Event Analysis Report

Daly City – Property Damage

EIR No.: EI200621A

Date of Event: June 21, 2020

Date Reported to the CPUC: June 22, 2020

Issue No(s).: CAP # 119200915

Report Rev: 01

[redacted]	[redacted]	04/01/2022
Leadership Approver	Signature	Date
[redacted]	[redacted]	3/7/2022
Incident Investigator	Signature	Date

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1. EXECUTIVE SUMMARY

On June 21, 2020, at 2015 hours, a residential structure fire occurred inside the garage located at [redacted] in Daly City ("Incident Location"). The Incident Location is served by the Daly City 1112 12kV Underground Distribution Circuit. The North County Fire Authority ("NCFA") responded to the fire and requested PG&E's assistance. The troubleman arrived and took voltage readings at the customer's meter panel and found a voltage imbalance reading of 113V and 133V [1]. The troubleman located the underground secondary splice box and found a failed neutral splice[2]. The troubleman repaired the neutral splice and then retested the voltage at the customer's panel and it was within normal limits.

Based upon all information available, the Electric Incident Investigation ("EII") team concluded that PG&E experienced an underground neutral splice failure. PG&E understands that a compromised secondary neutral can cause voltage imbalance and could potentially create a fire hazard due to circuit overload and overheating. The NCFA report indicates that the heat and subsequent fire most likely ignited when clothes from atop a clothes dryer fell onto multiple tool batteries plugged into a power strip coupled with another power strip. Although the failed neutral splice and voltage imbalance could have been a contributing cause of the fire, it is impossible to make this determination definitively.

PG&E reported this incident to the CPUC on June 22, 2020 at 1625 hours under the Property Damage criterion, triggering the investigation by PG&E's EII group. This report summarizes the findings of the investigation.

PG&E performed an Event Analysis investigation which included a site visit, field observations, GO 165 Patrols and Inspections analysis, Secondary Voltage analysis, Transformer Loading Data analysis, Applied Technology Services ("ATS") Failure analysis, SmartMeter analysis, and a Construction Standards and Procedures review.

No potential non-conformances or non-compliances were identified as a result of the EII investigation. A hazard-barrier analysis was performed, and no potential non-conformances/non-compliances were identified as a result of this investigation.

[1] ELEC_RULES_2.C.1.a.pdf

[2] Data Request #1 Question 18.c, PG&E previously stated "No splice was involved in this incident" and is correcting this here in the Event Analysis Report. The splice involved is a compression splice.

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 June 21, 2020, a residential garage fire occurred at the Incident Location, resulting in damage to the customer's garage and contents inside the garage. PG&E dispatched a troubleman who found voltage imbalances at the customer's meter panel and also an underground neutral splice failure.

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

3. **EXTENT OF CONDITION**

3.1. PG&E Ignitions Tracker Database

PG&E conducted a search of its Ignition Tracker Database from 2015 to June 2020. Of the 4,384 ignitions, 2 (excluding this incident) or 0.04% were found to involve underground secondary splice box equipment. The search found two comparable ignitions: one occurring on February 26, 2020 in which the ignition was limited to an underground secondary splice box and the second occurred on June 17, 2020 involving an underground secondary conductor.[3]

[3] Prior to 2020, the Ignitions Tracker Database did not track historical or comprehensive information of underground splice equipment and such, this data set may not be a full representation prior to this timeframe.

3.2. Underground Cables

Secondary cables provide the connections for underground services and distribute electricity at 600 volts (V) and below. The distribution underground secondary cable asset class is comprised of 9,042 circuit miles of 600-V class cable.[4]

Secondary underground cable failures are not currently tracked. Secondary cable failures do not typically release high levels of energy; therefore, they are not considered a safety risk to the public. There are currently no risk based condition monitoring programs in place for secondary underground cable.

3.3 PG&E Material Problem Report Database

This investigation looked at the Material Problem Report ("MPR") database regarding underground connectors and splices. From 2015, the MPR found 59 reported underground (primary and secondary) connector and splice failures with only one or 1.6% that explicitly states a failure due to corrosion and which the MPR team is currently evaluating. Since these materials fail due to melting and charring, they lose any failure morphologies, which creates difficulty in determining the root cause for the failure.

