INVESTIGATION REPORT
OF THE DECEMBER 4, 2017 WILDFIRE
IN SANTA PAULA, CALIFORNIA
INVOLVING SOUTHERN CALIFORNIA EDISON FACILITIES
THAT CAME TO BE KNOWN AS THE THOMAS FIRE

SAFETY AND ENFORCEMENT DIVISION

ELECTRIC SAFETY AND RELIABILITY BRANCH
LOS ANGELES

TABLE OF CONTENTS

Page

Definitions

Circuit breaker - An electrical component that incorporates automatic operation and protective features to monitor, control, and protect downstream circuits from excess current and other potentially damaging electrical transients.

Electrical fault - Any abnormal electric current wherein electric current is redirected or interrupted from its intended electric path. Examples of faults are short-circuit and open-circuit faults.

Fault isolation - A process to isolate sections of a circuit to determine the exact location and cause of a fault.

Lockout - When a circuit breaker relays to lockout, it opens and an additional protective lockout circuit is activated. In these instances, the lockout circuit needs to be manually reset by an operator before the circuit breaker can be closed again. The purpose of the lockout circuit is to notify the operator that one of the protective sensing elements within the circuit breaker control center (also called a Relay) has sensed a problem and that the circuit breaker, as well as the entire circuit to which it is connected, needs to be investigated.

No Test Order (NTO) – An NTO is an operation restriction that Edison system operators must implement to guarantee that electrical equipment associated with a work site will not be re-energized following a relay operation on a circuit. An NTO must be requested by a qualified electrical worker after he/she has determined that the electrical hazards associated with the work performed are such that an NTO is appropriate and necessary for safety. When a qualified electrical worker holds an NTO on a circuit, all automatic reclosing equipment directly associated with the work performed on the circuit will be made non-automatic, preventing the automatic re-energization of the circuit in the event of a relay operation. The jurisdictional switching center provides the NTO and only the worker that requested the NTO may release it.

Power restoration - A process to return from abnormal to normal electrical circuit conditions. Normal circuit conditions can be defined in terms of power sources, current paths, and power recipients.

Remote Automatic Reclosers (RAR) - RARs are small circuit breakers located at the top of distribution poles and are typically used on very long distribution feeders. Their function is to isolate a section of the feeder in fault or overload conditions and thereby minimize the number of customers without service. Since they act as small circuit breakers, they have the capability to restore power automatically in temporary fault situations, hence the name "recloser".

Remote Control Switch (RCS) - RCSs are devices installed on a circuit for the purpose of sectionalizing the circuit to facilitate power restoration. They are not load-breaking switches and do not function as protective devices. RCSs operate after a

circuit has already been de-energized for a set amount of time, thereby assisting in restoration by automatically isolating certain sections of a circuit.

Red Flag Warning (RFW) - A warning issued by the National Weather Service to indicate that warm temperatures, very low humidity, and stronger winds are expected to combine to produce an increased risk of fire danger.

Relay (noun) - An electrically automated operated switch. It is a programmable microprocessor-based device that provides control, protection, automation, monitoring, and metering for circuit breakers and the electrical distribution circuits to which circuit breakers are electrically connected.

Relay (verb) - When a circuit breaker "relays," it changes positions. It can change from the open position to the closed position or vice versa, based on the design of the control circuit for the circuit breaker. Distribution scale circuit breakers utilize relay circuits for the opening and closing functions of a circuit breaker.

Sectionalize - Use intervening switch gear and other devices (i.e. circuit breaker, pole switch, recloser, relay, drop-out fuse) to break electrical connections, therefore dividing a distribution circuit into electrically isolated sections.

Switch - A device for making and breaking a connection in an electrical circuit.

System Operating Bulletin (SOB) – Southern California Edison (SCE) uses SOBs to define operating procedures, policies, and restrictions for both regular and conditional operations.

Tie wire – A length of wire used to affix a conductor to an insulator.

I. Summary of Incident:

At 1823 hours on December 4, 2017, a wildland fire that came to be known as the Thomas Fire was reported in the city of Santa Paula in Ventura County.[1] At 1841 hours, remote automatic recloser (RAR) 1228 on Southern California Edison's Castro 16 kV circuit relayed to a lockout.[2] The initial outage following this operation impacted a total of 31 customers and resulted in over 354,000 customer-minutes of interruption (CMI).[3] As the Thomas Fire spread, outages on December 4, 2017 would eventually impact over 260,000 Edison customers.[4]

[1] County of Santa Barbara Fire Department Report CA-VNC-103156.

[2] Bates SCE-SED00003451.

[3] Bates SCE-SED00003150.

[4] Bates SCE-SED00014370.

The California Department of Forestry and Fire Protection (CAL FIRE) and the Ventura County Fire Department (VCFD) performed a joint investigation into the causes of the ignition of the Thomas Fire and determined that Edison's facilities were the source of two separate ignitions that eventually merged together during the course of the fire. One ignition site was adjacent to a private residence along Koenigstein Road, an offshoot of California State Route 150, and the other ignition site was in the Anlauf Canyon area of Ventura County.

At the Koenigstein Road site, VCFD found that an energized section of 16 kV conductor supported between Edison utility pole number 729565E and utility pole number 729566E failed, fell down, and ignited dry brush at the base of utility pole number 729566E.[5] At the Anlauf Canyon site, VCFD found that a fire started when multiple 16 kV conductors came into contact with each other, also referred to as wire-slap, which released particles of molten metal that ignited dry brush.[6] The conductors were suspended between Edison utility poles numbered 1025341E, 1202085E, and 3002114E.[7] The exact start time of each fire is unknown, however the Santa Barbara County Fire Department recorded a notice of the existence of a fire in Anlauf Canyon on December 4, 2017 at 1823 hours.[8] The Santa Barbara County Fire Department notice is consistent with the first phone report to Station 20 of the Ventura County Fire Department and with the statements of a witness at Koenigstein Road at 1930 hours on the same day.[9]

The Thomas Fire burned 281,893 acres[10] and was fully controlled on January 12, 2018.[11] The Thomas Fire destroyed 1,063 structures, damaged 280,[12] and resulted in two fatalities; one civilian and one firefighter.[13] Edison reported the total cost of repair to its facilities due to the Thomas Fire to be $49,422,744.[14]

[5] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103338, Dated: December 4, 2017.

[6] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017.

[7] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017.

