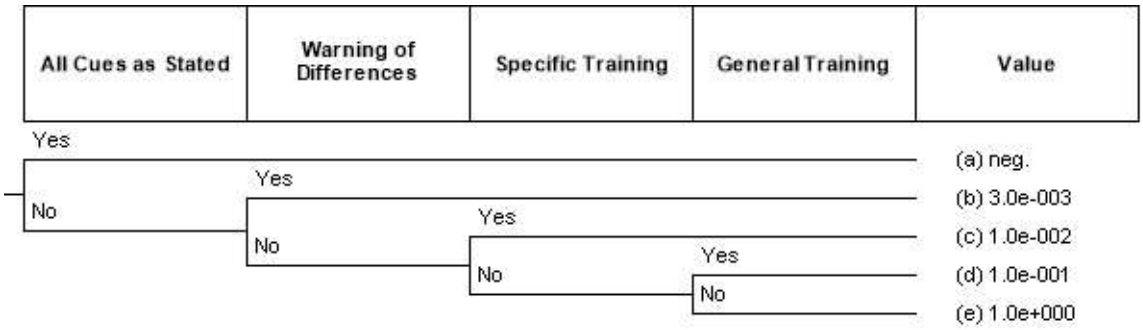
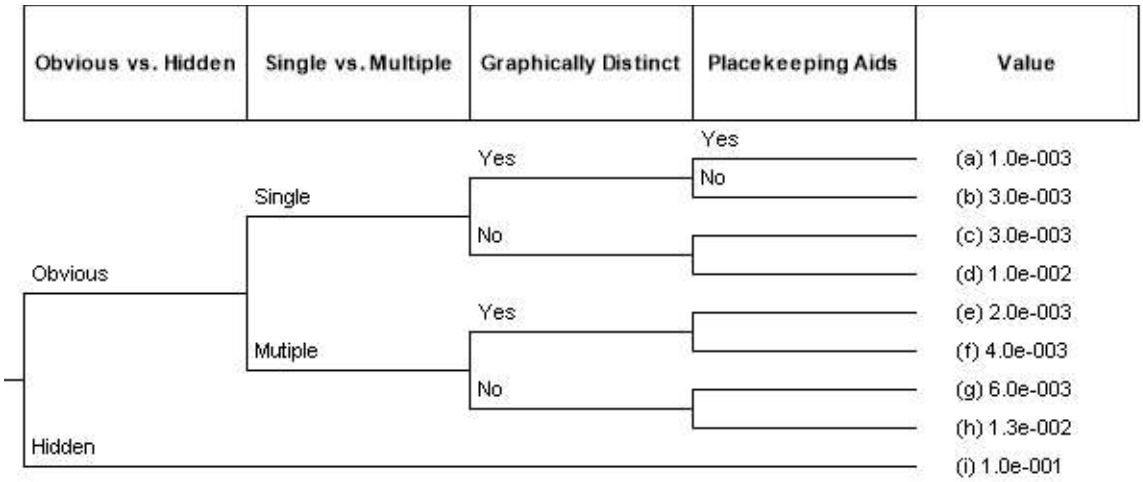
Pcd: Information misleading

Notes/Assumptions:



Pce: Skip a step in procedure

Notes/Assumptions:



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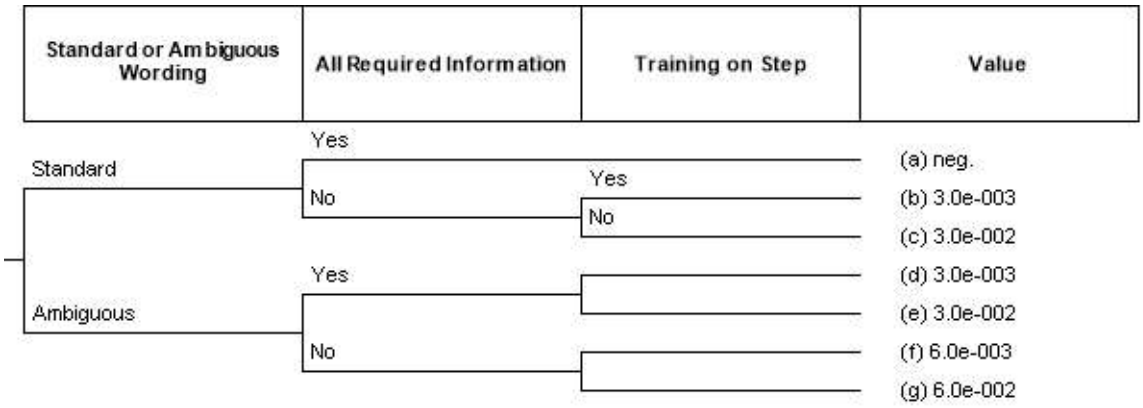
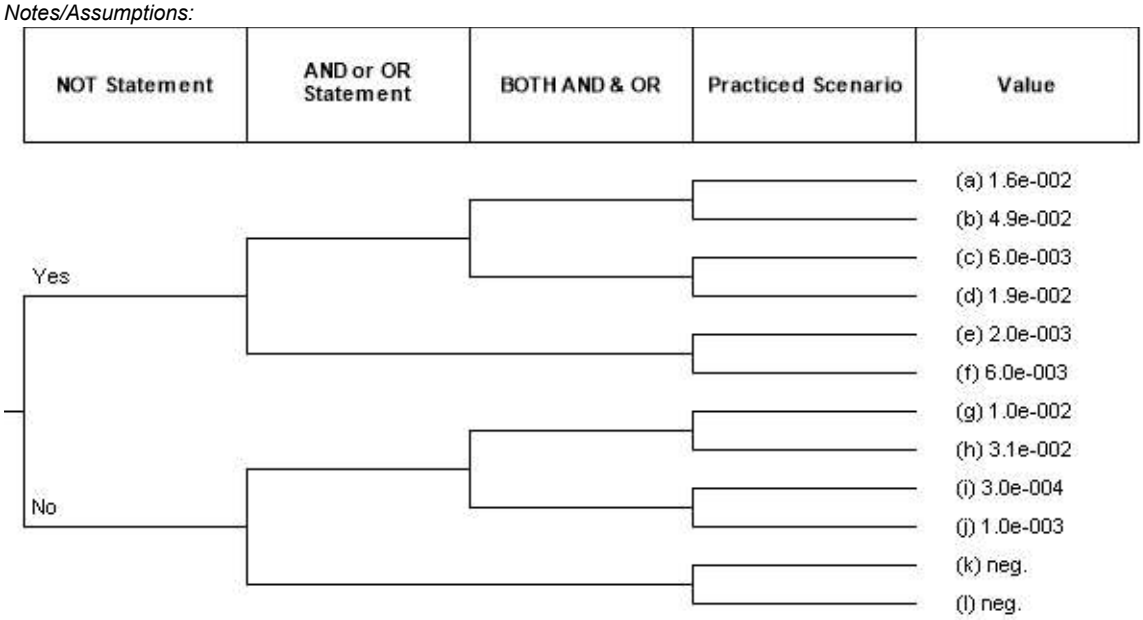
Pcf: Misinterpret Instructions

Notes/Assumptions:



Pcg: Misinterpret decision logic

Notes/Assumptions:



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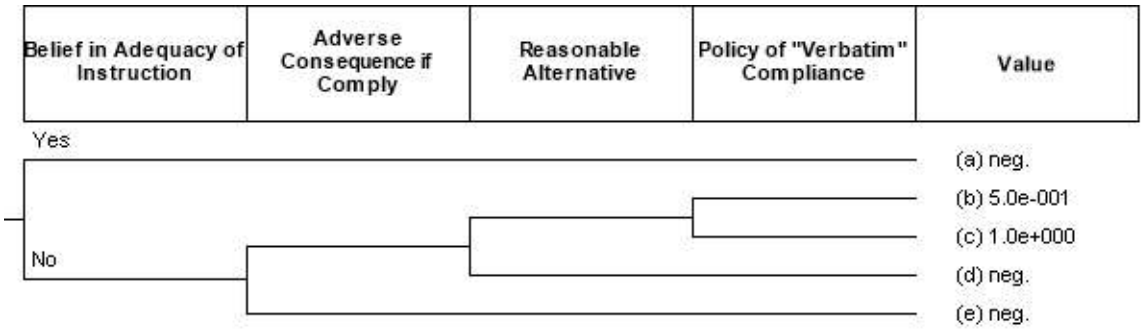
Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery											
	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-			1.00E+00		0.0
Pcb	n/a	-	-	-	-	-			1.00E+00		0.0
Pcc	n/a	-	-	-	-	-			1.00E+00		0.0
Pcd	n/a	-	-	-	-	-			1.00E+00		0.0
Pce	n/a	X	-	-	-	-			1.00E-01		0.0
Pcf	n/a	-	-	-	-	-			1.00E+00		0.0
Pcg	n/a	-	-	-	-	-			1.00E+00		0.0
Pch	n/a	-	-	-	-	-			1.00E+00		0.0
Final Pc (with recovery credited)											0.00E+00
Notes											

Execution Performance Shaping Factors		
Environment	Lighting	Portable
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Special Requirements	Tools	Required
Special Requirements	Tools	Adequate
Special Requirements	Tools	Available
Complexity of Response	Execution	Complex
Equipment Accessibility (Cognitive)		

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Equipment Accessibility (Execution)	EB	Accessible

Stress	
Moderate	
Plant Response As Expected:	Yes
Workload:	Low
Performance Shaping Factors:	Negative
Notes	
Plant response is not as expected in that there is an extended SBO, but FLEX strategies are available and the crews have been trained on these actions. Once ELAP is declared this is the expected response. The crew has a few hours to align the diesel for battery charging, and there is sufficient crew to monitor plant conditions. The TDAFW pump is assumed to be running. Workload is considered low. - Work in ELAP conditions may require the use of portable lighting, and there may be poor weather conditions related to the loss of offsite power. "Negative" PSFs are considered to always be applicable	

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Execution Unrecovered							
Procedure		Comment					
Step No.	Instruction / Comment	Error Type	THERP		HEP	Stress Factor	Override
			Table	Item			
FSP 5 Att 1 Step 1a	Connect cable between the following (CB-436): ● Term Box FX-4, FX BATTERY CHARGER FEED, TRAIN A. ● XDS0257, FX FUSED SWITCH DEVICE (on DPN1HA2).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		
	Location:	EB				Total Step HEP	5.46E-02
FSP 5 Att 1 Step 1b	Connect cable between the following (CB-436): ● Term Box FX-6, FX BATTERY CHARGER FEED, TRAIN B. ● XDS0258, FX FUSED SWITCH DEVICE (on DPN1HB2).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		
	Location:	EB				Total Step HEP	5.46E-02
FSP 5 Att 1 Step c	Close the following disconnect switch for the battery bus to be energized (CB-436): ● XDS0257, FX FUSED SWITCH	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		

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	DEVICE (on DPN1HA2). ● XDS0258, FX FUSED SWITCH DEVICE (on DPN1HB2).						
	Location:	EB				Total Step HEP	3.68E-03
FSP 5 Att 1 Step 1d	Ensure the following breakers are CLOSED (IB-412): ● DPN1HA 21, DPN1HA2. ● DPN1HB 21, DPN1HB2.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	12	3.80E-03		
		EOC	20-12	12	3.80E-03		
	Location:	EB				Total Step HEP	1.78E-02
FSG P Att 1 Step 1e	Close both of the following breakers on APN4071 (EB): ● Breaker 31,33,35, FX SUPPLY TO XBC0020 BATTERY CHARGER. ● Breaker 43,45,47, FX SUPPLY TO XBC0021 BATTERY CHARGER.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	12	3.80E-03		
		EOC	20-12	12	3.80E-03		
	Location:	EB				Total Step HEP	1.78E-02
FSP 5 Att 1 Step 1f	Close the DC OUTPUT Breakers on both	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	12	3.80E-03		
		EOC	20-12	12	3.80E-03		

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	of the following (EB): ● XBC0020, FX XBC0020 BATTERY CHARGER. ● XBC0021, FX XBC0021 BATTERY CHARGER.						
	Location:	EB				Total Step HEP	1.78E-02
FSP Att 1 Step 1g	Ensure DC VOLTS is indicated on the Battery Chargers (EB).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-11	2	1.30E-03		
	Location:	EB				Total Step HEP	5.20E-03
FSP 5 Att 1 Step 1k	IF XSW1DA AND 1DB are NOT energized, THEN close the AC INPUT Breakers on both of the following (EB): ● XBC0020, FX XBC0020 BATTERY CHARGER. ● XBC0021, FX XBC0021 BATTERY CHARGER.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	12	3.80E-03		
		EOC	20-12	12	3.80E-03		
	Location:	EB				Total Step HEP	1.78E-02
FSP 5 Att 1 Step 2	IF DPN1HA is powered from	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	11	6.30E-03		

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	XBC0020, THEN open the following breakers: ● XMC1DA2X 08KM, BATT CHARGER 1A XBC1A-ED (IB-463) . ● XMC1DA2Y 08KM, BATTERY CHARGER 1A-1B XCB1A-1B-EB (AB-412).	EOC	20-12	12	3.80E-03		
	Location:	EB				Total Step HEP	2.28E-02
FSP 5Att 1 Step 3	IF DPN1HB is powered from XBC0021, THEN open the following breakers: ● XMC1DB2X 02KM, BATT CHARGER 1B XBC1B-ED (IB-436). ● XMC1DB2Y 05KM, BATT CHARGER 1A-1B XBC1A-1B-ED (AB-463).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	12	3.80E-03		
		EOC	20-12	12	3.80E-03		
	Location:	EB				Total Step HEP	1.78E-02
FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-11	2	1.30E-03		

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	XBA1B from either the EB or the CTGs.						
	Location:	EB				Total Step HEP	5.20E-03

Execution Recovered							
Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
FSP 5 Att 1 Step 1a		Connect cable between the following (CB-436): ● Term Box FX-4, FX BATTERY CHARGER FEED, TRAIN A. ● XDS0257, FX FUSED SWITCH DEVICE (on DPN1HA2).	5.46E-02				1.48E-06
	FSP Att 1 Step 1g	Ensure DC VOLTS is indicated on the Battery Chargers (EB).		5.20E-03	ZD	5.20E-03	
	FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		5.20E-03	ZD	5.20E-03	
FSP 5 Att 1 Step 1b		Connect cable between the following (CB-436): ● Term Box FX-6, FX BATTERY	5.46E-02				1.48E-06

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		CHARGER FEED, TRAIN B. ● XDS0258, FX FUSED SWITCH DEVICE (on DPN1HB2).					
	FSP Att 1 Step 1g	Ensure DC VOLTS is indicated on the Battery Chargers (EB).		5.20E-03	ZD	5.20E-03	
	FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		5.20E-03	ZD	5.20E-03	
FSP 5 Att 1 Step c		Close the following disconnect switch for the battery bus to be energized (CB-436): ● XDS0257, FX FUSED SWITCH DEVICE (on DPN1HA2). ● XDS0258, FX FUSED SWITCH DEVICE (on DPN1HB2).	3.68E-03				9.95E-08
	FSP Att 1 Step 1g	Ensure DC VOLTS is indicated on the Battery Chargers (EB).		5.20E-03	ZD	5.20E-03	
	FSP-5.0 Step 19	Verify battery charging capability		5.20E-03	ZD	5.20E-03	

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		has been restored to XBA1A AND XBA1B from either the EB or the CTGs.					
FSP 5 Att 1 Step 1d		Ensure the following breakers are CLOSED (IB-412): ● DPN1HA 21, DPN1HA2. ● DPN1HB 21, DPN1HB2.	1.78E-02				4.81E-07
	FSP Att 1 Step 1g	Ensure DC VOLTS is indicated on the Battery Chargers (EB).		5.20E-03	ZD	5.20E-03	
	FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		5.20E-03	ZD	5.20E-03	
FSG P Att 1 Step 1e		Close both of the following breakers on APN4071 (EB): ● Breaker 31,33,35, FX SUPPLY TO XBC0020 BATTERY CHARGER. ● Breaker 43,45,47, FX SUPPLY TO XBC0021 BATTERY CHARGER.	1.78E-02				4.81E-07

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	FSP Att 1 Step 1g	Ensure DC VOLTS is indicated on the Battery Chargers (EB).		5.20E-03	ZD	5.20E-03	
	FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		5.20E-03	ZD	5.20E-03	
FSP 5 Att 1 Step 1f		Close the DC OUTPUT Breakers on both of the following (EB): ● XBC0020, FX XBC0020 BATTERY CHARGER. ● XBC0021, FX XBC0021 BATTERY CHARGER.	1.78E-02				4.81E-07
	FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		5.20E-03	ZD	5.20E-03	
	FSP Att 1 Step 1g	Ensure DC VOLTS is indicated on the Battery Chargers (EB).		5.20E-03	ZD	5.20E-03	
FSP 5 Att 1 Step 1k		IF XSW1DA AND 1DB are NOT energized, THEN	1.78E-02				9.26E-05

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		close the AC INPUT Breakers on both of the following (EB): ● XBC0020, FX XBC0020 BATTERY CHARGER. ● XBC0021, FX XBC0021 BATTERY CHARGER.					
	FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		5.20E-03	ZD	5.20E-03	
FSP 5 Att 1 Step 2		IF DPN1HA is powered from XBC0020, THEN open the following breakers: ● XMC1DA2X 08KM, BATT CHARGER 1A XBC1A-ED (IB-463) . ● XMC1DA2Y 08KM, BATTERY CHARGER 1A-1B XCB1A-1B-EB (AB-412).	2.28E-02				1.19E-04
	FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND		5.20E-03	ZD	5.20E-03	

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		XBA1B from either the EB or the CTGs.					
FSP 5Att 1 Step 3		IF DPN1HB is powered from XBC0021, THEN open the following breakers: ● XMC1DB2X 02KM, BATT CHARGER 1B XBC1B-ED (IB-436). ● XMC1DB2Y 05KM, BATT CHARGER 1A-1B XBC1A-1B-ED (AB-463).	1.78E-02				9.26E-05
	FSP-5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		5.20E-03	ZD	5.20E-03	
		Total Unrecovered:	2.25E-01			**Total Recovered:**	3.08E-04

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HEP-C-ELAPDECLARE, Operators Fail to Declare ELAP

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	M. Blue/JH			9/27/2023
Reviewer				9/27/2023

HEP Summary			
	Pcog	**Pexe**	**Total HEP**
Method	CBDTM	THERP	CBDTM+THERP
Without Recovery	7.00E-03	0.00E+00	
With Recovery	1.01E-03	0.00E+00	1.01E-03
Distribution Type	Beta	**Variance**	1.33E-06

RAW	FV	Risk Significant
		N/A

Identification and Definition
1. Initial conditions: Reactor Operating at full power 2. Initiating event: Loss of Offsite Power followed by successful reactor and turbine trip 3. Accident sequence - preceding functional failures and successes Successful reactor and turbine trip. One diesel generator runs for 6 hours with AFW success The other diesel is not available due to maintenance or random failure. At 6 hours, the running diesel fails placing the plant in a station blackout. 4. Procedural progression: EOP-6 is entered from EOP-1.0, E-0, REACTOR TRIP OR SAFETY INJECTION, Step 3, on indication that all AC emergency busses are deenergized. 5. Operator action high level success criteria: Declaration of ELAP allowing for implementation of Procedure FSP 5.0 INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING 6. Consequence of failure: Some FLEX equipment including the combustion turbine engines are not able to be used. The FLEX SG injection pump and pumper trucks for SG injection are still available for use as those are directed from the SBO procedure, EOP 6.0.

Cues and Indications	
Initial Cue	EOP-6 Step 14 Alternate: IF at any time it is determined that power can NOT be restored within two hours, THEN declare ELAP and perform FSP-5.0, INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING, while continuing with this procedure. REFER TO ATTACHMENT 15 FLEX PERSONNEL CAPABILITIES for onsite staff utilization.
Recovery Cue	No explicit recovery cue
Cue Comments	For these scenarios, all power is lost to ESF BUS 1DA AND ESF BUS 1DB.

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	EOP-6 is entered from EOP-1.0, E-0, REACTOR TRIP OR SAFETY INJECTION, Step 3, on indication that all ac emergency busses are deenergized.
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	EOP-6.0 (ECA-0.0 LOSS OF ALL ESF AC POWER) Revision: 41
Cognitive Step Number	14 - alternative action
Cognitive Instruction	IF at any time it is determined that power can NOT be restored within two hours, THEN declare ELAP and perform FSP-5.0, INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING, while continuing with this procedure. REFER TO ATTACHMENT 15 FLEX PERSONNEL CAPABILITIES for onsite staff utilization.
Execution Procedure	Execution: Not Selected
Execution Instruction	
Job Performance Measure	JPM: Not Selected
Notes	
Cognition only HEP.	

Training	
Classroom Training	0.5 per year
Simulator Training	0.5 per year

Crew Member	Included	Total Available	Required for Execution	Notes
Shift Manager	No	1	1	
Shift Supervisor	No	1	0	
Shift Engineer (STA)	No	1	0	
Reactor Operators	Yes	1	0	
Auxiliary Operators	Yes	1	0	
Health Physics	Yes	1	0	
Chemistry	Yes	1	0	
Mechanics	Yes	1	0	
Electricians	Yes	1	0	
I&C Maintenance	Yes	1	0	
Notes				

Operator Interview Insights
(email from Robbie Crain 9/26/2023) For ELAP declaration it would depend on an assessment of the severity of the event. A discussion would occur between Operations, Site Management, and Maintenance Departments to determine the estimated timeline for restoration of power from installed plant equipment sources. Basic strategies would be what is the availability of emergency diesel generators/safeguards electrical busses/safeguards transformers and transmission lines/PARR 13.8 kV line based on the event and how long would it take to restore them. System Control would be directed to restore offsite power to VC Summer using SOP-700, Electric System Restoration Plan. SOP-700 gives priority to restoring

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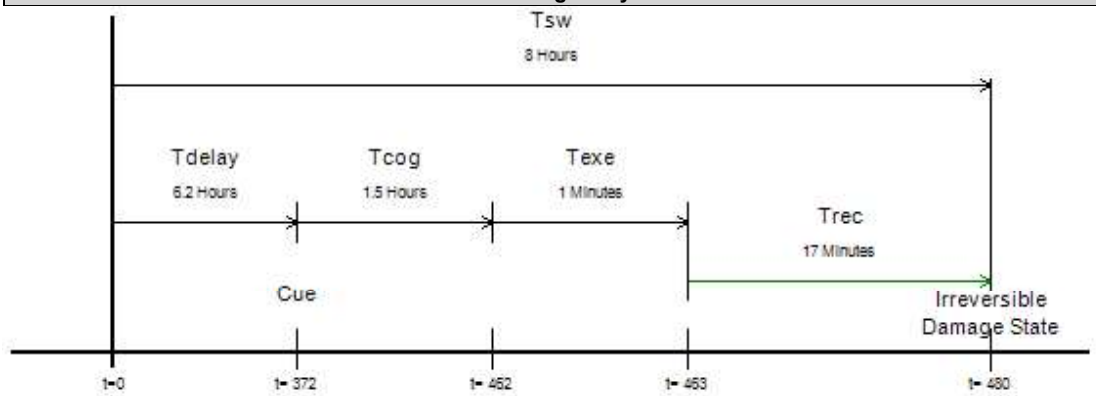
power to Summer Station. During these conversations and assessments timelines are constantly being evaluated and communicated, and if it is determined at any time that power cannot be restored within 2 hours, an ELAP is immediately declared. Classroom training and simulator training both communicate this expectation. Simulator training includes varied scenarios that put into practice the assessment of power restoration strategies.

Timing Analysis



T_{sw}	8 Hours
T_{delay}	6.2 Hours
T_{cog}	1.5 Hours
T_{exe}	1 Minutes
Time available for cognition and recovery	107 Minutes
Time available for recovery	17 Minutes
SPAR-H Available time (cognitive)	107 Minutes
SPAR-H Available time (execution) ratio	18.00 Minutes
EPRI Minimum level of dependence for recovery	MD

Notes

Tsw: Station blackout occurs at 6 hours after loss of offsite power. A conservative 2 hours for ELAP declaration is allowed, although the operators would have a little more rime to implement battery charging (most limiting case). The 8 hours is used as a conservative value.

Tdelay - Operators indicated that approximately it would take approximately 10 minutes to reach step 13 of EOP-6 (See HEP-C-CTG-DEPLOY), an additional minute is added to reach step 14.

Tcog: Operators are discussing the possibility of recovering power within 2 hours. A estimate of 1.5 hours is assumed for the cognition portion.

Cognitive Analysis

Pc Failure Mechanism	**Branch**	**HEP**
Pca: Availability of Information	a	n/a
Pcb: Failure of Attention	e	3.00E-03
Pcc: Misread/miscommunicate data	a	n/a
Pcd: Information misleading	a	n/a
Pce: Skip a step in procedure	e	2.00E-03
Pcf: Misinterpret Instructions	a	n/a
Pcg: Misinterpret decision logic	e	2.00E-03
Pch: Deliberate violation	a	n/a
Initial Pc(without recovery credited)		7.00E-03

Notes

Delay implementation Tree from NUREG-2199 utilizes a tree with 3 decision points:

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1. RELUCTANCE AND VIABLE ALTERNATIVE: EXISTS Vs ABSENT
Delaying ELAP does not provide viable alternatives since the batteries would fail.
This is assessed as ABSENT

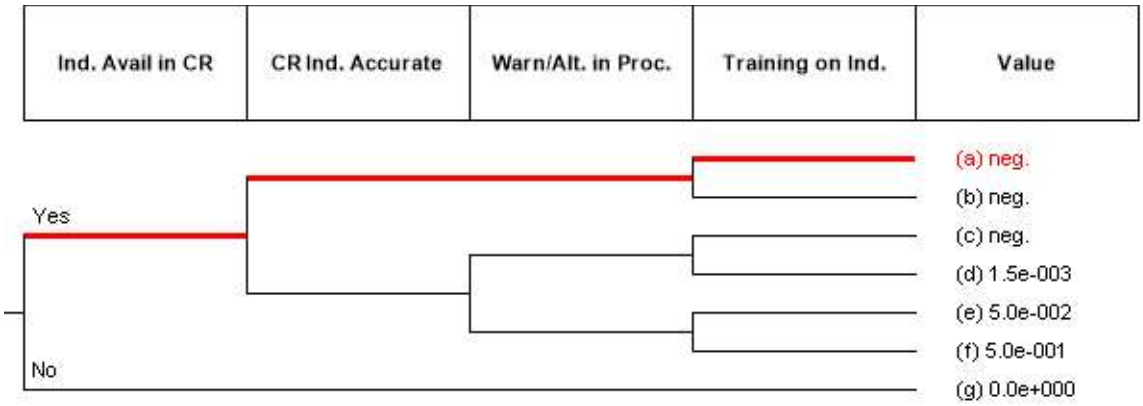
2. ASSESSMENT OF MARGIN: CORRECT Vs INCORRECT
The operators are trained on the ELAP procedures. The timeline requires operators to provide power to the battery chargers within 3 hours or begin load shedding.
Alignment of the EB diesel takes 30 minutes, but longer if power is needed from the CTGs.
This is taken to be CORRECT

3. ADDITIONAL CUES: YES Vs NO
This branch point of the tree is not evaluated for cases in which "Reluctance and Viable Alternative" is ABSENT and the operators' "Assessment of Margin" is CORRECT.

This branch of the tree gives 1.7E-5.

Pca: Availability of Information

Notes/Assumptions: All information is available in the MCR regarding AC power.



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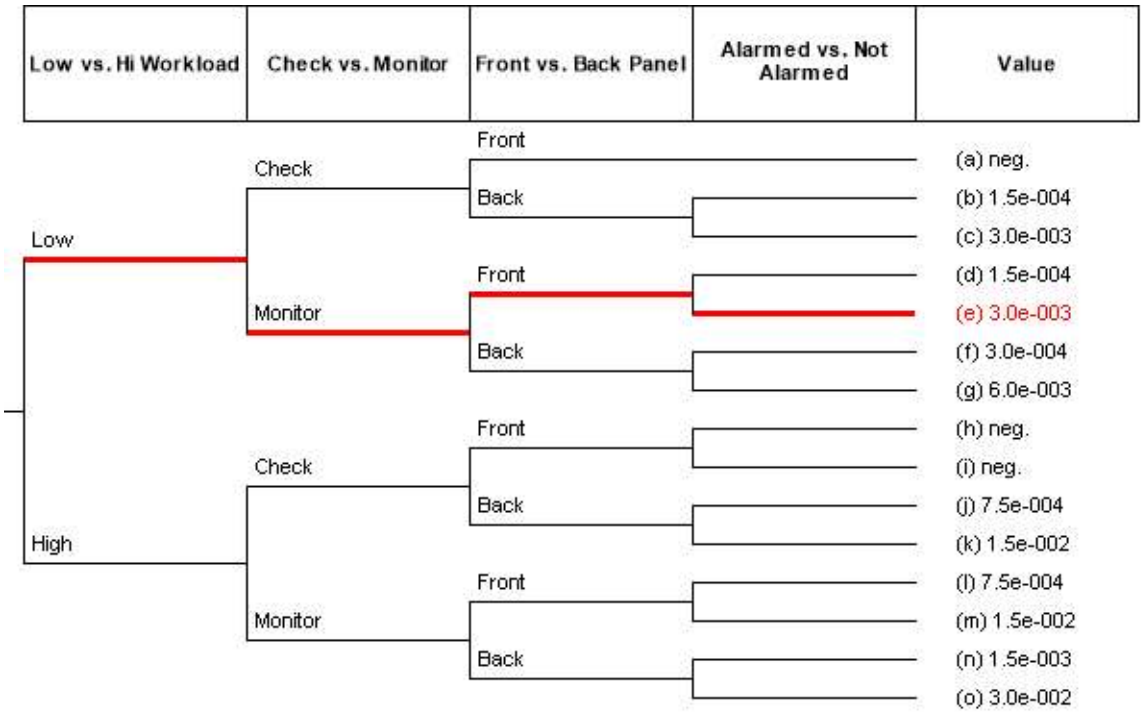
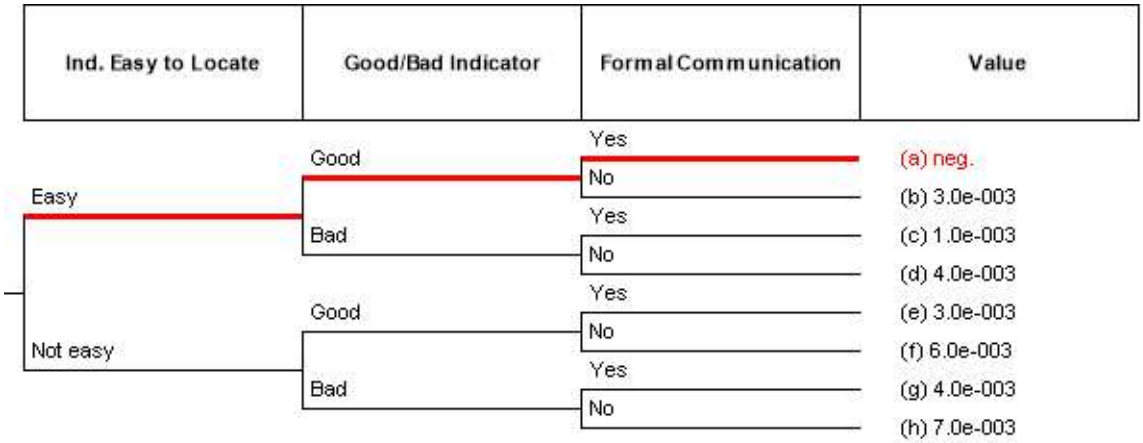
Pcb: Failure of Attention

Notes/Assumptions: The crew is constantly monitoring power and communicating status of various AC sources to the control room.