3.4 SAP Data Search

A search in SAP for all open and completed EC tags for similar underground failures was conducted from June 2015 to June 2020 on the Daly City 1112 Distribution Circuit. There was one instance found to have occurred in the same year of this event which occurred in May 2020 on the same circuit involving a splice shown in Figure 1. This incident did not result in a structure fire.

[4] TD-8106 Distribution Line Underground Asset Management Plan (Excluding Network System), Rev. 1 06/2020 (Table 2., page 9, Section 2.3.2.4, page 17, Section 2.3.2.5, page 18)

City	Completn date	Object Code Txt	Circuit
DALY CITY	1/16/2019	Lid/Frame	02264-1108, DALY CITY
DALY CITY	1/16/2019	Hardware	02264-1108, DALY CITY
DALY CITY	2/8/2019	Lid/Frame	02264-1108, DALY CITY
DALY CITY	3/15/2019	Transformer - Padmount	02264-1108, DALY CITY
DALY CITY	4/20/2019	Lid/Frame	02264-1104, DALY CITY
DALY CITY	8/25/2019	Lid/Frame	02264-1108, DALY CITY
DALY CITY	8/25/2019	Lid/Frame	02264-1108, DALY CITY
DALY CITY	9/18/2019	Conductor	
DALY CITY	3/3/2020	Connector/Splice	02264-1104, DALY CITY
DALY CITY	5/21/2020	Connector/Splice	02264-1112, DALY CITY

Figure 1: Extent of Condition SAP search regarding underground connector/splice

4. **EVENT SUMMARY**

Please refer to the 20-Day Report submitted to the CPUC on July 17, 2020, and all included attachments for a summary of the incident and actions taken by the PG&E Troubleman.

The NCFA reports that the fire was contained to the garage where they found:

> "power strip that was piggy backed onto another power strip. The strip that was piggybacked had multiple cordless tool batteries plugged into it. It appears as if some clothes fell on top of the batteries. This caused them to heat up and ignite the clothes. These batteries where next to or on the clothes dryer."[5]

Upon arrival at the Incident Location, a PG&E troubleman spoke with the homeowner who reported that the fire started at the customer-owned surge protector located inside the garage. The troubleman voltage-tested the customer's meter panel which measured 113V and 133V; indicating a voltage imbalance[6]. Next, the troubleman located the underground secondary splice box that serves the Incident Location and found a voltage imbalance of the 120/240V service connection and after troubleshooting the cables, determined the issue to be with the neutral splice. The troubleman then initiated the repair of the underground neutral splice. The troubleman also noted corrosion in and around the neutral splice which he retained as evidence along with the pin terminal connector and rubberized sheath covering. Following the repair, the

[5] North County Fire Authority Report 202020-5100.pdf
[6] ELEC_RULES_2.C.1.a.pdf

troubleman retested at the customer's meter panel and obtained a normal limit voltage test at 0100 hours on June 22, 2020.

See Figure 2 for a diagram of the Incident Location, the UG Secondary Service, and the UG Transformer on the Daly City 1112 12kV Circuit.

4.1. Incident Timeline

Incident Timeline	
Date/Time	Event
June 21, 2020 at 2015 hours	North County Fire Authority received a call to the Incident Location
June 21, 2020 at 2020 hours	North County Fire Authority arrived at the Incident Location and began fire suppression activity inside the garage
June 21, 2020 at 2125 hours	PG&E received an emergency call from North County Fire Authority reporting a structure fire at the Incident Location
June 21, 2020 at 2155 hours	PG&E troubleman received an emergency dispatch regarding a structure fire at the Incident Location
June 21, 2020 at 2200 hours	North County Fire Authority cleared and departed the Incident Location
June 21, 2020 at 2210 hours	PG&E troubleman arrived at the Incident Location and checked the voltage reading at the SmartMeter that measured 113V and 133V

