

Electric Transmission and Substation Strategic Asset Failure Evaluation (SAFE) Program

SUMMARY

This utility procedure describes the process for conducting evaluations of electric transmission and substation asset failure incidents to assess apparent causes and make recommendations to iterate findings back into asset strategy.

This procedure also describes PG&E's near-term objective of assessing all in-service equipment failure incidents, excluding any failures caused by vegetation, third-party activities, and other external causes (e.g., gunshot).

After the near-term process matures, this procedure may be updated to also assess asset damages identified through the inspection process before the asset fails in-service.

This process supports the Transmission and Substation Asset Strategy Teams' ability to continuously trend and assess systemic failure threats to the system and to implement appropriate maintenance programs and preventive measures to ensure safe and reliable operations.

Level of Use: Informational Use

TARGET AUDIENCE

The procedure is addressed to the following PG&E personnel:

- Asset failure analysis, electric operations asset strategy
- Electric operations transmission and substation asset strategy
- Electric operations standards and methodology
- Transmission substation maintenance and construction (M&C)
- Electric operations system protection
- Applied technology services (ATS)

SAFETY

Performing this procedure does not raise the risk of a specific hazard to personnel, the public, or equipment.

BEFORE YOU START

NA

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PROCEDURE STEPS

1 Objective

The Strategic Asset Failure Evaluation (SAFE) process ensures that all in-service electric transmission and substation equipment failures are recorded and assessed for further investigation; the findings are iterated into proactive asset strategies to improve safety and performance. This continuous evaluation identifies systemic, operational, and/or environmental changes that may potentially affect the magnitude of risk and threats to PG&E's electric transmission and substation system.

2 Roles and Responsibilities

2.1 [Table 1](#) describes the key roles and responsibilities for implementing this procedure:

Table 1. Key Roles and Responsibilities

Title	Responsibilities
Director of Electric Transmission and Substation Asset Strategy	Approves revisions to this procedure.
Manager of Transmission Asset Strategy and Manager of Substation Asset Strategy	<ul style="list-style-type: none"> Responsible for all changes to this procedure. Implements adequate processes and controls to ensure compliance with this procedure. Has decision-making authority for implementing the program elements of and deviations from the procedures, if required.

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Title	Responsibilities
Manager of Asset Failure Analysis	<ul style="list-style-type: none"> • Manages the program management team for the SAFE process. • Oversees the development and implementation of this procedure. • Oversees the Apparent Cause Evaluation (ACE) of specific asset failure incidents, when required.
Program Manager, Asset Failure Analysis	<ul style="list-style-type: none"> • Works with the M&C team to ensure event response data collection (through Inspect App. and Corrective Action Program [CAP] events) is standardized and consistently meets minimum expectations. • Continuously improves asset data access for engineers to investigate events. • Facilitates regular monthly incident review sessions with subject matter experts (SMEs). • Tracks decisions made and action items identified through monthly meetings. • Issues CAP event for critical incidents, assigns to right owners, and tracks progress. • Develops and owns dashboard for tracking the progress, decisions, and completion of action items. • Shares regular updates on specific wins and/or trends identified in failure analyses. • Leads ACE for specific asset failure incidents, when required. • Attaches SAFE Report (SAFER) summaries to the incident CAP event report for easy reference.
Applied Technology Services (ATS) Asset Failure Analysis Engineer	<ul style="list-style-type: none"> • Continuously monitors the failed equipment sent to ATS or collected and stored at regional storage for analysis. • Conducts preliminary visual inspection of the failed equipment and provides a one-page summary and photos to assist SMEs investigating the incident. • Stores searchable one-page summaries as part of the ATS Documentum (D2) database. • Attaches one-page summaries to the CAP event report for easy reference. • Coordinates with M&C superintendents for the storage of failed equipment (when needed).
M&C Superintendents	<ul style="list-style-type: none"> • Generates a CAP item for all equipment failure incidents to track immediate actions taken, pictures from the incidents, and any preliminary findings. • Collects and stores failed equipment as evidence, based on Utility Procedure TD-1957P-01 (transmission only). • Ensures pictures from the failure site are captured through the applicable data sources (i.e., Inspect App via Line Corrective [LC] repair records).
Asset Strategy Component Engineers	<ul style="list-style-type: none"> • Reviews each in-service failure as outlined in this procedure. • Collaborates with cross functional teams to gather supplemental data; investigates and assesses the extent of the condition of in-service failure incidents. Presents background SAFERs on the failure incidents at monthly SAFE meetings.