[8] County of Santa Barbara Fire Department Report CA-VNC-103156.

[9] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017.

[10] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017.

[11] https://www.fire.ca.gov/incidents/2017/12/4/thomas-fire/

[12] https://www.fire.ca.gov/incidents/2017/12/4/thomas-fire/

[13] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017.

[14] Bates SCE-SED00004155.

Among the responding fire departments for the Thomas Fire were CAL FIRE, Ventura County Fire Department (VCFD), Santa Barbara County Fire Department, City of Ventura Fire Department, and the City of Santa Paula Fire Department.[15] The Thomas Fire origin area was located in a Tier 3 (i.e. "Elevated" fire risk) area of the California Public Utilities Commission's (CPUC) High Fire Threat District (HFTD) map. The burn area included both Tier 2 and Tier 3 HFTD areas.[16]

A. Violation(s):

SED reviewed and analyzed records, inspected and examined physical evidence, and interviewed witnesses related to this incident to determine compliance with Commission rules and regulations. SED determined that Edison committed five (5) violations of the PU Code and Commission rules:

- One (1) violation of GO 95, Rule 38, Minimum Clearances of Wires from Other Wires; one (1) violation of GO 95, Rule 31.1, Design, Construction and Maintenance; and one (1) violation of PU Code §399.2(a):
  - Edison failed to maintain a minimum required clearance between the conductors on the Castro 16 kV circuit.
- One (1) violation of GO 95, Rule 19, Cooperation with Commission Staff and one (1) violation of PU Code § 316:
  - Edison failed to provide the list of evidence and records used for Edison's own investigation.
  - Edison failed to provide all photographs, notes, reports, and text messages generated by first responders to the incident.

[15] https://www.fire.ca.gov/incidents/2017/12/4/thomas-fire/

[16] The HFTD was not formally adopted until 2018, after the ignition of this fire, therefore enhanced rules and regulations applicable to Tiers 2 and 3 of the HFTD were not applicable to this location at the time of the incident.

II. Background

A. Witnesses

Table 1: Witnesses in SED's Investigation

No.	Name	Title	Address
1	Koko Tomassian	SED Investigator	320 W. 4th St, Los Angeles, CA 90013
2	Joceline Pereira	SED Investigator	320 W. 4th St, Los Angeles, CA 90013
3	Bryan Pena	SED Investigator	320 W. 4th St, Los Angeles, CA 90013
4	Julie Olin	Edison Claims Advisor	2244 Walnut Grove Ave, Rosemead, CA 91770
5	Eric Coolidge	Edison Claims Advisor	2244 Walnut Grove Ave, Rosemead, CA 91770

B. Evidence

Table 2: Evidence in SED's Investigation

No.	Description
1	Edison 315 Letter dated December 29, 2017
2	SED Investigator Data Request (DR) SED-001 and responses
3	SED Investigator Data Request (DR) SED-001B and responses
4	SED Investigator Data Request (DR) SED-002 and responses
5	SED Investigator Data Request (DR) SED-003 and responses
6	SED Investigator Data Request (DR) SED-004 and responses
7	SED Investigator Data Request (DR) SED-005 and responses
8	SED Investigator Data Request (DR) SED-006 and responses
9	SED Investigator Data Request (DR) SED-007 and responses
10	SED Investigator Data Request (DR) SED-009 and responses
11	CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017
12	CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103338, Dated: December 4, 2017
13	County of Santa Barbara Fire Department Report CA-VNC-103156
14	JHNolt Associates Project Status Memorandum – Thomas Fire, dated October 24, 2018

C. Description of Edison Facilities

Edison's Castro 16 kV circuit is fed from the Wakefield substation and incorporates three primary protective devices.[17] These devices provide power sensing and protection for the Castro 16 kV circuit starting from the furthest point upstream in the circuit at the Wakefield substation.[18]

[17] Bates SCE-SED00004194.

[18] Bates SCE-SED00003446.