June 21, 2020 at 2215 hours	PG&E troubleman located the underground secondary splice box located halfway down the block, opened the vault lid and tested the neutral cable with an Amp Meter and found no amperage
June 21, 2020 at 2220 hours	PG&E troubleman shut down the power at the customer's meter panel to make the location safe
June 21, 2020 at 2250 hours	PG&E troubleman repaired the cable by replacing the neutral splice at the underground secondary splice box and checked and confirmed normal voltage limits
June 21, 2020 at 2350 hours	PG&E troubleman re-checked voltage readings at the customer meter panel and confirmed voltage was within normal limits
June 22, 2020 at 0020 hours	PG&E troubleman restored power to the Incident Location at the customer meter panel
June 22, 2020 at 0150 hours	PG&E troubleman photographed the Incident Location and the neutral with pin terminal and departs
June 22, 2020 at 1625 hours	PG&E reported the incident to CPUC under the Property Damage criterion
June 24, 2020	The failed neutral and pin terminal connector are collected and tagged into evidence

5. HISTORY

5.1 Asset History

PG&E records indicate that the underground distribution secondary facilities, which includes the secondary splice box, were likely completed in 1970.

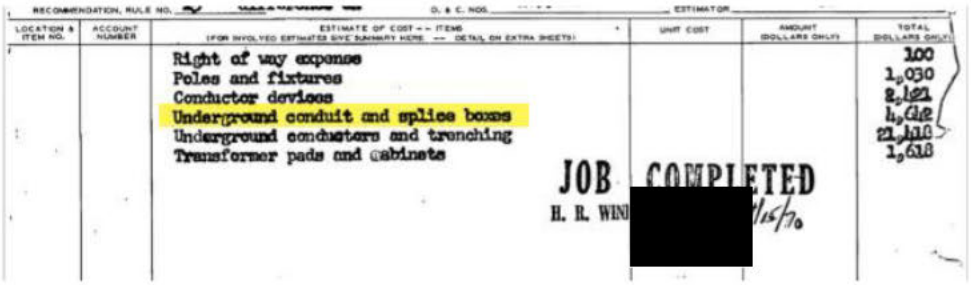
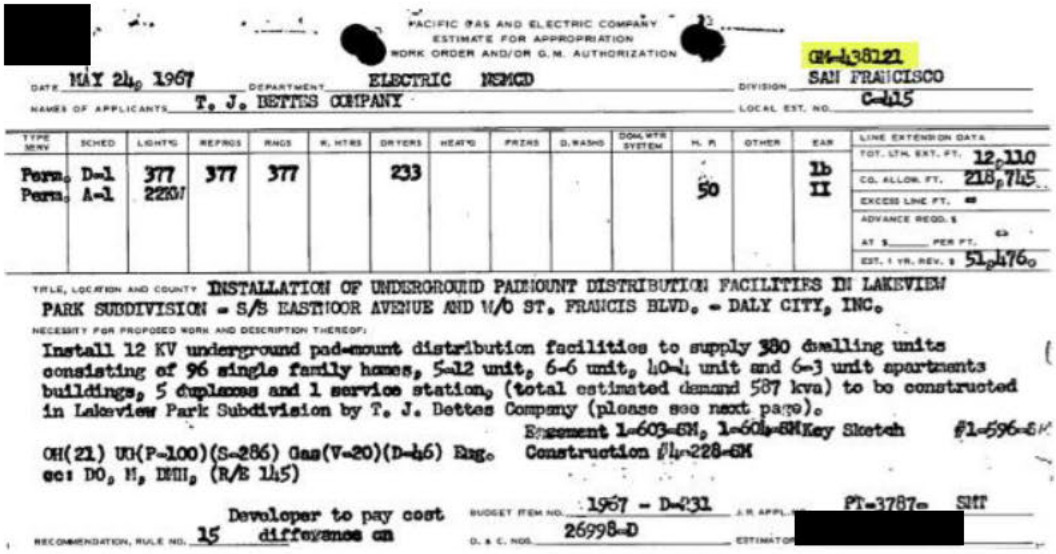


Figure 3: PG&E record indicating when the secondary splice box was most likely complete (these boxes were unmapped at the time of installation)

The secondary service, neutral splice, and pin terminal connector are not identified in the as-built record in 1967. Subsequently, PG&E is unable to determine the install date of these assets. However, the underground service to the Incident Location is currently mapped in the Electric Distribution Geographic Information System. PG&E believes the Incident Location home

was built in 1974[7]. It can be fairly assumed that the splice may have been installed at this time when the house was constructed and is most likely an original installation.

Current guidance from the Electric Distribution As-Built Drawing Handbook [8] includes which documentation is required for underground service cable and secondary boxes, and requires as-built drawings for these assets.



