Incident Summary #II-1531785-2023 (#34231) (FINAL)

SUPPORTING INFORMATION	Incident Date		April 5, 2023
	Location		Chilliwack
	Regulated industry sector		Electrical - Low voltage electrical system (30V to 750V)
	Impact – Injury	Qty injuries	0
		Injury description	N/A
		Injury rating	None
	Impact – Damage	Damage description	Damage to underground service cable, and overhead utility service conductors.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		At a residential property a concrete forming stake was driven into an underground service cable causing an electrical fault that resulted in overhead utility lines melting, falling to the ground, and leaving the property without power.
INVESTIGATION CONCLUSIONS	Site, system and components		The residential property consists of a single-family dwelling located on the south side of the property, and a new detached shop that was under construction at the time of the incident on the northwest corner of the property (Image 1). The electrical service to the property is fed from a utility pole mounted 50 KVA transformer with overhead 4/0 AWG size *neutral supported cable service conductors ran 100 feet to a 30-foot-long private pole. There are 250 KCMil sized aluminum conductors in a metallic raceway on the pole, that are installed from the top of the pole down to the meter, and a 250 KCMil sized ACWU service cable that is ran underground from the meter to a 200 amp electrical panel in the car garage of the dwelling (Image 2). *Neutral supported cable is a cable that is used to run overhead between poles or structures. The neutral conductor is bare in this cable and the centre of the neutral is a steel core called the messenger. The purpose of the messenger wire is to support the weight of the cable in the overhead span. In a typical residential application, neutral supported cable or Triplex has two insulated line conductors that are wrapped around the bare neutral conductor.

Incident Summary #II-1531785-2023 (#34231) (FINAL)

Failure scenario(s)	During construction of the new detached shop on the property, the construction crew was setting the concrete forms for the shop foundation. The concrete forms are braced for support, and metal stakes are driven into the ground to hold the braces in place. One of these metal stakes was driven into the electrical service cable that was buried underground between the private pole, and the existing house. The metal stake pierced the cable between one of the insulated line conductors, and the insulated neutral conductor. The stake pushed some of the insulation on the conductors back but was not in direct contact with the bare aluminum of the conductors. Approximately an hour after the stake was driven into the cable, a concrete pump truck arrived for the concrete pour. The truck parked with the front about 10 feet back of the east end of the shop foundation forms. With the outriggers, and the boom extended out on the truck, the front right outrigger was applying a minimum of 16,000 pounds and a maximum of 48,000 pounds of weight to the ground about ten feet away from where the stake was driven into the cable. The movement in the ground from the pressure exerted on the front right outrigger was enough to shift the metal stake and create contact between the line conductor and the neutral conductor in the underground cable. This contact between the line and neutral conductors completed a short circuit that caused fault current on the conductors, and the overhead utility lines started smoking and sparking. Within seconds the utility lines fell to the ground cutting off power to the property. In an electrical line to neutral fault, the fault current always wants to try to complete the circuit by following the lowest impedance path back to the source. The neutral conductor is the conductor that is grounded and bonded to the noncurrent carrying metal parts in the utility distribution system and is therefore the path of least resistance for the neutral fault current to flow. In this case the utility pole mounted transformer and the length of the cable determine the amount of fault current that will flow. The transformer size is 50 kVA with a percent impedance of 1.5% - 3%, and the length of conductor between the transformer and where the stake was driven into the cable is approximately 140 feet. The fault current was in the range of 4300 amps – 5700 amps. This high amperage in the conductors in the overhead line was enough to create enough heat to melt the insulation on the line conductors that are in contact with the bare neutral. This caused the smoking, and sparking when the line conductor insulation melted, and direct contact was made between the line and neutral. This extreme high heat caused the overhead conductors to break apart and fall to the ground.
Facts and evidence	Facts and evidence gathered onsite: • The cable appeared to be buried two to three feet deep from original grade but was difficult to confirm due to the excavation for the shop foundation. • The metal stake used was two feet long. • The underground cable was examined and found that the red (ungrounded) conductor and the neutral (grounded) conductor contacted each other through the metal stake. • The damaged utility overhead wires had been removed from site. • A video sent from the general contractor shows the overhead utility lines smoking and sparking. Interview with Homeowner: • The exact location of the underground cable was not located prior to driving the metal stakes into the ground, because it was outside of the perimeter of the foundation for the new shop, and the homeowner was not aware that the cable was at risk of being damaged.

Incident Summary #II-1531785-2023 (#34231) (FINAL)

