TECHNICAL SAFETY BC

Incident Summary #II-1200345-2021 (#22189) (FINAL)

SUPPORTING INFORMATION	Incident Date		November 19, 2019
	Location		Port Coquitlam
	Regulated industry sector		Electrical - Low voltage electrical system (30V to 750V)
Impact	Injury	Qty injuries	0
		Injury description	None
		Injury rating	None
	Damage	Damage description	Fire damage to the communications wiring, cable box and the wooden siding and ceiling in the carport area. Melting damage to the overhead cable TV and 120/240 Volt service conductors.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		An open service neutral condition related to a melted overhead conductor on a 120/240 Volt service resulted in a home's communication boxes, cables and the surrounding walls and ceilings being burnt due to a fire in the carport.
INVESTIGATION CONCLUSIONS	Site, system and components		**Overhead services:** • Overhead power and communications services for residential homes run from the utility pole systems, at height through the open air, to the house. • The power service provides electricity from the pole mount power transformers to the home's main electrical panel. • The communication services provide items such as cable TV, internet, and telephone from the overhead communications distribution systems to the home. **Power systems:** • The utility overhead power distribution system consists of high voltage power lines (over 750 Volt) that feed pole mount transformers. These transform the high voltage down to 120/240 Volt power for premises. • The overhead 120/240 Volt distribution lines consist of 3 conductors. There are two insulated line conductors and the neutral which may be bare or insulated. These are run between the street power poles either as parallel individual conductors or with neutral supported cable. A neutral supported (NS) cable is a spiral wound set of conductors supported by the bare neutral (identified) conductor. • The neutral conductor normally carries any imbalance of current between the line conductors (Diagram 1a). While 240 Volt loads do not create imbalance in current to the service neutral conductor, any imbalance in premise loading between either of the two 120 Volt service conductors and the service neutral conductor will result in continuous current on the service neutral under normal operating condition (Diagram 1a). • The overhead power service drop to the premise is rated at 120/240 Volts and is run with neutral supported cable.

- The two insulated conductors under normal operation have a nominal 240 Volt potential between each other for loads such as dryers and stoves, but a nominal 120 Volt potential to the neutral conductor for loads such as lights and plugs.

Open service neutral

- If a three wire 120/240 Volt system's neutral conductor becomes loose or disconnected it can result in power quality issues. Depending on the difference in load between the two 120 Volt lines, the respective voltages may vary between 0 to 240 Volts from the nominal 120 Volt. The results of the voltage variations may include flickering, dimming, and brightening of lighting as well as overvoltage damage to 120 Volt appliances or devices.
- The line conductors are terminated with insulated compression connectors (commonly referred to as Insulinks) at the utility pole and at the house.
- The line conductor terminations are physically separated from the bare neutral conductor.

Cable TV communications system:

- The communication systems include coaxial cable infrastructure that under normal operation carries extra low voltage (not exceeding 30 Volts) analog cable, digital cable, and internet signals. Cable TV wiring is not designed to carry 120/240V power.
- The coaxial cable consists of a center conductor, a surrounding dielectric insulation layer, a concentric braided conductive sheath, and an outer insulating layer.

System grounding/ bonding:

- The power system's neutral conductor and the sheath of the coaxial cable TV system are both required to be effectively bonded at each premise to the ground earth electrode, which may be, for example metal rods or a metal plate buried in the earth.
- The 120/240 Volt service has a system bonding jumper that connects the neutral conductor to the noncurrent carrying metal components of the system such as the conduits, bonding conductors and boxes. The jumper is typically a machine screw or metal strap in the main electrical panel.
- The bonding connection of all non current carrying metal parts of the power and communications systems to the buildings earth electrode ensures:
    i. The noncurrent carrying metal components of each system are at the same potential.
    ii. External faults, such as lightning, are directed to the low impedance path to ground.
    iii. Potential faults from the power system that contact the bonded metal components of the systems follow the low impedance path back to the power panel to trip the associated circuit breaker.
- The neutral for the utility distribution system is grounded to the earth at the wooden power poles with a grounding conductor and grounding electrode.
- In the main service panel located in the home, the neutral is bonded to ground by way of a copper conductor that runs to the earth electrode.
- The communications strand is a grounded bare wire run horizontally between utility street poles that:
    i. Supports the communications utility distribution cables and fittings.
    ii. Supports the connections for the perpendicular communication service drops that issue out to premises.
    iii. Is run at a distance below the power lines but is interconnected to the power distribution system's grounding conductor and electrode.