[redacted] PACIFIC GAS AND ELECTRIC COMPANY
ESTIMATE FOR APPROPRIATION
WORK ORDER AND/OR G.M. AUTHORIZATION
G4-438121

DATE MAY 24, 1967 DEPARTMENT ELECTRIC MSMCD DIVISION SAN FRANCISCO
NAMES OF APPLICANTS T. J. DETTES COMPANY LOCAL EST. NO. C-415

TYPE SERV	SCHED	LIGHTG	REFRIG	RNGS	H. HTRS	DRYERS	HEATG	FRZRS	D.WASHS	DOM. HTR SYSTEM	H. P.	OTHER	EAR	LINE EXTENSION DATA
Perm.	D-1	377	377	377		233					50		1b	TOT. LTH. EXT. FT. 12,110
Perm.	A-1	2237											II	CO. ALLOW. FT. 218,745
														EXCESS LINE FT.
														ADVANCE REQD. $
														AT $ PER FT.
														EST. 1 YR. REV. $ 51,476.

TITLE, LOCATION AND COUNTY INSTALLATION OF UNDERGROUND PAIRMOUNT DISTRIBUTION FACILITIES IN LAKEVIEW PARK SUBDIVISION - S/S EASTMOOR AVENUE AND W/O ST. FRANCIS BLVD. - DALY CITY, INC.

NECESSITY FOR PROPOSED WORK AND DESCRIPTION THEREOF:
Install 12 KV underground pad-mount distribution facilities to supply 380 dwelling units consisting of 96 single family homes, 5-12 unit, 6-6 unit, 10-4 unit and 6-3 unit apartments buildings, 5 duplexes and 1 service station, (total estimated demand 587 kva) to be constructed in Lakeview Park Subdivision by T. J. Dettes Company (please see next page).
Easement 1-603-SM, 1-604-SM Key Sketch #1-596-SM
OH(21) UG(P-100)(S-286) Gas(V-20)(D-46) Eng. Construction #1-228-SM
cc: DO, M, DHM, (R/E 145)

RECOMMENDATION, RULE NO. 15 Developer to pay cost difference on BUDGET ITEM NO. 1967 - D-231 J.O. APPL. PT-3787- SHT
D. & C. NOS. 26998-D ESTIMATOR [redacted]

Figure 4: As-built record for subdivision development record dated May 24, 1967

6. OBSERVATIONS & EVENT ANALYSIS

PG&E performed an Event Analysis investigation of the incident which included a site inspection, field observations, GO 165 Patrol and Inspections analysis, Secondary Voltage analysis, Transformer Loading Data analysis, ATS Failure analysis, SmartMeter analysis, and Construction Standards and Procedures review. Observations from these analyses are summarized below. These analyses found no conclusive physical or documentary evidence to identify the apparent cause of the fire.

6.1 Field Observations

[7] ATS report "Metallurgical Evaluation of a Failed Splice from the Secondary Neutral Connection at the Splice box located at [redacted] in Daly City" Report #: 413.62-22.12, Dated February 22, 2022

[8] TD-2051M Electric Distribution As-Built Drawing Handbook, December 2016 (pages 50, 51 & 53)

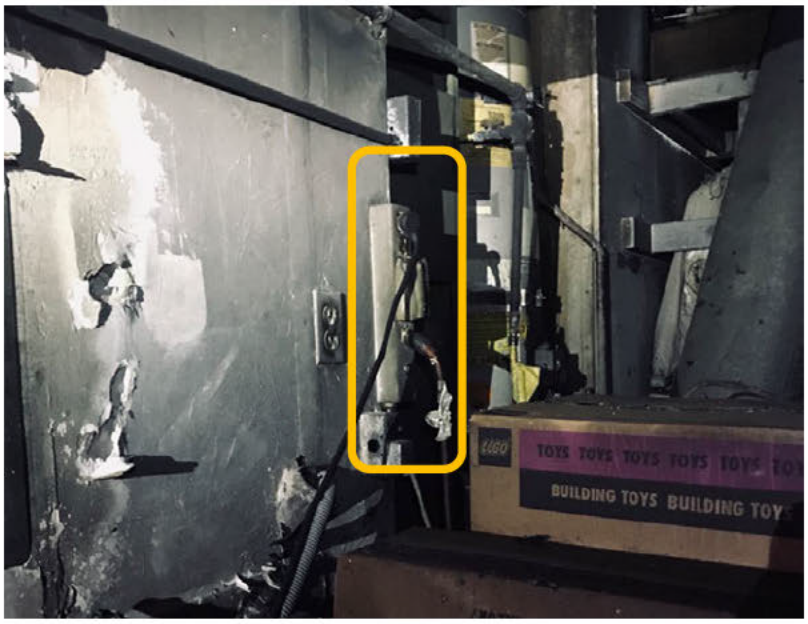
Observations were made by the responding troubleman on the date of the incident, by NCFA, and EII personnel:

