

Incident Summary #II-1263823-2021 (#24292) (FINAL)

SUPPORTING INFORMATION	Incident Date		October 5, 2021	
	Location		Courtenay, British Columbia	
	Regulated industry sector		Electrical	
	Impact	Injury	Qty injuries	1
			Injury description	Shock received on left forearm, leaving minor redness in a localised area.
		Damage	Injury rating	Minor
			Damage description	“A” phase conductor had a thermal event take place inside the service raceway. The raceway for service conductor had a hole burnt through. Entrance cap to the main service raceway was broken and dislodged. Main service ground had a metal connector that burnt through.
			Damage rating	Moderate
	Incident rating		Moderate	
Incident overview		Contractor was servicing electrical equipment in preparation for replacement the following week. Contractor received an electrical shock while working on the exterior of an energized panel by touching his left forearm to the exterior can of the electrical panel.		
INVESTIGATION CONCLUSIONS	Site, system and components		<p>The facility is a commercial office space with an overhead electrical service. The service consists of two parallel metal service conduits attached to the outside of the building that bring power from the utility service to the main service switch.</p> <p>Under normal working conditions, a system bonding jumper connects the neutral return path to the earth ground. It also assures equipotential connection to the exposed non current carrying metal throughout the system.</p> <p>The metal service conduits are electrical and mechanically connected (bonded) to the main service switch.</p> <p>The insulation integrity of service conductors is paramount for preventing current leaking from energized conductors to the grounded metal raceway.</p> <p>Under normal working conditions, the entry cap to the weather head would prevent foreign bodies from entering the service raceway.</p>	
	Failure scenario(s)		A service conductor’s insulation was likely damaged when it was originally installed inside the service conduit. Rain likely entered the damaged weather head as it was not fully sealed. The rain water accumulated in the horizontal conduit section and led to the service conductor with the missing insulation shorting to the metal service conduit. The short circuit very likely energized the exposed metal components of the electrical equipment including the conduit and the panel enclosure and then shocked the electrician when they contacted the electrical equipment.	

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<p>Facts and evidence</p>	<ul style="list-style-type: none"> • Contractor declared that he had received a shock while working in the electrical service closet on a piece of electrical equipment. • The electrical service equipment did not have a proper system bonding jumper installed (figure 1). • Ground wire connector that enters main distribution was destroyed from arcing as it had made a high resistance connection to the service conduit/panel (fig. 2, 3). • Service raceway had a 2-centimetre hole that was caused because of thermal arcing (figure 4). • Service conductor was damaged approx. 3 meters into the service raceway and between 7 to 12 centimetres and shows signs of melted copper and insulation (figure 5, 6). • The entrance cap to the service raceway was broken and dislodged, leaving it exposed to the elements, allowing water to enter raceway (figure 4). • Water marks on the conductor, and inside the service raceway (figure 5).
<p>Causes and contributing factors</p>	<p>The probable cause of the shock was due to a short between an energized service conductor and the service raceway.</p> <p>A contributing factor was the lack of a system bonding jumper that left no solid connection between the main panels bare metal components and the neutral conductor to clear the fault.</p> <p>Another contributing factor to the incident was that the entrance cap on the weather head was severely damaged and the duct seal inside the raceway was compromised causing an opening around the conductors for water to enter the raceway freely.</p>



Figure 1 - Service disconnect switch with the required system bonding jumper screw missing



Figure 2 – Connector melted from passing current to the neutral conductor



Figure 3 – Close up of metal connector melted



Figure 4 - Location of the parallel metal service conduits (in red). The arcing occurred on the horizontal section of the upper conduit with the smoke mark shown on the backboard (bottom). Damage to the entrance cap openings (top left). Back view of the arcing hole on the damaged conduit and smoke damage on the adjacent conduit (top right).