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Title	Responsibilities
	<ul style="list-style-type: none">Finalizes the decision on next steps, including the level of causal evaluation and type of causal evaluation required.Identifies the appropriate corrective actions based on the findings from the asset failure incident review.Owens the implementation of corrective actions. (Corrective actions may include changes to existing asset replacement programs, improvement to risk models, and/or the creation of new asset management programs.)
Electric Standards SMEs	<ul style="list-style-type: none">Provides guidance on issues investigations related to design and standards.Leads the investigation on any Material Problem Reports (MPRs) issued for failed transmission and substation equipment collected and sent to ATS.Provides a report on MPR findings for failed transmission and substation equipment.Owens the corrective actions related to any issues identified with engineering design and work methods.Incorporates findings when considering future design/work methods.

3 Strategic Asset Failure Evaluation (SAFE) Process

3.1 CONDUCT periodic reviews to ensure that all in-service equipment failure incidents on the electric transmission and substation system are evaluated.

- Findings from incident investigation and evaluations may provide important information about risks and threats to the system.
- Findings are used to identify improvement opportunities to mitigate risks.

3.2 The SAFE process flow is depicted in [Appendix A, "SAFE Evaluation Process Overview,"](#) on Page 12. The remainder of this document discusses the process to follow for these evaluations shown in Appendix A.

4 Equipment Failure Incident Triggers

4.1 The electric transmission and substation failure incidents evaluated through the SAFE process may include, but are not limited to:

- In-service equipment failure incidents (SEE the [Definitions](#) on Page 9 to understand which issues are included).
- Discretionary events that may not fit into the current scope but are flagged for review due to the potential for systemic safety or reliability implications, opportunity to improve asset strategy, or other relevant criteria.

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- 4.2 The M&C Team GENERATES a Corrective Action Program (CAP) event report for all equipment failures that meet the defined incident triggers.
1. IF PG&E personnel identify additional action required related to an incident,

THEN REASSIGN the same CAP to an asset strategy component engineer. The associated action items are tracked as part of the overall CAP.

5 Data Gathering

- 5.1 The SAFE review process involves the collection of current available information related to the failed equipment, including historical operation, maintenance and inspection records, potential for systemic threats, and any past evaluations of similar incidents.
- 5.2 The data sources used in the data gathering process, at a minimum, are as follows:
- Transmission Operations Tracking and Logging (TOTL) Application/System Dispatch Office Items.
 - Patrol findings reported during daily transmission and substation (T&S) Outage Review Team (ORT) calls for transmission and substation.
 - CAP event reports.
 - Transmission and Substation Asset Failure Master Tracker Spreadsheet.
 - ATS preliminary summary documentation of failed equipment where the failed equipment is collected for analysis. The ATS preliminary summary report format is shown in [Appendix B](#) on Page 13.
 - Repair information for the incident documented in SAP as a Line Corrective (LC) record.
 - Inspection records (ground/climbing/aerial inspections, drone inspections, infrared [IR] inspections, routine and supplemental inspections, etc.).
 - Maintenance records.
 - Historical failure records at the location where the incident occurred.
 - Electric Transmission Geographic Information System (ETGIS).

Potential additional data sources to be used as needed:

- Electrical Loading Data (PI).
- Relevant Asset Management Program (AMP) sections.

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5.2 (continued)

- Relevant Failure Mode and Effect Analysis (FMEA) failure mode descriptions.
- Known Bad Actor Asset lists.
- Any relevant future workplans at the location of the failure.

6 Evaluating System Risks and Threats

6.1 The Asset Failure Analysis Team HOSTS monthly SAFE review meetings.

1. During these meetings, REVIEW all asset failure incidents that meet the triggers defined in [Section 4, "Equipment Failure Incident Triggers,"](#) on Page 4.
2. SCHEDULE additional smaller group meetings to ensure that all required failure incidents are evaluated, if needed.