- Observation 1: On the date of the incident, NCFA observed that the fire was located inside the garage, near the garage main door leading to the home. The fire was concentrated on the back wall inside of the garage. The NCFA report indicates that the heat and subsequent fire appears to have ignited when clothes from atop a clothes dryer fell onto multiple tool batteries plugged into a power strip coupled with another power strip. The small fire charred the corner of the garage and damaged the contents inside the garage that produced a lot of heat and smoke. The source was from the customer's powered equipment that may have electrically failed and malfunctioned.

- Observation 2: On the date of the incident, the responding troubleman found an imbalance voltage reading at the Incident Location SmartMeter of 113V and 133V; outside the allowable voltage limit. The troubleman quickly found a neutral splice and pin connector at the underground secondary splice box and after testing with the Amp meter, repaired the neutral wire. The troubleman re-tested the meter at the customer's panel and found the voltage to be within normal limits.

Photograph 1: Taken on June 22, 2020 of the secondary neutral splice with pin terminal connector (Top) and rubberized cover (Bottom) that was recovered by the troubleman

Photograph 2: Taken by the troubleman on June 21, 2020 of the outside of the Incident Location and boarded garage



Photograph 3: Taken by the troubleman on June 21, 2020 inside of the garage that depicts the customer's 50v surge protector plugged into a second surge protector

- Observation 3: On October 4, 2021 the EII investigator met with the PG&E restoration supervisor at the Incident Location and inspected the repair by the troubleman. There were no anomalies found.

Photograph 4: Taken on October 4, 2021 of the secondary splice box lid

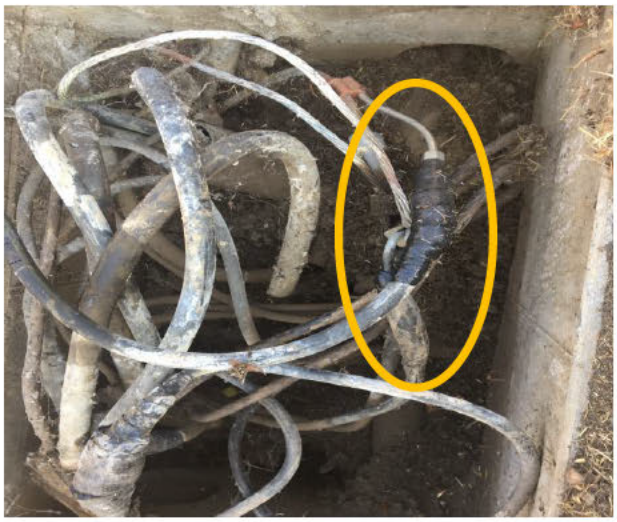


Photo 5: Taken on October 4, 2021 of the neutral splice repair previously made by the troubleman

6.2 GO 165 Patrols and Inspections Analysis:

The last underground ("UG") inspection prior to the incident took place on May 18, 2018 and the last UG Patrol was on May 23, 2019. Neither showed any anomalies at the Incident Location.

Patrol and inspection of secondary enclosures include only a visual evaluation of the exterior of visible enclosures to identify obvious structural hazards or problems.[9] Secondary cable failures

[9] The words boxes/enclosures have the same meaning and are used interchangeably in this report.

do not typically release high levels of energy; therefore, they are not considered a safety risk from a public safety and service reliability perspective[10].

6.3 Secondary Voltage Analysis

PG&E looked at the SmartMeter voltage profile for the Incident Location six months prior to the incident. The voltage analysis show voltage within normal limits of 228V - 252V for a secondary 120/240V service.