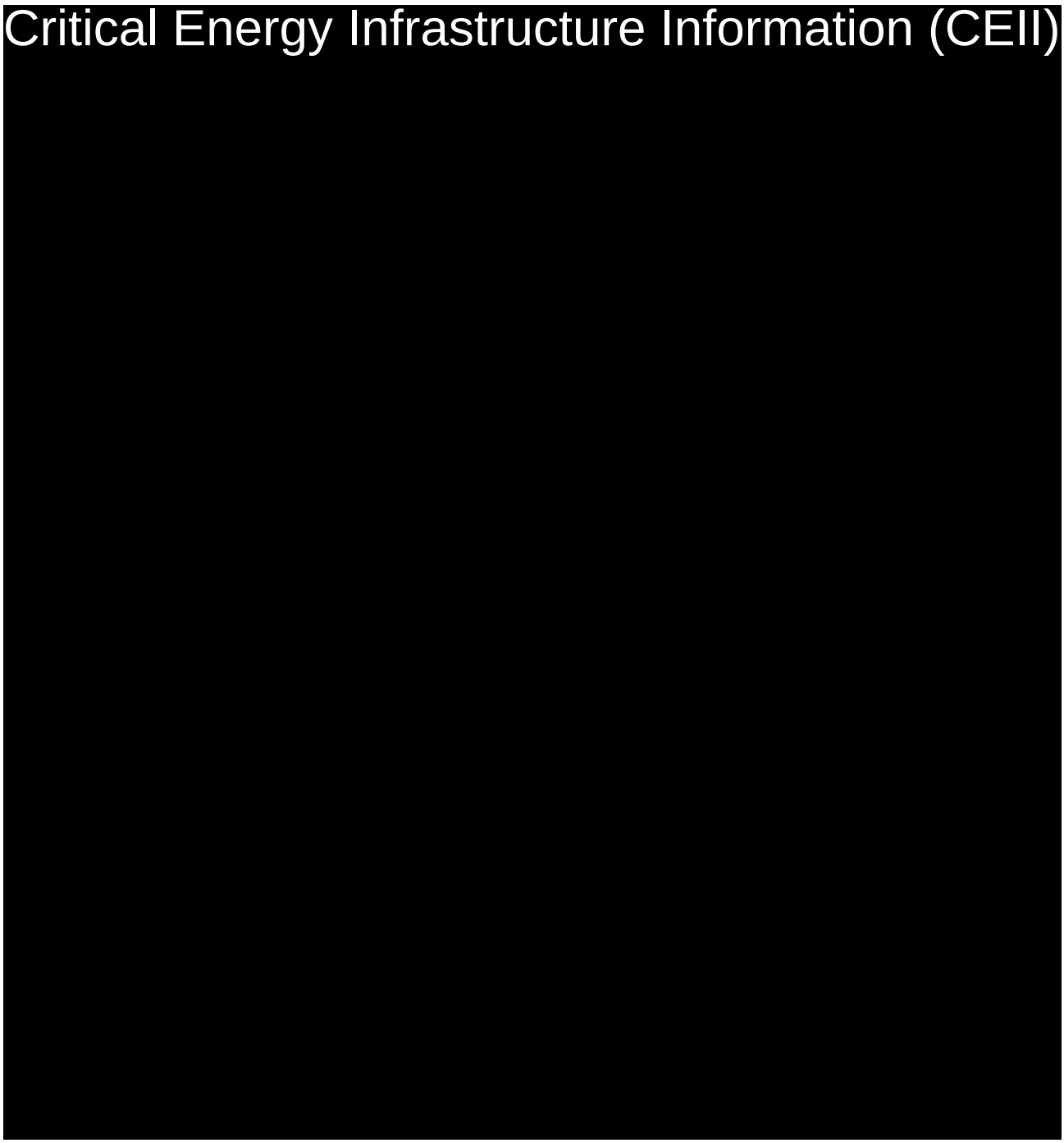

Figure 1: Edison's Castro 16 kV circuit map[19]

These devices are configured to monitor the circuit at different locations and send a signal to selectively interrupt and de-energize different sections the circuit after detecting a predetermined fault condition. The devices are normally configured to wait a set amount of time before they then send an additional signal to re-energize sections of the circuit by re-establishing circuit continuity. The devices then test the circuit to see if

[19] Bates SCE-SED00004194.

the fault condition has cleared. If fault condition is still present, the protective devices will interrupt and de-energize the circuit again. However, if the fault is cleared, the circuit will remain energized.

During Red Flag Warnings (RFWs), Edison implements SOB 322 which restricts automatic relay and reclose operations in fire hazard areas. In these instances, circuit breakers and remote automatic reclosers on circuits affected by SOB 322 are made non-automatic and will lockout following the first relay operation. After a lockout, an Edison employee must patrol the circuit to determine whether it is safe to reenergize the circuit as required by Section 5.1 of SOB 322.[20] According to Edison's records, SOB 322 was put into effect on the Castro 16 kV circuit on December 3, 2017 and remained in effect throughout the day of the Thomas Fire incident on December 4, 2017.[21]

The first circuit protection device, located within the Wakefield Substation, is the Castro 16 kV circuit breaker and relay which was a Mitsubishi Electric Power Products medium voltage circuit breaker with manufacture's designation MEPPI17D25-1 and ABB Relay DPU2000R protection system.[22] The second circuit protection device, located downstream of the main circuit breakers, was RAR 0179 which consisted of a Cooper RXE recloser equipped with a Schweitzer Engineering Laboratories SEL-351R-2 relay.[23] The third circuit protection device, located on a branch circuit downstream of RAR 0179, was RAR 1228 which consisted of a G&W Viper recloser equipped with a Schweitzer Engineering Laboratories SEL-351R-4 relay.[24]

The protection devices equipped to monitor the Castro 16 kV circuit were enabled to provide overcurrent protection as well as protect against certain other circuit conditions. This means that the devices were set to sense different types of overcurrent conditions on the circuit and respond by selectively de-energizing the circuit in the affected sections. The downed conductor at Koenigstein Road as well as the wire slap event in Anlauf Canyon likely caused separate overcurrent conditions on the Castro 16 kV circuit. Edison's records indicate that there were automatic operations of both RAR 0179 at 1927 hours[25] and RAR 1228 at 1841 hours[26] on December 4, 2017. The timing of the circuit events as expressed by different witnesses at Koenigstein Road and within Anlauf Canyon were corroborated with the timing of the protection system operations as recorded by Edison's circuit protection system.

[20] Bates SCE-SED00003591.

[21] Bates SCE-SED00014019.

[22] Bates SCE-SED00003445.

[23] Bates SCE-SED00003445.

[24] Bates SCE-SED00003446.

[25] Bates SCE-SED00003450.

[26] Bates SCE-SED00003452.

The Edison facilities involved at the Koenigstein Road incident site included the downed center conductor of No. 4 ACSR overhead primary conductor between utility poles numbered 729566E and 729565E as well as all interconnecting components used to suspend the conductor. The poles were Douglas fir wooden poles[27] that supported the overhead conductors using pin-type insulators with vise tops that held conductors in place using a clamp-style mechanism at the top of the insulator. Utility pole 729566E was a 50-foot class H1[28] pole and utility pole 729565E was a 45-foot class 2[29] pole. The linear distance between the two poles that supported the downed primary conductor was approximately 274 feet.[30]

The Edison facilities involved in the Anlauf Canyon incident site include three 16 kV No. 4 ACSR conductors suspended between utility poles numbered 1025341E, 1202085E, and 3002114E, totaling six spans of conductors. Utility pole 1025341E was a 45-foot class H3[31] pole. Utility pole 1202085E was a 45-foot class 4[32] pole. Utility pole 3002114E was a 45-foot class 4[33] pole. The linear distance between utility pole 1025341E and 1202085E was approximately 71 feet. The linear distance between utility pole 1202085E and 3002114E was approximately 271 feet.[34] Unlike the Koenigstein Road incident location, the conductors at Anlauf Canyon were found suspended in the air and not in contact with the ground.

Evidence collection for both of the Thomas Fire incident locations, Anlauf Canyon and Koenigstein Road, began on December 28, 2017.[35] All evidence associated with both of the Thomas Fire incident locations was retained by CALFIRE, the Ventura County Fire Department or Southern California Edison.[36]

D. Description of Events

On December 3, 2017, the National Weather Service forecasted that strong Santa Ana winds would impact parts of Edison's service territory with extreme fire danger expected and issued a RFW at 2200 hours.[37]

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[27] Bates SCE-SED00010010.

[28] American National Standards Institute (ANSI) O5.1 wood pole class.

[29] American National Standards Institute (ANSI) O5.1 wood pole class.

[30] Bates SCE-SED00010010.

[31] American National Standards Institute (ANSI) O5.1 wood pole class.

[32] American National Standards Institute (ANSI) O5.1 wood pole class.

