Event Analysis Report

San Francisco – Media

EIR No.: EI200212A

Date of Event: February 12, 2020

Date Reported to the CPUC: February 12, 2020

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Report Rev: 01

[redacted]	[redacted]	5/6/2022
Leadership Approver	Signature	Date
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Incident Investigator	Signature	Date

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1. EXECUTIVE SUMMARY

On February 12, 2020 at 1950 hours, an equipment failure on the San Francisco Y 1137 12kV Underground Distribution Circuit resulted in 9,100 customers out of power and caused a fire at the intersection of Laguna and Hayes Street in San Francisco. Six T-body junction points, two elbow attachments, and associated hardware were retained as evidence.

This incident was reported in a timely manner to the CPUC on February 12, 2020 at 2345 hours under the media criterion, initiating an investigation by the Electric Incident Investigations ("EII") team. This report reviews the findings of that investigation. PG&E performed an event analysis which included interviews with PG&E personnel, failure analysis, review of construction standards and procedures, protection analysis, maintenance history, and patrol and inspection records. Based on all information available, PG&E concluded that the cause of the incident was the failure of an Elastimold 600/200A reducer plug and elbow assembly due to insulation degradation. The damaged equipment was replaced the next day.

A hazard-barrier analysis was performed, and no potential non-conformances/non-compliances were identified during this investigation. No corrective or general actions were identified.

This report concludes PG&E's investigation into this incident. Unless otherwise noted herein, where there are conflicts between this report and previous PG&E reports related to this incident, this report shall take precedence. If additional information becomes available with the potential to affect the conclusions of this investigation, PG&E reserves the right to re-open this investigation. All times, customer counts, and measurements in this report are approximate.

2. PROBLEM STATEMENT

On February 12, 2020 at 1950 hours, an equipment failure on the San Francisco Y 1137 12kV Underground Distribution Circuit resulted in 9,100 customers out of power and caused a fire at the intersection of Laguna Street and Hayes Street in San Francisco. The customers were without power for almost two hours and the equipment was repaired the next day.

This event was reported to the CPUC under the Media criterion, triggering the investigation by the EII group. This report summarizes the findings of the investigation.

3. EXTENT OF CONDITION

Elastimold 600/200A reducer plugs and elbows are not specifically tracked by Asset Strategy nor mapped in GIS. In SAP there are 605 equipment entries with the equipment type “Elbow” in San Francisco. This type of equipment is installed all over PG&E’s service area.

In 2019 and 2020 there were two other CPUC reportable incidents (EI190518A and EI200525A) involving similar equipment failures.

A review of the CAP database yielded limited relevant incidents.

From 2015 to 2022 there were 65 confirmed Material Problem Reports (“MPR”) related to various components of 600/200A reducer plugs and elbows manufactured by Elastimold.

4. EVENT SUMMARY

Please refer to the 20-Day Report submitted to the CPUC on March 13, 2020 for a summary of the incident.

5. HISTORY

Based on a review of PG&E’s GIS data, it appears the affected equipment was installed between 1968 and 1971.

6. OBSERVATIONS & EVENT ANALYSIS

6.1. Field Observations

When the responding cableman and a supervisor arrived at the intersection of Laguna Street and Hayes Street in San Francisco (“Incident Location”), they observed the San Francisco Fire Department (“SFFD”) on site and smoke coming from a manhole (later identified as the primary subsurface enclosure GW5086 #5 box). The cableman reported seeing an enclosure with the frame up out of the ground. The enclosure appeared to house a connection point with no switch. SFFD roped off the area and the cableman performed switching operations to re-energize customers. The cableman observed Man On Line (“MOL”) tags on the same circuit. The supervisor noted that there was ongoing construction on the SF X circuit, so the Incident Location was being back fed from the SF Y circuit.[1]

[1] PG&E Field Personnel and Distribution Engineering interviews

Figure 1: The location of the fire. Taken February 12, 2020

PG&E is aware of a video posted to Twitter the night of the incident by an unknown individual, which purports to be a video of the incident.[2] PG&E does not know who took the video or whether it is an accurate video of the incident. The video shows an explosion from what appears to be a smoking manhole roped off with yellow caution tape.

[2] DR2004061 - Laguna-Hayes - Media.pdf, Data Request submitted to the CPUC May 12, 2020

The responding cableman, with assistance from three troublemen, performed switching operations and restored all customers by 2145 hours on February 12, 2020.[3] Repairs were completed the next day.