Figure 5: Historical voltage data from January 2020 to July 2020

On the date of the incident, the data shows the voltage for the Incident Location is within the normal limit of 228V - 252V pursuant to Rule 2.[11]

[10] TD-8106 Line Underground Asset Management Plan (Excluding Network System), Rev. 1, 06/2020 (Section 2.3.2.4, page 17, Section 2.3.2.5, page 18)
[11] ELEC_RULES_2.pdf

Figure 6 Voltage data on the date of the incident

6.4. Transformer Loading Data Analysis

Transformer loading data was analyzed for the underground transformer serving the Incident Location (CGC #314273643707) twelve months prior to the incident date. The data shows the maximum customer usage for each month on the transformer. There is no known instance that transformer loading, over time, could cause or contribute to a secondary neutral splice to fail.

Transformer loading is the outcome, not the cause of customer added load. Customer loading is connected to the transformer through secondary and service conductors.[12] Customer loading patterns can overload the phase and neutral service conductors (that serve a single customer) as well as the secondary conductors (that serve multiple customers) and any connections involved including the transformer itself. Because the neutral of a 120/240V service carries the difference in amperes between each leg of a 120/240V single phase service, the neutral conductor cannot singularly be overloaded past its ampacity rating without also overloading a

[12] Transformer loading is caused by the customer's load and not the transformers loading condition

phase conductor. This loading can only be caused by the customer's load and not the transformer loading condition.

6.5 ATS Failure Analysis

The troubleman retained the neutral splice and pin connection with the rubberized cover on June 22, 2020 and was provided to ATS for failure analysis. The purpose of the evaluation was to metallurgically evaluate the failed neutral splice and pin connection to determine the failure mechanism and document the results of the evaluation. The utilized laboratory techniques were Visual Examination and Scanning Electron Microscopy ("SEM").

ATS Conclusion

Based on the visual examination of the inside surface of the splice and the copper wire, it can be concluded that the splice failed by arcing as evidenced by melted globules on the copper wire. Whitish corrosion debris could be seen on the splice as well as the edge of the splice in this region of the damaged insulation. This corrosion was attributed due to liquid water and moisture ingress through the cracked insulation.

If the secondary neutral connection is open or compromised, objectionable neutral current will flow on metal parts of the electrical system. Additionally, the operating voltage for the loads on one line can rise, while the operating voltage for the other line(s) will drop resulting in a load imbalance. When voltages exceed or drop below the electrical equipment ratings, it can result in circuit overload and cause overheating which can pose a fire hazard. Additionally, the neutral service conductor serves as the effective ground-fault current path and when it is damaged open, or missing, protective devices may not timely clear a ground fault. As a result, metal parts of electrical equipment may become energized at line voltage resulting in components getting hot.

6.6 SmartMeter Analysis

A SmartMeter analysis was conducted of all 20 meters served by the underground transformer (CGC #314273643707) located on Saint Marks Court. No outage activity was noted 24 hours prior to the incident or around the time of the garage structure fire at the Incident Location. On the day of the incident, all 20 meters had voltages within the normal limit of 228V - 252V. Searching a year prior to the incident, the PG&E Voltage Reliability Team does not have any

records of voltage complaints for these customers. The first indication of the power loss and Last Gasp for the Incident Location was at the time the troubleman took the Incident Location out of power at 2220 hours.

6.7 Construction Standards and Procedures Review

PG&E's underground construction standard document, 015251 - Connectors for Insulated Cables Underground Distribution Systems (dated 2/21/1978) is the most applicable PG&E standard. This document identifies Burndy as the manufacturer for pin terminal YE25AG14, which is believed to be the model of the failed neutral splice. This model appears to be the correct application for joining 19-strand 1/0 aluminum and #2 Cu cable according to the PG&E standard.[13]

7. **CAUSE & CONTRIBUTING CAUSES**

PG&E found the cause of the secondary splice failure was due to corrosion and subsequent arcing. It is possible this failure contributed to the fire at the Incident Location, but ultimately it is unknown. The NCFA report indicates that the heat and subsequent fire ignition appears to have ignited when clothes from atop a clothes dryer fell onto multiple tool batteries plugged into a power strip coupled with another power strip.