	• The underground cable was installed under an electrical homeowner's permit at the time the house was built in 2017. There was no record of how deep the cable was buried under that permit. • The homeowner stated the cable was buried two feet underground and was installed to BC electrical code. • There was no sign of anything wrong until the concrete pumper truck was set up on site. • The homeowner's mother and daughter were in the house when the incident occurred, and the house did not lose power until the utility lines fell to the ground. Interview with the general contractor: • The exact location of the cable was not identified prior to commencing work on the new detached shop. • The contractor stated that the cable was buried 6 inches deep at the point it where the stake was driven in, but the ground was excavated for the shop foundation at this point, so it was difficult to tell exactly how deep the cable was originally buried. • The contractor stated that the underground cable was closer to the surface, closer to the pole, suggesting that when the cable was installed it was a bit to short and extra length was gained by pulling it up closer to the surface. • The location that the stake was driven through the cable was approximately ten feet away from the pole. • There was no sign of anything wrong until the concrete pump truck was set up onsite. • When the concrete pump truck was set up suddenly the overhead utility lines started smoking and sparking and within seconds they broke apart and fell to the ground. Information from the concrete pump truck company: • Total weight of truck 64,000 pounds. Outrigger maximum weight 48,000 pounds. Phone call with Utility power line technician: • He arrived onsite and cut the power off to the energized utility lines that were still hanging down from the utility pole on the street. • He took the damaged overhead utility wires with him. • He stated that the insulation on the line conductors was melted in certain locations from the heat on the bare neutral conductor from the fault current. He stated that at the point the overhead utility wires broke apart, the insulation had melted off the line conductors and they came into direct contact with the bare neutral conductor. The heat from this short circuit caused the break in the utility wires.
Causes and contributing factors	It's very likely that the metal concrete forming stake that pierced the underground service cable, met the neutral and a line conductor causing the electrical fault that resulted in downed utility overhead lines, and a power outage to the property. Contributing factors to this incident were the cable location not being identified prior to construction starting, the depth of the cable in partially excavated ground, and the weight of the concrete pump truck outrigger causing movement in the ground.

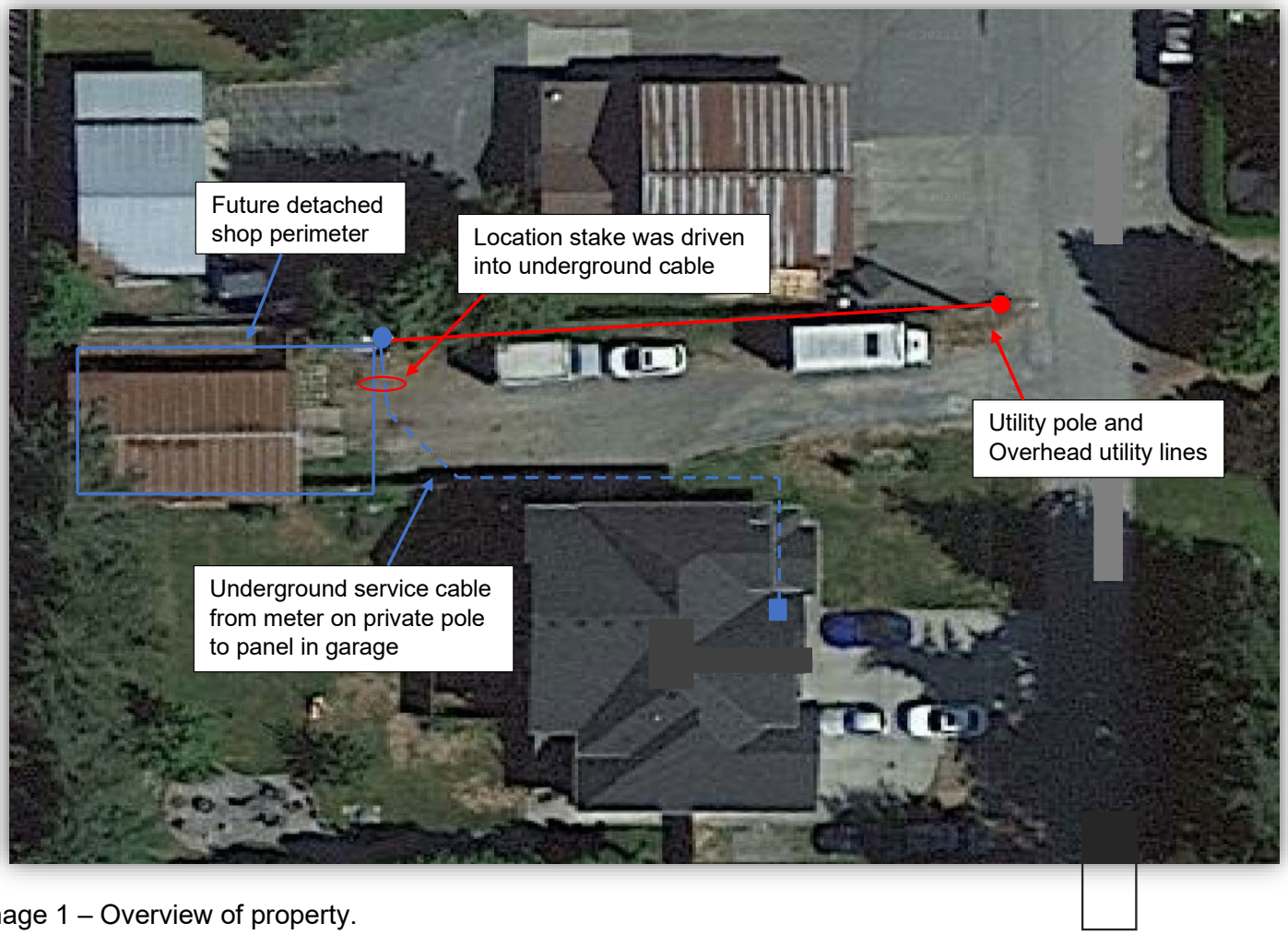

Image 1 – Overview of property.

Image 2 - Street view of property.

Image 3 – Damaged cable from the concrete forming stake.

Image 4 – Metal stakes used for concrete forming braces and the length of metal stakes.

Image 5 – Screenshots of smoking and sparking utility lines from a phone video taken by a site worker.