CALIFORNIA PUBLIC UTILITIES COMMISSION
Safety and Enforcement Division
Electric Safety and Reliability Branch

Incident Investigation Report

Report Date: 04/29/2015

Incident Number: E 20140515-01

Utility: Southern California Edison

Date and Time of the Incident: 5/15/2014, 3:14:00 AM

Location of the Incident: 6439 Danby Ave.
Whittier, CA
County: Los Angeles

Summary of Incident:

A Southern California Edison (SCE) 12 kV overhead copper conductor broke and fell to the ground. A person contacted the downed conductor and was electrocuted. Safety and Enforcement Division's (SED's) investigation found that high contact resistance between an aluminum one-bolt parallel groove connector and the copper conductor caused the copper conductor to fail and fall to the ground.

Fatality / Injury: There was 1 fatality reported.

Property Damage: $48,966

Utility Facilities involved: Bronco, 12 kV Circuit

Witnesses:

	Name	*Title/Role*	*Phone*
1	Richard Kyo	CPUC - SED Investigator	
2	Gregory Greene	SCE Senior Claims Rep.	626-302-6667
3	John Nieves	Resident of 6439 Danby	323-712-0433

Evidence:

	Source	*Description*
1	SCE	Initial Report, 05/15/2014
2	CPUC/SED	Field Visit, 05/15/2014
3	CPUC/SED	Interview with John Nieves, 05/15/2014
4	SCE	Final Report, 06/10/2014
5	LA Sheriff's Dept.	Incident 2014-03379-1575-493
6	SCE	Data Request Response, 03/26/2015
7	SCE	Supplemental Data Request Response, 04/27/2015

Observations and Findings:

On May 15, 2014 at 0252 hours, a mallard duck flew into the west conductor of SCE's 12 kV Bronco circuit between poles numbered 857342E and 857343E located in the rear of 10414 Rose Hedge Drive. The impact caused the west conductor to contact the center conductor. The resulting fault current caused the center conductor between poles numbered 857342E and 857343E and the east conductor between poles 875336E and 875337E to fail and fall to the ground.

Juan Manuel Nieves, resident of 6439 Danby Avenue, left his house to investigate a loud noise. He stepped on the east conductor previously supported by poles numbered 875336E and 875337E and was electrocuted. At 0311 hours, SCE was notified of the incident by the Los Angeles County Sheriff's Department Pico Rivera Station.

On May 15, 2014 at approximately 0800 hours, SED's investigator Richard Kyo arrived at the incident location. Mr. Kyo observed that the high voltage signs facing the incident area were in good condition. Mr. Kyo also observed that the east conductor on pole number 857336E separated at an aluminum-to-copper, one-bolt parallel groove connector. The connector joined an American Wire Gauge (AWG) No. 6 copper conductor to an AWG No. 4 ACSR (aluminum conductor steel reinforced) conductor.

Poles numbered 857342E and 857343E are 69.5 feet apart. The duck was found 26.5 feet north of pole number 857343E. The center conductor supported by poles number 857342E and 857343E broke at approximately mid-span. Poles numbered 857336E and 857337E are 155 feet apart.

Mr. Kyo interviewed John Nieves, son of Juan Manuel Nieves. He indicated the following: At around 0249 hours, there was a loud bang. Juan Nieves went into the backyard to investigate. The backyard was very dark. Juan was not aware of the energized, downed conductor. The downed conductor was "moving around" and contacted Juan. Juan was shocked and fell to the ground. The conductor hit his stomach. Juan grabbed the conductor with his right hand, moved the conductor away, and then expired. Paramedics were called afterwards.

Mr. Kyo observed SCE take the following measurements at the rear of 6439 Danby Avenue:

- Above ground clearance of west conductor at crossarm on pole number 857336E: 31 feet three 3 inches.
- Above ground clearance of center conductor at crossarm on pole number 857336E: 31 feet three 8 inches.
- Above ground clearance of east conductor at crossarm on pole number 857336E: 32 feet three 1 inch.
- Horizontal clearance of west conductor to center conductor crossarm on pole number 857336E: 34.5 inches.
- Horizontal clearance of center conductor to east conductor crossarm on pole number 857336E: 70 inches.
- Above ground clearance of west conductor at crossarm on pole number 857337E: 34 feet three 1 inch.
- Above ground clearance of center conductor at crossarm on pole number 857337E: 34 feet three 1 inch.
- Above ground clearance of east conductor at crossarm on pole number 857337E: 34 feet.
- Horizontal clearance of west conductor to center conductor on crossarm on pole number 857337E: 39.5 inches.
- Horizontal clearance of center conductor to east conductor on crossarm on pole number 857337E: 70 inches.

Additionally, Mr. Kyo observed SCE take the following measurements at the rear of 10414 Rose Hedge Drive:

- Above ground clearance of west conductor at crossarm on pole number 857342E: 32 feet three 6 inches.
- Above ground clearance of center conductor at crossarm on pole number 857342E: 32 feet three 6 inches.
- Above ground clearance of east conductor at crossarm on pole number 857342E: 32 feet three 5 inches.
- Horizontal clearance of west conductor to center conductor crossarm on pole number 857336E: 84 inches.
- Horizontal clearance of center conductor to east conductor crossarm on pole number 857336E: 28 inches.
- Above ground clearance of west conductor at crossarm on pole number 857343E: 35 feet.
- Above ground clearance of center conductor at crossarm on pole number 857343E: 34 feet three 6 inches.
- Above ground clearance of east conductor at crossarm on pole number 857343E: 33 feet, six inches.