Pcc: Misread/miscommunicate data

Notes/Assumptions: All clocks and indications are clear and easy to locate.



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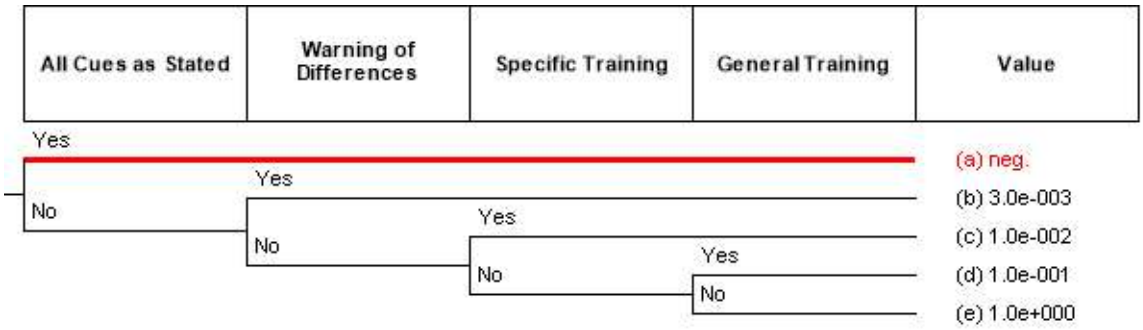
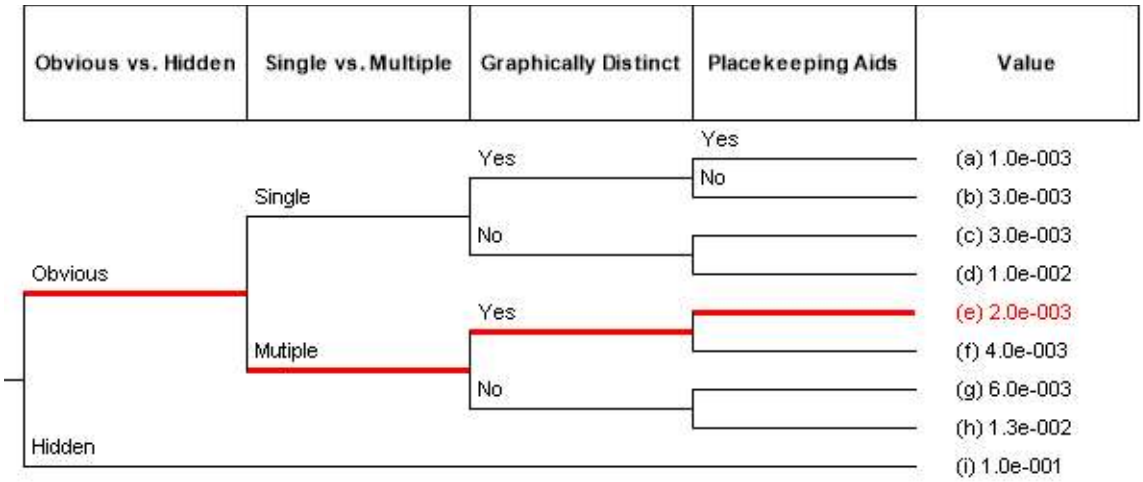
Pcd: Information misleading

Notes/Assumptions:



Pce: Skip a step in procedure

Notes/Assumptions:



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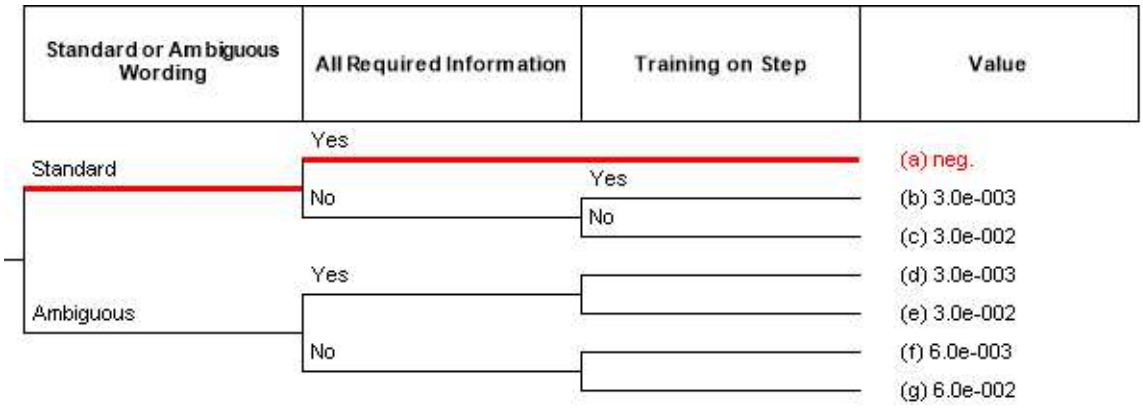
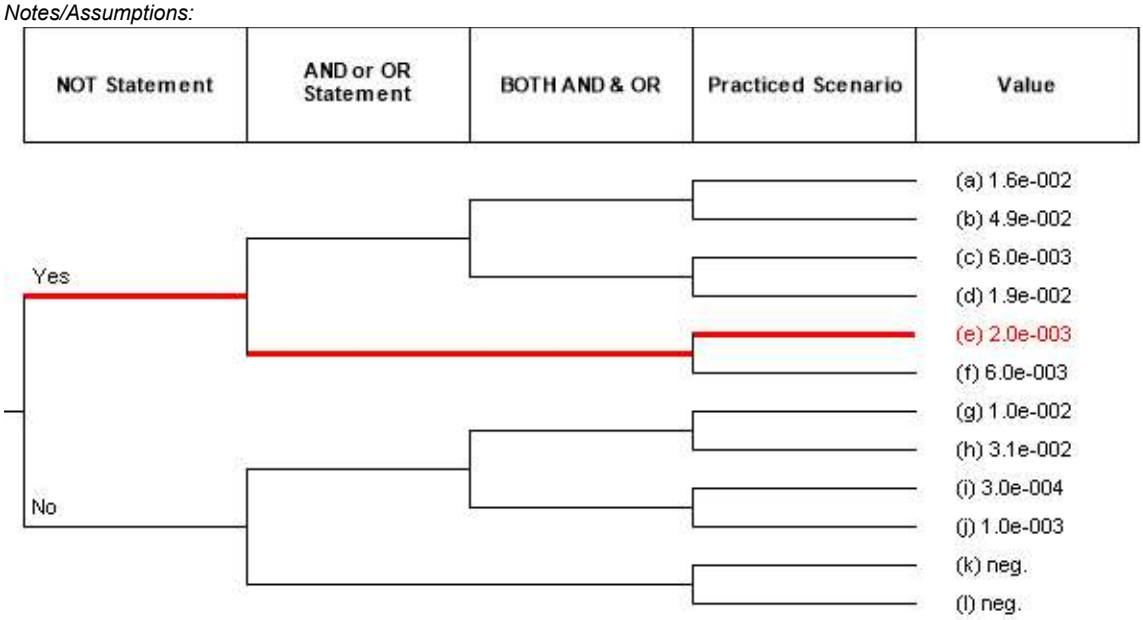
Pcf: Misinterpret Instructions

Notes/Assumptions:



Pcg: Misinterpret decision logic

Notes/Assumptions:



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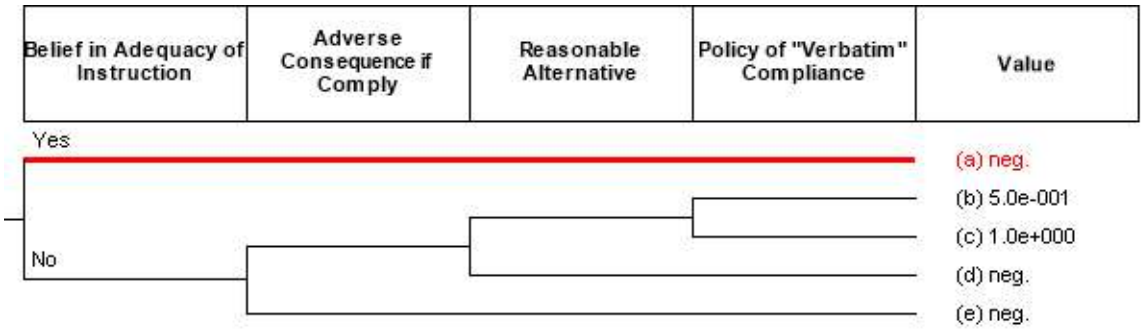
Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery											
	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-			1.00E+00		0.0
Pcb	3.00E-03	-	-	X	-	-		MD	1.45E-01		4.36E-04
Pcc	n/a	-	-	-	-	-			1.00E+00		0.0
Pcd	n/a	-	-	-	-	-			1.00E+00		0.0
Pce	2.00E-03	X	-	-	-	-		MD	1.45E-01		2.89E-04
Pcf	n/a	-	-	-	-	-			1.00E+00		0.0
Pcg	2.00E-03	-	-	X	-	-		MD	1.45E-01		2.89E-04
Pch	n/a	-	-	-	-	-			1.00E+00		0.0
Final Pc (with recovery credited)											1.01E-03
Notes											

Execution Performance Shaping Factors		
Environment	Lighting	Normal
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Complexity of Response	Execution	Simple
Equipment Accessibility (Cognitive)		
Equipment Accessibility (Execution)		

Stress

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High	
Plant Response As Expected:	Yes
Workload:	N/A
Performance Shaping Factors:	N/A
Notes	

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HEP-C-FW-FXPUMP, Operators fail to align Flex SG feed pump

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	**M. Blue/ JH**			**9/18/2023**
Reviewer				**9/18/2023**

HEP Summary					
	P_1	P_2	P_{cog}	P_{exe}	**Total HEP**
Method	CBDTM	HCR/ORE	Maximum	THERP	
HEP	4.96E-02	1.46E-05	4.96E-02	3.17E-02	7.97E-02
Distribution Type	Beta		**Variance**	4.48E-03	

RAW	FV	Risk Significant
		N/A

Identification and Definition
1. Initial conditions: Reactor Operating at full power 2. Initiating event: Loss of Offsite Power followed by successful reactor and turbine trip 3. Accident sequence - preceding functional failures and successes Successful reactor and turbine trip. One diesel generator runs for 6 hours with AFW success with MDAFW pump The other diesel is not available due to maintenance or random failure. At 6 hours, the running diesel fails placing the plant in a station blackout. This fails the running MDAFW pump. The TDAFW pump starts but then fails randomly after the operators reach Step 4 of FSP 5. 4. Procedural progression: EOP-6 is entered from EOP-1.0, E-0, REACTOR TRIP OR SAFETY INJECTION, Step 3, on indication that all ac emergency busses are deenergized. 5. Operator action high level success criteria: Successful EFW flow of 450gpm to one SG. 6. Consequence of failure: Loss of FW flow will result in core damage. There are also alternatives for providing EFW flow.

Cues and Indications	
Initial Cue	Loss of EFW flow
Recovery Cue	FSP-5.0 Step 21 Verify total EFW flow to SGs greater than 450 gpm
Cue Comments	
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	EOP-6.0 (ECA-0.0 LOSS OF ALL ESF AC POWER) Revision: 41

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Cognitive Step Number	Reference Number 3
Cognitive Instruction	IF EFW flow is lost AND is NOT immediately recoverable after Step 4 has been completed, THEN perform ATTACHMENT 10, LOW PRESSURE FEEDWATER.
Execution Procedure	FSP-20.3.1 (STAGING THE FX SG FEED PUMP USING THE EAST STRATEGY (EAST PEN FLEX HEADER)) Revision: 1
Execution Instruction	
Job Performance Measure	JPM: Not Selected
Other Procedures	FSP-5.0 (INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING) Revision: 3
	FSP-20.4.1 (STAGING THE FX UHS PUMPS) Revision: 1
	FSP-20.3.3 (FX SG FEED PUMP OPERATION) Revision: 1
	FSP-20.4.2 (FX UHS PUMP OPERATION USING DIRECT DRAFT SUCTION) Revision: 1
Notes	
This may also be performed from FSP 5.0 Step 25. REFER TO the following as appropriate to stage Steam Generator Make-up Equipment: ● FSP-20.3.1, STAGING THE FX SG FEED PUMP USING THE EAST STRATEGY (EAST PEN FLEX HEADER). OR ● FSP-20.3.2, STAGING THE FX SG FEED PUMP USING THE WEST STRATEGY (AB ROLL-UP DOOR) Or from EOP-6 Step 21a Response not met. Establish low pressure feedwater per ATTACHMENT 10, LOW PRESSURE FEEDWATER.	

Crew Member	Included	Total Available	Required for Execution	Notes
Shift Manager	No	1	0	
Shift Supervisor	No	1	0	
Shift Engineer (STA)	No	1	0	
Reactor Operators	Yes	1	0	
Auxiliary Operators	Yes	1	3	
Health Physics	Yes	1	0	
Chemistry	Yes	1	0	
Mechanics	Yes	1	0	
Electricians	Yes	1	0	
I&C Maintenance	Yes	1	0	
Notes				

Assumptions
1. Suction from the lake is assumed. 2. The flex pump may be deployed in different areas. Staging from the East is assumed as this is the preferred location. 3. Upon deployment of the pump, the operators will start the pump due to loss of FW flow.

Operator Interview Insights
This action was discussed with operators on September 12, 2023. Representatives from Dominion included Michael Vickery and Matthew Torres. The operators verified the 115 minute execution time from the Flex validation document.

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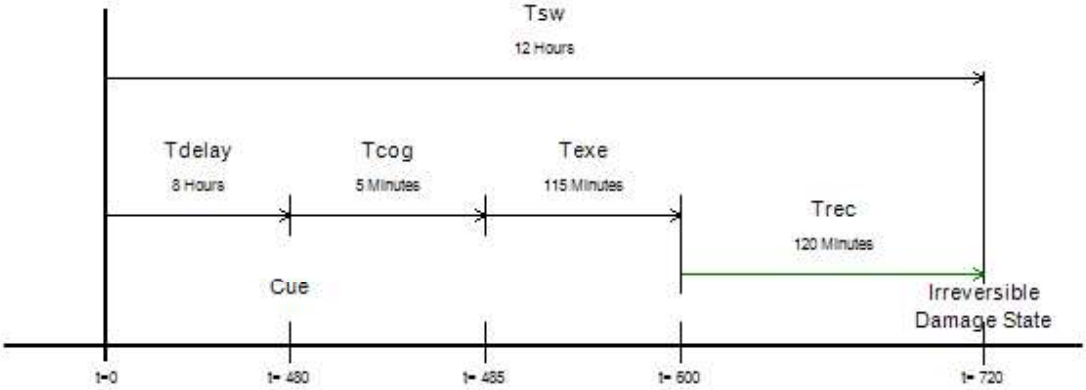
There are several strategies for obtaining FW flow.

Timing Analysis



T_{sw}	12 Hours
T_{delay}	8 Hours
T_{cog}	5 Minutes
T_{exe}	115 Minutes
Time available for cognition and recovery	125 Minutes
Time available for recovery	120 Minutes
SPAR-H Available time (cognitive)	125 Minutes
SPAR-H Available time (execution) ratio	2.04 Minutes
EPRI Minimum level of dependence for recovery	ZD

Notes

Tsw: Loss of offsite power at time t=0. DG A runs for 6 hours. EFW recovery in 6 hours after SBO will prevent core damage from MAAP cases LOOP-EFW-Case1-B and LOOP-EFW-Case2-B.

Tdelay: 6 hours of DG power before SBO conditions. An additional 2 hours is conservatively assumed to attempt other methods of FW injection (possible TDAFW recovery, consideration of using the pumper trucks.) Also this event conservatively assumes TDAFW pump failure at time 0, but this is also available if the TDAFW pump runs for a time and the operators proceed past step 4 in the procedure.

Tcog: 5 minutes assumed for crew discussions that TDAFW pump is not immediately recoverable.

Texe: 115 minutes from the FLEX validation document. Assumes deployment of UHS pumps concurrent with deployment of FLEX pumps.

Cognitive Analysis

Pc Failure Mechanism	**Branch**	**HEP**
Pca: Availability of Information	a	n/a
Pcb: Failure of Attention	i	n/a
Pcc: Misread/miscommunicate data	a	n/a
Pcd: Information misleading	a	n/a
Pce: Skip a step in procedure	g	6.00E-03
Pcf: Misinterpret Instructions	a	n/a
Pcg: Misinterpret decision logic	b	4.90E-02
Pch: Deliberate violation	a	n/a
Initial Pc(without recovery credited)		5.50E-02

Notes

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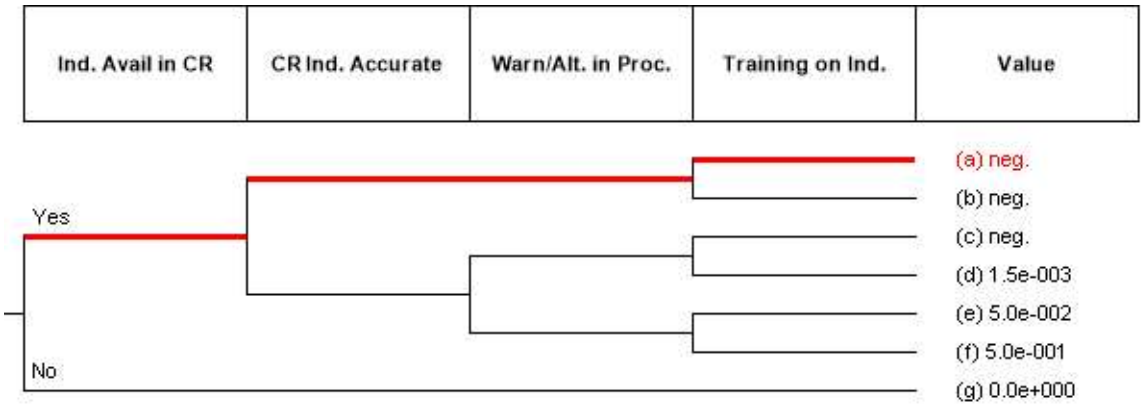
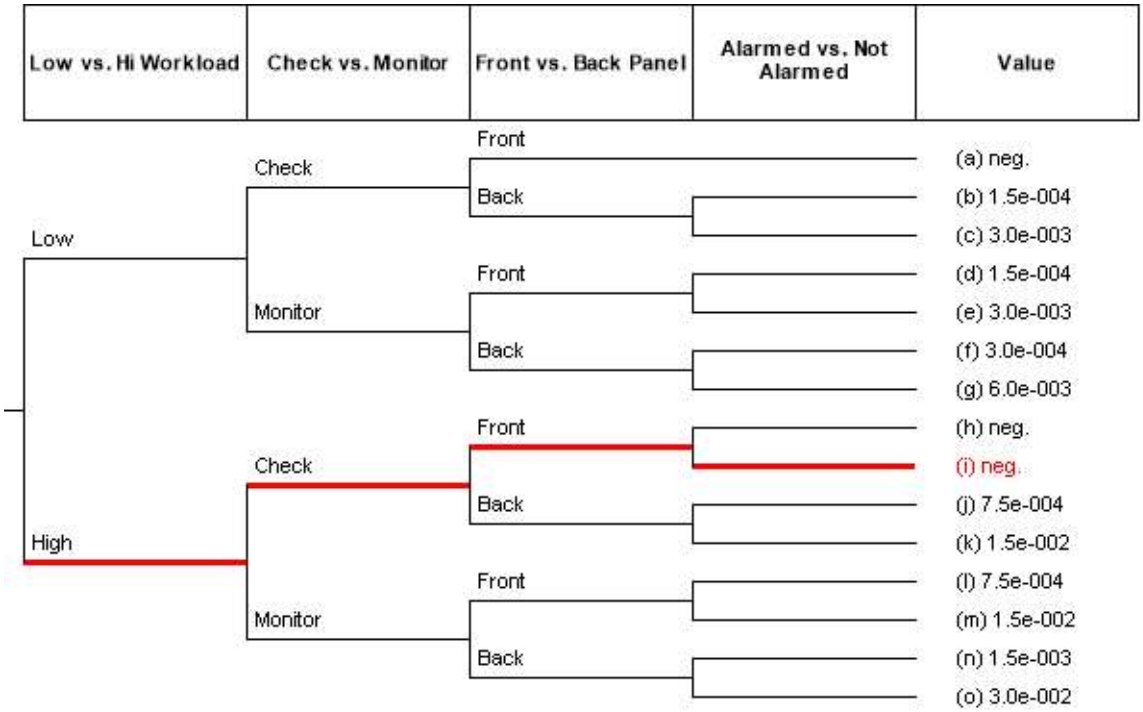
Pca: Availability of Information

Notes/Assumptions:



Pcb: Failure of Attention

Notes/Assumptions:



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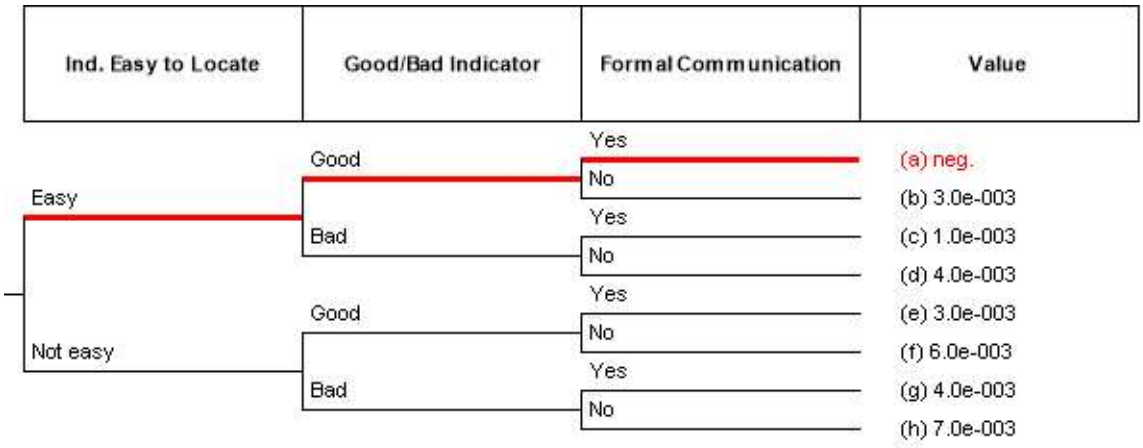
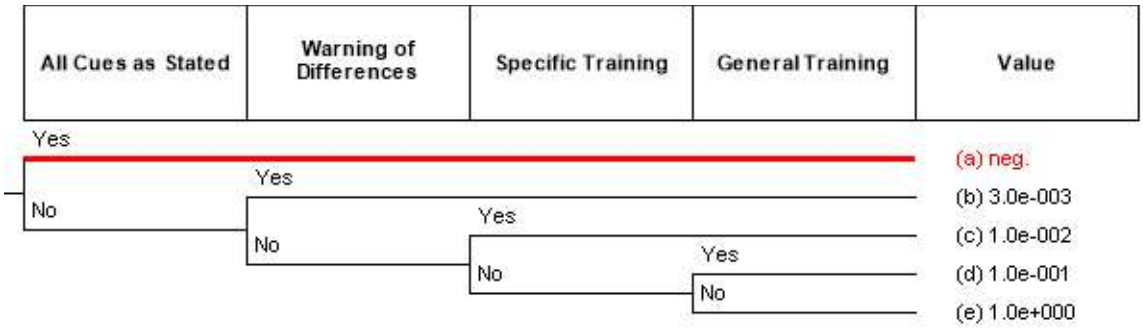
Pcc: Misread/miscommunicate data

Notes/Assumptions:



Pcd: Information misleading

Notes/Assumptions:



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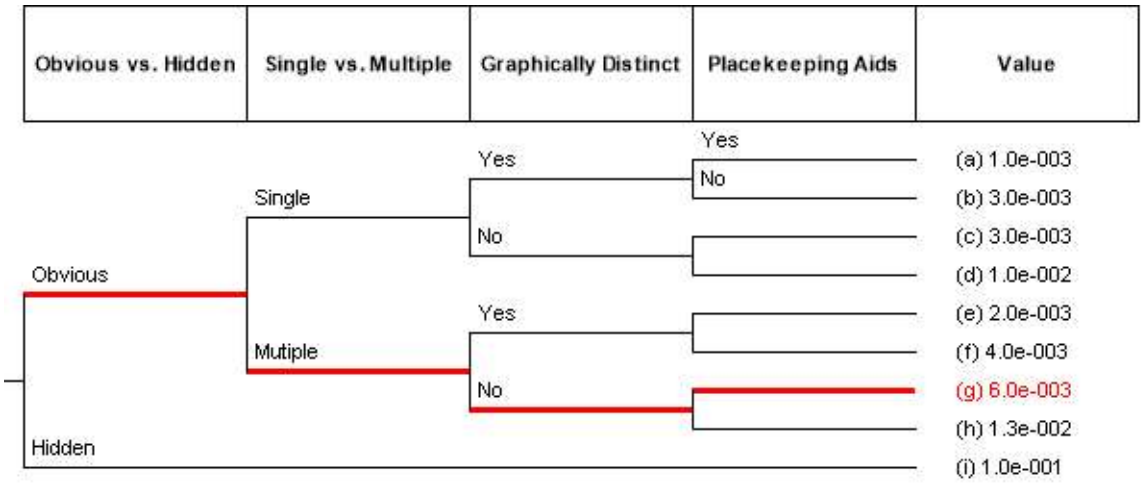
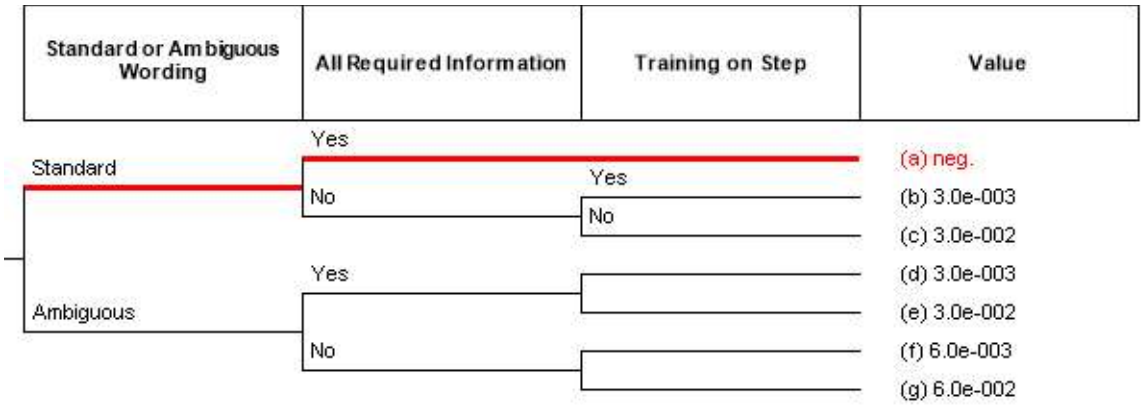
Pce: Skip a step in procedure

Notes/Assumptions:



Pcf: Misinterpret Instructions

Notes/Assumptions:



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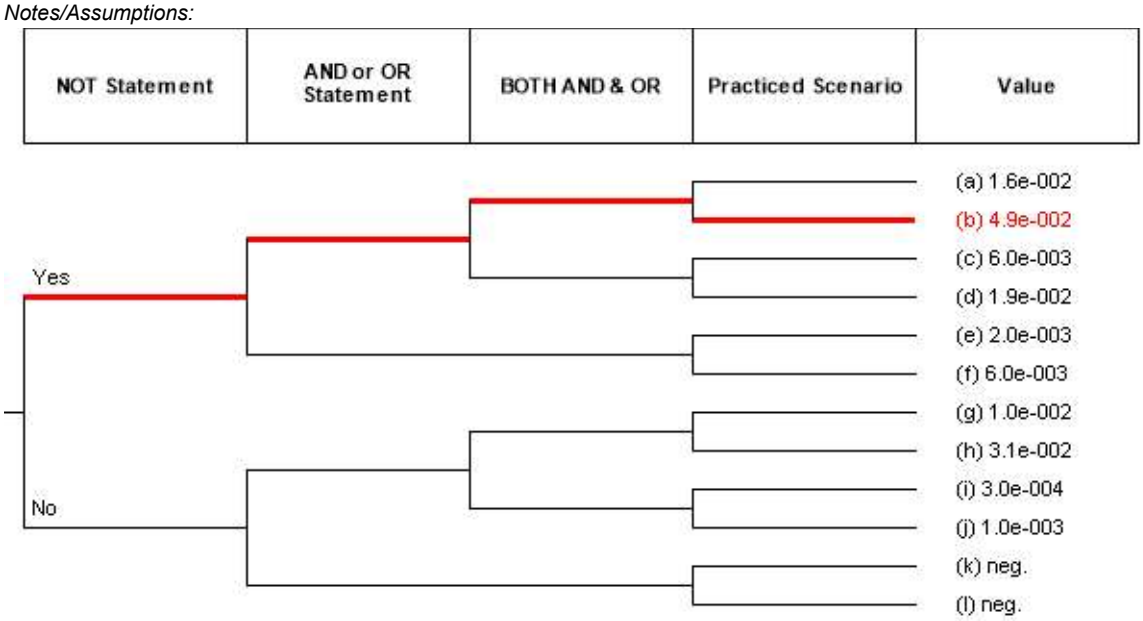
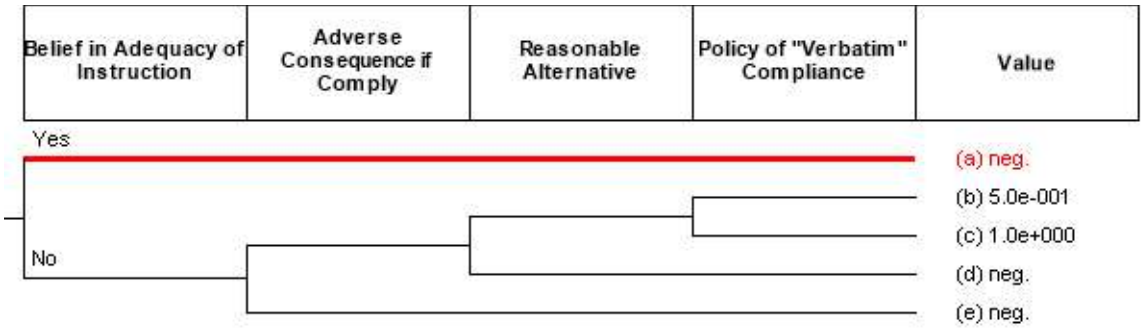
Pcg: Misinterpret decision logic

Notes/Assumptions:



Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery

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	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-			1.00E+00		0.0
Pcb	n/a	-	-	-	-	-			1.00E+00		0.0
Pcc	n/a	-	-	-	-	-			1.00E+00		0.0
Pcd	n/a	-	-	-	-	-			1.00E+00		0.0
Pce	6.00E-03	X	-	-	-	-			1.00E-01		6.00E-04
Pcf	n/a	-	-	-	-	-			1.00E+00		0.0
Pcg	4.90E-02	-	-	-	-	-			1.00E+00		4.90E-02
Pch	n/a	-	-	-	-	-			1.00E+00		0.0
Final Pc (with recovery credited)											4.96E-02
Notes											

Sigma Table				
Plant Type	Response Type	LB	Sigma	UB
BWR	CP1	0.4	0.7	1
	CP2	0.2	0.58	0.96
	CP3	0.59	0.75	0.91
PWR	CP1	0.26	0.57	0.88
	CP2	0.07	0.38	0.69
	CP3		0.77	
Sigma:	7.70E-01			
HEP:	1.46E-05			
Notes/Assumptions	CP3 action. Operators determine that other sources of EFW are not available.			