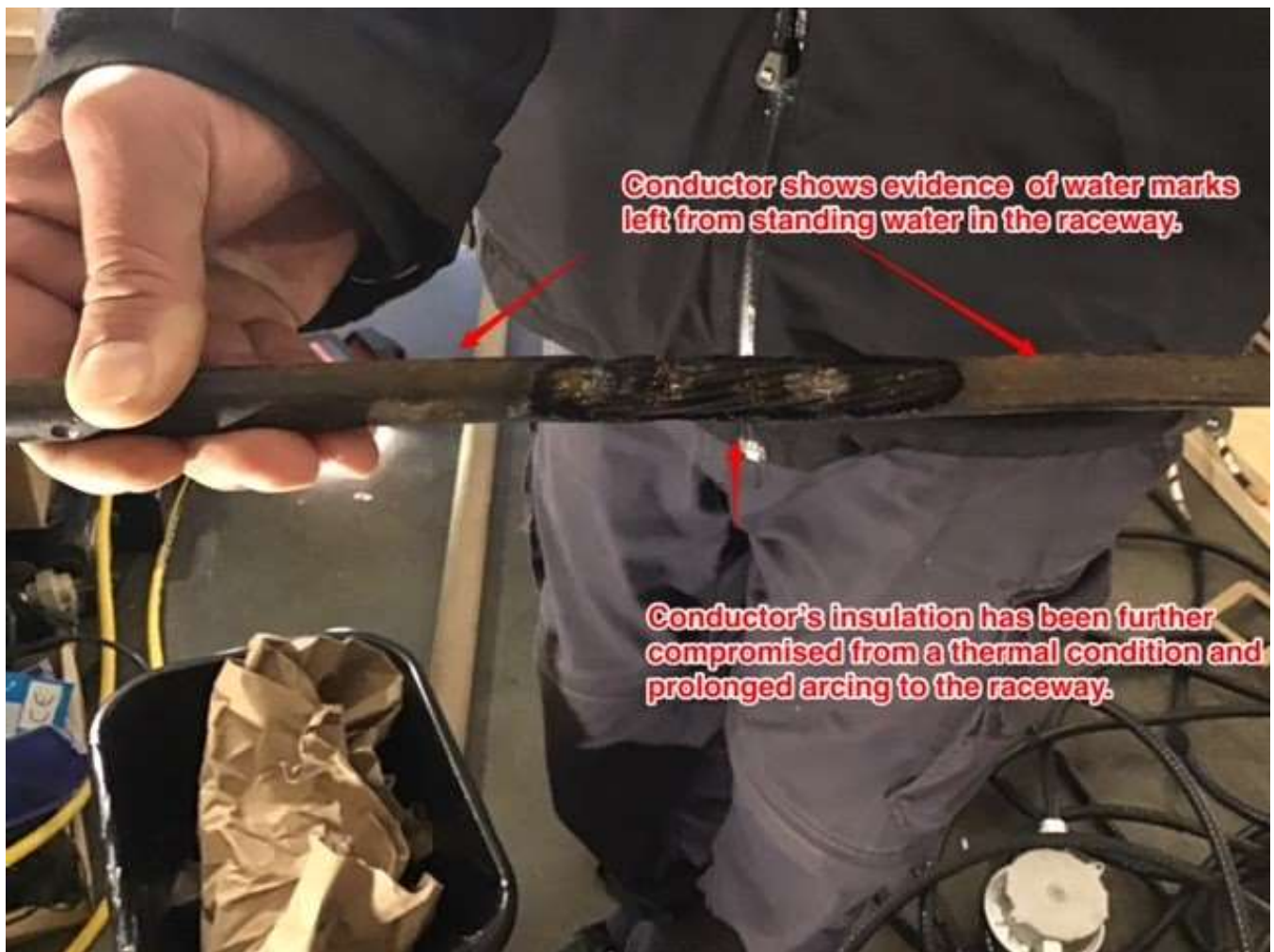


Figure 5 - Melting damage to the uninsulated portion of a line conductor



Figure 6 – Close up of melting damage to the uninsulated portion of a line conductor