[33] American National Standards Institute (ANSI) O5.1 wood pole class.

[34] Bates SCE-SED00012863, SCE-SED00013011, SCE-SED00013135.

[35] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017.

[36] Bates SCE-SED00009815, SCE-SED00009820.

[37] Bates SCE-SED00014019.

On December 4, 2017 at 1817 hours, a phase-to-phase fault event occurred between the A phase conductor and the B phase conductor of the Castro 16 kV circuit, downstream from RAR 1228.[38] The magnitude of the fault current was 908 Amps and the duration was not recorded by the protection system event recorder.[39] It is typical of protection devices, such as RAR 1228, to be configured to measure and consider both fault amplitude and fault duration before safety actions are triggered. The circuit at Anlauf Canyon was constructed of three different types of primary conductor, including #4 and 1/0 ACSR, and 4 AWG copper wire, having current carrying capacity ratings of 160, 280, and 195 amps respectively.[40] In this instance, though the phase-to-phase fault relay settings of RAR 1228 were set at 200 amps,[41] the combination of the fault current amplitude and the duration of the fault current were not high enough to cause RAR 1228 to operate and de-energize the circuit. Also at 1817 hours, two smart meters on the Castro 16 kV circuit, Meter No. 256000-035324 and Meter No. 259000-065411, registered a low voltage event lasting approximately two seconds.[42] At 1826 hours, a fire was reported in Anlauf Canyon, east of Steckel Park in Santa Paula.[43,44] At 1841 hours, RAR 1228 registered a second phase-to-phase fault event on the same conductors, measuring a magnitude of 1,593 Amps and a duration of 0.49 seconds, which caused protective device RAR 1228 to relay and lockout, de-energizing the circuit downstream of the device.[45] When RAR 1228 opened, de-energizing the section of the Castro 16 kV circuit in Anlauf Canyon, it remained open and did not test and reclose due to SOB 322 being in effect on that circuit.[46]

Around the same time[47] an Edison troubleman reported to the Anlauf Canyon area after an Edison dispatcher notified him of the presence of a fire in the area; however, the troubleman left the area after CAL FIRE denied him access. The troubleman returned later that night, at the direction of his field supervisor, to assist CAL FIRE's operations in removing damaged Edison facilities.[48]

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[38] Bates SCE-SED00013460.

[39] Bates SCE-SED00013460.

[40] Bates SCE-SED00010189.

[41] Bates SCE-SED00003446.

[42] Bates SCE-SED00010200, SCE-SED00010194.

[43] Edison 315 Letter dated December 29, 2017.

[44] Under PU Code 315, public utilities must file a report for every accident that meets incident reporting requirements. This is informally known as a "315 Letter."

[45] Bates SCE-SED00013460.

[46] Bates SCE-SED00014019.

[47] Edison was unable to provide an exact time for the troubleman's arrival at the Anlauf Canyon area.

[48] Examination Under Oath EUO [redacted] 013019.

On December 4, 2017, in a different area of Santa Paula, but along the same Castro 16 kV circuit, RAR 0179 experienced a fault at or about 1927 hours. Edison reported that the time recorded by its protective system may be different from the actual time of the event.[49] The fault caused RAR 0179 to relay and lockout, de-energizing the Castro 16 kV circuit downstream of RAR 0179. The magnitude of the fault current was 618 Amps and the duration of the fault current was 1.16 seconds. The fault was a phase-to-ground fault on the C phase conductor of the circuit.[50] At the time of the events described above, the Thomas Fire area (including the area around Koenigstein Road) was already secured by CAL FIRE. Edison personnel did not gain access to the area until later permitted by CAL FIRE.

On December 7, 2017, CAL FIRE informed Edison that its facilities were under investigation in relation to the ignition of fires in the vicinity of Koenigstein Road and Anlauf Canyon.[51]

CAL FIRE and VCFD eventually concluded that, in the Anlauf Canyon area of Santa Paula, Edison facilities experienced one or more wire slapping events which lead to the ejection of molten metal particulate that ignited dry brush and started the Thomas Fire.[52] In the Koenigstein Road area of Santa Paula, CAL FIRE and VCFD concluded that a downed primary conductor owned by Edison ignited a separate fire on the same day.[53]

[49] Bates SCE-SED00003449.

[50] Bates SCE-SED00004217.

[51] Bates SCE-SED00004154.

[52] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017.

[53] CAL FIRE and VCFD Joint Thomas Fire Report – Case Number: 17CAVNC103156, Dated: December 4, 2017.

III. SED's Investigation

A. Observations and Findings: Koenigstein Road

Edison conducted detailed inspections of the utility poles around the Koenigstein Road ignition site in August of 2014.[54] The inspections uncovered safety issues relating to pole moldings, high voltage signs, and pole tags, but reported no issues specific to the primary high voltage conductors, insulators, or fasteners that held the conductors in place.

During the initial visit to the ignition site along Koenigstein Road on December 8, 2017, SED investigators discovered that the exact location of the downed Edison conductor was a residential property at [redacted] Koenigstein Road, Santa Paula, California, 93060. The homeowner was home at the same time as the approximated circuit interruption action of RAR 0179. The homeowner provided statements to SED investigators that she heard an explosion, then moved to a location where she witnessed sparks falling to the ground, then witnessed the start of the fire.[55]

Upon surveying the Koenigstein site, SED investigators observed one end of the center conductor laying on the ground between poles numbered 729565E and 729566E. Multiple points along the conductor were frayed out but remained unbroken, commonly referred to as bird caging. Sections of the conductor were also blackened or charred. It was not apparent whether the discoloration on the conductor was due to an electrical event that occurred on the circuit or due to the fire. The bird caging, damaged conductor end, faults noted on the circuit (as described earlier in this report), and witness statements are all consistent with a failed conductor leading to a ground fault, fire, and circuit interruption on Edison's Castro 16 kV circuit downstream of RAR 0179.

SED analyzed the fault metrics reported by Edison concerning the circuit activity recorded at approximately 1927 hours on December 4, 2017 by RAR 0179[56], and compared them to the operational characteristics of the protection device monitoring that section of the Castro 16 kV circuit.[57] SED's analysis concluded that the device operated as expected with an actual relay time delay being recorded at 1.08 seconds[58], which corresponded to the expected time delay given by the Institute of Electrical and Electronics Engineers (IEEE) C37.112 standard for inverse-time operation characteristics of overcurrent relays.