Incident Summary #II-1200345-2021 (#22189) (FINAL)

	• The metal braided sheath for the cable TV's communications coaxial cabling is bonded to ground at the street communications distribution equipment. The sheath is also required to be bonded to ground at the house.
Failure scenario(s)	The overhead neutral conductor melted and severed near the street where the power service drop connects to the utility power distribution. The line conductor compression connectors had become bare over time as the insulation was degraded from the elements and friction. The energized connectors were repeatedly shorting to the bare neutral conductor until the neutral finally melted through. The communications bonding system then took the imbalance in current between the line conductors, which was only limited by the 100 Amp main circuit breaker. The communications bonding completed the neutral circuit back to the utility transformer grounding system. The communications bonding conductors and cable sheathes are smaller with a higher resistance than the service neutral conductor. The higher resistance resulted in the bonding conductors heating to the point where the insulation ignited and caught fire.
Facts and evidence	**Homeowner statements:** • The homeowner reported that in the weeks leading up to the incident, they experienced power quality issues such as lights flickering. • On the day of the incident, the homeowner was in the kitchen and noticed, through the carport door, that the carport area was glowing bright orange. When they opened the door, they saw the fire and called it in. **Utility line technician supervisor statements:** • The utility line technician supervisor stated that in a few days prior to the incident the homeowner had reported power quality issues which were in the queue to be examined by a utility line crew. This P3 type of call is not a rushed site visit. • Before the utility line crew went to the site for the power quality issues, the file was escalated to a P1 (1-2 hours) type of call as the fire department had placed an emergency disconnect request due to a fire. • Upon attendance on site, the utility line technician noticed that the neutral conductor was fully disconnected where the service drop meets the street power distribution system, and the current imbalance was being carried by the communications lines. • The line technician supervisor stated that the Insulink were flaking and were no longer insulated and that this can happen from items such as exposure to the elements, branches making contact and movement from swaying. **Electrician statement:** • The repairing electrician stated that the melted service neutral was the cause of the fire. **Site electrical observations:** • The cable TV coaxial cable sheath was bonded to ground with a bonding terminal (Figure 3) in the cable box. • A green insulated copper conductor connects from the cable bonding terminal to an all-around style clamp wrapped around the service conduit (Figure 4). • The cable tv bonding connection at the service conduit is missing the nut which is indicative of higher resistance loose connections (Figure 4). • The system bonding jumper in the main panel is a copper strap that connects the neutral terminals to the metal noncurrent carrying parts of the system. • The meter base conduit is effectively bonded to the system bonding jumper by way of the metal panel enclosure.

Incident Summary #II-1200345-2021 (#22189) (FINAL)

Causes and contributing factors	The incident occurred as the service neutral was melted and severed from shorting to a line conductor connector. This led to the communications bonding carrying the imbalance in line current and overheating until it caught on fire. Lack of separation between the neutral and the service line conductor compression connectors was likely the cause of the incident. The line conductor compression connectors becoming bare from the elements, friction, and electrical arcing was a contributing factor to the melting and opening of the neutral conductor. The cable TV bonding path completing the disconnected neutral circuit back to the power source was a contributing factor to the fire occurring.