6.2 Asset strategy component engineers are responsible for:

1. REVIEWING the data sources for the incident defined in [Section 5, "Data Gathering,"](#) on Page 5.
 - a. [Appendix C](#) on Page 14 contains a checklist of recommended areas to analyze for each incident.
2. LEADING discussion on preliminary findings from the failure incident during monthly SAFE meetings.
3. OWNING the analyses required to make decisions on next steps, LEADING discussions at monthly SAFE meetings, and DETERMINING the level of causal evaluation required for the incident.
 - a. The options for levels of causal evaluation are described in [Table 2](#).

Table 2. Causal Evaluation Options

Option #	Title	Description	Documentation Requirement
1	No further evaluation	No further action may be required: <ul style="list-style-type: none"> • If the failure mode is known (missed maintenance, past useful age, etc. that directly resulted in not addressing the failure mode in time). • No value is added from completing further investigation (e.g., would not result in any workplan, 	Document the reason for the decision in the SAFE Report (SAFER) slide and CAP event report description field.

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Option #	Title	Description	Documentation Requirement
		<p>modeling, strategy, design changes.)</p> <ul style="list-style-type: none"> There is already a robust control/plan in place for the failure type. 	
2	Direct Cause Evaluation	Leverage ATS facility to conduct Non-Destructive and Destructive evaluation of the failed equipment.	<p>ATS engineer attaches the failure analysis report to the CAP event report.</p> <p>Note: In the scenario where the incident is a California Public Utilities Commission (CPUC) reportable major incident, an SIF incident, or has a legal hold, the equipment analysis must be coordinated with the appropriate investigation team.</p>
3	Apparent Cause Evaluation (ACE)	<p>ACE investigations may be performed on failure incidents that require a deeper dive analysis to understand the failure mode and extent of the condition. The decision to conduct an ACE is determined by the asset strategy component engineer based on the preliminary evaluation of data gathered. The ACE analysis is led by the following teams:</p> <ul style="list-style-type: none"> ACE for major CPUC reportable incidents led by electric incident investigations (EIs). ACE for serious injury or fatality (SIF) incidents led by the CAP team. ACE for any other equipment failures led by the asset failure analysis team. 	<p>ACE report is attached to the CAP event report.</p> <p>Corrective actions identified through ACE are assigned as CAP action item(s) to the appropriate owners.</p>
4	Engineering design evaluation using the Material Problem Report (MPR) process	MPR report is issued if the failure incident is determined to be due to an engineering design or material issues.	MPR analysis is led by the Engineering Standards Team. Results from the MPR analysis is attached to the CAP event report.

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6.2 (continued)

4. CLOSING out incident evaluations after an appropriate level of analysis is completed and corrective actions are documented in CAP with the right action owners. The final list of findings and corrective actions are shared during monthly SAFE meetings.

7 Documentation

7.1 CAP Event Report

A CAP event report is issued for all in-service failure incidents.

1. The CAP event report for each incident documents the data gathered, decisions made on the level of causal evaluation, final reports from causal analysis, and associated corrective actions.

7.2 Asset Health/Risk Models and Asset Management Plan

Asset strategy component engineers TRACK the findings from these evaluations AND ASSESS trends that may require updates to asset health and risk models (e.g., Operability Assessment [OA] model).

1. These findings are also used to update the asset component strategies and future workplan strategies. RECORD the updates as part of Asset Management Plan (AMP) updates.

7.3 Meeting Notes from Monthly SAFE Meeting

DOCUMENT AND STORE summaries of discussions from monthly SAFE meetings in the following SharePoint folders:

- Transmission SAFE SharePoint: [TSAFE SharePoint](#)
- Substation SAFE SharePoint: [SSAFE SharePoint](#)

END of Instructions

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DEFINITIONS

In-service failure: Any asset that fails to operate as designed while in-service. For the purpose of this procedure, in-service failures include any unplanned equipment failure incidents that result in an automated trip of protective device, such as a relay or a circuit breaker tracked on the Transmission and Substation Asset Failure Master Tracker Spreadsheet and maintained by asset strategy personnel.