Execution Performance Shaping Factors		
Environment	Lighting	Portable
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Special Requirements	Tools	Required
Special Requirements	Tools	Adequate
Special Requirements	Tools	Available
Complexity of Response	Execution	Complex
Equipment Accessibility (Cognitive)		
Equipment Accessibility (Execution)	East Pen	Accessible

Stress	
High	
Plant Response As Expected:	Yes

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Workload:	High
Performance Shaping Factors:	Negative
Notes	
Plant response is not as expected due to the SBO. However, procedures exist to handle the SBO. For this scenario, the TDAFW pump assumes to start and then the operators are progressing through the SBO procedure, monitoring systems and checking the status of restoring power. Workload conservatively assumed to be high.	

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Execution Unrecovered							
Procedure		Comment				Stress Factor	Override
Step No.	Instruction / Comment	Error Type	THERP		HEP		
			Table	Item			
FSP 20.4.1 Step 3	Deploy XPP0234A(B) or C(D), FX UHS LIFT PP A(B) or C(D), and XPP0235A or B, FX UHS MN PP A or B, to the location selected in Step 1.	EOM	20-7b	2	1.3E-3	High	
		EOC	99	1	1.00E-02		
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	1.22E-01
FSP 20.4.1 Step 5	Perform one of the following: ●Connect a minimum of three 6 inch hard suction hoses with suction strainers between the lake and the suctions of XPP0235A or B, FX UHS MN PP A or B. ● Connect 6 inch FLEX hoses between the discharges of at least one Submersible Pump, XPP0234A(B)(C)(D), FX UHS LIFT PP A(B)(C)(D), and the suction of XPP0235A or B, FX	EOM	20-7b	2	1.3E-3	High	

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	UHS MN PP A or B as follows: a. Connect hoses from BLUE lift pump to BLUE suction valves on main pump. b. Connect hoses from RED lift pump to RED suction valves on main pump.						
	Location:					Total Step HEP	6.50E-03
FSP 20.4.1 Step 6	If the lift pumps will be used, connect hydraulic lines between XPP0234A(B)(C)(D), FX UHS LIFT PP A(B)(C)(D) and XPP0235A or B, FX UHS MN PP A or B, as follows: a. Connect hydraulic lines from BLUE hose reel to BLUE lift pump. b. Connect hydraulic lines from RED hose reel to RED lift pump.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	1.37E-01
FSP 20.4.1 Step 7	If the lift pumps will be used, using the TRACKED VEHICLE with crane, deploy	EOM	20-7b	2	1.3E-3	High	
		EOC	99	1	1.00E-02		

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	XPP0234A(B)(C)(D), FX UHS LIFT PP A(B)(C)(D), into the water.						
	Location:					Total Step HEP	5.65E-02
FSP 20.4.1 Step 8	Attach 5 inch FLEX hose(s) to the discharge of the XPP0235A or B, FX UHS MN PP A or B.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	7.15E-02
FSP 20.1.4 Step 9	Layout sufficient FLEX hose to allow connection to one of the following FLEX equipment points as desired: ● FLEX Feed Pump suction - East Strategy (FLEX Feed Header).	EOM	20-7b	2	1.3E-3	High	
		EOC	99	1	1.00E-02		
	Location:					Total Step HEP	5.65E-02
FSP 20.1.4 Step 10	Connect hose to desired FLEX component: ● FLEX Feed Pump suction - East Strategy (FLEX Feed Header).	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	7.15E-02
FSP 20.3.1 Step 2	Deploy XPP0237, FX SG FEED PP in one of the following locations:	EOM	20-7b	2	1.3E-3	High	
		EOC	99	1	1.00E-02		

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	● Near the access gate of the Security Fence around the CST if the CST will be the suction source. OR ● Near the East Pen FLEX Header if Monticello Reservoir or the Service Water Pond will be the suction source.						
	Location:					Total Step HEP	5.65E-02
FSP 20.3.1 Step 3	Attach one of the following to the suction of XPP0237, FX SG FEED PP: 5 inch non-collapsible FLEX hose from XVA31000-FX, CST DRN VLV 6 IN (YD 436). ● OR Discharge of XPP0235A(B), FX UHS MN PP A(B) per FSP-20.4.1, STAGING THE FX UHS PUMPS.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	7.15E-02
FSP 20.3.1 Step 5	Attach two 3 inch FLEX hoses (with 2.5 inch couplings)	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		

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	between the discharge of XPP0237, FX SG FEED PP and any two of the following valves on the FLEX header (Outside IB-436 East Pen): ● XVA09756A-FX, FX SYS MNFLD SUP VLV A. ● XVA09756B-FX, FX SYS MNFLD SUP VLV B. ● XVA09756C-FX, FX SYS MNFLD SUP VLV C.						
	Location:					Total Step HEP	1.37E-01
FSP 20.3.1 Step 6	Attach three 3 inch FLEX hoses (with 2.5 inch couplings) from the following valves on the FLEX header (IB-436 East Pen) to all three SGs: ● XVA09757A-FX, FX SYS MNFLD DISCH VLV A, to SG A at XVC11673-FW, MAIN FW TO SG A EMERG MU CHK (AB-436 West Pen). ● XVA09757B-FX, FX SYS MNFLD DISCH VLV B, to	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		

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	SG B at XVC11674-FW, MAIN FW TO SG B EMERG MU CHK (IB-436 East Pen). ● XVA09757C-FX, FX SYS MNFLD DISCH VLV C, to the hose connection at the bottom of the standpipe for SG C feed platform (IB-436 East Pen).						
	Location:					Total Step HEP	2.02E-01
FSP 20.3.1 Step 7	Attach a 3 inch FLEX hose (with 2.5 inch couplings) from the hose connection at the top of the standpipe for SG C feed platform to SG C at XVC11675-FW, MAIN FW TO SG C EMERG MU CHK (IB-436 East Pen).	EOM			1.3E-3	High	
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	7.15E-02
FSP 20.3.1 Step 8	Open XVA09754-FX, FX SYS MNFLD ISOL VLV (IB-436 East Pen).	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
	Location:					Total Step HEP	1.30E-02
FSP 20.3.1 Step 9	Open only the five valves on the East Pen FLEX Header	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		

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	with hoses connected to them: ● XVA09756A-FX, FX SYS MNFLD SUP VLV A (Outside IB-436 East Pen). ● XVA09756B-FX, FX SYS MNFLD SUP VLV B (Outside IB-436 East Pen). ● XVA09756C-FX, FX SYS MNFLD SUP VLV C (Outside IB-436 East Pen). ● XVA09757A-FX, FX SYS MNFLD DISCH VLV A (IB-436 East Pen). ● XVA09757B-FX, FX SYS MNFLD DISCH VLV B (IB-436 East Pen). ● XVA09757C-FX, FX SYS MNFLD DISCH VLV C (IB-436 East Pen).	EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
	Location:					Total Step HEP	4.55E-02
FSP 20.3.1 Step 10	Ensure all unused valves on the FLEX manifold (inside AND outside IB-436 East Pen) are CLOSED.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-14	1	1.30E-03		
	Location:					Total Step HEP	1.30E-02
EOP 6 Att 10 Step 2a	WHEN RCS Tavg is LESS THAN P-12	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	5	1.30E-03		

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	(552°F), THEN place both STM DUMP INTERLOCK Switches to BYP INTLK.						
	Location:	Main Control Room				Total Step HEP	1.30E-02
EOP 6 Att 10 Step 2b	Place the Steamline Power Relief A(B)(C) Mode Switch(s) in PWR RLF.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	5	1.30E-03		
	Location:	Main Control Room				Total Step HEP	1.30E-02
EOP 6 Att 10 Step 2c	Adjust the PWR RELIEF A(B)(C) SETPT Controller(s) as necessary to maintain SG pressure below 500 psig.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	5	1.30E-03		
	Location:	Main Control Room				Total Step HEP	1.30E-02
EOP 6 Att 10 Step 2f	As SG pressure approaches 500 psig, start XPP00237-FX, FX SG FEED PUMP, per FSP-20.3.3, FX SG FEED PUMP OPERATION.	EOM	20-7b	2	1.3E-3	High	
	Location:	East Pen				Total Step HEP	6.50E-03
FSP 20.3.3 Step 2	Close the following: • MINIMUM FLOW COOLING LINE. • MASTER DRAIN. • All four DRAIN valves.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		

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	● All three discharge DRAIN valves.						
	Location:	East Pen				Total Step HEP	3.25E-02
FSP 20.3.3 Step 3	Turn the BATTERY MASTER DISCONNECT switch to ON.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		
	Location:	East Pen				Total Step HEP	7.85E-03
FSP 20.3.3 Step 4	Open one inservice suction isolation valve.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.3.3 Step 5	Turn the engine start switch to ON.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	5	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.3.3 Step 7b	Establish water supply from one of the following: b) Align the suction of the SG Feed Pump to the discharge of either the UHS Pump or Booster/XFR Pump	EOM	20-7b	2	1.3E-3	High	
	Location:	East Pen				Total Step HEP	6.50E-03
FSP 20.4.2 Step 3	Turn both Master Power Switches ON: ● MASTER DISCONNECT ENGINE SIDE BANK A. ● MASTER DISCONNECT	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		

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	ELECTRONICS BANK B.						
	Location:	East Pen				Total Step HEP	9.20E-03
FSP 20.4.2 Step 5	Turn the engine start switch to ON.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		
	Location:	East Pen				Total Step HEP	7.85E-03
FSP 20.4.2 Step 6	Check engine display monitor on the control panel is energized.	EOM	20-7b	2	1.3E-3	High	
	Location:	East Pen				Total Step HEP	6.50E-03
FSP 20.4.2 Step 7	Turn the four primer disconnect switches ON: ● PRIMER 1 DISCONNECT. ● PRIMER 2 DISCONNECT. ● PRIMER 3 DISCONNECT. ● PRIMER 4 DISCONNECT.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:	East Pen				Total Step HEP	1.19E-02
FSP 20.4.2 Step 8	Close all discharge valves (valve is closed when its green CLOSED light is lit.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.4.2 Step 9	Open all suction isolation valves that have hoses attached.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		

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	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.4.10	Ensure any suction valve with no hose attached is closed.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.4.2 Step 11	Close all the following valves: ● Four AIR BLEEDER vent valves (one on each suction line). Two MASTER DRAIN valves (side by side under left side of trailer on suction end). ● ● Two suction header drain valves (one on each end of suction header). ● Two discharge header drain valves (one on each end of discharge header). ● MINIMUM FLOW COOLING LINE (on side of control panel). ● One MASTER DRAIN (locater under front of trailer). ● Four discharge line drain valves (one under each discharge valve).	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-13	1	1.30E-03		
		EOC	20-12	1	0.00E+00		

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	Location:	East Pen				Total Step HEP	4.55E-02
FSP 20.4.2 Step 12	Ensure a 2.5 inch hose is connected to the end of the engine cooling line.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
	Location:	East Pen				Total Step HEP	7.15E-02
FSP 20.4.2 Step 13	Route the engine cooling line hose back to the suction source.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	13	1.30E-02		
	Location:	East Pen				Total Step HEP	7.15E-02
FSP 20.4.2 Step 14a	Push one PRIME button to prime the pump.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	10	3.80E-03		
	Location:	East Pen				Total Step HEP	2.55E-02
FSP 20.4.2 Step 14c	IF the first PRIME does NOT prime the pump after 45 seconds, THEN release the first button and depress the other PRIME button for a maximum of 45 seconds.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	10	3.80E-03		
	Location:	East Pen				Total Step HEP	2.55E-02
FSP 20.4.2 Step 14d	Turn the engine start switch to START for a maximum of seven seconds or until engine starts then release.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	10	3.80E-03		
	Location:	East Pen				Total Step HEP	2.55E-02
FSP 20.4.2 Step 14 f	Using the INC button on the pump	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	10	3.80E-03		

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	speed controller, raise engine speed until pressure is indicated on PUMP DISCHARGE gauge.	EOC	20-9	1	0.00E+00		
	Location:	East Pen				Total Step HEP	2.55E-02
FSP 20.4.2 Step 14 g	If discharge pressure is unstable, repeat Steps 14.a and 14.b until discharge pressure stabilizes.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-9	1	0.00E+00		
	Location:	East Pen				Total Step HEP	6.50E-03
FSP 20.4.2 Step 15	Using the INC/DEC buttons on the pump controller, establish a minimum of 300 GPM total flow as indicated on the individual discharge flow indicators.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-10	1	3.80E-03		
	Location:	East Pen				Total Step HEP	2.55E-02
FSP 20.4.2 Step16	Verify pump discharge pressure is LESS THAN 300 psig.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-9	1	0.00E+00		
	Location:	East Pen				Total Step HEP	6.50E-03
FSP 20.3.3 Step 9	Ensure the speed control is set to IDLE by turning the engine throttle fully clockwise (located next to start switch).	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	5	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02

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FSP 20.3.3 Step 10	Turn the Pressure Relief Handwheel fully clockwise.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	5	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.3.3 Step 11	Turn the engine start switch to START.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-12	5	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.3.3 Step 12	Open the MINIMUM FLOW COOLING LINE valve	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.3.3 Step 14	Have Operations unlock and open the following final isolation valve on each Feedwater Header: ● XVG11670-FW, MAIN FW TO SG A EMERG MU ISOL (AB-436' West Pen). ● XVG11671-FW, MAIN FW TO SG B EMERG MU ISOL (IB-436' East Pen). ● XVG11672-FW, MAIN FW TO SG C EMERG MU ISOL (IB-436' East Pen).	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
	Comment	FW flow to only 1 SG is required so only 1 error of commission is included.					
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.3.3 Step 15	Slowly raise engine speed by turning the engine throttle counter clockwise until discharge pressure is between 500 and 550 psig as	EOM	20-7b	2	1.3E-3	High	
		EOC	20-10	1	3.80E-03		
		EOC	20-12	5	1.30E-03		

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	indicated on the PUMP DISCHARGE pressure gauge.						
	Location:	East Pen				Total Step HEP	3.20E-02
FSP 20.3.3 Step 16	Adjust the inservice discharge valve(s) until the desired flow is established as indicated on the individual header flow meter(s).	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.3.3 Step 17	After flow is established, close the MINIMUM FLOW COOLING LINE valve.	EOM	20-7b	2	1.3E-3	High	
		EOC	20-13	1	1.30E-03		
	Location:	East Pen				Total Step HEP	1.30E-02
FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.	EOM	20-7b	2	1.3E-3	High	
	Location:	East Pen				Total Step HEP	6.50E-03
EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.	EOM	20-7b	2	1.3E-3	High	
	Location:	Main Control Room				Total Step HEP	6.50E-03
Self Review		EOM	20-7b	2	1.3E-3	High	0.1
	Comment	There is sufficient time to allow for self review.					
	Location:	East Pen				Total Step HEP	1.00E-01

Execution Recovered							
Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step

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FSP 20.4.1 Step 3		Deploy XPP0234A(B) or C(D), FX UHS LIFT PP A(B) or C(D), and XPP0235A or B, FX UHS MN PP A or B, to the location selected in Step 1.	1.22E-01				7.90E-04
	FSP 20.4.2 Step 6	Check engine display monitor on the control panel is energized.		6.50E-03	ZD	6.50E-03	
FSP 20.4.1 Step 5		Perform one of the following: ●Connect a minimum of three 6 inch hard suction hoses with suction strainers between the lake and the suctions of XPP0235A or B, FX UHS MN PP A or B. ● Connect 6 inch FLEX hoses between the discharges of at least one Submersible Pump, XPP0234A(B)(C)(D), FX UHS LIFT PP A(B)(C)(D), and the suction of XPP0235A or B, FX UHS MN PP A or B as follows: a. Connect hoses from BLUE lift pump to BLUE suction valves on main pump.	6.50E-03				6.50E-03

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		b. Connect hoses from RED lift pump to RED suction valves on main pump.					
FSP 20.4.1 Step 6		If the lift pumps will be used, connect hydraulic lines between XPP0234A(B)(C)(D), FX UHS LIFT PP A(B)(C)(D) and XPP0235A or B, FX UHS MN PP A or B, as follows: a. Connect hydraulic lines from BLUE hose reel to BLUE lift pump. b. Connect hydraulic lines from RED hose reel to RED lift pump.	1.37E-01				8.87E-04
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	
FSP 20.4.1 Step 7		If the lift pumps will be used, using the TRACKED VEHICLE with crane, deploy XPP0234A(B)(C)(D), FX UHS LIFT PP A(B)(C)(D), into the water.	5.65E-02				3.67E-04
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs		6.50E-03	ZD	6.50E-03	

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		between 26% [41%] and 60%.					
FSP 20.4.1 Step 8		Attach 5 inch FLEX hose(s) to the discharge of the XPP0235A or B, FX UHS MN PP A or B.	7.15E-02				4.65E-04
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	
FSP 20.1.4 Step 9		Layout sufficient FLEX hose to allow connection to one of the following FLEX equipment points as desired: ● FLEX Feed Pump suction - East Strategy (FLEX Feed Header).	5.65E-02				2.39E-06
	FSP 20.3.3 Step 7b	Establish water supply from one of the following: b) Align the suction of the SG Feed Pump to the discharge of either the UHS Pump or Booster/XFR Pump		6.50E-03	ZD	6.50E-03	
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs		6.50E-03	ZD	6.50E-03	

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		between 26% [41%] and 60%.					
FSP 20.1.4 Step 10		Connect hose to desired FLEX component: ● FLEX Feed Pump suction - East Strategy (FLEX Feed Header).	7.15E-02				4.65E-04
	FSP 20.3.3 Step 7b	Establish water supply from one of the following: b) Align the suction of the SG Feed Pump to the discharge of either the UHS Pump or Booster/XFR Pump		6.50E-03	ZD	6.50E-03	
FSP 20.3.1 Step 2		Deploy XPP0237, FX SG FEED PP in one of the following locations: ● Near the access gate of the Security Fence around the CST if the CST will be the suction source. OR ● Near the East Pen FLEX Header if Monticello Reservoir or the Service Water Pond will be the suction source.	5.65E-02				3.67E-04
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all		6.50E-03	ZD	6.50E-03	

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		INTACT SGs between 26% [41%] and 60%.					
FSP 20.3.1 Step 3		Attach one of the following to the suction of XPP0237, FX SG FEED PP: 5 inch non-collapsible FLEX hose from XVA31000-FX, CST DRN VLV 6 IN (YD 436). ● OR Discharge of XPP0235A(B), FX UHS MN PP A(B) per FSP-20.4.1, STAGING THE FX UHS PUMPS.	7.15E-02				3.02E-06
	FSP 20.3.3 Step 7b	Establish water supply from one of the following: b) Align the suction of the SG Feed Pump to the discharge of either the UHS Pump or Booster/XFR Pump		6.50E-03	ZD	6.50E-03	
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	
FSP 20.3.1 Step 5		Attach two 3 inch FLEX hoses (with 2.5 inch couplings)	1.37E-01				8.87E-04

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		between the discharge of XPP0237, FX SG FEED PP and any two of the following valves on the FLEX header (Outside IB-436 East Pen): ● XVA09756A-FX, FX SYS MNFLD SUP VLV A. ● XVA09756B-FX, FX SYS MNFLD SUP VLV B. ● XVA09756C-FX, FX SYS MNFLD SUP VLV C.					
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	
FSP 20.3.1 Step 6		Attach three 3 inch FLEX hoses (with 2.5 inch couplings) from the following valves on the FLEX header (IB-436 East Pen) to all three SGs: ● XVA09757A-FX, FX SYS MNFLD DISCH VLV A, to SG A at XVC11673-FW, MAIN FW TO SG A EMERG MU CHK (AB-436 West Pen).	2.02E-01				1.31E-03

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		● XVA09757B-FX, FX SYS MNFLD DISCH VLV B, to SG B at XVC11674-FW, MAIN FW TO SG B EMERG MU CHK (IB-436 East Pen). ● XVA09757C-FX, FX SYS MNFLD DISCH VLV C, to the hose connection at the bottom of the standpipe for SG C feed platform (IB-436 East Pen).					
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	
FSP 20.3.1 Step 7		Attach a 3 inch FLEX hose (with 2.5 inch couplings) from the hose connection at the top of the standpipe for SG C feed platform to SG C at XVC11675-FW, MAIN FW TO SG C EMERG MU CHK (IB-436 East Pen).	7.15E-02				4.65E-04
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	

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FSP 20.3.1 Step 8		Open XVA09754-FX, FX SYS MNFLD ISOL VLV (IB-436 East Pen).	1.30E-02				8.45E-05
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	
FSP 20.3.1 Step 9		Open only the five valves on the East Pen FLEX Header with hoses connected to them: ● XVA09756A-FX, FX SYS MNFLD SUP VLV A (Outside IB-436 East Pen). ● XVA09756B-FX, FX SYS MNFLD SUP VLV B (Outside IB-436 East Pen). ● XVA09756C-FX, FX SYS MNFLD SUP VLV C (Outside IB-436 East Pen). ● XVA09757A-FX, FX SYS MNFLD DISCH VLV A (IB-436 East Pen). ● XVA09757B-FX, FX SYS MNFLD DISCH VLV B (IB-436 East Pen). ● XVA09757C-FX, FX SYS MNFLD DISCH VLV C (IB-436 East Pen).	4.55E-02				2.96E-04

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	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	
FSP 20.3.1 Step 10		Ensure all unused valves on the FLEX manifold (inside AND outside IB-436 East Pen) are CLOSED.	1.30E-02				8.45E-05
	EOP 6 Att 1 Step 4	Maintain Narrow Range SG level in all INTACT SGs between 26% [41%] and 60%.		6.50E-03	ZD	6.50E-03	
EOP 6 Att 10 Step 2a		WHEN RCS Tavg is LESS THAN P-12 (552°F), THEN place both STM DUMP INTERLOCK Switches to BYP INTLK.	1.30E-02				8.45E-05
	EOP 6 Att 10 Step 2f	As SG pressure approaches 500 psig, start XPP00237-FX, FX SG FEED PUMP, per FSP-20.3.3, FX SG FEED PUMP OPERATION.		6.50E-03	ZD	6.50E-03	
EOP 6 Att 10 Step 2b		Place the Steamline Power Relief A(B)(C) Mode Switch(s) in PWR RLF.	1.30E-02				8.45E-05

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	EOP 6 Att 10 Step 2f	As SG pressure approaches 500 psig, start XPP00237-FX, FX SG FEED PUMP, per FSP-20.3.3, FX SG FEED PUMP OPERATION.		6.50E-03	ZD	6.50E-03	
EOP 6 Att 10 Step 2c		Adjust the PWR RELIEF A(B)(C) SETPT Controller(s) as necessary to maintain SG pressure below 500 psig.	1.30E-02				8.45E-05
	EOP 6 Att 10 Step 2f	As SG pressure approaches 500 psig, start XPP00237-FX, FX SG FEED PUMP, per FSP-20.3.3, FX SG FEED PUMP OPERATION.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 2		Close the following: ● MINIMUM FLOW COOLING LINE. ● MASTER DRAIN. ● All four DRAIN valves. ● All three discharge DRAIN valves.	3.25E-02				2.11E-04
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 3		Turn the BATTERY MASTER DISCONNECT switch to ON.	7.85E-03				5.10E-05

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	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 4		Open one inservice suction isolation valve.	1.30E-02				8.45E-05
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 5		Turn the engine start switch to ON.	1.30E-02				8.45E-05
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.4.2 Step 3		Turn both Master Power Switches ON: ● MASTER DISCONNECT ENGINE SIDE BANK A. ● MASTER DISCONNECT ELECTRONICS BANK B.	9.20E-03				5.98E-05
	FSP 20.4.2 Step 6	Check engine display monitor on the control panel is energized.		6.50E-03	ZD	6.50E-03	
FSP 20.4.2 Step 5		Turn the engine start switch to ON.	7.85E-03				5.10E-05
	FSP 20.4.2 Step 6	Check engine display monitor on the control panel is energized.		6.50E-03	ZD	6.50E-03	

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FSP 20.4.2 Step 7		Turn the four primer disconnect switches ON: ● PRIMER 1 DISCONNECT. ● PRIMER 2 DISCONNECT. ● PRIMER 3 DISCONNECT. ● PRIMER 4 DISCONNECT.	1.19E-02				3.03E-04
	FSP 20.4.2 Step 15	Using the INC/DEC buttons on the pump controller, establish a minimum of 300 GPM total flow as indicated on the individual discharge flow indicators.		2.55E-02	ZD	2.55E-02	
FSP 20.4.2 Step 8		Close all discharge valves (valve is closed when its green CLOSED light is lit.	1.30E-02				3.32E-04
	FSP 20.4.2 Step 15	Using the INC/DEC buttons on the pump controller, establish a minimum of 300 GPM total flow as indicated on the individual discharge flow indicators.		2.55E-02	ZD	2.55E-02	
FSP 20.4.2 Step 9		Open all suction isolation valves that have hoses attached.	1.30E-02				3.32E-04

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	FSP 20.4.2 Step 15	Using the INC/DEC buttons on the pump controller, establish a minimum of 300 GPM total flow as indicated on the individual discharge flow indicators.		2.55E-02	ZD	2.55E-02	
FSP 20.4.10		Ensure any suction valve with no hose attached is closed.	1.30E-02				3.32E-04
	FSP 20.4.2 Step 15	Using the INC/DEC buttons on the pump controller, establish a minimum of 300 GPM total flow as indicated on the individual discharge flow indicators.		2.55E-02	ZD	2.55E-02	
FSP 20.4.2 Step 11		Close all the following valves: ● Four AIR BLEEDER vent valves (one on each suction line). Two MASTER DRAIN valves (side by side under left side of trailer on suction end). ● ● Two suction header drain valves (one on each end of suction header).	4.55E-02				1.16E-03

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		● Two discharge header drain valves (one on each end of discharge header). ● MINIMUM FLOW COOLING LINE (on side of control panel). ● One MASTER DRAIN (locater under front of trailer). ● Four discharge line drain valves (one under each discharge valve).					
	FSP 20.4.2 Step 15	Using the INC/DEC buttons on the pump controller, establish a minimum of 300 GPM total flow as indicated on the individual discharge flow indicators.		2.55E-02	ZD	2.55E-02	
FSP 20.4.2 Step 12		Ensure a 2.5 inch hose is connected to the end of the engine cooling line.	7.15E-02				7.15E-03
	Self Review			1.00E-01	ZD	1.00E-01	
FSP 20.4.2 Step 13		Route the engine cooling line hose back to the suction source.	7.15E-02				7.15E-03
	Self Review			1.00E-01	ZD	1.00E-01	
FSP 20.4.2 Step 14a		Push one PRIME button to prime the pump.	2.55E-02				4.23E-06

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	FSP 20.4.2 Step 14 g	If discharge pressure is unstable, repeat Steps 14.a and 14.b until discharge pressure stabilizes.		6.50E-03	ZD	6.50E-03	
	FSP 20.4.2 Step 14c	IF the first PRIME does NOT prime the pump after 45 seconds, THEN release the first button and depress the other PRIME button for a maximum of 45 seconds.		2.55E-02	ZD	2.55E-02	
FSP 20.4.2 Step 14d		Turn the engine start switch to START for a maximum of seven seconds or until engine starts then release.	2.55E-02				1.66E-04
	FSP 20.4.2 Step16	Verify pump discharge pressure is LESS THAN 300 psig.		6.50E-03	ZD	6.50E-03	
FSP 20.4.2 Step 14 f		Using the INC button on the pump speed controller, raise engine speed until pressure is indicated on PUMP DISCHARGE gauge.	2.55E-02				1.66E-04
	FSP 20.4.2 Step16	Verify pump discharge pressure is		6.50E-03	ZD	6.50E-03	

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		LESS THAN 300 psig.					
FSP 20.3.3 Step 9		Ensure the speed control is set to IDLE by turning the engine throttle fully clockwise (located next to start switch).	1.30E-02				8.45E-05
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 10		Turn the Pressure Relief Handwheel fully clockwise.	1.30E-02				8.45E-05
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 11		Turn the engine start switch to START.	1.30E-02				8.45E-05
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 12		Open the MINIMUM FLOW COOLING LINE valve	1.30E-02				8.45E-05
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 14		Have Operations unlock and open the following final isolation valve on	1.30E-02				8.45E-05

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		each Feedwater Header: ● XVG11670-FW, MAIN FW TO SG A EMERG MU ISOL (AB-436' West Pen). ● XVG11671-FW, MAIN FW TO SG B EMERG MU ISOL (IB-436' East Pen). ● XVG11672-FW, MAIN FW TO SG C EMERG MU ISOL (IB-436' East Pen).					
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 15		Slowly raise engine speed by turning the engine throttle counter clockwise until discharge pressure is between 500 and 550 psig as indicated on the PUMP DISCHARGE pressure gauge.	3.20E-02				2.08E-04
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 16		Adjust the inservice discharge valve(s) until the desired flow is established as indicated on the	1.30E-02				8.45E-05

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		individual header flow meter(s).					
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
FSP 20.3.3 Step 17		After flow is established, close the MINIMUM FLOW COOLING LINE valve.	1.30E-02				8.45E-05
	FSP 20.3.3 Step 18	IF required, THEN adjust engine RPM to maintain desired discharge pressure.		6.50E-03	ZD	6.50E-03	
		Total Unrecovered:	1.00E+00			**Total Recovered:**	3.17E-02

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HEP-C-FX-CTG1, OPERATOR FAILS TO ALIGN to AC BUSSES AND START 1 CTG (for battery charging)

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	**M. Blue/JH**			**9/14/2023**
Reviewer				**9/14/2023**

HEP Summary					
	P_1	P_2	P_{cog}	P_{exe}	Total HEP
Method	CBDTM	HCR/ORE	Maximum	THERP	
HEP	0.00E+00	0.00E+00	0.00E+00	2.57E-03	2.57E-03
Distribution Type	Beta		**Variance**	7.45E-06	

RAW	FV	Risk Significant
		N/A

Identification and Definition
A loss of offsite power occurs at time t=0. Reactor and turbine trip are successful. One diesel generator runs for 6 hours powering the motor driven AFW pump. After 6 hours, the diesel stops running and there is a station blackout. Operators enter EOP-6. Step 13 instructs the operators to stage the CTGs. Step 14 calls for declaration of Extended Loss of AC Power (ELAP) if power is not expected to be restored within 2 hours. ELAP is conservatively assumed to be declared 2 hours later. At this point the CTGs are staged. After ELAP declaration, the operators enter procedure FSP-5.0 which instructs powering of the DC Battery chargers with the EB diesel at step 4. In this scenario, the EB diesel is unavailable due to maintenance or random failure. The batteries will be changed from the CTG when aligned. No other failures are assumed at the ELAP declaration for this HEP.