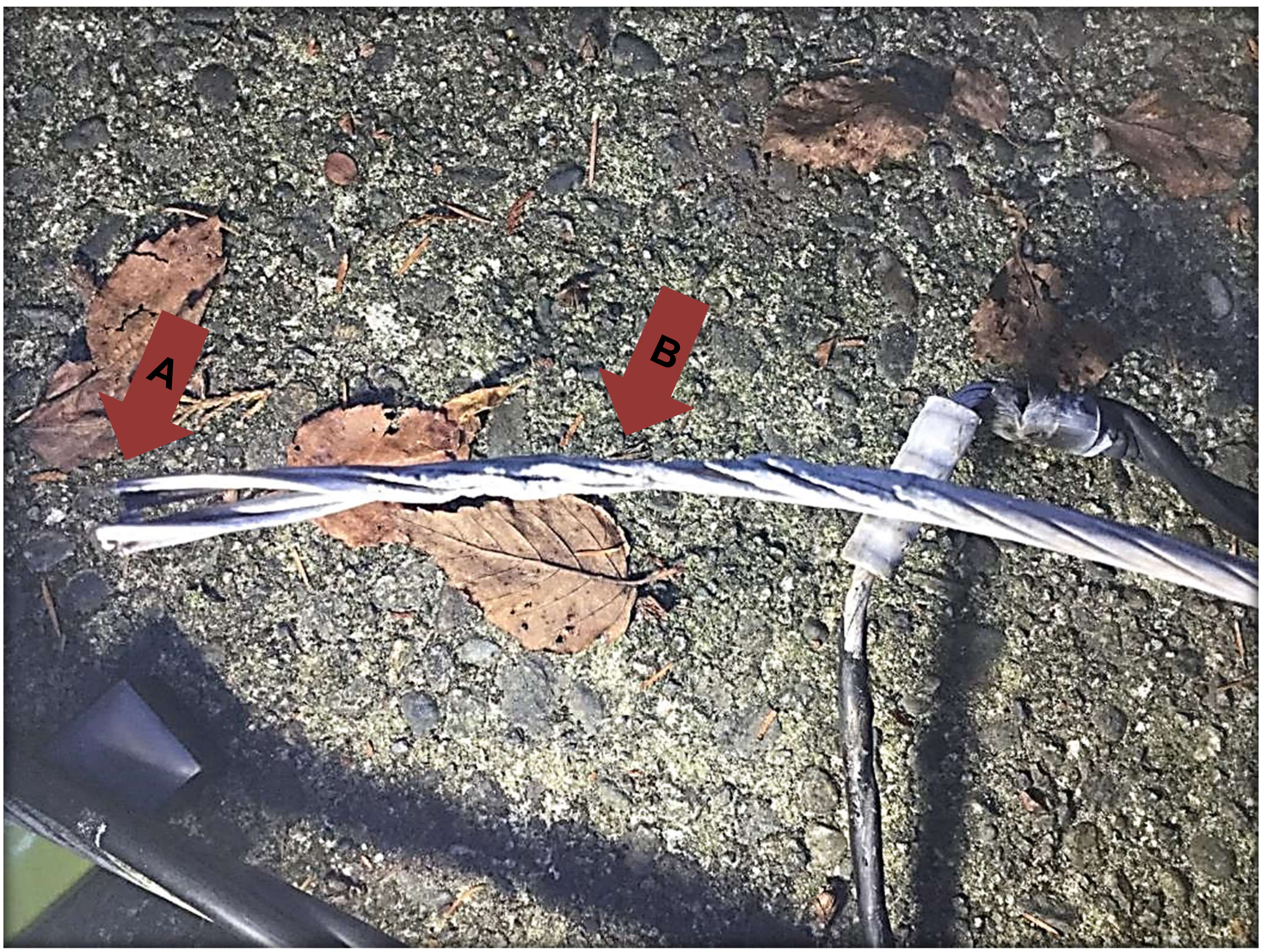


Figure 1 - Neutral conductor melted end (arrow A) and neutral conductor abraded (arrow B).

Figure 2 - 240 volt conductor compression connectors without insulation (arrows).

Figure 3a (top) - Fire damage to the upper wall & ceiling.
Figure 3b (bottom) - Fire damage to the wall, the cable box burnt away and mounting screws remaining (rectangles), cable TV bonding terminal, burnt and fallen cables (ovals).