[54] Bates SCE-SED00011942.

[55] Interview Questions Form, 12/08/2017, [redacted].

[56] Bates SCE-SED00004217.

[57] Schweitzer Engineering Laboratories SEL-351R-2 Recloser Control Instruction Manual.

[58] Bates SCE-SED00004217.

Site photos depict the Koenigstein ignition site, pole 729566E, and pole 729565E. The primary conductor failed towards the 729566E side of the span and remained attached on the 729565E side.

Figure 2: SED photo Koenigstein site, 729566E at the fore, 729565E at the rear.

Figure 3: SED photo of Koenigstein site, 729565E with center primary conductor laying on the ground.

CAL FIRE removed and stored as evidence both ends of the center conductor running between poles numbered 729565E and 729566E. Depicted below in Figure 4 is one end of the failed conductor which appears charred, melted, and is missing material, thereby not appearing as a complete continuous conductor. The other end of the failed conductor shown in Figure 5, is hidden by multiple wraps of black electrical tape. At the time of SED's inspection of the failed conductor, CAL FIRE did not allow SED to remove the electrical tape and examine the other end of the failed conductor. If, at a later date, CAL FIRE conducts a controlled viewing of the end of the conductor covered in electrical tape, then SED investigators will document findings in an updated version of this report.

Figure 4: SED photo of Koenigstein evidence, one end of failed conductor.

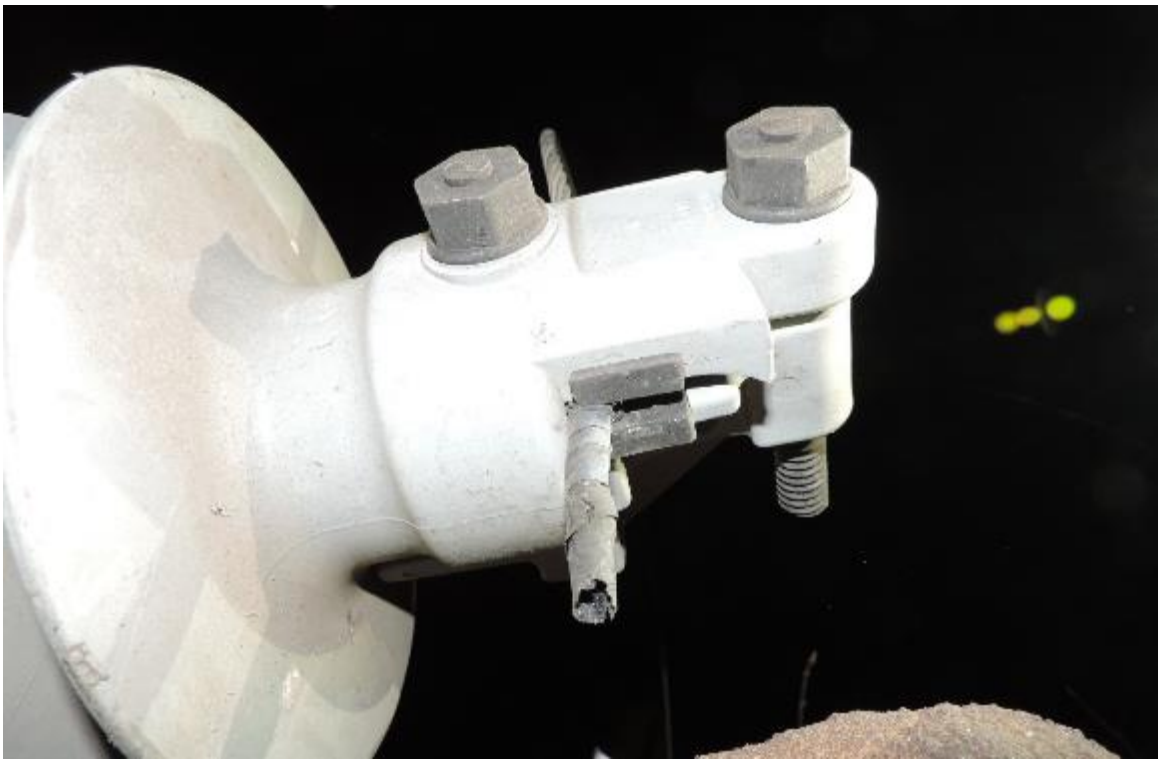

Figure 5: SED photo of Koenigstein evidence, other end of failed conductor (covered with electrical tape) still attached in the vise of the insulator mounted to 729566E

B. Observations and Findings: Anlauf Canyon

The most recent detailed inspection of the utility poles related to the Anlauf Canyon ignition site was conducted by Edison in May of 2013. No findings or notifications resulted from this inspection.[59] During its annual patrol inspection for the same area, Edison uncovered issues related to pole tags and ground moldings, with no issues reported related to conductor condition.[60]

SED visited Anlauf Canyon on December 28, 2017 to examine poles numbered 1025341E, 1202085E, and 3002114E and their associated conductors. The figure below depicts the configuration of the three subject poles. By the time SED had arrived, Edison had already removed the conductors from the poles at the request of CAL FIRE, therefore SED was unable to observe these conductors in their original state immediately following the incident. Edison had cut down the top of pole 1202085E. The conductors had been removed from their connections on poles numbered 1025341E and 3002114E and lain across the ground in the same configuration as they were when they were attached to the poles. CAL FIRE retained the three lengths of conductor at its Fresno facility. Edison retained the top of pole 1202085E.