NOTE

A few incidents may not be captured in the Master Tracker Spreadsheet because they did not create an outage (e.g., a substation asset failure may not cause any trip due to system redundancy). Component engineers identify and discuss these incidents on a case-by-case basis during SAFE meetings.

Integrated Logging Information System (ILIS): An in-house, web-based logging application used to document all outage switching steps that impact customers. Collects the outage cause and fault location. Creates outage events, tracks customer counts, and calculates customer outage minutes in real time.

Transmission Operations Tracking & Logging (TOTL): Web-based application used by transmission grid operations. Consolidates the capabilities of the predecessor applications SLIC and eSLIC for logging, scheduling, and outage coordination with the California Independent System Operator's (CAISO's) new web Operation Maintenance and Construction (OMS) outage management tool. (Compare to the definition for [ILIS](#) above.)

IMPLEMENTATION RESPONSIBILITIES

The Asset Failure Analysis Team manages the implementation and operations of the SAFE program, including scheduling regular meetings, tracking evaluations to completion, and ensuring evaluations are properly documented.

The director of transmission and substation asset strategy oversees the responsibilities of the component engineers (see [Table 1](#) on Page 2).

GOVERNING DOCUMENT

NA

COMPLIANCE REQUIREMENT / REGULATORY COMMITMENT

Records and Information Management:

Information or records generated by this procedure must be managed in accordance with the Enterprise Records and Information (ERIM) program Policy, Standards and Enterprise Records Retention Schedule (ERRS). Refer to [GOV-7101S, "Enterprise Records and Information Management Standard,"](#) and related standards.

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COMPLIANCE REQUIREMENT / REGULATORY COMMITMENT (continued)

Management of records includes, but is not limited to:

- Integrity
- Storage
- Retention and Disposition
- Classification and Protection

REFERENCE DOCUMENTS

Developmental References:

[*Electric System Inspections and Preventative Maintenance Program \(TD-8123M\):*](#)

- [Substation Failure Model Effect Analysis \(FMEA\)](#)
- [Transmission Failure Model Effect Analysis \(FMEA\)](#)

Utility Procedures:

- [GOV-6101P-08, "Corrective Action Program Procedure"](#)
- [GOV-6102P-06, "Enterprise Cause Evaluation Process Procedure"](#)
- [LAW-3001P-02: "First Responders Evidence Procedure"](#)
 - [First Responder Evidence Procedure Quick Reference Guide](#)
- [RISK-6305P-02, "Electric Incident Investigations \(EII\) Procedure"](#)
- [TD-1957P-01, "Electric Transmission Line Equipment Failure Sample Collection"](#)
- [TD-2200P-01, "Outage Reporting Details and Accuracy Verification Process"](#)
- [TD-2200P-02, "Detailed Non-Restorable Outage Reporting Process"](#)

Supplemental References:

NA

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APPENDICES

[Appendix A, "Strategic Asset Failure Evaluation Process Overview"](#)

[Appendix B, "ATS Preliminary Summary Report Format"](#)

[Appendix C, "Checklist of Analysis Topics for Each Failure Incident"](#)