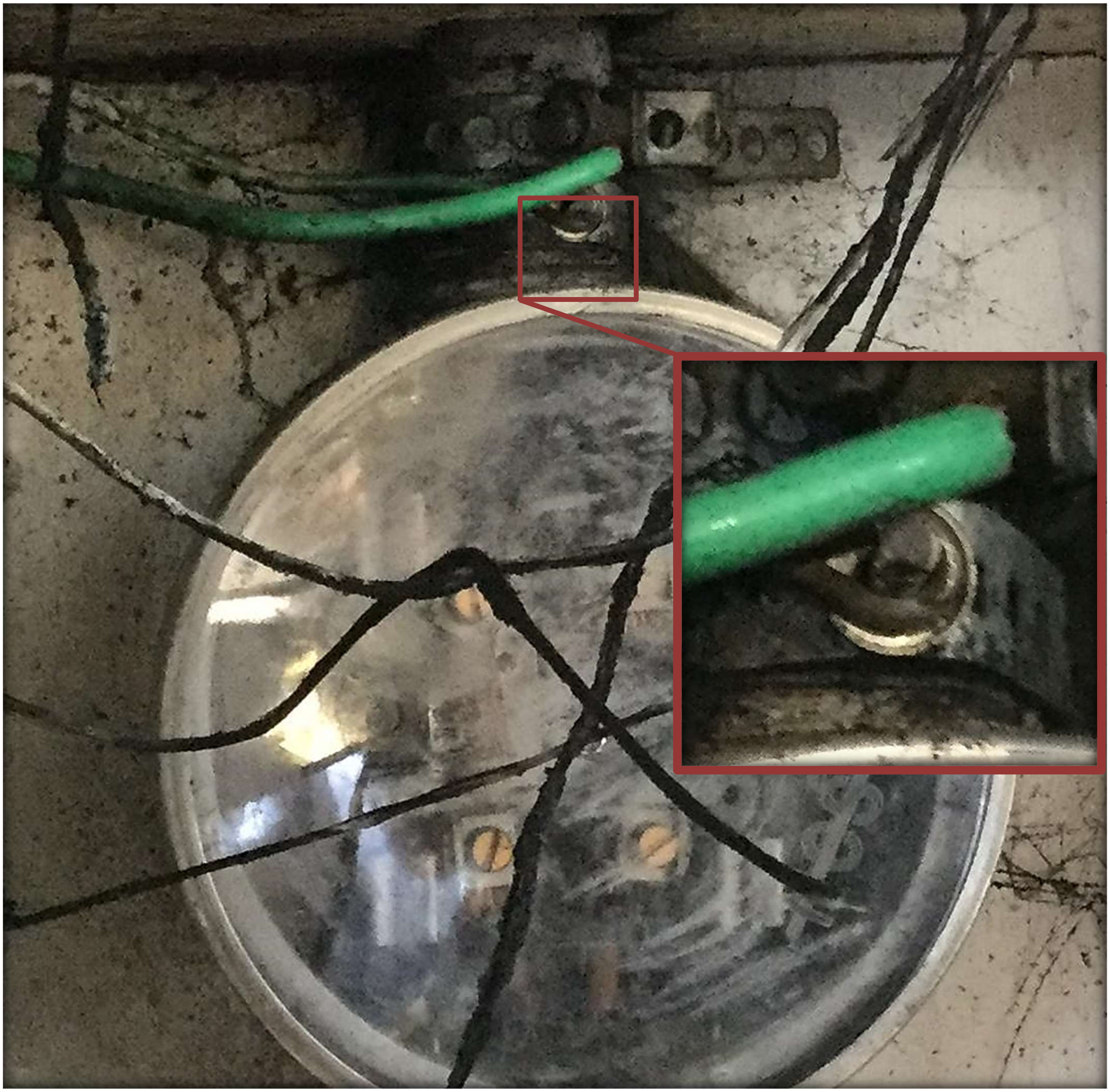


Figure 4 - Cable TV bonding strap around the service conduit with no nut and a high resistance loose connection (rectangles).

Figure 5 - Closeup of cable TV service drop splice with melted tape.