[59] Bates SCE-SED00011942

[60] Bates SCE-SED00011817

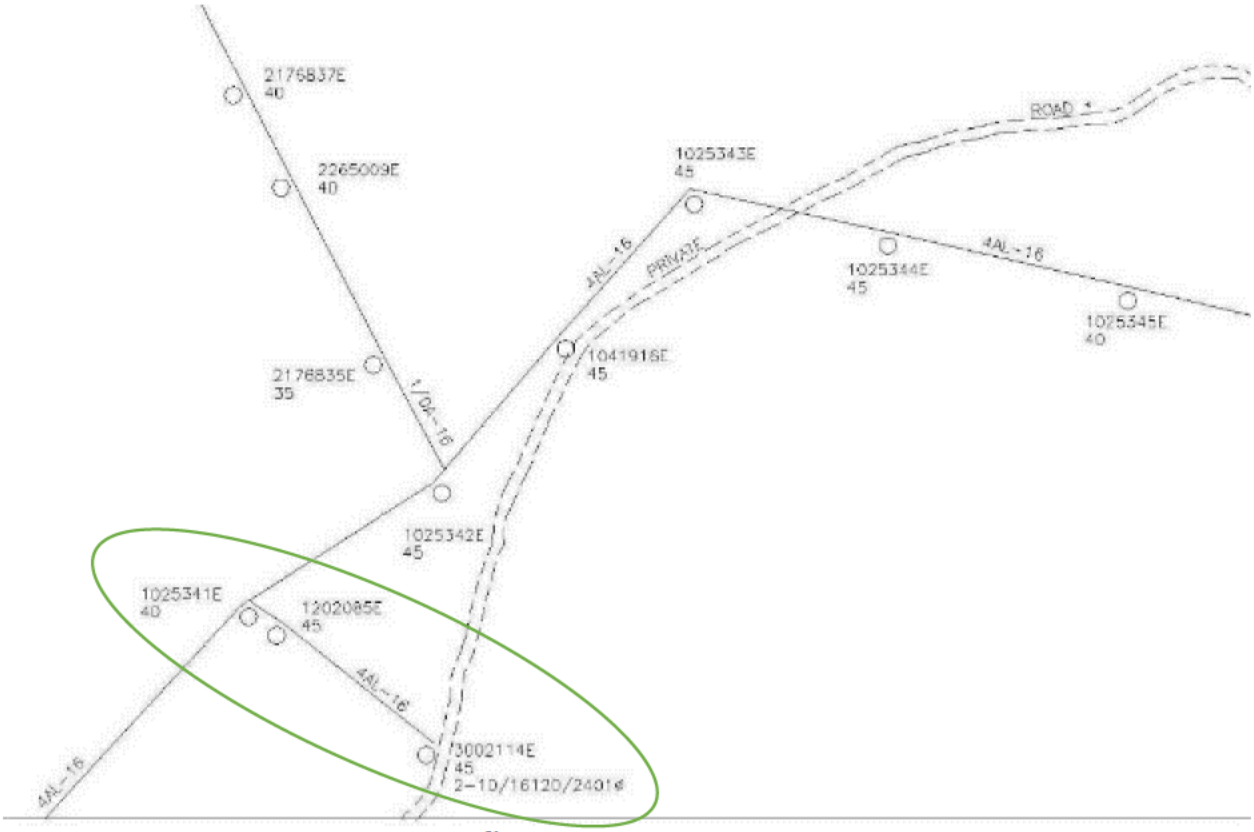

Figure 6: FIM Anlauf Canyon area of interest[61]

[61] Bates SCE-SED00009852.

Figure 7: SED photo of Anlauf Canyon site, the top of pole 1202085E removed by Edison.

SED observed damage on the east and center conductors including burn marks, arc marks, and loss of material referred to as “pitting” as shown in the figures below. Pitting is an indicator that wire-slap has occurred; however, SED was unable to determine how recently these pitting marks were made. SED examined these same conductors at CAL FIRE’s Fresno facility on February 7, 2017, and found further evidence of damage, including broken strands and bird caging. However, CAL FIRE denied SED’s request to unravel the conductors to examine them more closely. Because SED could not unravel the conductors, SED was unable to take measurements to estimate the location of the damage on the conductors and review the relative locations of the observed damage along the conductors, which would have been useful to confirm whether the damage corresponded in location to similar damage on the adjacent conductor. Corresponding damage would support the conclusion that two or more conductors had made contact.

Figure 10: SED photo of Anlauf Canyon site, pitting on the east conductor between poles numbered 3002114E and 1202085E.

Figure 11: Edison photograph depicting damage on two unidentified adjacent conductors between poles numbered 1025341E and 3002114E.[62]

[62] Bates SCE-SED00004897.

Figure 12: Edison photograph depicting damage on the center conductor between poles numbered 1025341E and 1202085E.[63]

[63] Bates SCE-SED00004872.

Figure 13: SED photo of February 2017 Anlauf Canyon evidence examination, damage on the east conductor between poles numbered 1025341E and 3002114E.

Figure 14: SED photo of February 2017 Anlauf Canyon evidence examination, arc marks and bird-caging on the east conductor between poles numbered 1025341E and 3002114E.

Figure 15: SED photo of February 2017 Anlauf Canyon evidence examination, burn marks and broken strands on center conductor between poles numbered 1025341E and 3002114E.

SED met with VCFD and CAL FIRE investigators on November 27, 2018, and again on December 13, 2018, to discuss findings related to the Thomas Fire. On November 27, 2018, VCFD shared its investigative work that led to its conclusion that there was conductor-to-conductor contact in Anlauf Canyon. VCFD obtained surveillance video footage from several sources that show two flashes of light occurring simultaneously at approximately 1817 hours. VCFD attributed the flashes of light to arcing events resulting from contact between two conductors. VCFD also noted that some of the footage captured the early moments of the fire ignition, minutes before the first eyewitnesses called 911 at 1823 hours. VCFD used the surveillance camera footage to determine the general location of the two flashes of light. Its assessment was that the flashes of light originated in Anlauf Canyon. SED investigators were unable to obtain and analyze the surveillance video footage.

During the meeting with VCFD on November 27, 2018, SED obtained a written report dated October 24, 2018, by JHNolt Associates, an independent contractor who employs electrical, mechanical, and corrosion engineers. CAL FIRE and VCFD contracted with JHNolt Associates to examine the area of the Thomas Fire. JHNolt Associates identified "considerable evidence of line slap" on the conductors between pole 3002114E and a non-Edison pole servicing third-party equipment.[64] JHNolt Associates identified these conductors as having "the highest density of line-slap arc damage" relative to CAL FIRE and VCFD's area of interest.[65] The written report included no information on the condition of other conductors in the examined area. However, JHNolt Associates later examined the damage that VCFD identified on the conductors between poles 3002114E and 1202085E and confirmed that the damage appeared consistent with an arc event.[66]

SED analyzed the fault metrics reported by Edison concerning the circuit activity recorded by RAR 1228[67] and compared them to the operational characteristics of the protection device monitoring that section of the Castro 16 KV circuit.[68] SED concluded that the second event recorded by the RAR's event recorder at 1841 hours, the device operated as expected with an actual relay time delay being recorded at 0.43 seconds[69], which corresponded to the expected time delay given by the IEEE C37.112 standard for inverse-time operation characteristics of overcurrent relays. Edison reported that the fault magnitude and duration were not significant enough for the RAR to operate during the first fault event.[70]

[64] JHNolt Associates Project Status Memorandum – Thomas Fire, dated October 24, 2018.