A hazard-barrier analysis was performed, and no corrective/general actions were identified as a result.

[13] Document 015251 “Connectors For Insulated Cables Underground Distribution Systems – Sheet No. 27 dated 2/21/1978

Barrier Analysis					
Hazard:	Failed UG Secondary Neutral Splice				
Target:	UG Secondary Neutral Conductor				
Barrier	**Objective**	**Expected Performance**	**Did Barrier Perform as Expected**	**Did Barrier Contribute to Incident**	**Defect**
Patrol and Inspection Records	Identify any nonconformances with PG&E assets UG, OH structure. (PG&E assets)	Patrol or Inspections would identify any compelling abnormalities with PG&E equipment	Yes, PG&E conducted GO 165 Patrols on 3/4/2016 and 5/23/2019 and Inspections on 1/26/2015 and 5/18/2018 did not detect any abnormal conditions at the underground transformer	No	None found
Design and Construction Standard 015251 for Connectors for insulated Cables Underground Distributions Systems	PG&E standardizes which equipment for various applications	The correct equipment s used per PG&E standards	Yes	No	None found
PG&E-Voltage Complaint Inspection (TD-2011P-03)	Customer contacts PG&E to report a possible voltage complaint concern	Inspection would identify any related issues on PG&E side or customer side of electrical system. If it is a customer related ssue, the customer is required to make repairs	Unknown. The customer did not contact PG&E with any voltage complaint related concerns (searched from a year prior to the ncident)	Unknown	None

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

No corrective or general actions were identified as a result of this investigation.

9. REFERENCES

Internal Databases

PG&E Ignition Event Database inquiry

Material Problem Report Database inquiry

SAP Search of Underground Splice Failures (EC Tag Notifications) inquiry

EIR Reportable Data, inquiry

Voltage Reliability Data inquiry

Transformer Loading Data inquiry

Internal Documents

Document 015251 “Connectors For Insulated Cables Underground Distribution Systems – Sheet No. 27, dated 2/21/1978

Electric Rule 2.C.1.a

TD-2011P-03 Voltage Complaint Inspection Rev. 0, 08-15-2017
TD-2051M-Electric Distribution As-Built Drawing Handbook, Rev. 0, December 2016 (pages 50, 51 and 53)

TD-2305M-Electric Distribution Preventative Maintenance Manual Publication Date: April 1, 2016 (pages 120, 126 and 136)

TD-8106 Distribution Line Underground Asset Management Plan (Excluding Network System), Revision 1, 06/2020 (Table 2., page 9, Section 2.3.2.4, page 17, Section 2.3.2.5, page 18)

Reports:

ATS report "Metallurgical Evaluation of a Failed Splice from the Secondary Neutral Connection at the Splice box located at [redacted] in Daly City" Report #: 413.62-22.12, Dated March 25, 2022

10. **ATTACHMENTS**

Attachment 01_ATS Metallurgical Evaluation Report# 413.62-22.12, Rev. 1_CONF.pdf

Attachment 02_North County Fire Authority Report 2020-5100_CONF.pdf

11. **PREVIOUSLY COMPLETED REPORTS AND DATA REQUESTS**

20-Day Report

EI200621A_Daly City - Property Damage_20-Day.pdf, submitted to the CPUC July 17, 2020

Attachment 01_2016 GO165 patrol records_CONF.pdf

Attachment 02_2019 GO165 patrol records_CONF.pdf

Attachment 03_2015 GO165 inspection records_CONF.pdf

Attachment 04_2018 GO165 inspection records_CONF.pdf

Attachment 05_FAS tag 5419634008_CONF.pdf

Attachment 06_Post-Incident photographs_CONF.pdf

Attachment 07_North County Fire Authority Incident Fire Report 2020-5100.pdf

Attachment 08_Incident Map-Diagram_CONF.pdf

Data Request

DRU-2764: Data Request #1, submitted to the CPUC on August 31, 2020

Attachment 01_Q01-Q19_Names_CONF.pdf

Attachment 02_Q02_Investigators_Witnesses_CONF.pdf

Attachment 03_Q04_Evidence Location_CONF.pdf

Attachment 04_Q16_DalyCity_Internal Data_20200715160938_12_Hour Prior_CONF.xlsx