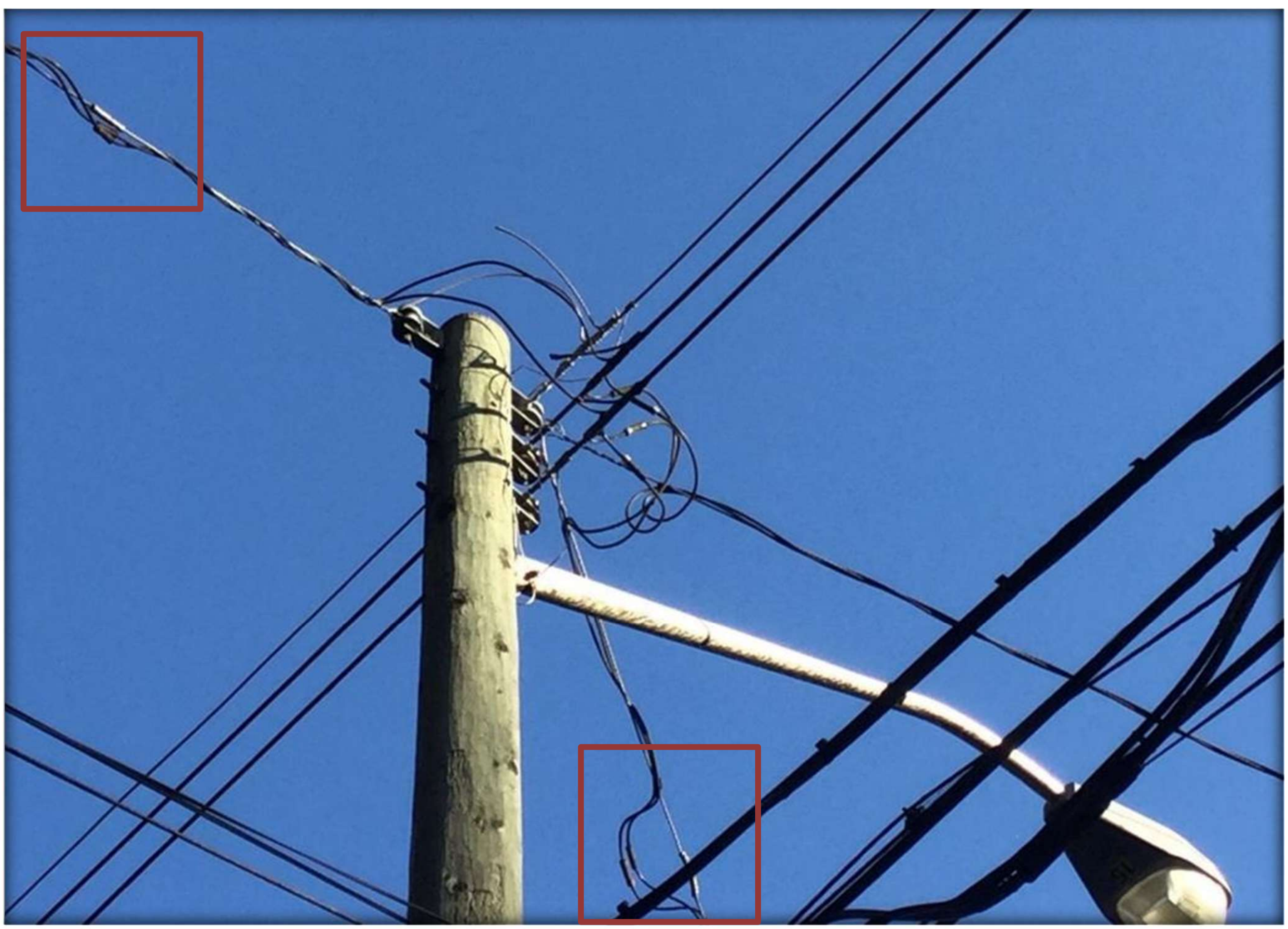
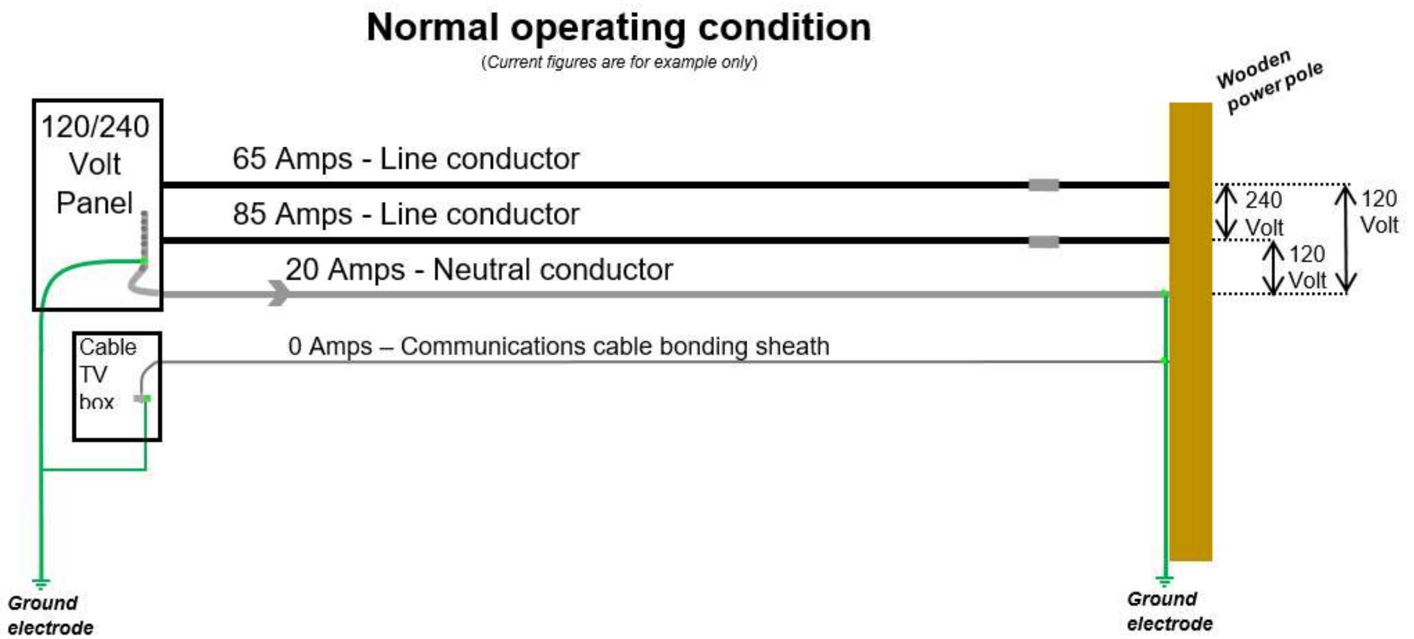