6.2. Failure Analysis

PG&E collected the T-body junction points, the elbow attachments, and associated hardware into evidence. Note that the responders and crew first believed that only two of the elbows had been recovered. Upon examination, ATS found the damaged remains of the third elbow (shown in Figure 3) amongst the evidence.

Figure 2: Condition of the damaged equipment on the night of the incident.

Visual inspection showed that the phase A reducing tap plug suffered insulation degradation that led to a ground fault. A review of the relay event data further showed that there were two ground fault events during the incident. See the ATS Report provided to the CPUC on June 16, 2020 for further details.

[3] ILIS 20-0021287

Figure 3: The evidence collected from A phase. The failed tap plug and elbow are shown on the left.

6.3. System Protection Analysis

Below are the details of the two faults described in the ATS report.

Fault 1

- Recorded on primary relay SEL 351-6
- Max current: 5,590A on A Phase (indicates a ground fault)
- B & C Phases had normal load current
- Primary relay tripped the FDR Y-1137 breaker on Time Over-Current (TOC) at 1952 hours
- This corresponds to the FNL on ILIS 20-0021287

Fault 2

- Recorded on primary relay SEL 351-6
- Max current: 5,460A on A Phase (indicates a ground fault)

- B & C Phases had normal load current
- Primary relay tripped the FDR Y-1137 breaker on Time Over-Current (TOC) at 2006 hours
- This corresponds to the NG Test on ILIS 20-0021287

ATS noted that the second fault may have caused further damage to the failed component. It is unclear if the timing of the fire correlates with the first or second fault.

6.4. Control Center Analysis

The two faults described in the previous section led EII to consider the troubleshooting technique unique to the underground circuits in PG&E's system. The second fault can likely be ascribed to steps in Section 11 of procedure TD-2700P-11 ("Testing and Sectionalizing Distribution Equipment").

During an underground outage, the fault location is often not obvious. Unlike overhead circuits, there is not a visual indication of failure, such as a downed wire, to confirm the fault location. There is also little SCADA visibility in PG&E's San Francisco underground circuits. Operators and troublemen rely on interrupters and fault indicators to isolate an outage to a smaller section of the circuit. See Section 6.5 for more information on fault indicators.

If an entire circuit trips, hazard reports are often the only clue that could lead to the fault location. However, if there is a hazard report it means that equipment may have already failed in a way that created a hazardous situation.

To isolate a fault when there are no hazards reported, the operator coordinates with the cablemen to energize, or "test," smaller and smaller sections of the circuit until it remains energized without tripping. When the breaker holds closed like this it is referred to as "testing good." If the circuit trips again it is called "no good" ("NG") and indicates the fault is still included in the path that was just tested. The second ground fault described in ATS' review of fault data is likely one of these tests.

This methodical technique of testing a circuit enables the operator to locate an underground fault. However, multiple tests can damage good conductor by exposing it to fault current multiple

times. It is also possible to further damage the equipment at the fault location or cause arcing each time the fault location is re-energized. No existing CAP issues were found that reference the downsides of existing troubleshooting methods in underground circuits.

Absent the resources for extensive conductor replacement and SCADA installation, the above described technique is the currently accepted practice for locating an underground fault in the distribution system if other means of detecting the fault location are unavailable. Procedure TD-2700P-11 includes instructions to select sectionalizing points to minimize danger to life and property and to minimize the number of tests.

6.5. Internal Guidance Analysis

Fault Indicators

Fault indicators are intended to help operators locate faults without needing to test into the fault as described in TD-2700P-11. It is unclear what fault indicators were available to aid in troubleshooting for this incident. However, if there had been sufficient fault indicators visible to the operator and field personnel it could have prevented the second fault noted in the ATS report.

Fault indicators are tested every three years as part of PG&Es routine underground inspections.[4] A non-functional fault indicator will either be replaced as minor work by the inspector or will be entered into an Electric Corrective ("EC") notification. This should enable timely replacement of any broken indicators. A review of SAP notifications for the last five years is detailed in the table below. The data shows that EC notifications for fault indicators, including those in San Francisco, are being closed in a timely fashion. No additional corrective action is recommended at this time.

UG Fault Indicator Notifications 2017 - 2021			
Total Open	200	SF Open	1
Total Closed	17543	SF Closed	29
Total	17743	SF Total	30

Table 1: Underground Fault Indicator EC Notification Data

[4] Internal email from PG&E's Director of System Inspections, April 7, 2022

PG&E's Asset Strategy team notes that the Electric Program Investment Charge ("EPIC") 4.0 is currently soliciting solutions to solve UG fault locating. One of these solutions is to utilize new technologies and communicating modes for UG fault indicators. If this solution is able to secure EPIC funding, its completion would be anticipated by end of 2026.[5]

System Inspections

Underground facilities are inspected every 3 years. The job aid for underground inspections includes guidance for inspecting vaults and enclosures for damage. It also includes guidance to inspect fault indicators, cables, and dead-break elbows among other common items. A selection of relevant pages is included in Attachment 01.