[65] JHNolt Associates Project Status Memorandum – Thomas Fire, dated October 24, 2018.

[66] County of Santa Barbara Fire Department Report CA-VNC-103156.

[67] Bates SCE-SED00013460.

[68] Schweitzer Engineering Laboratories SEL-351R-4 Recloser Control Instruction Manual.

[69] Bates SCE-SED00013460.

[70] Bates SCE-SED00013460.

SED did not determine any source of ignition or any unusual events on Edison's facilities that may have led to the ignition of a fire. SED's conclusion regarding the ignition events that happened at Anluaf Canyon and Koenigstein Road are based on the joint VCFD-CAL FIRE report.

C. Violations

SED reviewed and analyzed records, examined physical evidence, and interviewed witnesses related to this incident to determine compliance with Commission regulations. SED's investigation discovered three (3) violations.

General Order 95, Rule 38 - Minimum Clearances of Wires from Other Wires, states:

> *The minimum vertical, horizontal or radial clearances of wires from other wires shall not be less than the values given in Table 2 and are based on a temperature of 60° F. and no wind. Conductors may be deadended at the crossarm or have reduced clearances at points of transposition, and shall not be held in violation of Table 2, Cases 8–15, inclusive.*
>
> *The clearances in Table 2 shall in no case be reduced more than 10 percent, except mid-span in Tier 3 of the High Fire-Threat District where they shall be reduced by no more than 5 percent, because of temperature and loading as specified in Rule 43 or because of a difference in size or design of the supporting pins, hardware or insulators. All clearances of less than 5 inches shall be applied between surfaces, and clearances of 5 inches or more shall be applied to the center lines of such items. The utilities of interest (including electric supply and/or communication companies) shall cooperate and provide relevant information for sag calculations for their facilities, upon request.*

General Order 95, Rule 38, Table 2, Case 17, Column F requires 16 kV conductors of the same circuit to maintain clearance of 6 inches.

Violation 1.

VCFD and CAL FIRE concluded in their joint investigation of the Anlauf Canyon ignition site that two or more conductors of the same circuit between poles numbered 1025341E, 1202085E, and 3002114E made contact on December 4, 2017. When the conductors made contact, their clearance was reduced to almost zero, therefore Edison violated GO 95, Rule 38, because it did not ensure that its conductors maintained the minimum clearance. SED's conclusion is based on the information in the joint VCFD-CAL FIRE report.

General Order 95, Rule 31.1 - Design, Construction and Maintenance, states:

> *Electrical supply and communication systems shall be designed, constructed, and maintained for their intended use, regard being given to the conditions under which they are to be operated, to enable the furnishing of safe, proper, and adequate service.*
>
> *For all particulars not specified in these rules, design, construction, and maintenance should be done in accordance with accepted good practice for the given local conditions known at the time by those responsible for the design, construction, or maintenance of communication or supply lines and equipment.*
>
> *A supply or communications company is in compliance with this rule if it designs, constructs, and maintains a facility in accordance with the particulars specified in General Order 95, except that if an intended use or known local conditions require a higher standard than the particulars specified in General Order 95 to enable the furnishing of safe, proper, and adequate service, the company shall follow the higher standard.*
>
> *For all particulars not specified in General Order 95, a supply or communications company is in compliance with this rule if it designs, constructs and maintains a facility in accordance with accepted good practice for the intended use and known local conditions.*

GO 95, Rule 31.1 requires utilities to design, operate, and maintain their facilities for their intended purpose and in a safe manner consistent with industry standard practices and based on known local conditions.

Violation 2

Edison records indicate that detailed inspections were conducted on the power lines at Anlauf Canyon on February 14, 2008 and again on May 2, 2013 and that inspectors failed to identify any deficiencies. Edison's Inspection Procedures for Overhead Detailed Inspections require that Edison inspectors check the condition of conductors for excessive slack. Excessive slack could make it easier for conductors to make contact during windy conditions.

Under GO 95, Rule 31.1, Edison is required to design its facilities so that it can provide safe and adequate service, and in accordance with accepted good practice and for the intended use of its facilities and known local conditions. Additionally, GO 95, Rule 38 requires Edison to install and maintain safe clearances between its overhead conductors to prevent them from contacting each other. Rule 38 also requires that "The clearances in Table 2 shall in no case be reduced more than 10 percent, except mid-span in Tier 3 of the High Fire-Threat District where they shall be reduced by no more than 5 percent, because of temperature and loading as specified in Rule 43." Rule 43

require utilities to account for "A horizontal wind pressure of 8 pounds per square foot of projected area on cylindrical surfaces" when designing and maintaining their overhead conductors. In this case, 8 pounds per square inch would result in 56 MPH.

The fact that the conductors made contact during wind conditions that are normal to the local area, and the fact that the contact occurred at a wind speeds less than 56 MPH demonstrates that Edison did not maintain its overhead conductors safely and with the proper clearance. Edison should have designed and maintained its overhead to prevent contact. Edison could have accomplished this either by providing more clearance between its conductors or by using spacers to prevent contact. Edison inspectors should have recognized the potential for wire-slap in the primary conductors at Anlauf Canyon and should have mitigated the hazard. Edison's failure to properly maintain its overhead conductors by recognizing the need/necessity to increase the clearance between them, resulted in an ignition and ultimately, the fire.

California Public Utilities (PU) Code – PU Code § 399.2, states in part:

> (*a)(1) It is the policy of this state, and the intent of the Legislature, to reaffirm that each electrical corporation shall continue to operate its electric distribution grid in its service territory and shall do so in a safe, reliable, efficient, and cost-effective manner.*

PU Code § 399.2 require utilities to operate their facilities in a safe manner.

Violation 3

Edison failed to operate its facilities in a safe and reliable manner. When the overhead conductors made contact, they caused an ignition that started the fire. Edison should have maintained the clearance of its overhead conductors in a manner consistent with the clearance specified in GO 95, Rule 38. Edison should have recognized during its last detailed inspection that the clearance between its overhead conductors was not sufficient to prevent contact during windy conditions. By failing to recognize the danger imposed by improper clearance, Edison failed to operate its facilities safely as required by PU Code § 399.2, thus, causing an ignition that started the fire.