Cues and Indications	
Initial Cue	FSP-5 Step 16
Recovery Cue	
Cue Comments	
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	FSP-5.0 (INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING) Revision: 3
Cognitive Step Number	Step 16
Cognitive Instruction	Have Chemistry Personnel locally align the Combustion Turbine Generator(s) to at least one ESF bus per FSP-20.7, FLEX COMBUSTION

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	TURBINE GENERATOR OPERATION.
Execution Procedure	FSP-20.7 (FLEX COMBUSTION TURBINE GENERATOR OPERATION) Revision: 1
Execution Instruction	
Job Performance Measure	JPM: Not Selected

Notes

The cognitive step for aligning to the busses and starting the CTGs is in Procedure FSP-5 which is entered upon ELAP.

Step 16: Have Chemistry Personnel locally align the Combustion Turbine Generator(s) to at least one ESF bus per FSP-20.7, FLEX COMBUSTION TURBINE GENERATOR OPERATION.

and

Step 17: WHEN the Combustion Turbine Generators are aligned, THEN have Chemistry Personnel locally start the CTG(s) per FSP-20.7, FLEX COMBUSTION TURBINE GENERATOR OPERATION.

Training	
Classroom Training	

Crew Member	Included	Total Available	Required for Execution	Notes
Shift Manager	No	1	0	
Shift Supervisor	No	1	0	
Shift Engineer (STA)	No	1	0	
Reactor Operators	Yes	1	0	
Auxiliary Operators	Yes	1	0	
Health Physics	Yes	1	0	
Chemistry	Yes	1	1	
Mechanics	Yes	1	1	
Electricians	Yes	1	0	
I&C Maintenance	Yes	1	0	

Notes

Assumptions

1. It is assumed that the CTGs are deployed in the 2 hours prior to ELAP declaration. See HEP-C-CTG-DEPLOY
2. Typically, an execution error is assumed for each step in the procedure with a checkoff box.

Operator Interview Insights

This action was discussed with operators on September 12, 2023.
Representatives from Dominion included Michael Vickery and Matthew Torres.

The operators verified the 75 minute execution timing and that staging of the CTGs would occur prior to ELAP declaration.

It was noted that it is preferable to align the battery chargers to the EB diesel; however this is an option if that is unavailable,

Timing Analysis

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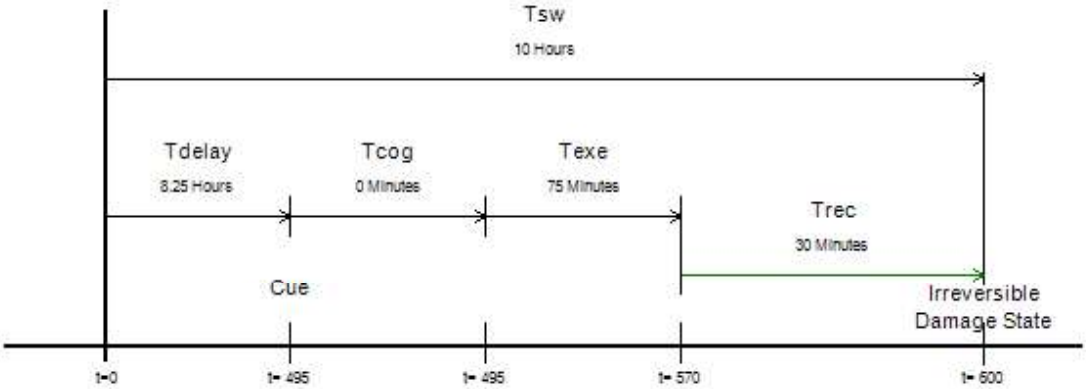

T_{sw}	10 Hours
T_{delay}	8.25 Hours
T_{cog}	0 Minutes
T_{exe}	75 Minutes
Time available for cognition and recovery	30 Minutes
Time available for recovery	30 Minutes
SPAR-H Available time (cognitive)	30 Minutes
SPAR-H Available time (execution) ratio	1.40 Minutes
EPRI Minimum level of dependence for recovery	MD
Notes	
Tsw: Battery life is 4 hours without load shedding. CTGs must be aligned and started within 4 hours after loss of all AC power. 6 hours of diesel power is assumed after loss of offsite power at time 0. Tdelay: 2 hours assumed for Operators to declare ELAP after SBO conditions begin at 6 hours. An additional 15 minutes assumed to progress through FSP 5 to step 16. Operators would begin staging the CTGs prior to the ELAP declaration. Execution for staging is assumed to be 50 minutes and occur in the 2 hours of station blackout prior to ELAP declaration (HEP-C-CTG-DEPLOY) Texe: From the FLEX Validation, 75 minutes is assumed for powering the busses from the CTGs.	

Cognitive Analysis		
Pc Failure Mechanism	**Branch**	**HEP**
Pca: Availability of Information		n/a
Pcb: Failure of Attention		n/a
Pcc: Misread/miscommunicate data		n/a
Pcd: Information misleading		n/a
Pce: Skip a step in procedure		n/a
Pcf: Misinterpret Instructions		n/a
Pcg: Misinterpret decision logic		n/a
Pch: Deliberate violation		n/a
Initial Pc(without recovery credited)		0.00E+00
Notes		
Execution only. Cognition portion is HEP-C-ELAPDECLARE.		

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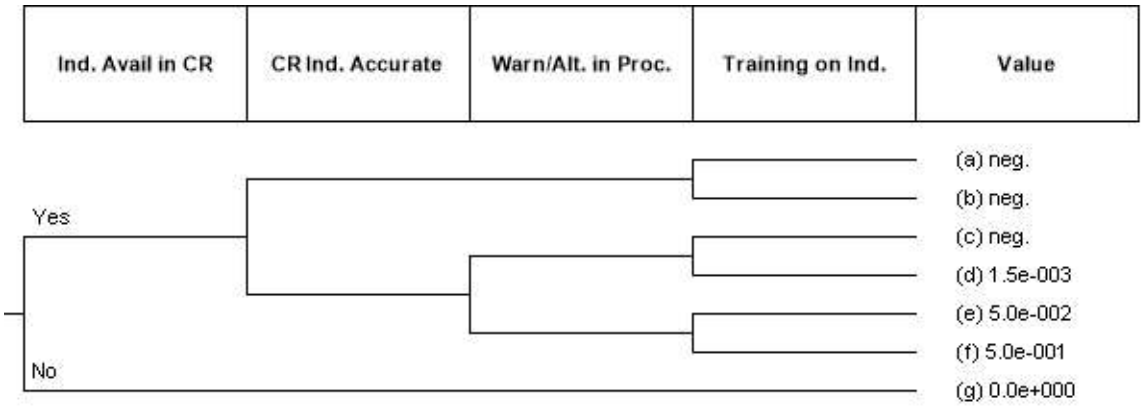
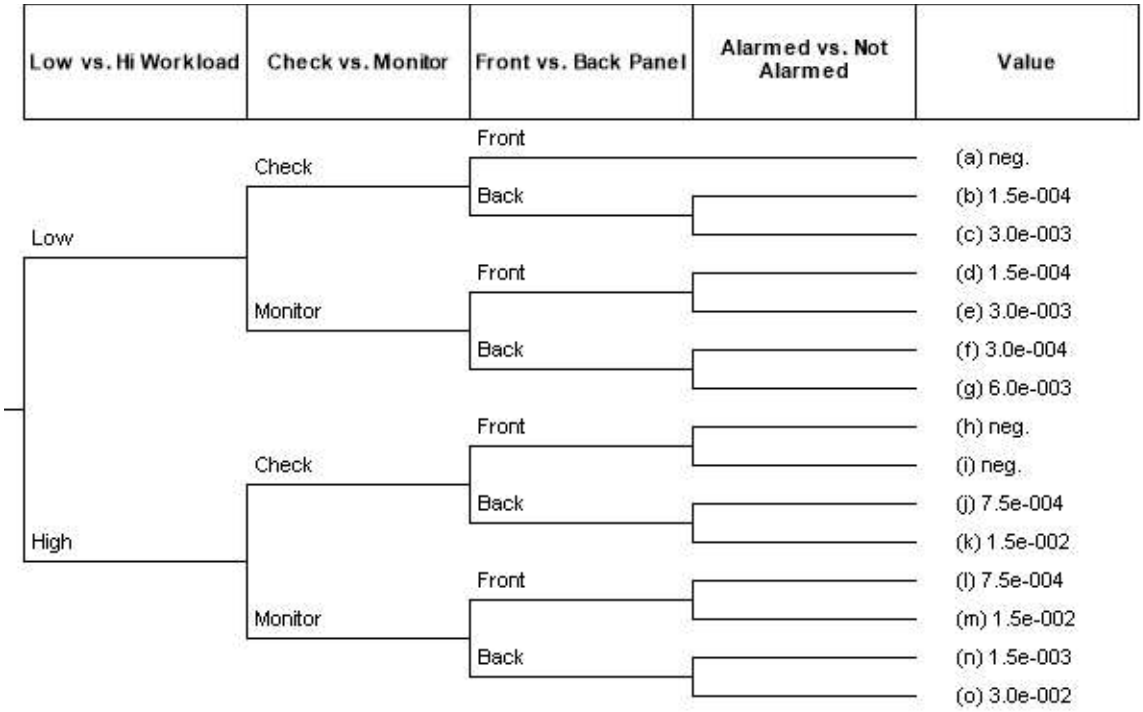
Pca: Availability of Information

Notes/Assumptions:



Pcb: Failure of Attention

Notes/Assumptions:



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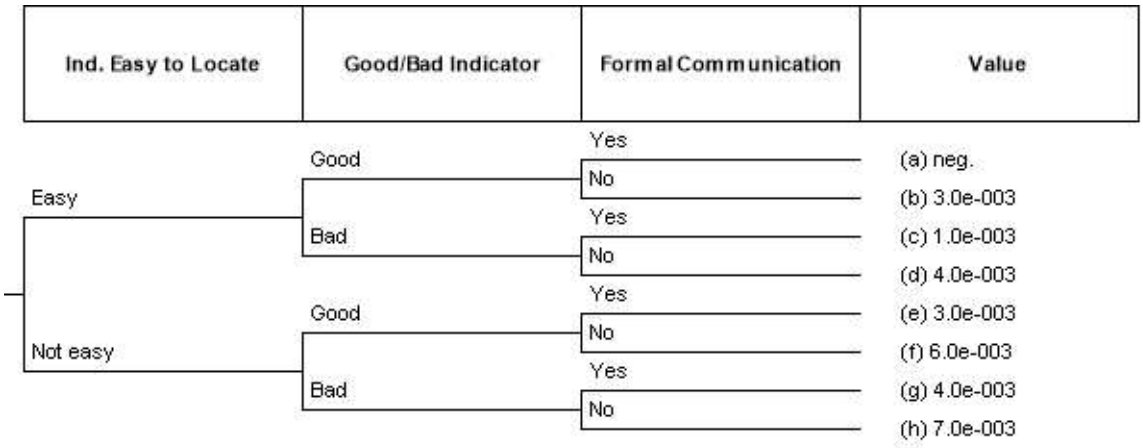
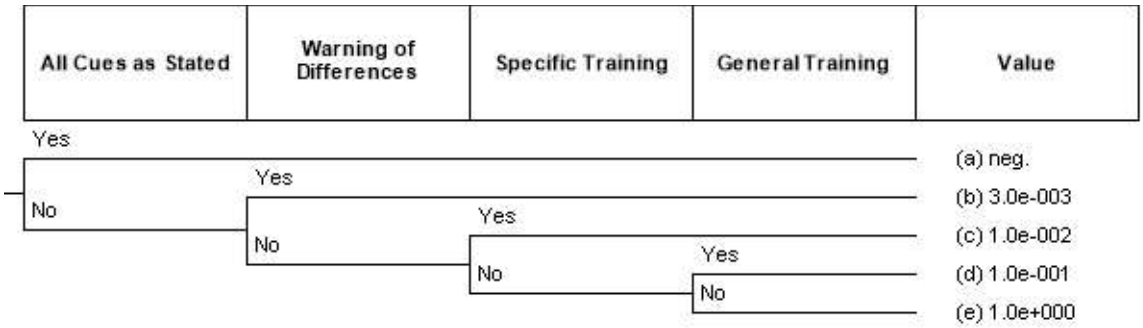
Pcc: Misread/miscommunicate data

Notes/Assumptions:



Pcd: Information misleading

Notes/Assumptions:



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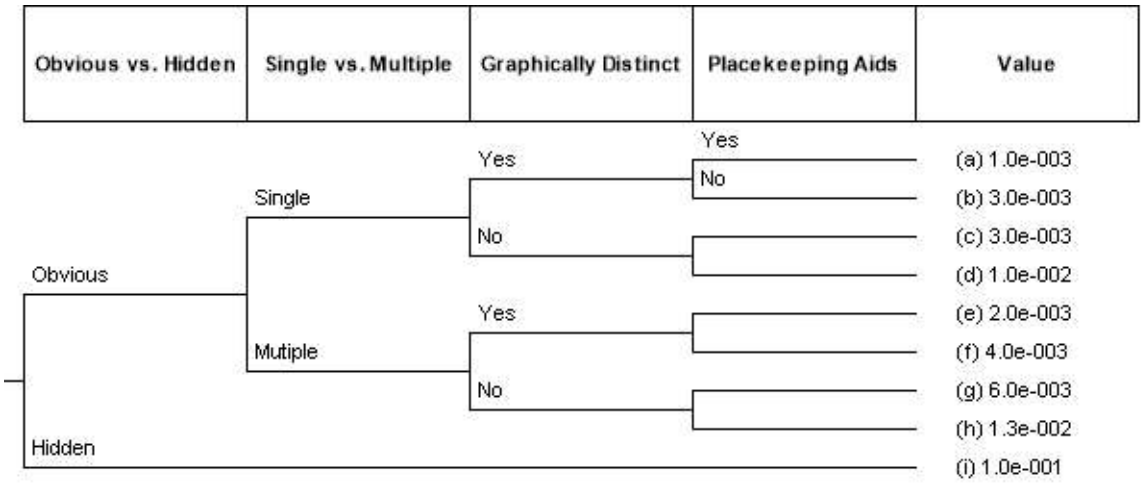
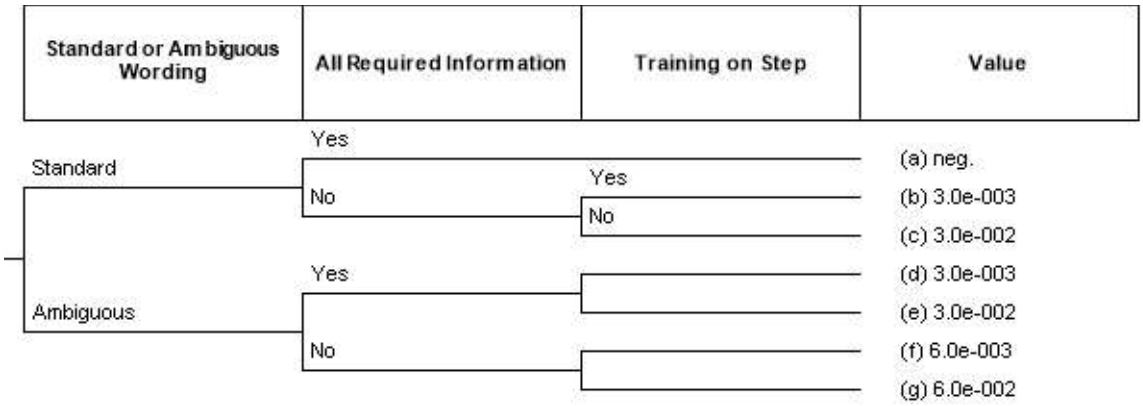
Pce: Skip a step in procedure

Notes/Assumptions:



Pcf: Misinterpret Instructions

Notes/Assumptions:



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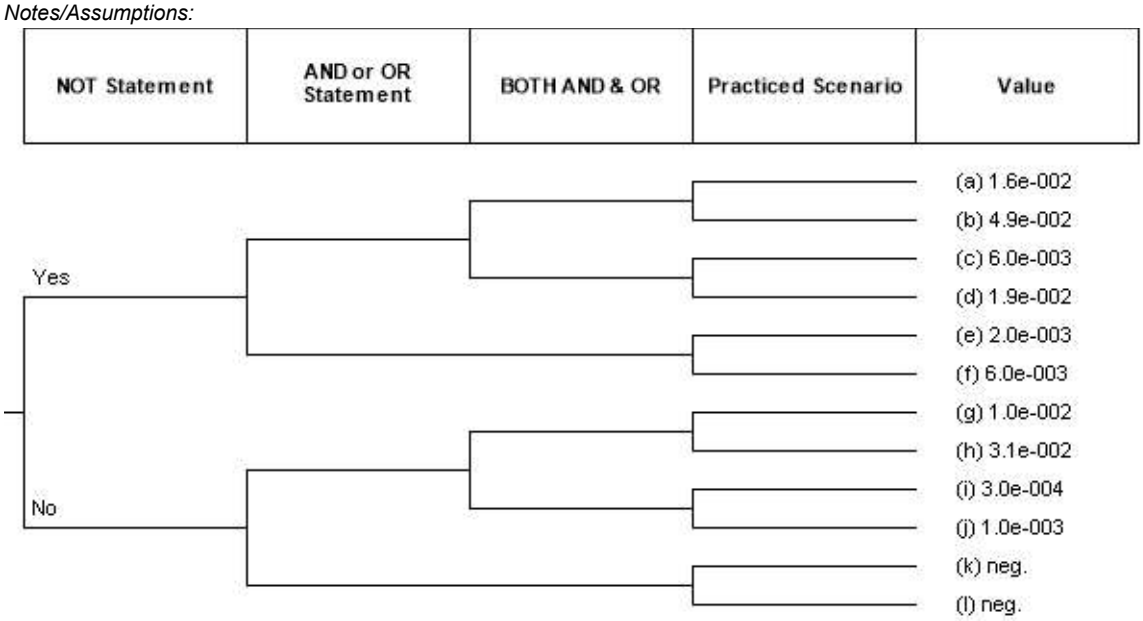
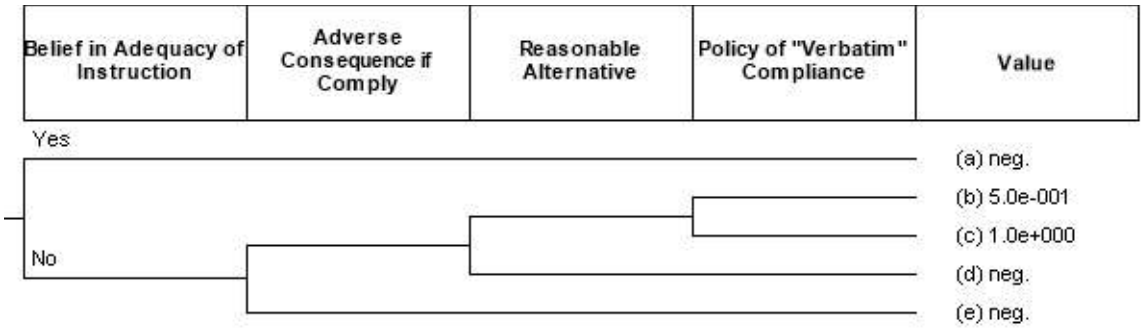
Pcg: Misinterpret decision logic

Notes/Assumptions:



Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery

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	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-			1.00E+00		0.0
Pcb	n/a	-	-	-	-	-			1.00E+00		0.0
Pcc	n/a	-	-	-	-	-			1.00E+00		0.0
Pcd	n/a	-	-	-	-	-			1.00E+00		0.0
Pce	n/a	-	-	-	-	-			1.00E+00		0.0
Pcf	n/a	-	-	-	-	-			1.00E+00		0.0
Pcg	n/a	-	-	-	-	-			1.00E+00		0.0
Pch	n/a	-	-	-	-	-			1.00E+00		0.0
Final Pc (with recovery credited)											0.00E+00
Notes											

Sigma Table				
Plant Type	Response Type	LB	Sigma	UB
BWR	CP1	0.4	0.7	1
	CP2	0.2	0.58	0.96
	CP3	0.59	0.75	0.91
PWR	CP1	0.26	0.57	0.88
	CP2	0.07	0.38	0.69
	CP3		0.77	
Sigma:	3.80E-01			
HEP:	0.00E+00			
Notes/Assumptions	CP2 action - operators are instructed to perform this action by procedure step directly.			

Execution Performance Shaping Factors		
Environment	Lighting	Emergency
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Special Requirements	Tools	Required
Special Requirements	Tools	Adequate
Special Requirements	Tools	Available
Complexity of Response	Execution	Complex
Equipment Accessibility (Cognitive)		
Equipment Accessibility (Execution)	CAR and Outside	Accessible

Stress
Moderate

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Plant Response As Expected:	Yes
Workload:	Low
Performance Shaping Factors:	Negative
Notes	
Plant response is not as expected in that there is an extended SBO, but FLEX strategies are available and the crews have been trained on these actions. Once ELAP is declared this is the expected response. The crew has a few hours to align the CTGs for battery charging, and there is sufficient crew to monitor plant conditions. The TDAFW pump is assumed to be running. Workload is considered low. - Work in ELAP conditions may require the use of portable lighting, and there may be poor weather conditions related to the loss of offsite power. "Negative" PSFs are considered to always be applicable	

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Execution Unrecovered							
Procedure		Comment				Stress Factor	Override
Step No.	Instruction / Comment	Error Type	THERP		HEP		
			Table	Item			
FSP-20.7 Step 2a	Supply fuel to the Combustion Turbines as follows: 1) Uncap the desired Portable Fuel Oil Storage Tank vent. 2) Insert the FLEX Portable Refueling skid suction stinger into the Diesel Fuel Oil Storage Tank vent. 3) Fill the Portable Fuel Oil Tank while continuing with this procedure.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	9	2.70E-03		
	Comment	No execution error is assumed for opening the cap, as inserting the suction stinger would not be possible with the cap open. This is assumed to be included in the "failure to mate a connector" execution error.					
	Location:	CAR and Outside				Total Step HEP	3.40E-02
FSP-20.7 Step 2b1	Connect cables between Terminal Box XBT105 and the following (IB-451, accessible from ladder in 1DB Switchgear Room):	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		

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	● Terminal Box XBT0106 (to XSW1DA). ● Terminal Box XBT0107 (to XSW1DB).						
	Location:	CAR and Outside				Total Step HEP	5.46E-02
FSP-20.7 Step 2b2a	Locally close XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B), as follows (IB-463): a) Inside the breaker cubical for XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B), ensure the DC control power fuses are installed.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
	Location:	CAR and Outside				Total Step HEP	2.86E-02
FSP-20.7 Step 2b2b	b) Turn ON DC control power: ● RRC. ● RRP.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:	CAR and Outside				Total Step HEP	3.68E-03
FSP 20.7 Step 2b2c	Ensure the following relays on XSW1DA are reset: ● 50G. ● 51X.	EOM	20-7b	2	1.3E-3	Moderate	

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	● 50/51/74 - Ø1. ● 50/51/74 - Ø2. ● 50/51/74 - Ø3.						
	Location:	CAR and Outside				Total Step HEP	2.60E-03
FSP 20.7 Step 2b2d	Locally close XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	12	3.80E-03		
	Location:	CAR and Outside				Total Step HEP	1.07E-02
FSP-20.7 Step 2b3a	Locally close XSW1DB 02, FLEX INCOMING BKR FROM XTG0200A(B), as follows (IB-436): a) Inside the breaker cubical for XSW1DB 02,FLEX INCOMING BKR FROM XTG0200A(B), ensure the DC control power fuses are installed.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	2.86E-02
FSP 20.7 Step 2b3b	b) Turn ON DC control power: ● RRC. ● RRP.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:	CAR and Outside				Total Step HEP	3.68E-03
FSP 20.7 Step 2b3c	Ensure the following relays are reset: ● 50G.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		

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	• 51X. • 50/51/74 - Ø1. • 50/51/74 - Ø2. • 50/51/74 - Ø3.	EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:	CAR and Outside				Total Step HEP	5.30E-03
FSP 20.7 Step 2b3d	Locally close XSW1DB 02, FLEX INCOMING BKR FROM XTG0200A(B).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	12	3.80E-03		
	Location:	CAR and Outside				Total Step HEP	1.07E-02
FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.	EOM	20-7b	2	1.3E-3	Moderate	
	Location:					Total Step HEP	2.60E-03
FSP-20.7 Step 2b5	Place the IGNITION toggle switch to ON (center) position for the Turbine(s) to be started.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
	Location:					Total Step HEP	3.14E-03
FSP-20.7 Step 2b7	Ensure the Portable Fuel Oil Tank is at least half full.	EOM			1.3E-3	Moderate	
		EOC	20-10	1	3.80E-03		
	Location:					Total Step HEP	1.02E-02
		EOM	20-7b	2	1.3E-3	Moderate	

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FSP 20.7 Step 2b9	When the fuel line is purged connect the fuel line to the CTG fuel system for each Turbine to be started.	EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	2.86E-02
FSP 20.7 Step 2b10	Open the fuel line isolation valve for each Turbine to be started.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-13	1	1.30E-03		
	Location:					Total Step HEP	5.20E-03
FSP-20.7 Step 2c1	Depress the START button until GROUP START is indicated on the Woodward display then release.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	10	3.80E-03		
	Location:					Total Step HEP	1.02E-02
FSP-20.7 Step 2c2	Verify the turbines start.	EOM	20-7b	2	1.3E-3	Moderate	
	Location:					Total Step HEP	2.60E-03
FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.	EOM	20-7b	2	1.3E-3	Moderate	
	Location:	CAR and Outside				Total Step HEP	2.60E-03

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Execution Recovered							
Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
FSP-20.7 Step 2a		Supply fuel to the Combustion Turbines as follows: 1) Uncap the desired Portable Fuel Oil Storage Tank vent. 2) Insert the FLEX Portable Refueling skid suction stinger into the Diesel Fuel Oil Storage Tank vent. 3) Fill the Portable Fuel Oil Tank while continuing with this procedure.	3.40E-02				2.03E-03
	FSP-20.7 Step 2b7	Ensure the Portable Fuel Oil Tank is at least half full.		1.02E-02	LD	5.97E-02	
FSP-20.7 Step 2b1		Connect cables between Terminal Box XBT105 and the following (IB-451, accessible from ladder in 1DB Switchgear Room): ● Terminal Box XBT0106 (to XSW1DA). ● Terminal Box XBT0107 (to XSW1DB).	5.46E-02				1.50E-04

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	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	LD	5.25E-02	
FSP-20.7 Step 2b2a		Locally close XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B), as follows (IB-463): a) Inside the breaker cubical for XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B), ensure the DC control power fuses are installed.	2.86E-02				7.87E-05
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	LD	5.25E-02	

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	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
FSP-20.7 Step 2b2b		b) Turn ON DC control power: ● RRC. ● RRP.	3.68E-03				1.01E-05
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	LD	5.25E-02	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
FSP 20.7 Step 2b2c		Ensure the following relays on XSW1DA are reset: ● 50G. ● 51X. ● 50/51/74 - Ø1. ● 50/51/74 - Ø2. ● 50/51/74 - Ø3.	2.60E-03				7.16E-06
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have		2.60E-03	LD	5.25E-02	

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		Electrical Maintenance investigate and swap breakers, if necessary.					
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
FSP 20.7 Step 2b2d		Locally close XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B).	1.07E-02				2.96E-05
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	LD	5.25E-02	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
FSP-20.7 Step 2b3a		Locally close XSW1DB 02, FLEX INCOMING BKR FROM XTG0200A(B), as follows (IB-436):	2.86E-02				7.87E-05

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		a) Inside the breaker cubical for XSW1DB 02,FLEX INCOMING BKR FROM XTG0200A(B), ensure the DC control power fuses are installed.					
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	LD	5.25E-02	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
FSP 20.7 Step 2b3b		b) Turn ON DC control power: ● RRC. ● RRP.	3.68E-03				1.01E-05
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance		2.60E-03	LD	5.25E-02	

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		investigate and swap breakers, if necessary.					
FSP 20.7 Step 2b3c		Ensure the following relays are reset: ● 50G. ● 51X. ● 50/51/74 - Ø1. ● 50/51/74 - Ø2. ● 50/51/74 - Ø3.	5.30E-03				1.46E-05
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	LD	5.25E-02	
FSP 20.7 Step 2b3d		Locally close XSW1DB 02, FLEX INCOMING BKR FROM XTG0200A(B).	1.07E-02				2.96E-05
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	

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	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	LD	5.25E-02	
FSP-20.7 Step 2b5		Place the IGNITION toggle switch to ON (center) position for the Turbine(s) to be started.	3.14E-03				8.64E-06
	FSP-20.7 Step 2c2	Verify the turbines start.		2.60E-03	LD	5.25E-02	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
FSP 20.7 Step 2b9		When the fuel line is purged connect the fuel line to the CTG fuel system for each Turbine to be started.	2.86E-02				7.87E-05
	FSP-20.7 Step 2c2	Verify the turbines start.		2.60E-03	LD	5.25E-02	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B		2.60E-03	LD	5.25E-02	

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		from either the EB or the CTGs.					
FSP 20.7 Step 2b10		Open the fuel line isolation valve for each Turbine to be started.	5.20E-03				1.43E-05
	FSP-20.7 Step 2c2	Verify the turbines start.		2.60E-03	LD	5.25E-02	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
FSP-20.7 Step 2c1		Depress the START button until GROUP START is indicated on the Woodward display then release.	1.02E-02				2.81E-05
	FSP-20.7 Step 2c2	Verify the turbines start.		2.60E-03	LD	5.25E-02	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	LD	5.25E-02	
		Total Unrecovered:	2.30E-01			**Total Recovered:**	2.57E-03

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HEP-C-FX-CTG2, OPERATOR FAILS TO ALIGN to AC BUSSES AND START 2 CTG (for MDAFW pump operation)

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	**M. Blue/JH**			**9/14/2023**
Reviewer				**9/14/2023**

HEP Summary					
	P_1	P_2	P_{cog}	P_{exe}	Total HEP
Method	CBDTM	HCR/ORE	Maximum	THERP	
HEP	0.00E+00	0.00E+00	0.00E+00	3.48E-04	3.48E-04
Distribution Type	Lognormal		**EF**	1.00E+01	

RAW	FV	Risk Significant
		N/A

Identification and Definition
A loss of offsite power occurs at time t=0. Reactor and turbine trip are successful. One diesel generator runs for 6 hours powering the motor driven AFW pump. After 6 hours, the diesel stops running and there is a station blackout. Operators enter EOP-6. Step 13 instructs the operators to stage the CTGs. Step 14 calls for declaration of Extended Loss of AC Power (ELAP) if power is not expected to be restored within 2 hours. ELAP is conservatively assumed to be declared 2 hours later. At this point the CTGs are staged. After ELAP declaration, the operators enter procedure FSP-5.0 which instructs powering at least one ESF bus with the CTGs. In this scenario, the TDAFW pump fails due to random failure. No other failures are assumed at the ELAP declaration for this HEP.