ATTACHMENTS

NA

DOCUMENT REVISION

NA

DOCUMENT APPROVER

██████████, Director, Transmission, Substation, and Storage Strategy

DOCUMENT OWNER

██████████ Manager, Asset Failure Analysis

DOCUMENT CONTACT

██████████ Principal Program Manager, Asset Failure Analysis

REVISION NOTES

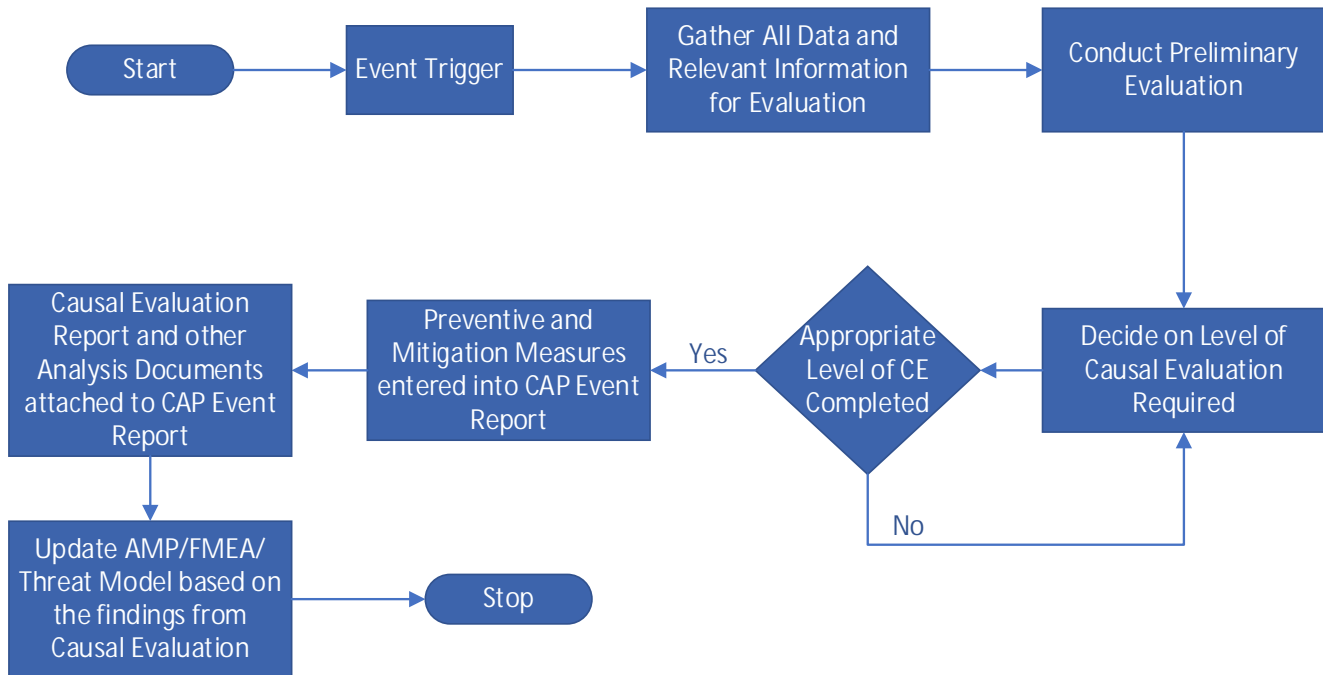
Where?	What Changed?
NA	This is a new utility procedure.

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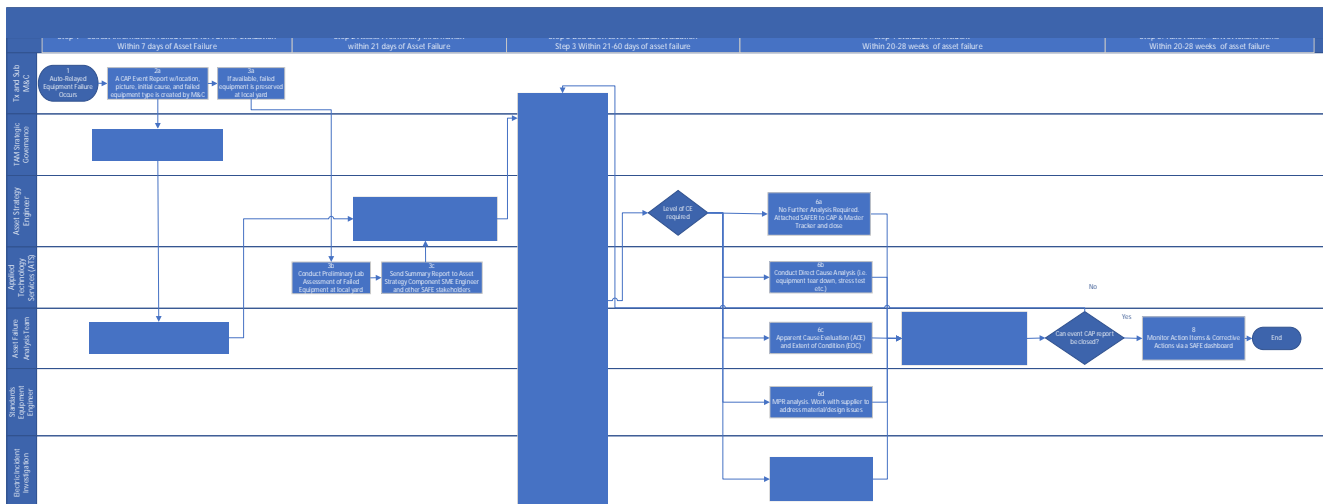
Appendix A, Strategic Asset Failure Evaluation Process Overview