General Order 95, Rule 19 - Cooperation with Commission Staff; Preservation of Evidence Related to Incidents Applicability of Rules, states:

> *Each utility shall provide full cooperation to Commission staff in an investigation into any major accident (as defined in Rule 17) or any reportable incident (as defined in CPUC Resolution E-4184), regardless of pending*
> *litigation or other investigations, including those which may be related to a*

Commission staff investigation. Once the scene of the incident has been made safe and service has been restored, each utility shall provide Commission staff upon request immediate access to:

- *Any factual or physical evidence under the utility or utility agent's physical control, custody, or possession related to the incident;*
- *The name and contact information of any known percipient witness;*
- *Any employee percipient witness under the utility's control;*
- *The name and contact information of any person or entity that has taken possession of any physical evidence removed from the site of the incident;*
- *Any and all documents under the utility's control that are related to the incident and are not subject to the attorney-client privilege or attorney work product doctrine.*

Any and all documents or evidence collected as part of the utility's own investigation related to the incident shall be preserved for at least five years. The Commission's statutory authorization under Cal. Pub. Util. Code §§ 313, 314, 314.5, 315, 581, 582, 584, 701, 702, 771, 1794, 1795, 8037 and 8056 to obtain information from utilities, which relate to the incidents described above, is delegated to Commission staff.

California Public Utilities Code – PU Code § 316, states:

Each electrical corporation shall cooperate fully with the commission in an investigation into any major accident or any reportable incident, as these terms are defined by the commission, concerning overhead electric supply facilities, regardless of pending litigation or other investigations, including, but not limited to, those that may be related to a commission investigation.

(a) After the scene of the incident has been made safe and service has been restored, each electrical corporation shall provide the commission, upon its request, immediate access to all of the following:

(1) Any factual or physical evidence under the electrical corporation's, or its agent's, physical control, custody, or possession related to the incident.

(2) The name and contact information of any known percipient witness.

(3) Any employee percipient witness under the electrical corporation's control.

(4) The name and contact information of any person or entity that has taken possession of any physical evidence removed from the site of the incident.

(5) Any and all documents under the electrical corporation's control that are related to the incident and are not subject to attorney-client privilege or attorney work product doctrine.

(b) Each electrical corporation shall preserve any and all documents or evidence it collects as part of its own investigation related to the incident for at least five years or a shorter period of time as authorized by the commission.

Any and all documents collected by an electrical corporation pursuant to this section shall be catalogued and preserved in an accessible manner for assessment by commission investigators as determined by the commission.

General Order 95, Rule 19 and PU Code § 316 require that utilities cooperate with Commission staff, including SED, for the purposes of investigating accidents.

Violations 4 and 5.

During the course of its investigation of this incident, SED requested documents from Edison.[71] In one request, SED asked for a comprehensive list of all evidence and records that Edison would be using in its own investigation of the incident.[72] Edison objected to the request and did not comply, citing the attorney work product doctrine as the basis of its objection. In other incident investigations SED has discovered, through data request inquiries, that Edison creates maintenance, operation and/or repair records beyond the Commission's explicit General Order requirements. As is the case with all electric utilities, SED relies on Edison to maintain such internal records for its equipment and programs and provide such records to SED investigators when requested to do so. Under such circumstances, unless Edison had directly provided the records themselves or included such records in a comprehensive list, SED investigators would otherwise be unaware of their existence. By not providing a list of all evidence and records to SED, Edison impeded SED's ability to perform its own evidence review. Furthermore, Edison's actions prevented SED from reviewing all of the records available for the subject equipment or programs involved in the incident that may have contributed to the cause or circumstances that led up to the incident, impending SED's ability to conduct a thorough investigation.

[71] SED Investigator Data Request SED-001, SED-001B, SED-002, SED-003, SED-004, SED-005, SED-006, SED-007, SED-008, SED-009, SED-010.

[72] Bates SCE-SED00009814.

In another data request, SED asked that Edison provide all photographs, notes, reports, and text messages generated by Edison's first responders, which captured their observations of the start of the incident.[73] Edison objected to this request and did not comply, citing the attorney work product doctrine as the basis for its objection. Instead, Edison provided Interruption Log Sheets, repair orders, and photographs which were a limited subset of first responder documents that SED requested.

Because the destructive force of a wildfire can quickly alter a scene and destroy evidence, the earliest observations can be critical to understanding the events that occurred and determining the potential findings of an investigation. By not providing the comprehensive set of data and evidence that SED requested, Edison impeded and prolonged SED's investigation. Edison's actions prevented SED from reviewing all available information from the point at which the fire had least disturbed the electric facilities. The actions of Edison's first responders cannot preemptively be under the direction of Edison counsel. Any notes, reports, or text messages that SED requested would not be generated under the direction of Edison counsel and accordingly should not be subject to attorney-client or work product privilege.

For the reasons stated above, SED's investigation determined that Edison is in violation of PU Code § 316 and GO 95, Rule 19 for failing to provide: the list of evidence and records used for Edison's own investigation, as well as photographs, notes, reports, and text messages generated by first responders. In the spirit of full and transparent cooperation with the Commission and its staff, it is imperative that Edison respond to SED data requests with the most comprehensive information available. Without such comprehensive information, SED cannot conduct a thorough investigation, determine the root cause of the incident, expeditiously remedy any issues and prevent future similar incidents from occurring.

[73] Bates SCE-SED00011709.

IV. Conclusion

SED's investigation discovered that Edison committed five (5) violations of PU Code and Commission rules:

- One (1) violation of GO 95, Rule 38, Minimum Clearances of Wires from Other Wires; one (1) violation of GO 95, Rule 31.1, Design, Construction and Maintenance; and one (1) violation of PU Code §399.2(a):
  - Edison failed to maintain a minimum required clearance between the conductors on the Castro 16 kV circuit.
- One (1) violation of GO 95, Rule 19, Cooperation with Commission Staff and one (1) violation of PU Code § 316:
  - Edison failed to provide the list of evidence and records used for Edison's own investigation.
  - Edison failed to provide all photographs, notes, reports, and text messages generated by first responders to the incident.

If SED becomes aware of additional information pertaining to this incident that could modify SED's findings in this Incident Investigation Report, SED may re-open the investigation and may modify this report or take further actions as appropriate.