Cues and Indications	
Initial Cue	FSP-5 Step 16
Recovery Cue	
Cue Comments	
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	FSP-5.0 (INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING) Revision: 3
Cognitive Step Number	Step 16
Cognitive Instruction	Have Chemistry Personnel locally align the Combustion Turbine Generator(s) to at least one ESF bus per FSP-20.7, FLEX COMBUSTION

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	TURBINE GENERATOR OPERATION.
Execution Procedure	FSP-20.7 (FLEX COMBUSTION TURBINE GENERATOR OPERATION) Revision: 1
Execution Instruction	
Job Performance Measure	JPM: Not Selected

Notes

The cognitive step for aligning to the busses and starting the CTGs is in Procedure FSP-5 which is entered upon ELAP.

Step 16: Have Chemistry Personnel locally align the Combustion Turbine Generator(s) to at least one ESF bus per FSP-20.7, FLEX COMBUSTION TURBINE GENERATOR OPERATION.

and

Step 17: WHEN the Combustion Turbine Generators are aligned, THEN have Chemistry Personnel locally start the CTG(s) per FSP-20.7, FLEX COMBUSTION TURBINE GENERATOR OPERATION.

Training	
Classroom Training	

Crew Member	Included	Total Available	Required for Execution	Notes
Shift Manager	No	1	0	
Shift Supervisor	No	1	0	
Shift Engineer (STA)	No	1	0	
Reactor Operators	Yes	1	0	
Auxiliary Operators	Yes	1	0	
Health Physics	Yes	1	0	
Chemistry	Yes	1	1	
Mechanics	Yes	1	1	
Electricians	Yes	1	0	
I&C Maintenance	Yes	1	0	

Notes

Assumptions

1. It is assumed that the CTGs are deployed in the 2 hours prior to ELAP declaration. See HEP-C-CTG-DEPLOY
2. Typically, an execution error is assumed for each step in the procedure with a checkoff box.

Operator Interview Insights

This action was discussed with operators on September 12, 2023.
Representatives from Dominion included Michael Vickery and Matthew Torres.

The operators verified the 75 minute execution timing and that staging of the CTGs would occur prior to ELAP declaration.

It was noted that it is preferable to align the battery chargers to the EB diesel; however this is an option if that is unavailable,

Timing Analysis

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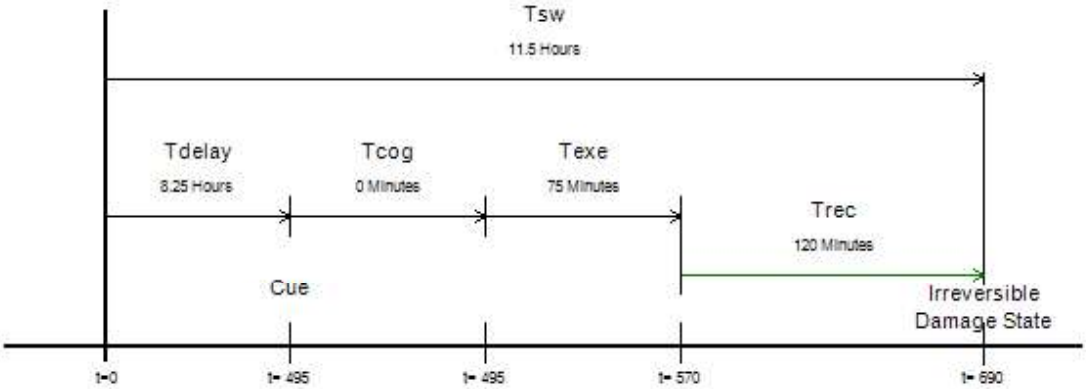

T_{sw}	11.5 Hours
T_{delay}	8.25 Hours
T_{cog}	0 Minutes
T_{exe}	75 Minutes
Time available for cognition and recovery	120 Minutes
Time available for recovery	120 Minutes
SPAR-H Available time (cognitive)	120 Minutes
SPAR-H Available time (execution) ratio	2.60 Minutes
EPRI Minimum level of dependence for recovery	ZD
Notes	
Tsw: Loss of offsite power at time t=0. DG A runs for 6 hours. EFW recovery in 6 hours after SBO will prevent core damage from MAAP cases LOOP-EFW-Case1-B and LOOP-EFW-Case2-B. Continuing through the procedure and starting the MDAFW pump is assumed to be 30 minutes (See HEP-C-STARTMDAFWCTG) Tdelay: 2 hours assumed for Operators to declare ELAP after SBO conditions begin at 6 hours. An additional 15 minutes assumed to progress through FSP 5 to step 16. Operators would begin staging the CTGs prior to the ELAP declaration. Execution for staging is assumed to be 50 minutes and occur in the 2 hours of station blackout prior to ELAP declaration (HEP-C-CTG-DEPLOY) Texe: From the FLEX Validation, 75 minutes is assumed for powering the busses from the CTGs.	

Cognitive Analysis		
Pc Failure Mechanism	**Branch**	**HEP**
Pca: Availability of Information		n/a
Pcb: Failure of Attention		n/a
Pcc: Misread/miscommunicate data		n/a
Pcd: Information misleading		n/a
Pce: Skip a step in procedure		n/a
Pcf: Misinterpret Instructions		n/a
Pcg: Misinterpret decision logic		n/a
Pch: Deliberate violation		n/a
Initial Pc(without recovery credited)		0.00E+00
Notes		
Execution only. Cognition portion is HEP-C-ELAPDECLARE.		

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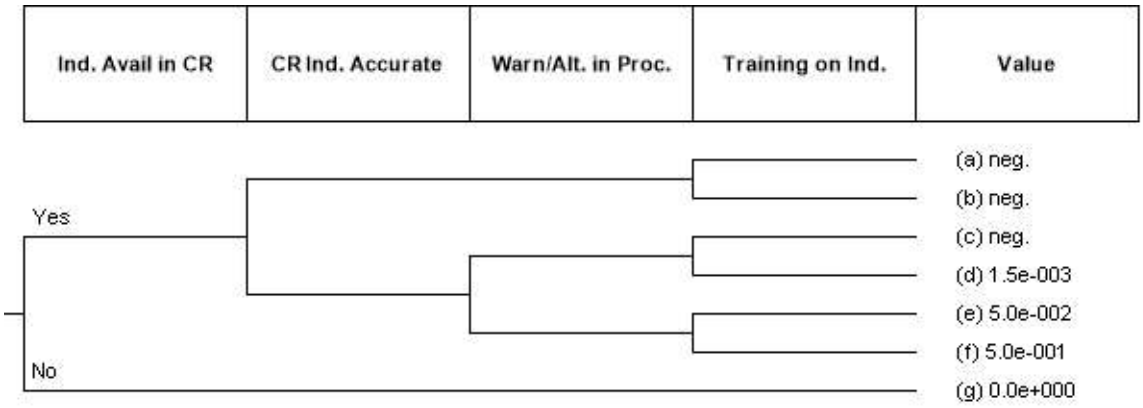
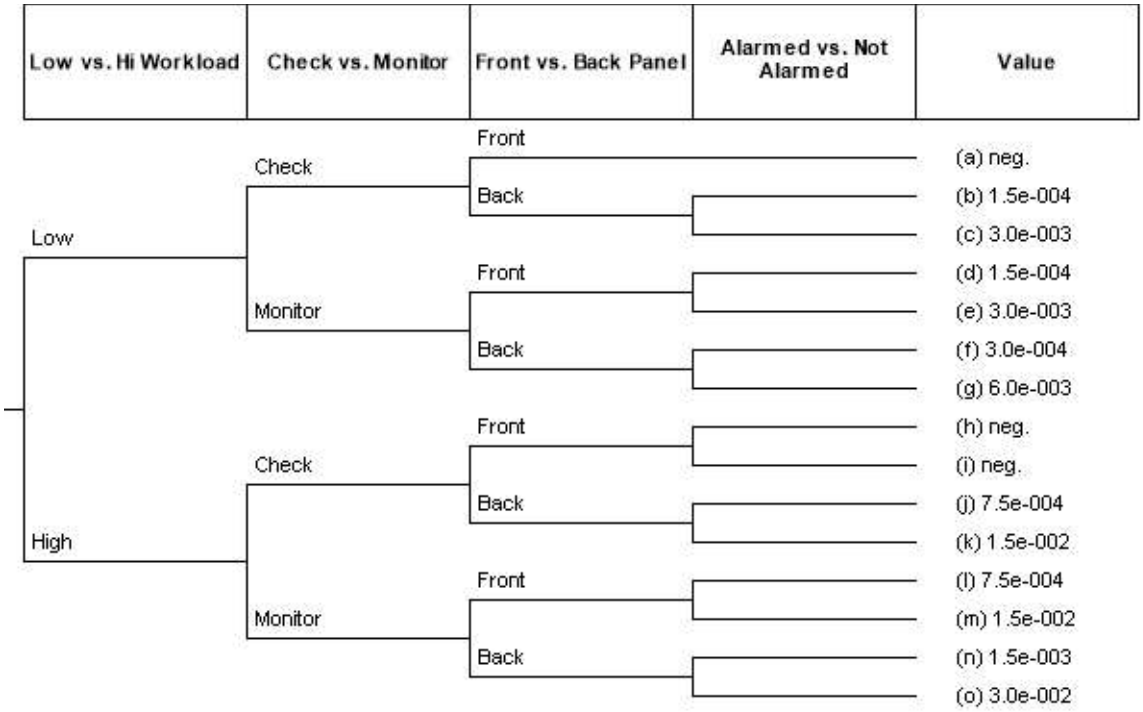
Pca: Availability of Information

Notes/Assumptions:



Pcb: Failure of Attention

Notes/Assumptions:



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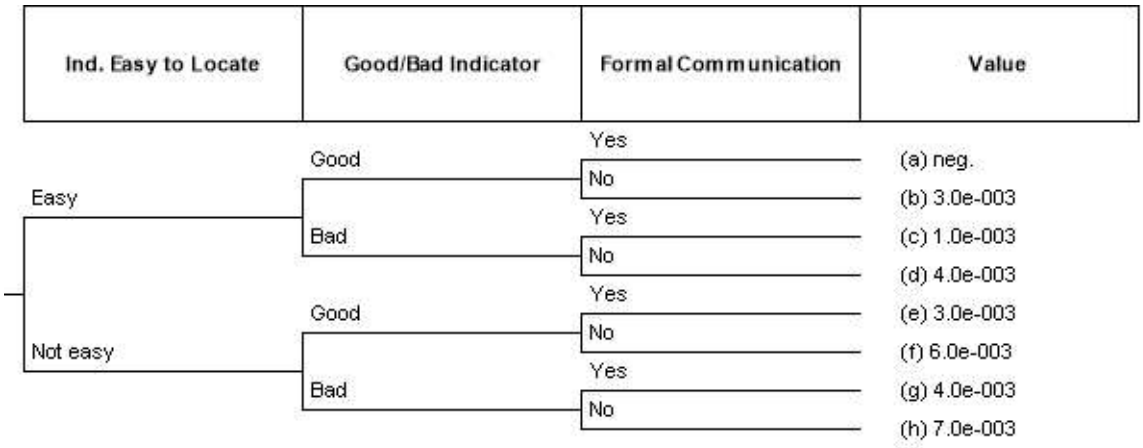
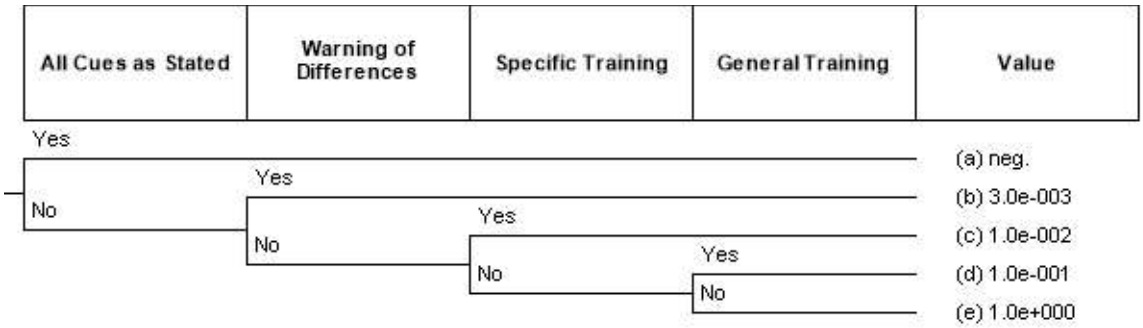
Pcc: Misread/miscommunicate data

Notes/Assumptions:



Pcd: Information misleading

Notes/Assumptions:



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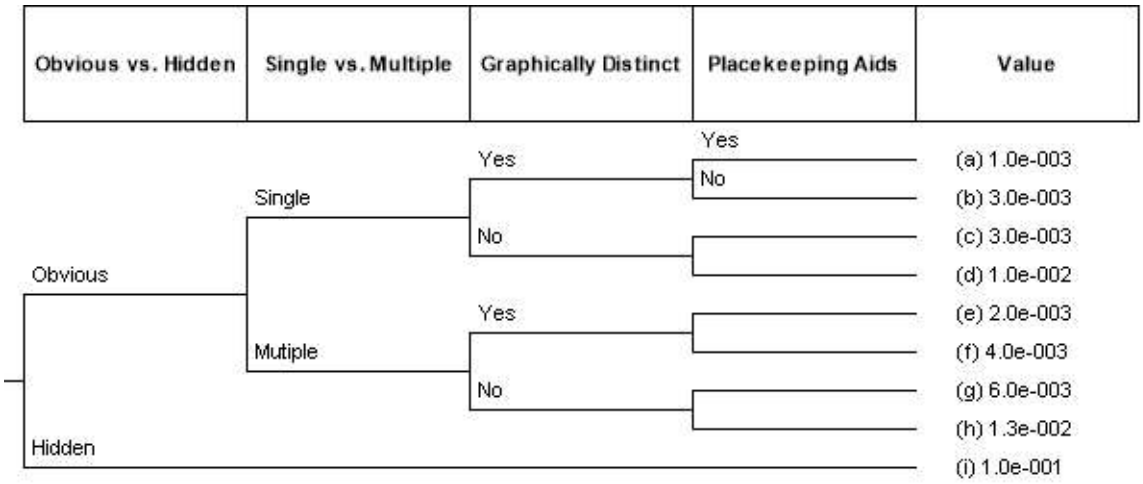
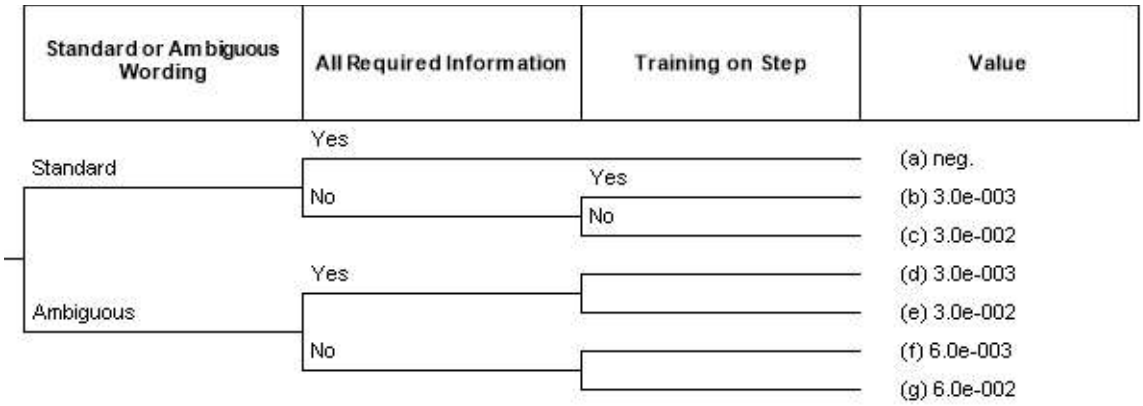
Pce: Skip a step in procedure

Notes/Assumptions:



Pcf: Misinterpret Instructions

Notes/Assumptions:



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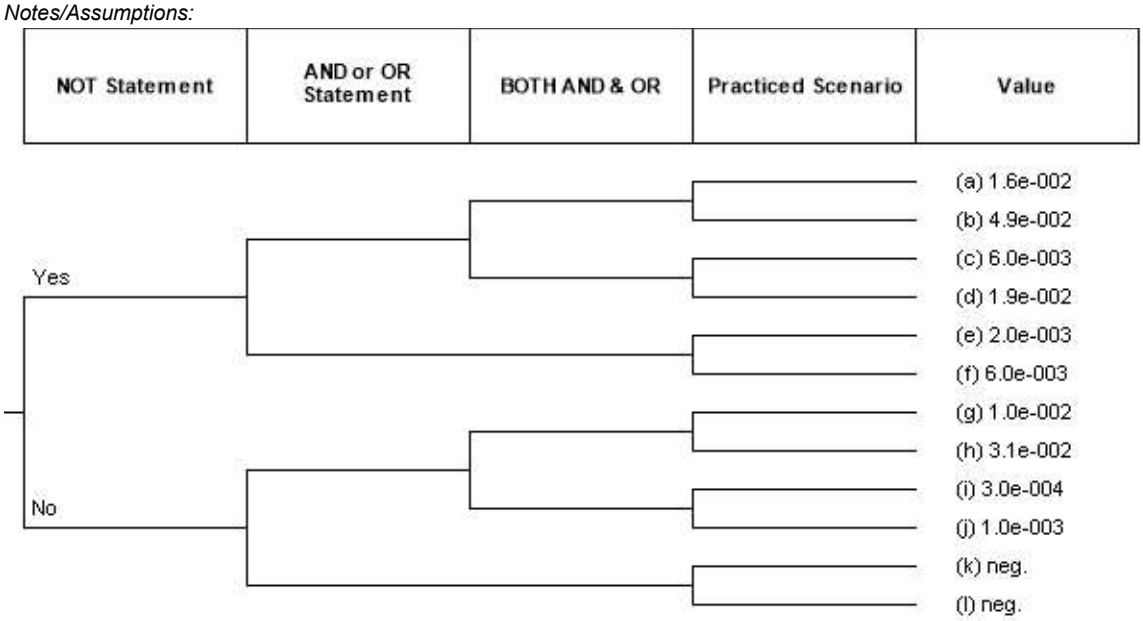
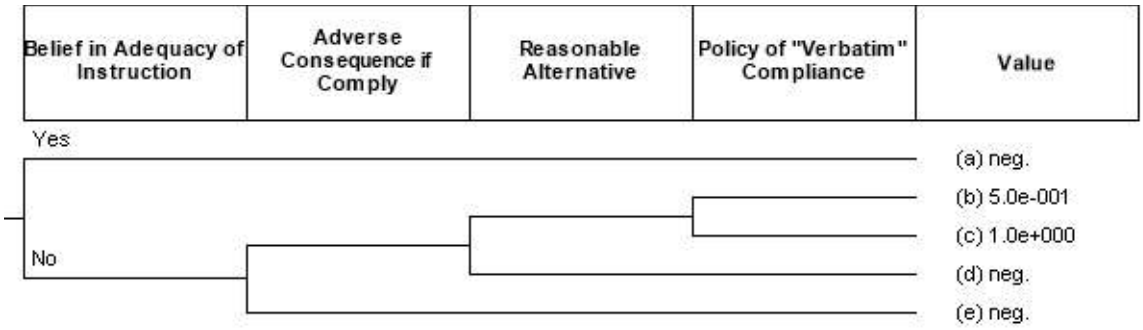
Pcg: Misinterpret decision logic

Notes/Assumptions:



Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery

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	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-			1.00E+00		0.0
Pcb	n/a	-	-	-	-	-			1.00E+00		0.0
Pcc	n/a	-	-	-	-	-			1.00E+00		0.0
Pcd	n/a	-	-	-	-	-			1.00E+00		0.0
Pce	n/a	-	-	-	-	-			1.00E+00		0.0
Pcf	n/a	-	-	-	-	-			1.00E+00		0.0
Pcg	n/a	-	-	-	-	-			1.00E+00		0.0
Pch	n/a	-	-	-	-	-			1.00E+00		0.0
Final Pc (with recovery credited)											0.00E+00
Notes											

Sigma Table				
Plant Type	Response Type	LB	Sigma	UB
BWR	CP1	0.4	0.7	1
	CP2	0.2	0.58	0.96
	CP3	0.59	0.75	0.91
PWR	CP1	0.26	0.57	0.88
	CP2	0.07	0.38	0.69
	CP3		0.77	
Sigma:	1.00E+00			
HEP:	0.00E+00			
Notes/Assumptions				

Execution Performance Shaping Factors		
Environment	Lighting	Emergency
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Special Requirements	Tools	Required
Special Requirements	Tools	Adequate
Special Requirements	Tools	Available
Complexity of Response	Execution	Complex
Equipment Accessibility (Cognitive)		
Equipment Accessibility (Execution)	CAR and Outside	Accessible

Stress	
Moderate	
Plant Response As Expected:	Yes
Workload:	Low
Performance Shaping Factors:	Negative
Notes	

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Plant response is not as expected in that there is an extended SBO, but FLEX strategies are available and the crews have been trained on these actions. Once ELAP is declared this is the expected response. The crew has a several hours to align the CTGs for EFW flow, and there is sufficient crew to monitor plant conditions. The TDAFW pump is assumed to be running. Workload is considered low. - Work in ELAP conditions may require the use of portable lighting, and there may be poor weather conditions related to the loss of offsite power. "Negative" PSFs are considered to always be applicable

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Execution Unrecovered							
Procedure		Comment				Stress Factor	Override
Step No.	Instruction / Comment	Error Type	THERP		HEP		
			Table	Item			
FSP-20.7 Step 2a	Supply fuel to the Combustion Turbines as follows: 1) Uncap the desired Portable Fuel Oil Storage Tank vent. 2) Insert the FLEX Portable Refueling skid suction stinger into the Diesel Fuel Oil Storage Tank vent. 3) Fill the Portable Fuel Oil Tank while continuing with this procedure.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	9	2.70E-03		
	Comment	No execution error is assumed for opening the cap, as inserting the suction stinger would not be possible with the cap open. This is assumed to be included in the "failure to mate a connector" execution error.					
	Location:	CAR and Outside				Total Step HEP	3.40E-02
FSP-20.7 Step 2b1	Connect cables between Terminal Box XBT105 and the following (IB-451, accessible from ladder in 1DB Switchgear Room):	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
		EOC	20-12	13	1.30E-02		

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	● Terminal Box XBT0106 (to XSW1DA). ● Terminal Box XBT0107 (to XSW1DB).						
	Location:	CAR and Outside				Total Step HEP	5.46E-02
FSP-20.7 Step 2b2a	Locally close XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B), as follows (IB-463): a) Inside the breaker cubical for XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B), ensure the DC control power fuses are installed.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
	Location:	CAR and Outside				Total Step HEP	2.86E-02
FSP-20.7 Step 2b2b	b) Turn ON DC control power: ● RRC. ● RRP.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:	CAR and Outside				Total Step HEP	3.68E-03
FSP 20.7 Step 2b2c	Ensure the following relays on XSW1DA are reset: ● 50G. ● 51X.	EOM	20-7b	2	1.3E-3	Moderate	

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	● 50/51/74 - Ø1. ● 50/51/74 - Ø2. ● 50/51/74 - Ø3.						
	Location:	CAR and Outside				Total Step HEP	2.60E-03
FSP 20.7 Step 2b2d	Locally close XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	12	3.80E-03		
	Location:	CAR and Outside				Total Step HEP	1.07E-02
FSP-20.7 Step 2b3a	Locally close XSW1DB 02, FLEX INCOMING BKR FROM XTG0200A(B), as follows (IB-436): a) Inside the breaker cubical for XSW1DB 02,FLEX INCOMING BKR FROM XTG0200A(B), ensure the DC control power fuses are installed.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	2.86E-02
FSP 20.7 Step 2b3b	b) Turn ON DC control power: ● RRC. ● RRP.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:	CAR and Outside				Total Step HEP	3.68E-03
FSP 20.7 Step 2b3c	Ensure the following relays are reset: ● 50G.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		

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	• 51X. • 50/51/74 - Ø1. • 50/51/74 - Ø2. • 50/51/74 - Ø3.	EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:	CAR and Outside				Total Step HEP	5.30E-03
FSP 20.7 Step 2b3d	Locally close XSW1DB 02, FLEX INCOMING BKR FROM XTG0200A(B).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	12	3.80E-03		
	Location:	CAR and Outside				Total Step HEP	1.07E-02
FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.	EOM	20-7b	2	1.3E-3	Moderate	
	Location:					Total Step HEP	2.60E-03
FSP-20.7 Step 2b5	Place the IGNITION toggle switch to ON (center) position for the Turbine(s) to be started.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	8a	2.70E-04		
	Location:					Total Step HEP	3.14E-03
FSP-20.7 Step 2b7	Ensure the Portable Fuel Oil Tank is at least half full.	EOM			1.3E-3	Moderate	
		EOC	20-10	1	3.80E-03		
	Location:					Total Step HEP	1.02E-02
		EOM	20-7b	2	1.3E-3	Moderate	

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FSP 20.7 Step 2b9	When the fuel line is purged connect the fuel line to the CTG fuel system for each Turbine to be started.	EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	2.86E-02
FSP 20.7 Step 2b10	Open the fuel line isolation valve for each Turbine to be started.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-13	1	1.30E-03		
	Location:					Total Step HEP	5.20E-03
FSP-20.7 Step 2c1	Depress the START button until GROUP START is indicated on the Woodward display then release.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	10	3.80E-03		
	Location:					Total Step HEP	1.02E-02
FSP-20.7 Step 2c2	Verify the turbines start.	EOM	20-7b	2	1.3E-3	Moderate	
	Location:					Total Step HEP	2.60E-03
FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.	EOM	20-7b	2	1.3E-3	Moderate	
	Location:	CAR and Outside				Total Step HEP	2.60E-03

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Execution Recovered							
Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
FSP-20.7 Step 2a		Supply fuel to the Combustion Turbines as follows: 1) Uncap the desired Portable Fuel Oil Storage Tank vent. 2) Insert the FLEX Portable Refueling skid suction stinger into the Diesel Fuel Oil Storage Tank vent. 3) Fill the Portable Fuel Oil Tank while continuing with this procedure.	3.40E-02				3.47E-04
	FSP-20.7 Step 2b7	Ensure the Portable Fuel Oil Tank is at least half full.		1.02E-02	ZD	1.02E-02	
FSP-20.7 Step 2b1		Connect cables between Terminal Box XBT105 and the following (IB-451, accessible from ladder in 1DB Switchgear Room): ● Terminal Box XBT0106 (to XSW1DA). ● Terminal Box XBT0107 (to XSW1DB).	5.46E-02				3.69E-07

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	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	ZD	2.60E-03	
FSP-20.7 Step 2b2a		Locally close XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B), as follows (IB-463): a) Inside the breaker cubical for XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B), ensure the DC control power fuses are installed.	2.86E-02				1.93E-07
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	ZD	2.60E-03	

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	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
FSP-20.7 Step 2b2b		b) Turn ON DC control power: ● RRC. ● RRP.	3.68E-03				2.49E-08
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	ZD	2.60E-03	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
FSP 20.7 Step 2b2c		Ensure the following relays on XSW1DA are reset: ● 50G. ● 51X. ● 50/51/74 - Ø1. ● 50/51/74 - Ø2. ● 50/51/74 - Ø3.	2.60E-03				1.76E-08
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have		2.60E-03	ZD	2.60E-03	

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		Electrical Maintenance investigate and swap breakers, if necessary.					
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
FSP 20.7 Step 2b2d		Locally close XSW1DA 09, FLEX INCOMING BKR FROM XTG0200A(B).	1.07E-02				7.26E-08
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	ZD	2.60E-03	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
FSP-20.7 Step 2b3a		Locally close XSW1DB 02, FLEX INCOMING BKR FROM XTG0200A(B), as follows (IB-436):	2.86E-02				1.93E-07

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		a) Inside the breaker cubical for XSW1DB 02,FLEX INCOMING BKR FROM XTG0200A(B), ensure the DC control power fuses are installed.					
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	ZD	2.60E-03	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
FSP 20.7 Step 2b3b		b) Turn ON DC control power: ● RRC. ● RRP.	3.68E-03				2.49E-08
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance		2.60E-03	ZD	2.60E-03	

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		investigate and swap breakers, if necessary.					
FSP 20.7 Step 2b3c		Ensure the following relays are reset: ● 50G. ● 51X. ● 50/51/74 - Ø1. ● 50/51/74 - Ø2. ● 50/51/74 - Ø3.	5.30E-03				3.58E-08
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	ZD	2.60E-03	
FSP 20.7 Step 2b3d		Locally close XSW1DB 02, FLEX INCOMING BKR FROM XTG0200A(B).	1.07E-02				7.26E-08
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	

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	FSP-27.0 Step 2b4	IF either breaker fails to close, THEN have Electrical Maintenance investigate and swap breakers, if necessary.		2.60E-03	ZD	2.60E-03	
FSP-20.7 Step 2b5		Place the IGNITION toggle switch to ON (center) position for the Turbine(s) to be started.	3.14E-03				2.12E-08
	FSP-20.7 Step 2c2	Verify the turbines start.		2.60E-03	ZD	2.60E-03	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
FSP 20.7 Step 2b9		When the fuel line is purged connect the fuel line to the CTG fuel system for each Turbine to be started.	2.86E-02				1.93E-07
	FSP-20.7 Step 2c2	Verify the turbines start.		2.60E-03	ZD	2.60E-03	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B		2.60E-03	ZD	2.60E-03	

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		from either the EB or the CTGs.					
FSP 20.7 Step 2b10		Open the fuel line isolation valve for each Turbine to be started.	5.20E-03				3.52E-08
	FSP-20.7 Step 2c2	Verify the turbines start.		2.60E-03	ZD	2.60E-03	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
FSP-20.7 Step 2c1		Depress the START button until GROUP START is indicated on the Woodward display then release.	1.02E-02				6.90E-08
	FSP-20.7 Step 2c2	Verify the turbines start.		2.60E-03	ZD	2.60E-03	
	FSP 5.0 Step 19	Verify battery charging capability has been restored to XBA1A AND XBA1B from either the EB or the CTGs.		2.60E-03	ZD	2.60E-03	
		Total Unrecovered:	2.30E-01			**Total Recovered:**	3.48E-04

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HEP-C-PUMPTRUCK, Operator fails to supply flow to SGs from pumper trucks

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	**M. Blue/JH**			**9/18/2023**
Reviewer				**9/18/2023**

HEP Summary					
	P_1	P_2	P_{cog}	P_{exe}	Total HEP
Method	CBDTM	HCR/ORE	Maximum	THERP	
HEP	1.96E-02	9.34E-06	1.96E-02	6.57E-03	2.60E-02
Distribution Type	Beta		**Variance**	5.50E-04	

RAW	FV	Risk Significant
		N/A

Identification and Definition
1. Initial conditions: Reactor Operating at full power 2. Initiating event: Loss of Offsite Power followed by successful reactor and turbine trip 3. Accident sequence - preceding functional failures and successes Successful reactor and turbine trip. One diesel generator runs for 6 hours with AFW success with MDAFW pump The other diesel is not available due to maintenance or random failure. At 6 hours, the running diesel fails placing the plant in a station blackout. This fails the running MDAFW pump. The TDAFW pump fails early due to random failure or maintenance unavailability 4. Procedural progression: EOP-6 is entered from EOP-1.0, E-0, REACTOR TRIP OR SAFETY INJECTION, Step 3, on indication that all ac emergency busses are deenergized. Step 4 requires checking the EFW flow to the SGs. Without flow the alternative action is to enter BDMG 4 to trouble shoot the TDAFW pump. Assuming the TDAFW pump is not in maintenance, the operators would attempt to recover the TDAFW pump. When it is determined not to be recoverable, the operators are instructed to enter BDMG 5 to provide flow from the pumper trucks. 5. Operator action high level success criteria: Successful EFW flow of 450 gpm to one SG. 6. Consequence of failure: Loss of FW flow will result in core damage. There are also alternatives for providing EFW flow.