Figure 6 - Example line connectors, bottom square separated, top left square less separate.



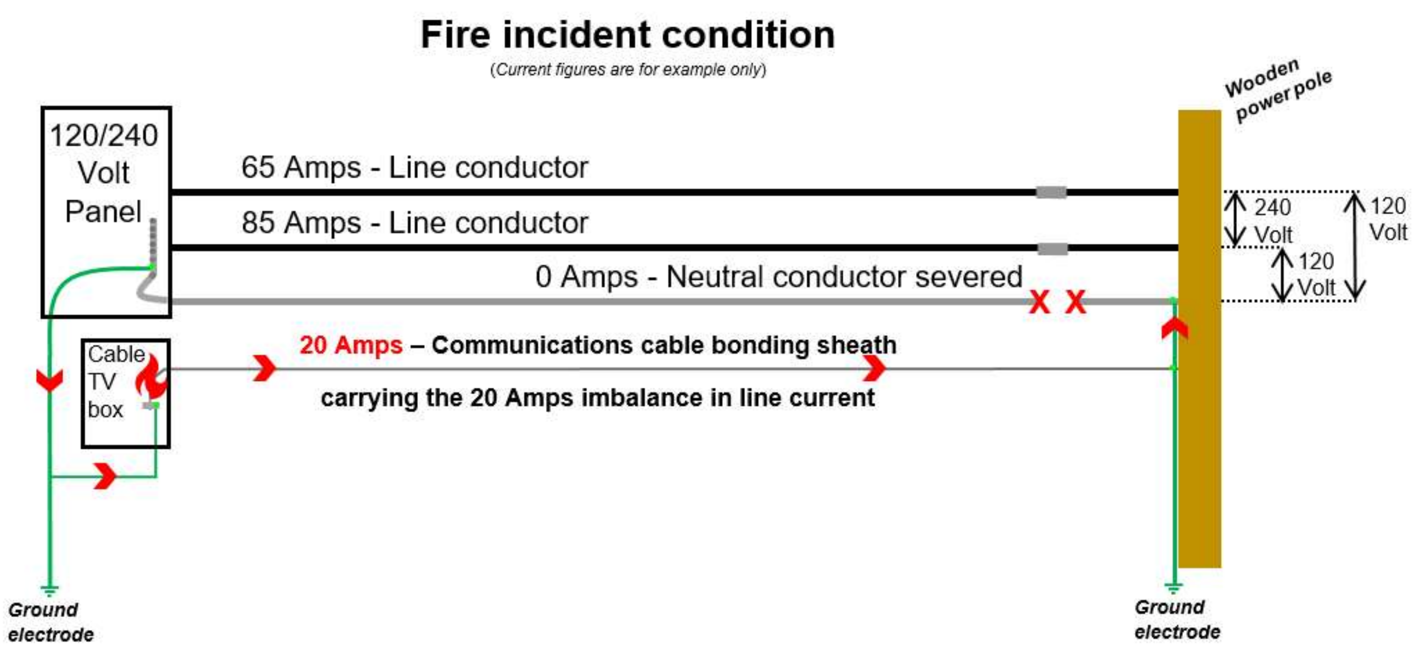


Diagram 1a, 1b - Normal operating condition vs. fire incident condition.