- Horizontal clearance of west conductor to center conductor on crossarm on pole number 857343E: 27 inches.
- Horizontal clearance of center conductor to east conductor on crossarm on pole number 857343E: 78 inches.

GO 95, Rule 37, *Minimum Clearances of Wires above Railroads, Thoroughfares, Buildings, Etc.*, states in part:

> The clearances specified in Table 1, Cases 2 to 6 inclusive, shall in no case be reduced more than 10% below the tabular values because of temperature and loading as specified in Rule 43 or other conditions.

Table 1, Case 3, Column E, requires the ground clearance of 12 kV supply conductors in areas accessible to pedestrians only to be no less than 15.3 feet. The above ground clearances noted above met this requirement.

GO 95, Rule 38, *Minimum Clearances of Wires from Other Wires*, states in part:

> The clearances in Table 2 shall in no case be reduced more than 10 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.

Table 2, Case 15, Column F, requires horizontal spacing of 12 kV supply conductors on the same crossarm to be no less than 15.75 inches. The horizontal conductor clearances noted above met this requirement.

SCE inspected poles numbered poles numbered 857342E and 857343E on November 29, 2010 with no findings. SCE inspected pole number 857336E on May 12, 2010 with no findings, and inspected pole number 857337E on June 15, 2011 and found damaged ground molding. The poles were most recently patrolled on January 9, 2014 with no findings. At the time of the incident, pole number 857337E had an open work order for a damaged ground molding.

Weather station KCAWHITT4, located approximately 0.75 miles east of the incident location, recorded the following weather information:

Time	Wind speed	Wind gust	Temperature
0250 hours	0 mph	0 mph	26.2 ºC / 71.9 ºF
0255 hours	0 mph	0 mph	22.3 ºC / 72.1 ºF

To date, SCE has not conducted any tests on the No. 6 copper conductor supported between poles numbered 857336E and 857337E to determine its exact cause of failure.

One highly plausible explanation for the connector failure is that the conductor failed at a high

resistance point. SCE indicated the following in its letter dated April 25, 2015:

> *"Edison notes that the conductor separated at its interface with a connector, which was attached to the conductor on the line side of a rigid copper dead-end. However, the main reason for a conductor to part is high temperature. Electrical current flowing through a conductor can elevate the temperature of the conductor to a level above ambient temperature. All conductors have an annealing temperature and a melting temperature. Annealing temperature is that temperature which can cause the conductor to soften, and lose some of its tensile strength. Melting temperature is that temperature which can cause the conductor to lose all of its tensile strength and therefore separate. High conductor temperature can be attributed to a fault on the electrical system, which causes a very high magnitude of current to flow through the conductor. At times, the magnitude of the current causes the temperature of the conductor to exceed its annealing and/or melting temperature."*

Applying IEEE Standard 738-1993 and the ambient conditions at the time of the incident, Mr. Kyo's analysis found that the conductor reached a temperature where reduction of tensile strength in the conductor was insufficient to cause it to fail.

Conductors and their associated components are installed and maintained with the intent to create a low resistance path to deliver electrical current. Galvanic corrosion occurs when two metals of different nobility (e.g. aluminum is anodic and copper is cathodic) come into contact in the presence of an electrolyte such as water. Many connectors come preinstalled with corrosion inhibiting grease. If the connector did not come preinstalled with grease, utility personnel would apply the grease prior to connecting the conductors. During the service life of the conductor, the grease may dry out and as a result lead to the propagation of corrosion deposits. Corrosion deposits have high resistance; therefore the formation of such products in the aluminum-to-copper interface of the connector increases contact resistance. During a fault current event, this high contact resistance may lead to the connector failing when a clean connector may not have failed. Mr. Kyo concluded that contaminants such as dirt or metallic oxides as a result of galvanic corrosion likely accumulated in the interface between the automatic splice and conductor. This would have created a high resistance contact point that potentially caused the conductor to heat up significantly above its melting point and fail during the fault current.

Aluminum connectors are installed and maintained with the intent to create a low resistance contact between the aluminum connector and any associated conductors (in this case, a copper conductor). When the contact area between the connector and conductor began to degrade, and the contact resistance began to increase, the aluminum connector no longer operated as intended.

GO 95, Rule 31.1 states, in relevant part:

> *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.*

SCE is in violation of GO 95, Rule 31.1, for not maintaining the aluminum connector for its intended use.

Preliminary Statement of Pertinent General Order, Public Utilities Code Requirements, and/or Federal Requirements:

	General Order	*GO Rule*
1	GO95	31.1
2	GO95	37
3	GO95	38

Conclusion:

SCE is in violation of GO 95 Rule 31.1 for not maintaining its aluminum-to-copper one-bolt parallel groove connector for its intended use.