Cues and Indications	
Initial Cue	TDAFW pump fails with no recovery

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Recovery Cue	
Cue Comments	This action is also directed by EOP-6 Attachment 10 Step 1 Alternative Action Locally align Fire Pumper Truck as a low pressure feed source to at least one SG. REFER TO BDMG-5.0, MANUALLY DEPRESSURIZE SGS AND USE LOW PRESSURE WATER SOURCES (TURBINE DRIVEN EMERGENCY FEEDWATER PUMP NOT AVAILABLE), ATTACHMENT I.
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	BDMG-4.0 (MANUAL OPERATION OF TURBINE DRIVEN EMERGENCY FEEDWATER PUMP (INCLUDES ABNORMAL OPERATION)) Revision: 2
Cognitive Step Number	Caution 5.0
Cognitive Instruction	If the TDEFP is NOT in operation and all efforts performed by THIS procedure to restore it to operation have been exhausted, then BDMG-5.0, Manually Depressurize SGS And Use Low Pressure Water Sources (Turbine Driven Emergency Feedwater Pump Not Available), should be implemented.
Execution Procedure	BDMG-5.0 (MANUALLY DEPRESSURIZE SGS AND USE LOW PRESSURE WATER SOURCES (TURBINE DRIVEN EMERGENCY FEEDWATER PUMP NOT AVAILABLE)) Revision: 2
Execution Instruction	
Job Performance Measure	JPM: Not Selected
Other Procedures	EOP-6.0 (ECA-0.0 LOSS OF ALL ESF AC POWER) Revision: 41
Notes	
The action to enter BMDG 4 occurs in Step 4 of EOP-6, alternative action. This action is also directed by EOP-6 Attachment 10 Step 1 Alternative Action Locally align Fire Pumper Truck as a low pressure feed source to at least one SG. REFER TO BDMG-5.0, MANUALLY DEPRESSURIZE SGS AND USE LOW PRESSURE WATER SOURCES (TURBINE DRIVEN EMERGENCY FEEDWATER PUMP NOT AVAILABLE), ATTACHMENT I. Entry from Step 4 is selected as Attachment 10 is only entered after Step 4 is completed.	

Crew Member	Included	Total Available	Required for Execution	Notes
Shift Manager	No	1	0	
Shift Supervisor	No	1	0	
Shift Engineer (STA)	No	1	0	
Reactor Operators	Yes	1	0	
Auxiliary Operators	Yes	1	1	
Health Physics	Yes	1	0	
Chemistry	Yes	1	1	
Mechanics	Yes	1	0	
Electricians	Yes	1	0	
I&C Maintenance	Yes	1	0	
Notes				

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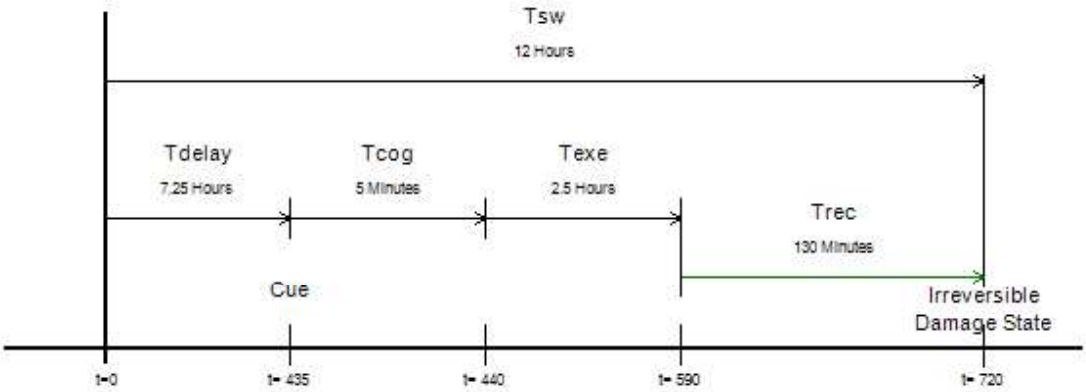
Assumptions
1. Suction from the lake is assumed. 2. SG wide range level indication is assumed to be available. 3. Only connection to one SG is assumed (only 1 is required to prevent core damage per MAAP cases LOOP-EFW-Case1-B and LOOP-EFW-Case2-B.

Operator Interview Insights
This action was discussed with operators on September 12, 2023. Representatives from Dominion included Michael Vickery and Matthew Torres. The operators estimated 2 hours as a conservative time for aligning the pumper truck. An additional 30 minutes was assumed for installing local instrumentation.

Timing Analysis



T_{sw}	12 Hours
T_{delay}	7.25 Hours
T_{cog}	5 Minutes
T_{exe}	2.5 Hours
Time available for cognition and recovery	135 Minutes
Time available for recovery	130 Minutes
SPAR-H Available time (cognitive)	135 Minutes
SPAR-H Available time (execution) ratio	1.87 Minutes
EPRI Minimum level of dependence for recovery	ZD

Notes

Tsw: Loss of offsite power at time t=0. DG A runs for 6 hours. EFW recovery in 6 hours after SBO will prevent core damage from MAAP cases LOOP-EFW-Case1-B and LOOP-EFW-Case2-B.

Tdelay: 6 hours of DG power before SBO conditions. 15 minutes conservatively estimated to get to EOP-6 step 4 and begin trouble shooting the TDAFW pump. 1 hour estimated to attempt to start the TDAFW pump before moving to BMDG 5 per Operator interview.

Tcog: 5 minutes assumed to assess state of the pumper trucks.

Texe: 2.5 hours estimated for performing the action with installation of local pressure gauges per operator interview.

Cognitive Analysis

Pc Failure Mechanism	Branch	HEP
Pca: Availability of Information	a	n/a
Pcb: Failure of Attention	i	n/a

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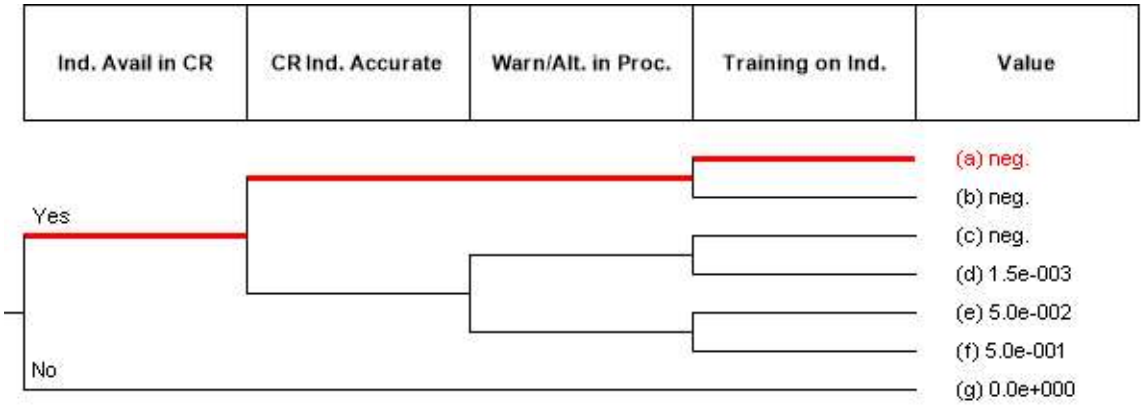
Pcc: Misread/miscommunicate data	a	n/a
Pcd: Information misleading	a	n/a
Pce: Skip a step in procedure	g	6.00E-03
Pcf: Misinterpret Instructions	a	n/a
Pcg: Misinterpret decision logic	d	1.90E-02
Pch: Deliberate violation	a	n/a
Initial Pc(without recovery credited)		2.50E-02
Notes		

Pca: Availability of Information

Notes/Assumptions:



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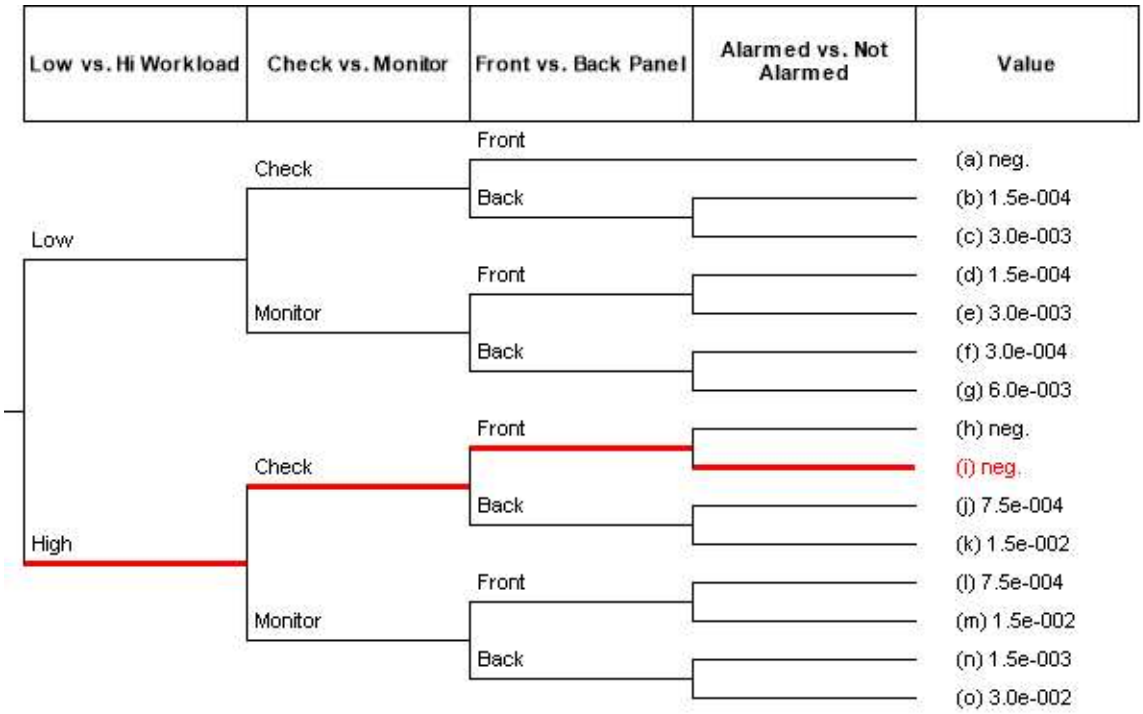
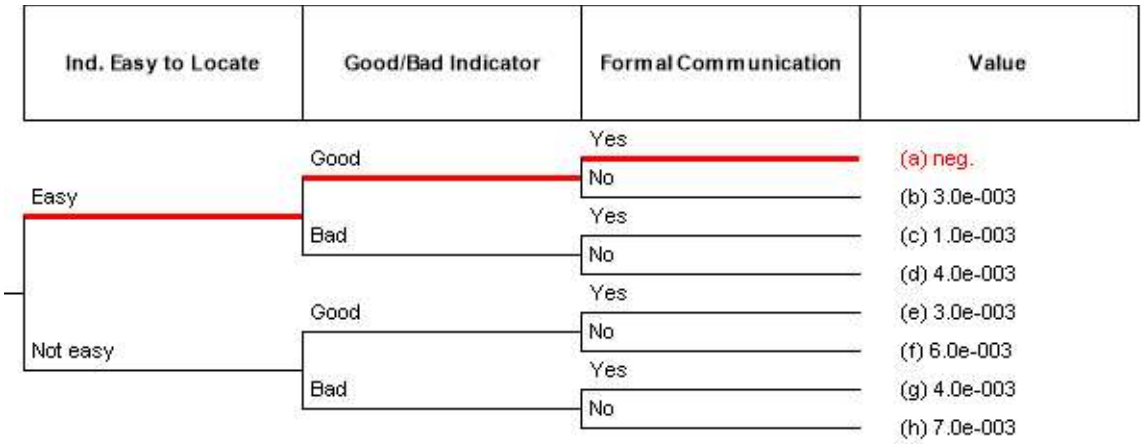
Pcb: Failure of Attention

Notes/Assumptions:



Pcc: Misread/miscommunicate data

Notes/Assumptions:



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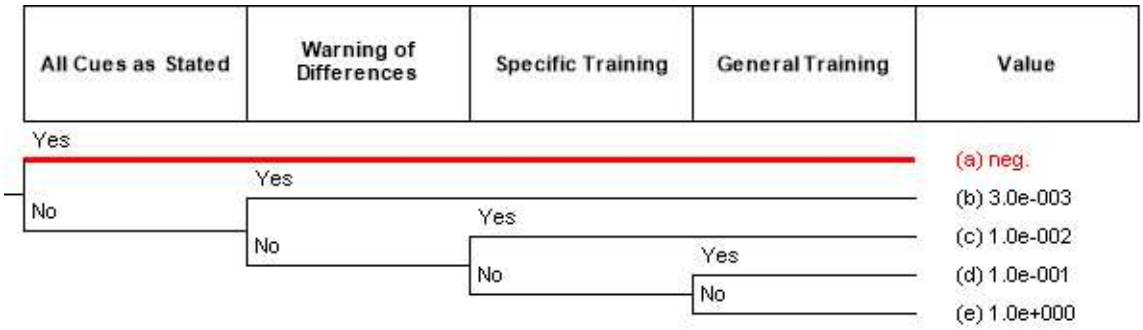
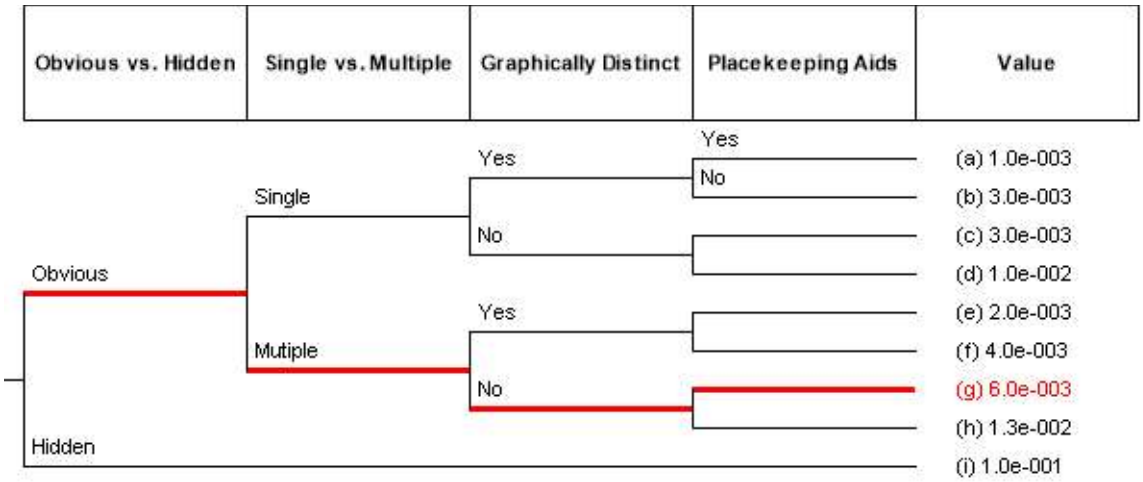
Pcd: Information misleading

Notes/Assumptions:



Pce: Skip a step in procedure

Notes/Assumptions:



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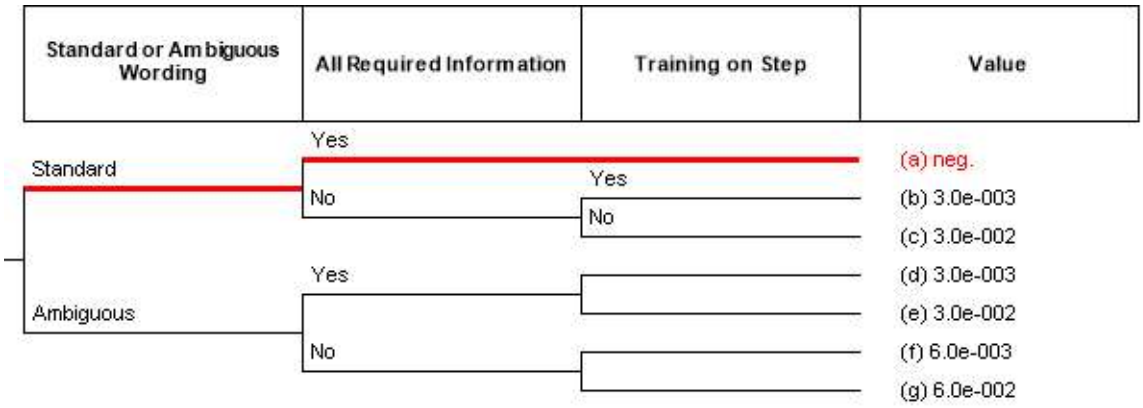
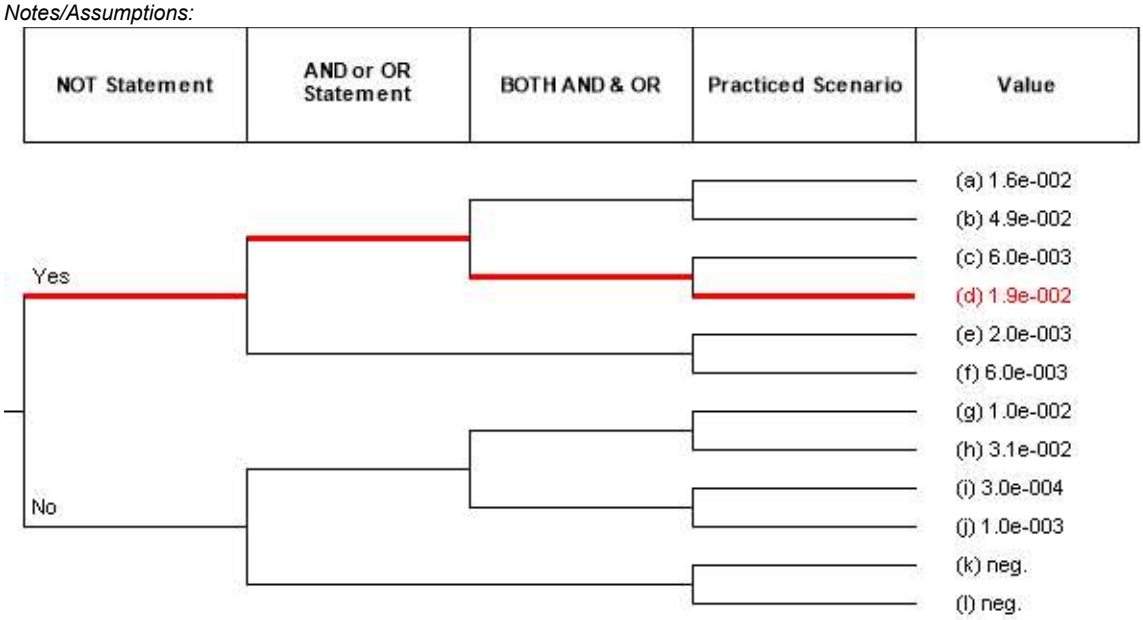
Pcf: Misinterpret Instructions

Notes/Assumptions:



Pcg: Misinterpret decision logic

Notes/Assumptions:



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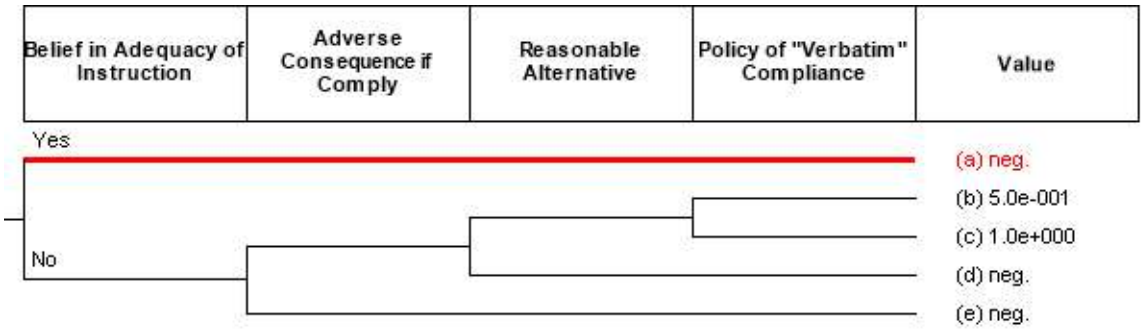
Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery											
	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-			1.00E+00		0.0
Pcb	n/a	-	-	-	-	-			1.00E+00		0.0
Pcc	n/a	-	-	-	-	-			1.00E+00		0.0
Pcd	n/a	-	-	-	-	-			1.00E+00		0.0
Pce	6.00E-03	X	-	-	-	-			1.00E-01		6.00E-04
Pcf	n/a	-	-	-	-	-			1.00E+00		0.0
Pcg	1.90E-02	-	-	-	-	-			1.00E+00		1.90E-02
Pch	n/a	-	-	-	-	-			1.00E+00		0.0
Final Pc (with recovery credited)											1.96E-02
Notes											

Sigma Table				
Plant Type	Response Type	LB	Sigma	UB
BWR	CP1	0.4	0.7	1
	CP2	0.2	0.58	0.96
	CP3	0.59	0.75	0.91
PWR	CP1	0.26	0.57	0.88
	CP2	0.07	0.38	0.69
	CP3		0.77	
Sigma:	7.70E-01			
HEP:	9.34E-06			
Notes/Assumptions	CP3 action. Operators are			

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	required to determine that the TDAFW pump is not recoverable.			

Execution Performance Shaping Factors		
Environment	Lighting	Emergency
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Special Requirements	Tools	Required
Special Requirements	Tools	Adequate
Special Requirements	Tools	Available
Complexity of Response	Execution	Simple
Equipment Accessibility (Cognitive)		
Equipment Accessibility (Execution)	AB-436	Accessible

Stress	
Moderate	
Plant Response As Expected:	Yes
Workload:	Low
Performance Shaping Factors:	Negative
Notes	
Plant response is not as expected in that there is an extended SBO, but FLEX strategies are available and the crews have been trained on these actions. Once ELAP is declared this is the expected response. The crew has a few hours to supply flow to the SG via the pumper truck and there is sufficient crew to monitor plant conditions. Workload is considered low. Work in ELAP conditions may require the use of portable lighting, and there may be poor weather conditions related to the loss of offsite power. "Negative" PSFs are considered to always be applicable.	

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Execution Unrecovered							
Procedure		Comment				Stress Factor	Override
Step No.	Instruction / Comment	Error Type	THERP		HEP		
			Table	Item			
BDMG-5.0 Step 5.4	If Plant Steam Generator pressure instrumentation is NOT available, establish local Main Steam pressure indication as follows: a. Obtain the B.5.b Steam Generator Depressurization Kit stored locally in the IB-436 East and AB-436 West Penetration areas. b. Install pressure gauges to any of the pressure transmitter test connections identified in the column for that Steam Generator:	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
	Comment	No execution error is assumed for obtaining the depressurization kit.					
	Location:	AB-436				Total Step HEP	2.86E-02
BDMG-5.0 Step 5.6b	If normal in-Plant instrumentation is NOT available for monitoring Steam Generator level, ensure monitoring	EOM	20-7b	2	1.3E-3	Moderate	

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	capability as follows: 1) Direct I&C personnel to obtain designated monitoring equipment from the B.5.b Storage areas: a) Attachment XII and designated equipment bag for: RCS Pressure Wide Range SG Wide Range Level ___ A ___B ___ C RCS Temperature b) Scaling attachment(s) for required instrument readings: RCS Pressure Wide Range – Att XIII SG Wide Range Level ___ A ___B ___ C – Att XIV						
	Location:					Total Step HEP	2.60E-03
BDMG-5.0 Att XVI Step1c	Connect field lead (+) to Fluke Loop Calibrator to +24 V Output (+).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	2.86E-02
BDMG-5.0 Att XVI Step 1d	Connect field lead (-) to Fluke Loop	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		

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	Calibrator to +24 V Output (COM).						
	Location:					Total Step HEP	2.86E-02
BDMG-5.0 Att XVI Step 1e	Press and hold the SOURCE SIM MEAS button while turning on the Loop Calibrator	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	10	3.80E-03		
	Location:					Total Step HEP	1.02E-02
BDMG-5.0 Att XIX Step 2	Perform the following: a. Isolate air supply for IPV02000-MS, MAIN STEAM HEADER A POWER RELIEF VALVE, by closing XVA76300-IA, INSTRUMENT AIR ISOLATION VALVE TO IPV02000-MS (AB-436). b. Isolate air supply for IPV02010-MS, MAIN STEAM HEADER B POWER RELIEF VALVE, by closing XVA76301-IA, INSTRUMENT AIR ISOLATION	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-13	1	1.30E-03		

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	VALVE TO IPV02010-MS (IB-436). c. Isolate air supply for IPV02020-MS, MAIN STEAM HEADER C POWER RELIEF VALVE, by closing XVA76302-IA, INSTRUMENT AIR ISOLATION VALVE TO IPV02020-MS (IB-436).						
	Location:					Total Step HEP	5.20E-03
BDMG-5.0 Att XIX Step 3, 4	3. Turn the valve handwheel in the open direction until spring resistance is felt. 4. Continue opening until the valve lifts from the seat.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-13	1	1.30E-03		
	Location:					Total Step HEP	5.20E-03
BMDG-5.0 Att XIX Step 5	Operate the valve with the handwheel as directed.	EOM	20-7b	2	1.3E-3	Moderate	
	Location:					Total Step HEP	2.60E-03
BMDG-5.0 Step 5.7b	Ensure intact Steam Generator pressures are maintained between	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-13	1	1.30E-03		

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	200 psig and 220 psig, as follows: 1) Throttle Steam Generator PORVs and verify the associated Steam Generator pressure remains between 200 psig and 220 psig.						
	Location:					Total Step HEP	5.20E-03
BMDG-5.0 Att I Step a1)	Connect 2 1/2" fire hose for the Main Feedwater B.5.b connections to the following check valves (IB-436): a) XVC11673-FW, MAIN FW TO SG A EMERG MU CHK. b) XVC11674-FW, MAIN FW TO SG B EMERG MU CHK. c) XVC11675-FW, MAIN FW TO SG C EMERG MU CHK.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-12	13	1.30E-02		
	Location:					Total Step HEP	2.86E-02
BMDG-5.0 Att I Step a2)	Route the 2 1/2" fire hose to the flow meters and then to the Pumper Truck (XFX100, FX AMERICAN	EOM			1.3E-3	Moderate	
		EOC	99	1	1.00E-02		

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	EAGLE PUMPER TRUCK, or XFX101, KME PUMPER TRUCK) discharge 5″ hose gated wye. The total length of 2 1/2” hose to the B.5.b connection point should be less than 200 feet.						
	Location:					Total Step HEP	2.26E-02
BMDG-5.0 Att I Step a4)	Connect the suction of a FX Pumper Truck to the closest available hydrant using two 2 ½”hoses and the 2 1/2” Siamese Suction adaptor (on Fire Pumper truck) or take a suction from the lake if required. The 5” discharge hose should be run to within 200’ of the primary penetration connection.	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	99	1	1.00E-02		
	Location:					Total Step HEP	2.26E-02
BMDG-5.0 Att I Step a6)	Charge the fire hose	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-13	1	1.30E-03		
	Location:					Total Step HEP	5.20E-03
BMDG-5.0 Att I Step a7)	Verify the FX Pumper Truck	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-11	2	1.30E-03		

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	discharge pressure is being maintained at approximately 290 psig (XFX100, FX AMERICAN EAGLE PUMPER TRUCK).						
	Location:					Total Step HEP	5.20E-03
BMDG-5.0 Att I Step a8)	Unlock and throttle open the following valves to feed the intact Steam Generators only (IB-436): a) XVG11670-FW, MAIN FW TO SG A EMERG MU ISOL. b) XVG11671-FW, MAIN FW TO SG B EMERG MU ISOL. c) XVG11672-FW, MAIN FW TO SG C EMERG MU ISOL	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-13	1	1.30E-03		
	Comment	FW flow to only 1 SG is assumed, thus only one error of commission is included here.					
	Location:					Total Step HEP	5.20E-03
BMDG-5.0 Step 5.8b	If Steam Generator Wide Range level instrumentation is available maintain Steam Generator Wide Range levels	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-13	1	1.30E-03		

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	between 45% and 55%.						
	Location:					Total Step HEP	5.20E-03
BMDG-5.0 Step 5.8c	Control flow, as follows: 1) If Steam Generator level and feed flow indication are available, throttle flow control valves to establish Steam Generator Wide Range levels between 45% and 55% (IB-423).	EOM	20-7b	2	1.3E-3	Moderate	
		EOC	20-10	1	3.80E-03		
	Location:					Total Step HEP	1.02E-02

Execution Recovered							
Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
BDMG-5.0 Step 5.4		If Plant Steam Generator pressure instrumentation is NOT available, establish local Main Steam pressure indication as follows: a. Obtain the B.5.b Steam Generator Depressurization Kit stored locally in the IB-436 East and AB-436 West Penetration areas. b. Install pressure gauges to any of the	2.86E-02				7.44E-05