Insulation degradation is one of the issues that inspectors check for, but if the damage had not progressed enough to be visible at the time of the last inspection then the inspector would not have seen it. The last two inspections prior to the incident were in August 2015 and September 2018 with no abnormalities at the incident location.

7. CAUSE & CONTRIBUTING CAUSES

Based on the failure analysis provided by ATS, EII concluded that this event was caused by equipment failure of the A Phase 600/200A reducer elbow. A Hazard Barrier Analysis was performed and identified no corrective actions.

[5] Internal email from PG&E's Sr. Manager of Distribution Asset Strategy, March 31, 2022

Hazard	Explosion inside an underground vault/enclosure				
Target	Equipment inside the vault/enclosure				
Barrier	**Objective**	**Expected Performance**	**Did Barrier Perform as Expected?**	**Did Barrier Contribute to Incident?**	**Defect**
PG&E Underground patrols and inspections (EDPM Manual)	Identify any nonconformances with underground equipment	Inspection or patrol would identify issues with PG&E equipment.	Unknown	Unknown	None
PG&E Receiving Inspection Procedure SCM-2101P-01-JA23: 600-Amp Elbow and Cable Assemblies And Terminations	Ensure components are correct and undamaged when PG&E receives them	The correct parts and materials are provided for installation	Yes, ATS reported no evidence of improper installation	No	None
Electric Corrective Tag Process	Repair or replace equipment identified by field personnel	Issues identified during inspections, patrols, and other field activities are corrected in a timely manner	Yes	No	None
PG&E Standard 076256: Explosion Resistant Manhole Covers and Frames	Install manhole covers that will not be dislodged into the air during a manhole explosion	Prevents injury during a manhole explosion	Unknown – no injuries were reported, but it is unclear if the manhole cover was dislodged into the air	No	None

8. CORRECTIVE/GENERAL ACTIONS (CA/GA) SUMMARY

No corrective or general actions were identified in the course of this investigation.

9. POTENTIAL NON-CONFORMANCES AND NON-COMPLIANCES

No potential non-conformances and non-compliances were identified as a result of this investigation.

10. REFERENCES

Internal Documents

ILIS 20-0021287

GIS data

Procedure TD-2700P-11

Standard 061683 (Fault Indicators)

Standard 076256 (Explosion Resistant Manhole Covers and Frames)

TD-2302P-05 Rev2 (Miscellaneous Inspection Requirements)

11. ATTACHMENTS

Attachment 01_UG Inspection Job Aid.pdf

Attachment 02_600 Amp Elbow Receiving Inspection Procedure.pdf

12. PREVIOUSLY COMPLETED REPORTS AND DATA REQUESTS

20-Day Report

EI200212A - Laguna Hayes - Media.pdf, submitted to the CPUC March 13, 2020

Attachment 01_2017 Patrol_CONF.pdf

Attachment 02_2019 Patrol_CONF.pdf

Attachment 03_2015 Inspection_CONF.pdf

Attachment 04_2018 Inspection_CONF.pdf

Attachment 05_EC Tag_118529297_CONF.pdf

Attachment 06_ILIS_20-0021287_CONF.pdf

Attachment 07_Post Incident Photos.pdf

Data Request

DR2004061 - Laguna-Hayes - Media.pdf, Data Request submitted to the CPUC May 12, 2020

Attachment 01_Q01_Investigators_CONF.pdf

Attachment 02_Q06_Pictures_CONF.pdf

Attachment 03_Q15_UG Cables_CONF.pdf

Attachment 04_Q16_Circuit load graph.pdf

Attachment 05_Q20_Clearance Procedure_CONF.pdf

Attachment 06_Q01 through Q26_Names_CONF.pdf

DR2004061 - Laguna-Hayes - Media_Supplemental.pdf, Supplemental submitted to the CPUC June 8, 2020

Attachment 07_Q03_Evidence_CONF.pdf

Attachment 08_Q11_Log of Protective device.xlsx

Attachment 09_Q11_map.pdf

DR2004061 - Laguna-Hayes - Media_Supplemental 02.pdf, Supplemental submitted to the CPUC June 16, 2020

Attachment 10_ATS Report 006.6-20.3 Rev 1 LAGUNA_HAYES_Final Signed_CONF.pdf