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Consolidated SAFE Process Flow




Detailed SAFE Process Flow – Link to Visio version [HERE](#)



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Appendix B, ATS Preliminary Summary Report Format


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XYZ Failure Summary

ATS Technical Contact:	
Received Date:	<div>Failure Impacts</div> <div>Green</div>
Background Describe incident	Safety: Describe. Customer: The failure resulted in a sustained interruption to over X,X00 customers. All customers were restored at XXXX hours on Date of xx/xx/xxxx
Preliminary Failure Mode Describe component tht failed and best guess at potential failure mode or need more data to determine	
Planned for coming weeks (month)	
Potential & Actual Barriers and Support Needed	

Internal



XYZ Failure Summary

EQUIPMENT INFO
MANUP:
TYPE
SN:
Year of MFR:
(all information known at the time)

As Received Photos

Internal

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Appendix C, Checklist of Analysis Topics for Each Failure Incident

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SAFER Template: Asset Family, Circuit/Station Impacted, Component Type, Date

SAFE SME: Joe Electric (J1E1)		CAP#: ILIS#, OIS#	
Failure Event Date: 1/28/21		Failure Impacts	
Background Event Info: ie: On December 9, 2020, at 1615 hours at the Kern Power Plant Substation in Bakersfield (Incident Location), a catastrophic failure of the C-phase bushing occurred on the 7th Standard-Kern 115 kV line CB #112. The oil-filled bushing on CB #112 C Phase's bus side ruptured, causing ignition and dispersing oil in the equipment's immediate vicinity		Input any relevant safety, reliability or near miss info Was	
Apparent Failure Mode Description. If known, use FMEA format. If unknown, Does the AMP need to be revised?			
Failed Component Description Description Age Manufacturer Model Open Tags? History of failures? Last Inspection? Bad Actor List? EOC		Extent of Condition If applicable, estimate of number of similar components operating with similar constraints as failed unit	
Recommended Actions/Support Needed: Action recommended and reason for action/inaction			



SME Analysis I: Asset Family, Circuit/Station Impacted, Component Type, Date

Suggested Format for Deep Dives

Part 1 - Inform on the Incident

- Do we know the failure mode and the threat on the system (corrosion, wind, weather, induction, etc)
- Was there an ignition? Was it CPUC Reportable?
- Is this a known issue (e.g. is the equipment type part of the Bad Actor List, were there existing tags)
- Effectiveness of the failure barriers:
 - Standards - Was the equipment not up to current standard
 - Maintenance - Could this issue have been prevented by maintenance
 - Inspection - Did we see any related issues in the last inspection. Was there any open tags.
 - Asset Strategy - Is there an existing WIP or asset replacement plan for the failed asset
- Extent of condition
 - How many of the same asset type of incidents do we have on the system
 - Does similar conditions (i.e. threat) exist on the system in other areas
- What can be done differently to avoid this issue in the future?
- Please also note any gaps in available data or areas where you could use additional data to support your analysis

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Appendix C, Checklist of Analysis Topics for Each Failure Incident

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SME Analysis II: Asset Family, Circuit/Station Impacted, Component Type, Date

Format for Deep Dives - **Suggested** Path Forward (SME Recommendation)

Part 2 - Suggest a decision on level of Causal Evaluation required

What are the open questions regarding this failure incident?

Based on what we know, what should be the level of Causal Evaluation?

1. No further action required - known issue, a strategy in place
2. Need ATS Direct Cause Analysis (DCA)
3. Conduct an Apparent Cause Evaluation (ACE) and Extent of Condition
4. Initiate an MPR analysis – for suspected design issue
5. Major CPUC reportable incident - EAR process (conducted by EII team)

Internal