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		pressure transmitter test connections identified in the column for that Steam Generator:					
	BMDG-5.0 Att XIX Step 5	Operate the valve with the handwheel as directed.		2.60E-03	ZD	2.60E-03	
BDMG-5.0 Step 5.6b		If normal in-Plant instrumentation is NOT available for monitoring Steam Generator level, ensure monitoring capability as follows: 1) Direct I&C personnel to obtain designated monitoring equipment from the B.5.b Storage areas: a) Attachment XII and designated equipment bag for: RCS Pressure Wide Range SG Wide Range Level ___ A ___B ___ C RCS Temperature b) Scaling attachment(s) for required instrument readings: RCS Pressure Wide Range – Att XIII SG Wide Range Level ___ A ___B ___ C – Att XIV	2.60E-03				2.65E-05

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	BMDG-5.0 Step 5.8c	Control flow, as follows: 1) If Steam Generator level and feed flow indication are available, throttle flow control valves to establish Steam Generator Wide Range levels between 45% and 55% (IB-423).		1.02E-02	ZD	1.02E-02	
BDMG-5.0 Att XVI Step1c		Connect field lead (+) to Fluke Loop Calibrator to +24 V Output (+).	2.86E-02				2.92E-04
	BMDG-5.0 Step 5.8c	Control flow, as follows: 1) If Steam Generator level and feed flow indication are available, throttle flow control valves to establish Steam Generator Wide Range levels between 45% and 55% (IB-423).		1.02E-02	ZD	1.02E-02	
BDMG-5.0 Att XVI Step 1d		Connect field lead (-) to Fluke Loop Calibrator to +24 V Output (COM).	2.86E-02				2.92E-04
	BMDG-5.0 Step 5.8c	Control flow, as follows: 1) If Steam Generator level and feed flow		1.02E-02	ZD	1.02E-02	

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		indication are available, throttle flow control valves to establish Steam Generator Wide Range levels between 45% and 55% (IB-423).					
BDMG-5.0 Att XVI Step 1e		Press and hold the SOURCE SIM MEAS button while turning on the Loop Calibrator	1.02E-02				1.04E-04
	BMDG-5.0 Step 5.8c	Control flow, as follows: 1) If Steam Generator level and feed flow indication are available, throttle flow control valves to establish Steam Generator Wide Range levels between 45% and 55% (IB-423).		1.02E-02	ZD	1.02E-02	
BDMG-5.0 Att XIX Step 2		Perform the following: a. Isolate air supply for IPV02000-MS, MAIN STEAM HEADER A POWER RELIEF VALVE, by closing XVA76300-IA, INSTRUMENT AIR ISOLATION VALVE TO IPV02000-MS (AB-436).	5.20E-03				5.20E-03

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		b. Isolate air supply for IPV02010-MS, MAIN STEAM HEADER B POWER RELIEF VALVE, by closing XVA76301-IA, INSTRUMENT AIR ISOLATION VALVE TO IPV02010-MS (IB-436). c. Isolate air supply for IPV02020-MS, MAIN STEAM HEADER C POWER RELIEF VALVE, by closing XVA76302-IA, INSTRUMENT AIR ISOLATION VALVE TO IPV02020-MS (IB-436).					
BDMG-5.0 Att XIX Step 3, 4		3. Turn the valve handwheel in the open direction until spring resistance is felt. 4. Continue opening until the valve lifts from the seat.	5.20E-03				1.35E-05
	BMDG-5.0 Att XIX Step 5	Operate the valve with the handwheel as directed.		2.60E-03	ZD	2.60E-03	
BMDG-5.0 Step 5.7b		Ensure intact Steam Generator pressures are maintained between 200 psig and 220 psig, as follows:	5.20E-03				5.30E-05

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		1) Throttle Steam Generator PORVs and verify the associated Steam Generator pressure remains between 200 psig and 220 psig.					
	BMDG-5.0 Step 5.8c	Control flow, as follows: 1) If Steam Generator level and feed flow indication are available, throttle flow control valves to establish Steam Generator Wide Range levels between 45% and 55% (IB-423).		1.02E-02	ZD	1.02E-02	
BMDG-5.0 Att I Step a1)		Connect 2 1/2" fire hose for the Main Feedwater B.5.b connections to the following check valves (IB-436): a) XVC11673-FW, MAIN FW TO SG A EMERG MU CHK. b) XVC11674-FW, MAIN FW TO SG B EMERG MU CHK. c) XVC11675-FW, MAIN FW TO SG C EMERG MU CHK.	2.86E-02				1.49E-04
	BMDG-5.0 Att I Step a7)	Verify the FX Pumper Truck discharge		5.20E-03	ZD	5.20E-03	

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		pressure is being maintained at approximately 290 psig (XFX100, FX AMERICAN EAGLE PUMPER TRUCK).					
BMDG-5.0 Att I Step a2)		Route the 2 1/2" fire hose to the flow meters and then to the Pumper Truck (XFX100, FX AMERICAN EAGLE PUMPER TRUCK, or XFX101, KME PUMPER TRUCK) discharge 5″ hose gated wye. The total length of 2 1/2” hose to the B.5.b connection point should be less than 200 feet.	2.26E-02				1.18E-04
	BMDG-5.0 Att I Step a7)	Verify the FX Pumper Truck discharge pressure is being maintained at approximately 290 psig (XFX100, FX AMERICAN EAGLE PUMPER TRUCK).		5.20E-03	ZD	5.20E-03	
BMDG-5.0 Att I Step a4)		Connect the suction of a FX Pumper Truck to the closest available hydrant using two 2 ½”hoses and the 2 1/2”	2.26E-02				1.18E-04

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		Siamese Suction adaptor (on Fire Pumper truck) or take a suction from the lake if required. The 5” discharge hose should be run to within 200’ of the primary penetration connection.					
	BMDG-5.0 Att I Step a7)	Verify the FX Pumper Truck discharge pressure is being maintained at approximately 290 psig (XFX100, FX AMERICAN EAGLE PUMPER TRUCK).		5.20E-03	ZD	5.20E-03	
BMDG-5.0 Att I Step a6)		Charge the fire hose	5.20E-03				2.70E-05
	BMDG-5.0 Att I Step a7)	Verify the FX Pumper Truck discharge pressure is being maintained at approximately 290 psig (XFX100, FX AMERICAN EAGLE PUMPER TRUCK).		5.20E-03	ZD	5.20E-03	
BMDG-5.0 Att I Step a8)		Unlock and throttle open the following valves to feed the intact Steam Generators only (IB-436):	5.20E-03				5.30E-05

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		a) XVG11670-FW, MAIN FW TO SG A EMERG MU ISOL. b) XVG11671-FW, MAIN FW TO SG B EMERG MU ISOL. c) XVG11672-FW, MAIN FW TO SG C EMERG MU ISOL					
	BMDG-5.0 Step 5.8c	Control flow, as follows: 1) If Steam Generator level and feed flow indication are available, throttle flow control valves to establish Steam Generator Wide Range levels between 45% and 55% (IB-423).		1.02E-02	ZD	1.02E-02	
BMDG-5.0 Step 5.8b		If Steam Generator Wide Range level instrumentation is available maintain Steam Generator Wide Range levels between 45% and 55%.	5.20E-03				5.30E-05
	BMDG-5.0 Step 5.8c	Control flow, as follows: 1) If Steam Generator level and feed flow indication are available, throttle flow control valves to establish		1.02E-02	ZD	1.02E-02	

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		Steam Generator Wide Range levels between 45% and 55% (IB-423).					
		Total Unrecovered:	2.04E-01			**Total Recovered:**	6.57E-03

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HEP-C-STARTMDAFWCTG, Operators fail to start the MDAFW pump with power from the CTGs

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	**M. Blue/JH**			**9/15/2023**
Reviewer				**9/15/2023**

HEP Summary					
	P_1	P_2	P_{cog}	P_{exe}	Total HEP
Method	CBDTM	HCR/ORE	Maximum	THERP	
HEP	6.00E-04	0.00E+00	6.00E-04	3.27E-05	6.33E-04
Distribution Type	Lognormal		**EF**	1.00E+01	

RAW	FV	Risk Significant
		N/A

Identification and Definition
A loss of offsite power occurs at time t=0. Reactor and turbine trip are successful. One diesel generator runs for 6 hours powering the motor driven AFW pump. After 6 hours, the diesel stops running and there is a station blackout. Operators enter EOP-6. Step 13 instructs the operators to stage the CTGs. Step 14 calls for declaration of Extended Loss of AC Power (ELAP) if power is not expected to be restored within 2 hours. ELAP is conservatively assumed to be declared 2 hours later. AT this pioint the CTGs are staged. After ELAP declaration,the operators enter procedure FSP-5.0 The Turbine driven feedwater pump fails due to random failure. As the operators proceed through FSP-5.0 Step 21 instructs starting of the MDAFW pump with the CTGs.

Cues and Indications	
Initial Cue	FSP-5.0 Step 21 Verify total EFW flow to SGs greater than 450 gpm
Recovery Cue	
Cue Comments	
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	FSP-5.0 (INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING) Revision: 3
Cognitive Step Number	21c
Cognitive Instruction	Establish EFW Flow per ATTACHMENT 8, HEAT SINK RESTORATION USING EMERGENCY FEEDWATER PUMPS.

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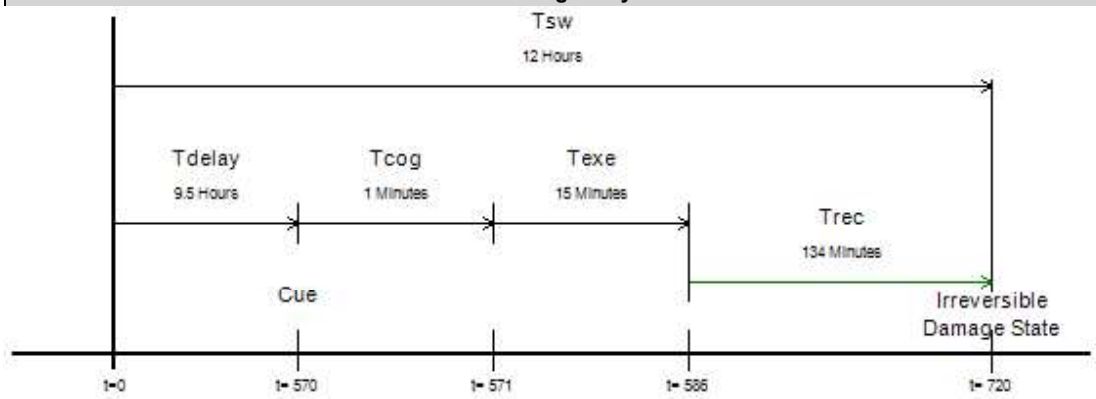
Execution Procedure	FSP-5.0 (INITIAL ASSESSMENT AND FLEX EQUIPMENT STAGING) Revision: 3
Execution Instruction	Attachment 8
Job Performance Measure	JPM: Not Selected
Notes	

Operator Interview Insights
Matthew Torres estimates less than 10 minutes for resetting relays and 2-3 minutes for operator MCR actions.

Timing Analysis



T_{sw}	12 Hours
T_{delay}	9.5 Hours
T_{cog}	1 Minutes
T_{exe}	15 Minutes
Time available for cognition and recovery	135 Minutes
Time available for recovery	134 Minutes
SPAR-H Available time (cognitive)	135 Minutes
SPAR-H Available time (execution) ratio	9.93 Minutes
EPRI Minimum level of dependence for recovery	ZD

Notes

Tsw: EFW operation must occur within 6 hours of the station blackout (MAAP Cases LOOP-EFW-Case1-A and LOOP-EFW-Case2-A). SBO occurs 6 hours after LOSP.

Tdelay: 6 hours of DG power. 2 hours to declare ELAP. 1.5 hours to proceed through FSP 5 including 1.25 hours for aligning CTGs (see HEP-C-FX-CTG2).

Tcog: 1 minute to verify flow and ensure both CTGs are running.

Texe: 15 minutes. 10 minutes for relay reset. 3 minutes for in MCR actions. 2 minutes for checking power on CTGs.

Cognitive Analysis

Pc Failure Mechanism	**Branch**	**HEP**
Pca: Availability of Information	a	n/a
Pcb: Failure of Attention	i	n/a
Pcc: Misread/miscommunicate data	a	n/a
Pcd: Information misleading	a	n/a
Pce: Skip a step in procedure	g	6.00E-03
Pcf: Misinterpret Instructions	a	n/a

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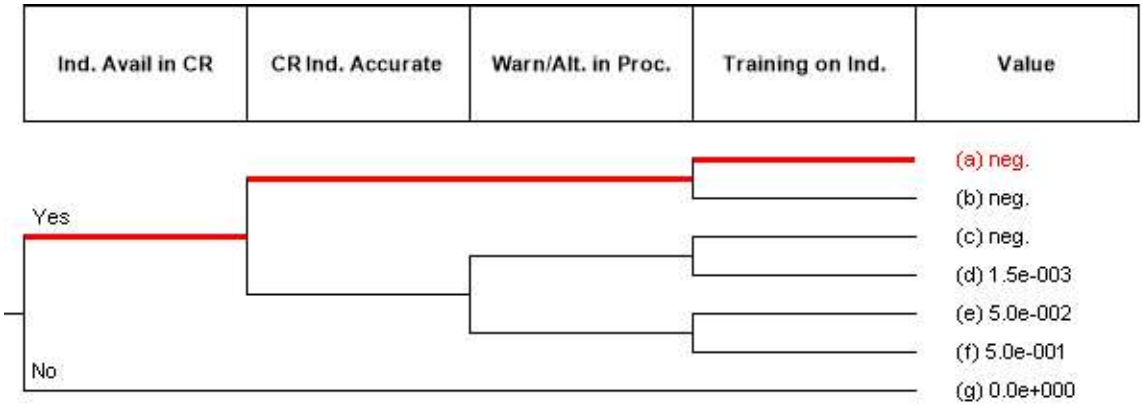
Pcg: Misinterpret decision logic	l	n/a
Pch: Deliberate violation	a	n/a
Initial Pc(without recovery credited)		6.00E-03
Notes		

Pca: Availability of Information

Notes/Assumptions:



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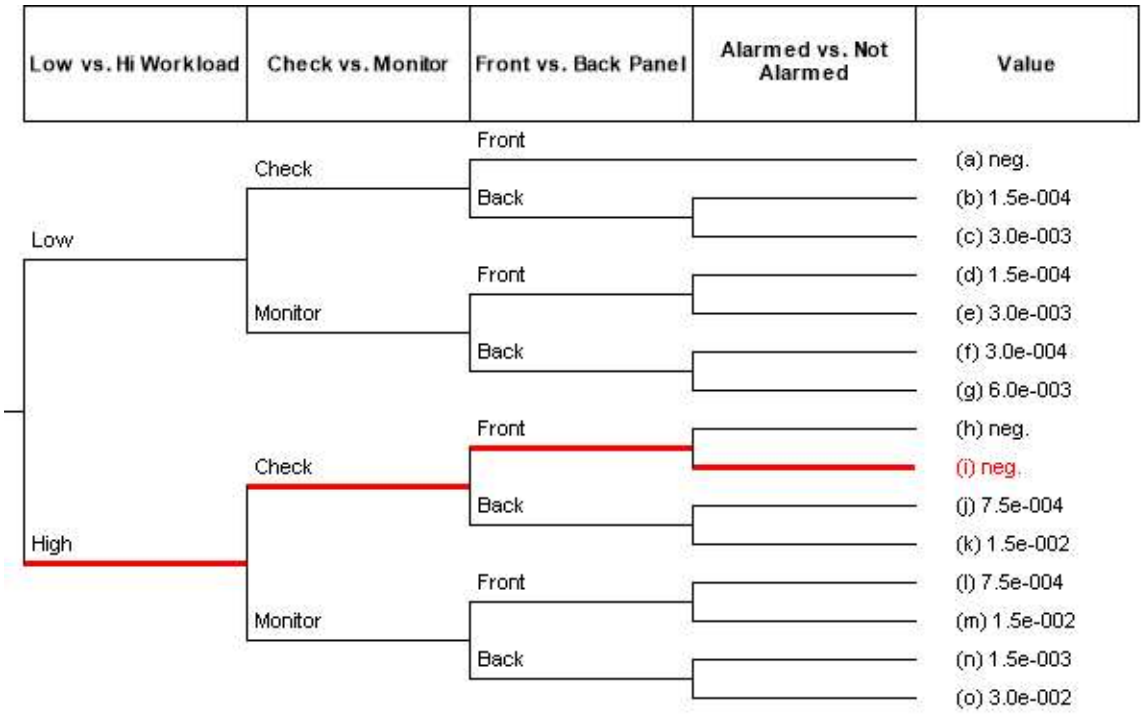
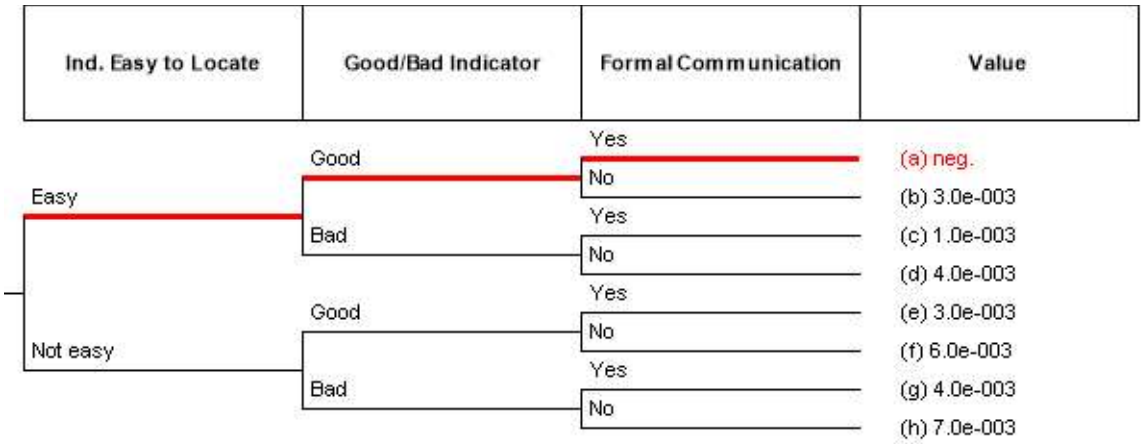
Pcb: Failure of Attention

Notes/Assumptions:



Pcc: Misread/miscommunicate data

Notes/Assumptions:



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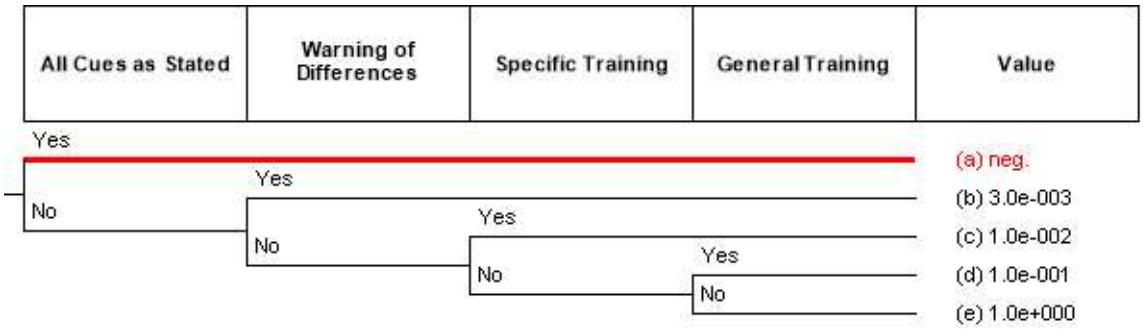
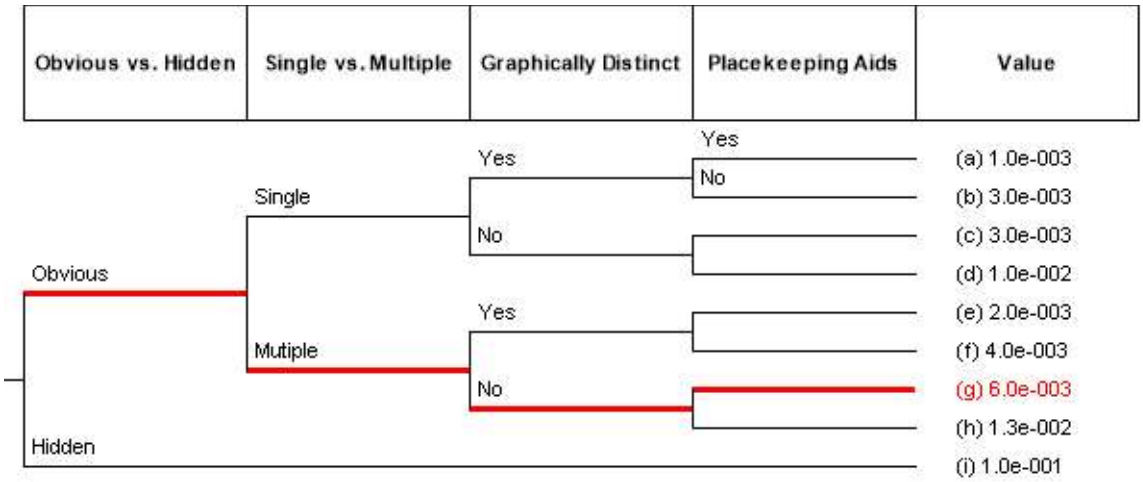
Pcd: Information misleading

Notes/Assumptions:



Pce: Skip a step in procedure

Notes/Assumptions:



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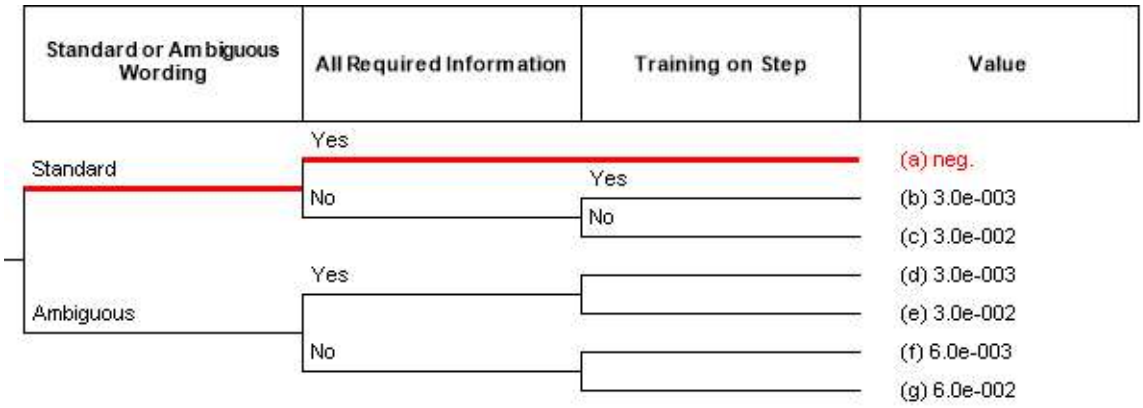
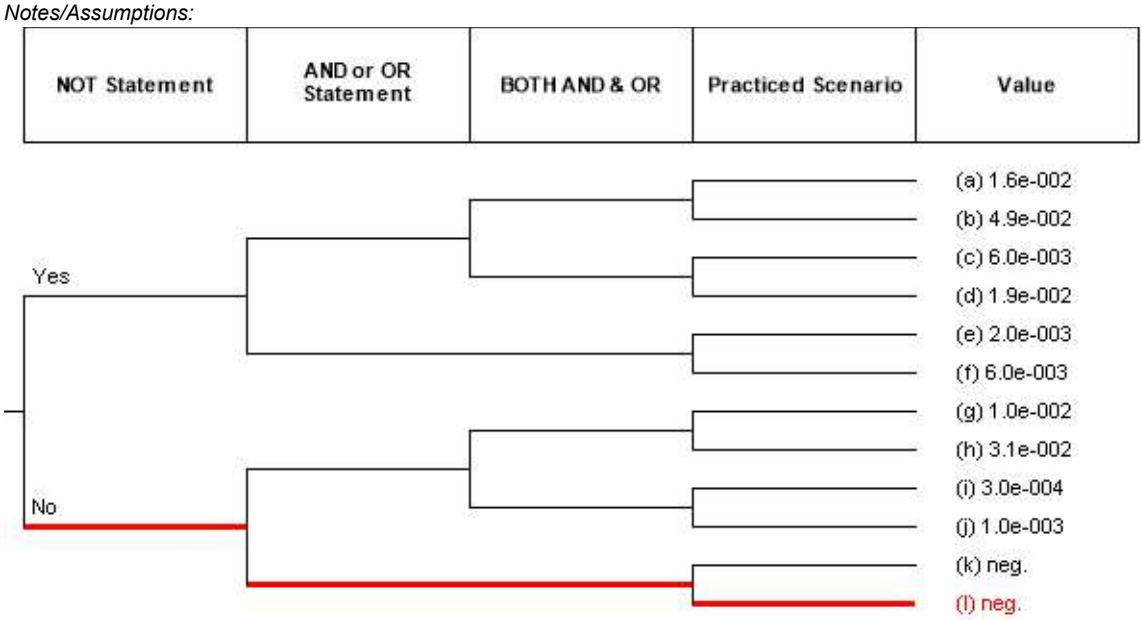
Pcf: Misinterpret Instructions

Notes/Assumptions:



Pcg: Misinterpret decision logic

Notes/Assumptions:



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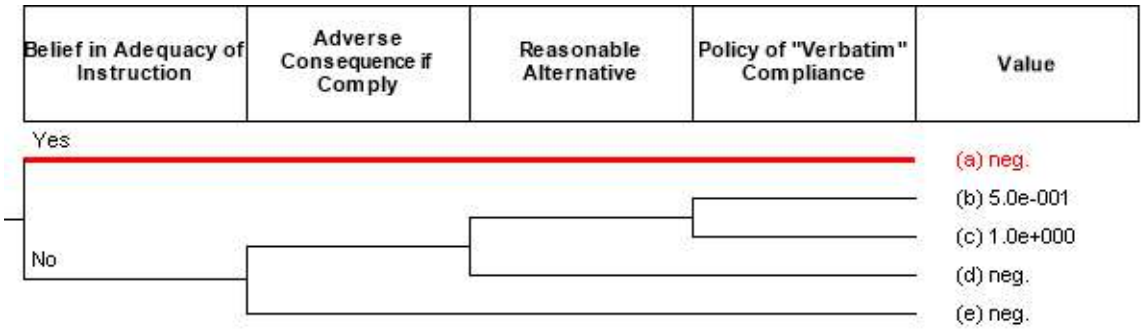
Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery											
	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-			1.00E+00		0.0
Pcb	n/a	-	-	-	-	-			1.00E+00		0.0
Pcc	n/a	-	-	-	-	-			1.00E+00		0.0
Pcd	n/a	-	-	-	-	-			1.00E+00		0.0
Pce	6.00E-03	X	-	-	-	-			1.00E-01		6.00E-04
Pcf	n/a	-	-	-	-	-			1.00E+00		0.0
Pcg	n/a	-	-	-	-	-			1.00E+00		0.0
Pch	n/a	-	-	-	-	-			1.00E+00		0.0
Final Pc (with recovery credited)											6.00E-04
Notes											

Sigma Table				
Plant Type	Response Type	LB	Sigma	UB
BWR	CP1	0.4	0.7	1
	CP2	0.2	0.58	0.96
	CP3	0.59	0.75	0.91
PWR	CP1	0.26	0.57	0.88
	CP2	0.07	0.38	0.69
	CP3		0.77	
Sigma:	5.70E-01			
HEP:	0.00E+00			
Notes/Assumptions				

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Execution Performance Shaping Factors		
Environment	Lighting	Emergency
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Complexity of Response	Execution	Simple
Equipment Accessibility (Cognitive)		
Equipment Accessibility (Execution)		

Stress	
Moderate	
Plant Response As Expected:	Yes
Workload:	Low
Performance Shaping Factors:	Negative
Notes	
Plant response is not as expected in that there is an extended SBO, but FLEX strategies are available and the crews have been trained on these actions. Once ELAP is declared this is the expected response. The crew has several hours to restore EFW flow, and there is sufficient crew to monitor plant conditions. The CTGs are running. Workload is considered low. - Work in ELAP conditions may require the use of portable lighting, and there may be poor weather conditions related to the loss of offsite power. "Negative" PSFs are considered to always be applicable	

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Execution Unrecovered							
Procedure		Comment					
Step No.	Instruction / Comment	Error Type	THERP		HEP	Stress Factor	Override
			Table	Item			
FSP 5.0 Att 8 Step 1	Place all EFW valves in MAN: ● FCV-3531(3541)(3551), MD EFP TO SG A(B)(C). ● FCV-3536(3546)(3556), TD EFP TO SG A(B)(C).	EOM	20-7b	1	4.3E-4	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:					Total Step HEP	1.94E-03
FSP 5.0 Att 8 Step 2	Hold the following switches to RESET for at least one second and release: Hold the following switches to RESET for at least one second and release: ● TD EFP RESET ● MD EFP RESET	EOM	20-7b	1	4.3E-4	Moderate	
		EOC	20-12	10	3.80E-03		
		EOC	20-12	10	3.80E-03		
	Location:					Total Step HEP	1.61E-02
FSP 5.0 Att 8 Step 3	Close all of the following valves using the hand controllers: ● FCV-3531(3541)(3551), MD EFP TO SG A(B)(C).	EOM	20-7b	1	4.3E-4	Moderate	
		EOC	20-12	5	1.30E-03		
		EOC	20-12	5	1.30E-03		

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	● FCV-3536(3546)(3556), TD EFP TO SG A(B)(C).						
	Location:					Total Step HEP	6.06E-03
FSP 5.0 Att 8 Step 4	Locally ensure the combined load of both Combustion Turbine Generators is LESS THAN 430KW as indicated on the Woodward EasyGen 3000 Display panels (front of each Generator).	EOM	20-7b	1	4.3E-4	Moderate	
		EOC	20-10	2	1.30E-03		
		EOC	20-10	2	1.30E-03		
	Location:					Total Step HEP	6.06E-03
FSP 5.0 Att 8 Step 5	IF required, THEN locally reset the following relays on XSW1DA 13, EMERG FD WTR PP XPP0021A-EF (IB-463): ● 50G ● 50/51/74 - 01 ● 50/51/74 - 02 ● 50/51/74 - 03	EOM	20-7b	1	4.3E-4	Moderate	
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
		EOC	20-12	8a	2.70E-04		
	Location:					Total Step HEP	3.02E-03
FSP 5.0 Att 8 Step 6	Start one MD EFW Pump.	EOM	20-7b	1	4.3E-4	Moderate	
		EOC	20-12	8a	2.70E-04		

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	Location:					Total Step HEP	1.40E-03
FSP 5.0 Att 8 Step 8	Throttle EFW Flow Control Valves to establish GREATER THAN 450 gpm total EFW flow to INTACT SGs.	EOM	20-7b	1	4.3E-4	Moderate	
		EOC	20-12	5	1.30E-03		
	Location:					Total Step HEP	3.46E-03
FSP 5.0 Att 8 Step 9	WHEN EFW Flow is established, THEN verify the Battery Chargers and Inverters remained energized.	EOM	20-7b	1	4.3E-4	Moderate	
	Location:					Total Step HEP	8.60E-04

Execution Recovered							
Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
FSP 5.0 Att 8 Step 1		Place all EFW valves in MAN: ● FCV-3531(3541)(3551), MD EFP TO SG A(B)(C). ● FCV-3536(3546)(3556), TD EFP TO SG A(B)(C).	1.94E-03				1.67E-06
	FSP 5.0 Att 8 Step 9	WHEN EFW Flow is established, THEN verify the Battery Chargers and		8.60E-04	ZD	8.60E-04	

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		Inverters remained energized.					
FSP 5.0 Att 8 Step 2		Hold the following switches to RESET for at least one second and release: Hold the following switches to RESET for at least one second and release: ● TD EFP RESET ● MD EFP RESET	1.61E-02				1.38E-05
	FSP 5.0 Att 8 Step 9	WHEN EFW Flow is established, THEN verify the Battery Chargers and Inverters remained energized.		8.60E-04	ZD	8.60E-04	
FSP 5.0 Att 8 Step 3		Close all of the following valves using the hand controllers: ● FCV-3531(3541)(3551), MD EFP TO SG A(B)(C). ● FCV-3536(3546)(3556), TD EFP TO SG A(B)(C).	6.06E-03				5.21E-06
	FSP 5.0 Att 8 Step 9	WHEN EFW Flow is established, THEN verify the Battery Chargers and		8.60E-04	ZD	8.60E-04	

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		Inverters remained energized.					
FSP 5.0 Att 8 Step 4		Locally ensure the combined load of both Combustion Turbine Generators is LESS THAN 430KW as indicated on the Woodward EasyGen 3000 Display panels (front of each Generator).	6.06E-03				5.21E-06
	FSP 5.0 Att 8 Step 9	WHEN EFW Flow is established, THEN verify the Battery Chargers and Inverters remained energized.		8.60E-04	ZD	8.60E-04	
FSP 5.0 Att 8 Step 5		IF required, THEN locally reset the following relays on XSW1DA 13, EMERG FD WTR PP XPP0021A-EF (IB-463): ● 50G ● 50/51/74 - 01 ● 50/51/74 - 02 ● 50/51/74 - 03	3.02E-03				2.60E-06
	FSP 5.0 Att 8 Step 9	WHEN EFW Flow is established, THEN verify the Battery Chargers and		8.60E-04	ZD	8.60E-04	

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		Inverters remained energized.					
FSP 5.0 Att 8 Step 6		Start one MD EFW Pump.	1.40E-03				1.20E-06
	FSP 5.0 Att 8 Step 9	WHEN EFW Flow is established, THEN verify the Battery Chargers and Inverters remained energized.		8.60E-04	ZD	8.60E-04	
FSP 5.0 Att 8 Step 8		Throttle EFW Flow Control Valves to establish GREATER THAN 450 gpm total EFW flow to INTACT SGs.	3.46E-03				2.98E-06
	FSP 5.0 Att 8 Step 9	WHEN EFW Flow is established, THEN verify the Battery Chargers and Inverters remained energized.		8.60E-04	ZD	8.60E-04	
		Total Unrecovered:	3.80E-02			**Total Recovered:**	3.27E-05

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OAR4-F, OPERATOR FAILS TO ALIGN HP CL RECIRC (Non-ISLOCA)) DURING A FIRE EVENT

Plant	Data File	File Size	File Date	Record Date
xxxxx	VCSNS_HRA_EDGSDP_v52_10132023.hra	9056256	10/16/2023	10/16/2023
	Name			**Date**
Analyst	**M Blue/Jensen Hughes**			**9/1/2023**
Reviewer	**D. MacLeod**			**9/1/2023**

HEP Summary					
	P_1	P_2	P_{cog}	P_{exe}	Total HEP
Method	CBDTM	HCR/ORE	Maximum	THERP	
HEP	1.52E-03	0.00E+00	1.52E-03	1.74E-02	1.89E-02
Distribution Type	Beta		**Variance**	3.04E-04	

RAW	FV	Risk Significant
0.00E+00	0.00E+00	NO

Identification and Definition
Following Safety Injection, the RWST level will drop to a low level as its contents are injected into the containment sump via the RCS. When the low low level (18%) is reached in the RWST, the pumps taking suction on the RWST automatically re-align to the containment sump. For this operator action, both low and high pressure pumps are shifted into recirculation.

Cues and Indications	
Initial Cue	COLD LEG RECIRCULATION TRANSITION CRITERION IF RWST level decreases to LESS THAN 18%, THEN GO TO EOP-2.2, TRANSFER TO COLD LEG RECIRCULATION, Step 1.
Recovery Cue	
Cue Comments	
Degree of Clarity	Clarity of Cues and Indications are modeled explicitly in CBDTM

Procedures	
Cognitive Procedure	EOP-2.0 (E-1 LOSS OF REACTOR OR SECONDARY COOLANT) Revision: 18
Cognitive Step Number	Reference Page, 4
Cognitive Instruction	If RWST level is less than 18% go to EOP 2.2.
Execution Procedure	EOP-2.2 (ES-1.3 TRANSFER TO COLD LEG RECIRCULATION) Revision: 19
Execution Instruction	
Job Performance Measure	JPM: Not Selected
Notes	
EOP 2.2, Transfer to cold leg recirculation	

Training	
Simulator Training	

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Crew Member	Included	Total Available	Required for Execution	Notes
I&C Maintenance	No	0	0	
CRS (SRO)	No	0	1	---
Shift Supervisor (SRO)	No	0	1	---
Shift Engineer	No	0	1	---
NROATC (RO)	No	0	1	---
BOP Operator (RO)	No	0	1	---
CB Operator	No	0	0	---
AB Upper AO	No	0	1	---
IB AO	No	0	0	---
TB AO	No	0	1	---
AB Lower AO	No	0	0	---
Shift Manager	No	1	0	
Shift Supervisor	No	1	0	
Shift Engineer (STA)	No	1	0	
Reactor Operators	Yes	1	1	
Auxiliary Operators	Yes	1	1	
Health Physics	Yes	1	0	
Chemistry	Yes	1	0	
Mechanics	Yes	1	0	
Electricians	Yes	1	0	
Notes				

Analyst Notes
OAR5

Operator Interview Insights

Example cutset for future operator interviews:
%FLD1 FLOODING INITIATING EVENT (LOSS OF CCW TRAIN A) 9.90E-04 1.04E-10
EFT-CC-SACV-FO4 SPRING ASSISTED CHECK VALVES XVC-1009A, -1009B, -1009C CCF TO OPEN 2.14E-05
NOSBO-FLAG NO STATION BLACKOUT SEQUENCE MARKER 1.00E+00
OAR4 OPERATOR FAILS TO ALIGN HP CL RECIRC (Non- ISLOCA)) 4.90E-03

Timing Analysis

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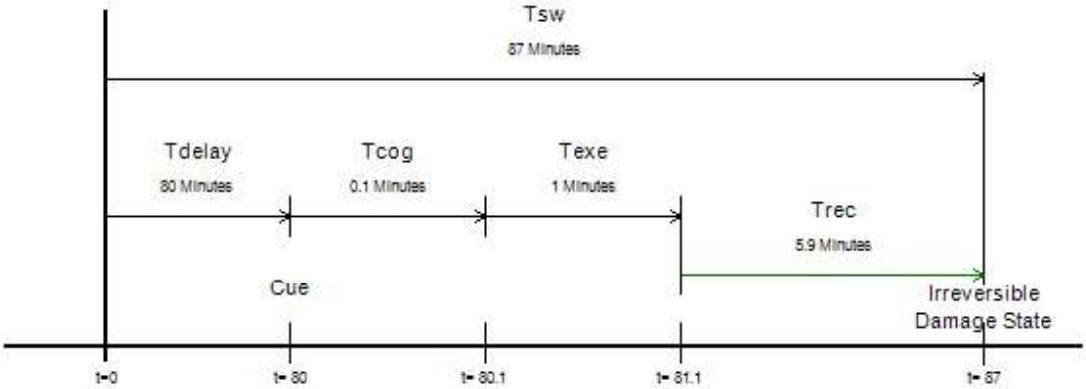

T_{sw}	87 Minutes
T_{delay}	80 Minutes
T_{cog}	0.1 Minutes
T_{exe}	1 Minutes
Time available for cognition and recovery	6 Minutes
Time available for recovery	5.9 Minutes
SPAR-H Available time (cognitive)	6 Minutes
SPAR-H Available time (execution) ratio	6.90 Minutes
EPRI Minimum level of dependence for recovery	HD

Notes

Tsw: 81 min + 6 min = 87 mins
This HEP supports both SLOCA and MLOCA, and therefore two cases were run with MLOCA case being the more bounding. MAAP case SLOCA-HPR which is a 2" break LOCA, shows that reactor trips and charging pumps start at 60 sec, containment sprays are activated 18 min after reactor trip, transfer to EOP-2.2, ES-1.3, TRANSFER TO COLD LEG RECIRCULATION (when RWST level drops to below 18%) takes place 81 min after reactor trip, and RWST level drops to 10% (all pumps taking suction from RWST need to be secured to prevent cavitation per Step 2 of ES 1.3) takes place just 6 min later. MAAP case MLOCA-HPR is a 6" break LOCA, shows that reactor trips and charging pumps start at 6 sec, containment sprays are activated 74 sec after reactor trip, transfer to EOP-2.2, ES-1.3, TRANSFER TO COLD LEG RECIRCULATION (when RWST level drops to below 18%) takes place 68 min after reactor trip, and RWST level drops to 10% (all pumps taking suction from RWST need to be secured to prevent cavitation per Step 2 of ES 1.3) takes place just 6 min later.

Texe: 1min. Past interviews with operations indicate that 5 minutes or less is needed for simple manipulations inside the control room.

Tcog: 0.1 min: Because of the long delay before the low RWST level, operators will be monitoring this long before the swap is required and cognitive time is assumed to be 0.1 minute. This is based on small LOCA since medium LOCA is able to use automatic low pressure recirculation. Meredith Blue (JH) note: There is no additional time added to tcog for fire due to the 80 minute delay. At this time the fire is likely put out and the fire procedure exited.

Cognitive Analysis		
Pc Failure Mechanism	**Branch**	**HEP**
Pca: Availability of Information	a	n/a
Pcb: Failure of Attention	d	1.50E-04
Pcc: Misread/miscommunicate data	a	n/a
Pcd: Information misleading	a	n/a
Pce: Skip a step in procedure	c	3.00E-03
Pcf: Misinterpret Instructions	a	n/a
Pcg: Misinterpret decision logic	k	n/a

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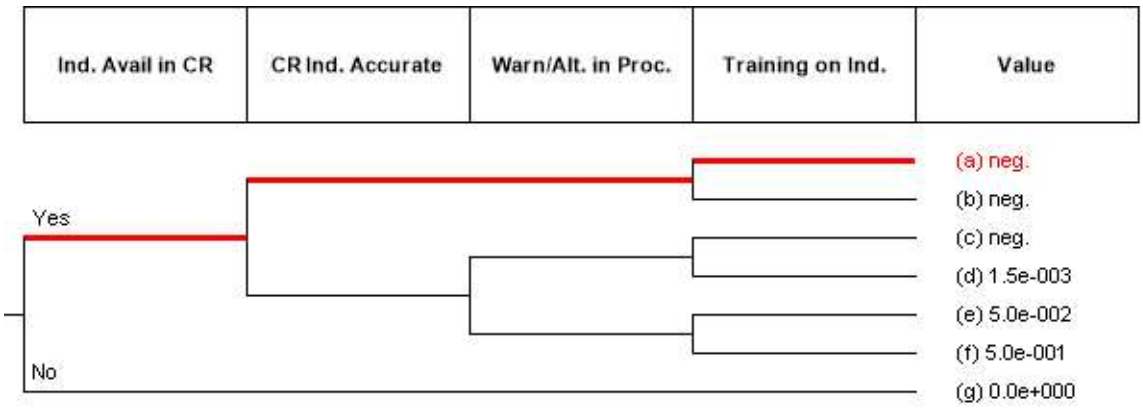
Pch: Deliberate violation	a	n/a
Initial Pc(without recovery credited)		3.15E-03
Notes		
Assumes place keeping aids are used by all crews for Pce		

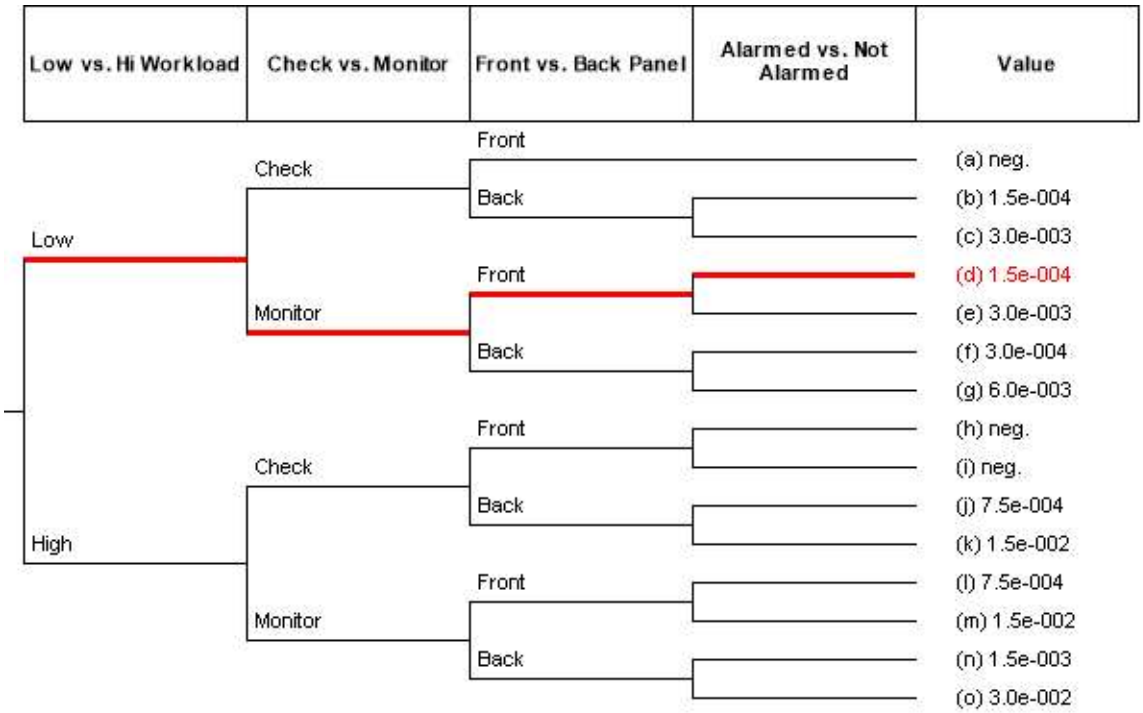
Pca: Availability of Information

Notes/Assumptions:



Pcb: Failure of Attention

Notes/Assumptions:



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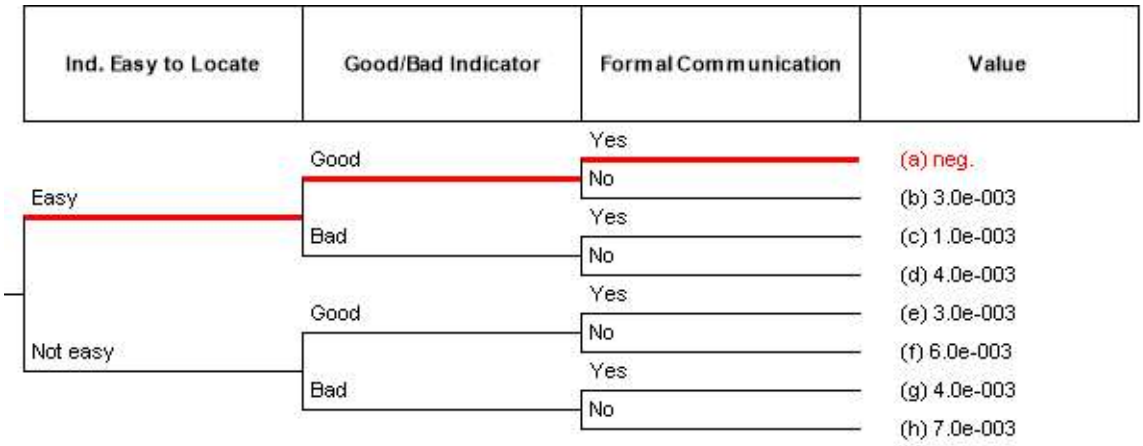
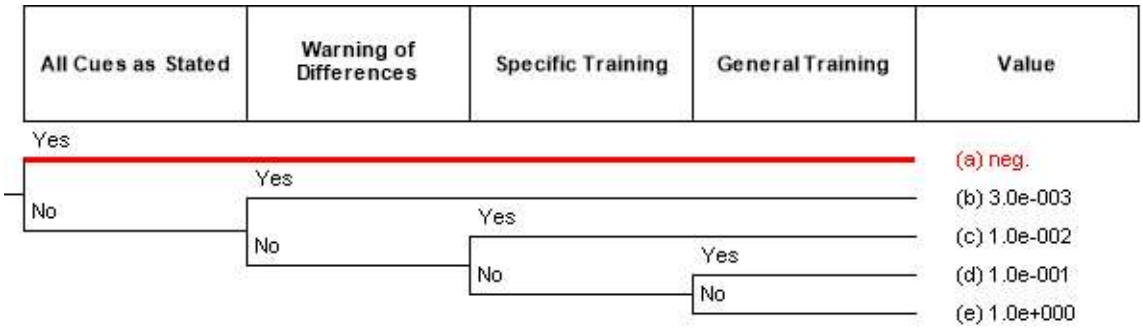
Pcc: Misread/miscommunicate data

Notes/Assumptions:



Pcd: Information misleading

Notes/Assumptions:



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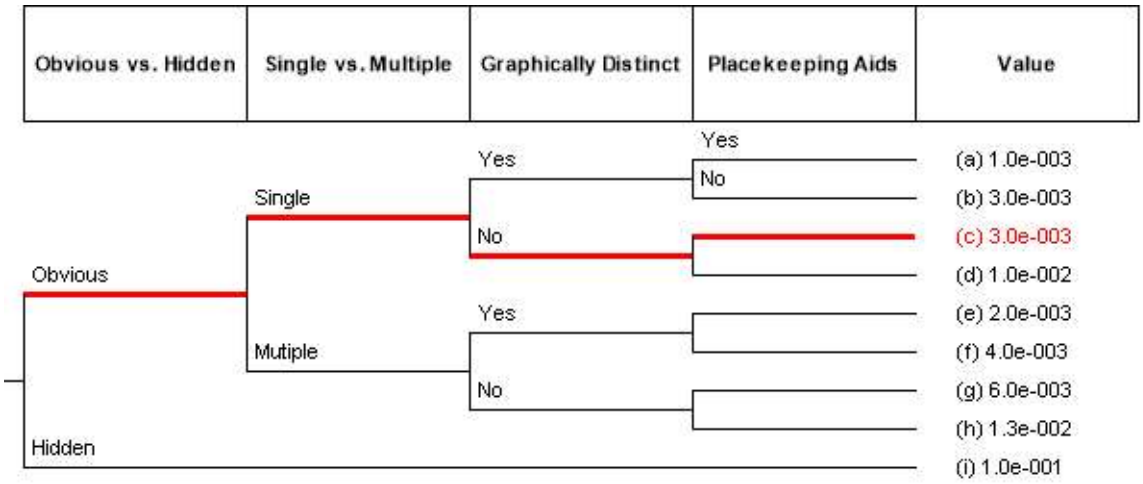
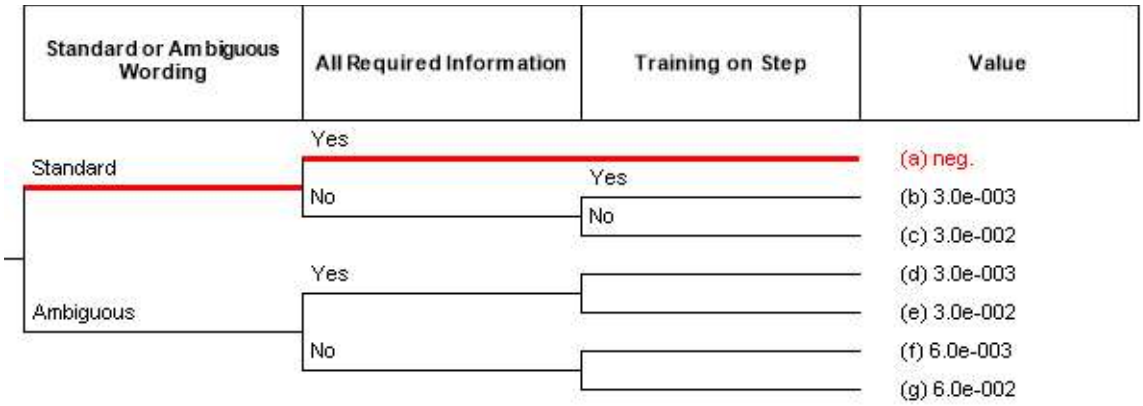
Pce: Skip a step in procedure

Notes/Assumptions:



Pcf: Misinterpret Instructions

Notes/Assumptions:



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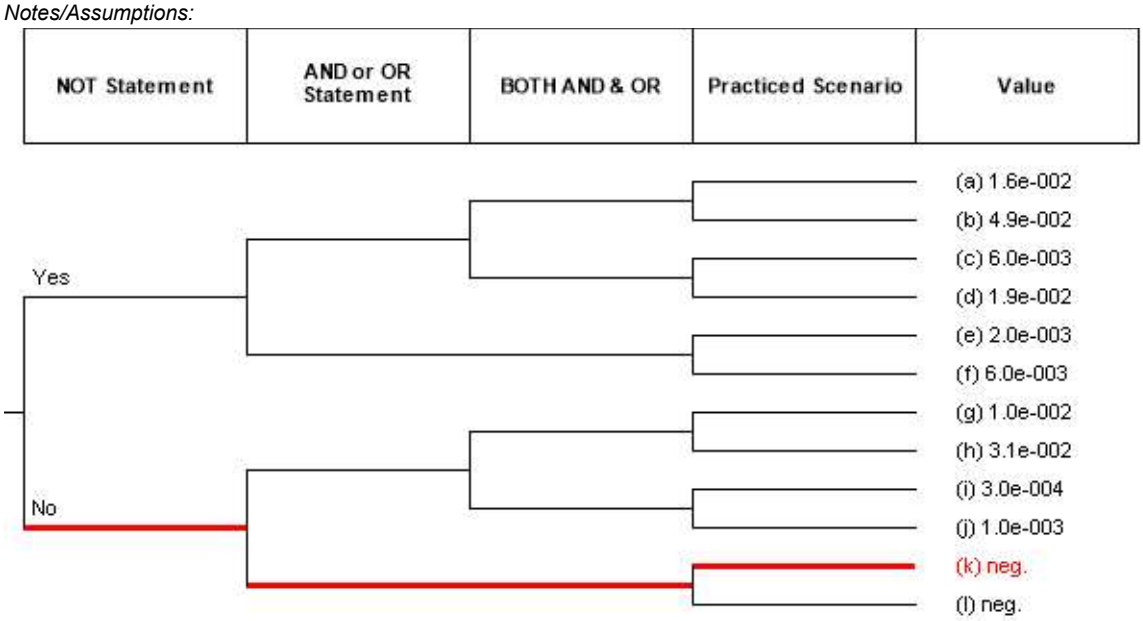
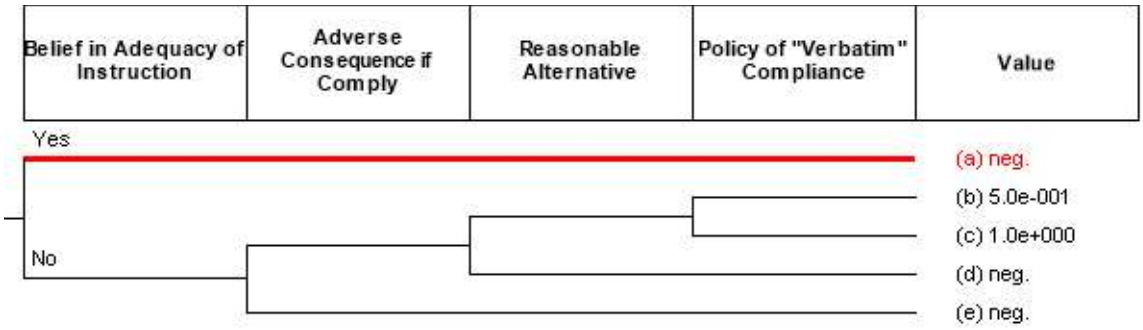
Pcg: Misinterpret decision logic

Notes/Assumptions:



Pch: Deliberate violation

Notes/Assumptions:



Cognitive Recovery

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	Initial HEP	Self Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	Dependency Level	Multiply HEP by	Override Value	Final Value
Pca	n/a	-	-	-	-	-		N/A	1.00E+00		0.0
Pcb	1.50E-04	-	-	X	-	-		N/A	1.00E-01		1.50E-05
Pcc	n/a	-	-	-	-	-		N/A	1.00E+00		0.0
Pcd	n/a	-	-	-	-	-		N/A	1.00E+00		0.0
Pce	3.00E-03	X	-	-	-	-		HD	5.02E-01		1.50E-03
Pcf	n/a	-	-	-	-	-		N/A	1.00E+00		0.0
Pcg	n/a	-	-	-	-	-		N/A	1.00E+00		0.0
Pch	n/a	-	-	-	-	-		N/A	1.00E+00		0.0
Final Pc (with recovery credited)											1.52E-03
Notes											
Time added to window to allow STA review on Pcb so this should be revisited! STA Reviews and Extra Crew credited.											

Sigma Table				
Plant Type	Response Type	LB	Sigma	UB
BWR	CP1	0.4	0.7	1
	CP2	0.2	0.58	0.96
	CP3	0.59	0.75	0.91
PWR	CP1	0.26	0.57	0.88
	CP2	0.07	0.38	0.69
	CP3		0.77	
Sigma:	3.80E-01			
HEP:	0.00E+00			
Notes/Assumptions	CP2 HFEs are actions in which the operators receive an alert but must delay implementation until a specific plant parameter is reached.			

Execution Performance Shaping Factors		
Environment	Lighting	Normal
	Heat/Humidity	Normal
	Radiation	Non Radiation Area
	Atmosphere	Normal
Complexity of Response	Execution	Simple
Equipment Accessibility (Cognitive)	Main Control Room	Accessible
Equipment Accessibility (Execution)	Main Control Room	Accessible

Stress	
High	
Plant Response As Expected:	Yes

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Workload:	High
Performance Shaping Factors:	Negative
Notes	
Performed in the control room, practiced on the simulator.	

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Execution Unrecovered							
Procedure		Comment				Stress Factor	Override
Step No.	Instruction / Comment	Error Type	THERP		HEP		
			Table	Item			
EOP 2.2 Step 4	Ensure both MVG-8811A and MVG-8812A, RHR SUMP A to RHR PP A are open Ensure MVg-8809A, RWST to RHR PP A is closed	EOM	20-7b	1	4.3E-4	High	
		EOC	20-12	3	1.30E-03		
	Location:	Main Control Room				Total Step HEP	8.65E-03
EOP 2.2 Step 6	Verify at least one train of RHR has been aligned to the RHR Sumps	EOM	20-7b	1	4.3E-4	High	
	Location:	Main Control Room				Total Step HEP	2.15E-03
EOP 2.2, 7	Reset both SI RESET TRAIN A(B) Switches	EOM	20-7b	1	4.3E-4	High	
		EOC	20-12	3	1.30E-03		
	Location:					Total Step HEP	8.65E-03
EOP 2.2, 8a	Ensure both RHR Pumps A(B) are running	EOM	20-7b	1	4.3E-4	High	
		EOC	20-12	3	1.30E-03		
	Location:					Total Step HEP	8.65E-03
EOP 2.2, 8 d	Open MVG-8706 A (B) RHR LP A(B) TO CHG PP	EOM	20-7b	1	4.3E-4	High	
		EOC	20-12	3	1.30E-03		
	Location:					Total Step HEP	8.65E-03
EOP 2.2 , 8 e	Close LCV-115B(D) RWST TO CHG PP SUCT	EOM	20-7b	1	4.3E-4	High	
		EOC	20-12	3	1.30E-03		
	Location:					Total Step HEP	8.65E-03
EOP 2.2, 8 f	Verify stable flow on FI-943 CHG LOOP B CLD/HOT LG FLOW GPM.	EOM	20-7b	1	4.3E-4	High	
		EOC	20-12	3	1.30E-03		
	Location:					Total Step HEP	8.65E-03

Execution Recovered							
Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
EOP 2.2 Step 4		Ensure both MVG-8811A and	8.65E-03				4.33E-03

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		MVG-8812A, RHR SUMP A to RHR PP A are open Ensure MVg-8809A, RWST to RHR PP A is closed					
	EOP 2.2 Step 6	Verify at least one train of RHR has been aligned to the RHR Sumps		2.15E-03	HD	5.01E-01	
EOP 2.2, 7		Reset both SI RESET TRAIN A(B) Switches	8.65E-03				4.36E-03
	EOP 2.2 , 8 e	Close LCV-115B(D) RWST TO CHG PP SUCT		8.65E-03	HD	5.04E-01	
EOP 2.2, 8a		Ensure both RHR Pumps A(B) are running	8.65E-03				4.36E-03
	EOP 2.2, 8 f	Verify stable flow on FI-943 CHG LOOP B CLD/HOT LG FLOW GPM.		8.65E-03	HD	5.04E-01	
EOP 2.2, 8 d		Open MVG-8706 A (B) RHR LP A(B) TO CHG PP	8.65E-03				4.36E-03
	EOP 2.2, 8 f	Verify stable flow on FI-943 CHG LOOP B CLD/HOT LG FLOW GPM.		8.65E-03	HD	5.04E-01	
		Total Unrecovered:	3.46E-02			**Total Recovered:**	1.74E-02

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Appendix F - File Catalog

File Name	Modified Date	File Size
EDG A SDP Quant 231016.zip	10/17/23	307,117 kb
EDG SDP Circuit Packages.zip	10/17/23	6,609 kb
VCSNS_HRA_EDGSDP_v52_10132023.hra	10/16/23	8.6 MB
PCCKS_FXPRA_EXPORT_2023-09-01_1518.MDB	9/1/2023	4.1 MB
VCS FMDB Rev_09-21-2023d.zip	9/21/2023	43 MB
VCS FMDB Revision log.xlsx	9/21/2023	128 kb

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