

Incident Summary #II-1194712-2021 (#22041) (FINAL)

SUPPORTING INFORMATION	Incident Date	May 14, 2021	
	Location	Victoria	
	Regulated industry sector	Electrical - High voltage electrical system (greater than 750V)	
	Impact	Qty injuries	0
		Injury description	Not Applicable
		Injury rating	None
	Damage	Damage description	Catastrophic phase to phase fault on high voltage equipment, as well as water damage to subsequent low voltage (600 volt) equipment and distribution systems
		Damage rating	Major
	Incident rating	Major	
Incident overview	Failure of a pressurized, underground irrigation pipe on a timed system caused water to infiltrate an underground conduit system leading to an electrical room ceiling junction box. This box pressurized, causing the water to force past cover, pour onto 600 Volt bus duct and distribution centre resulting in short circuit of main transformer.		
INVESTIGATION CONCLUSIONS	Site, system and components	<p>The site is a public facility, fed by a utility 3phase, 25KV high voltage service to an electrical room. The high voltage feeder then passes through 3, high voltage fuses (1 per phase), and then to a transformer which converts the 25KV to 347/600V for customer utilization. The fuses protect the transformer, feeder system and components up to the central distribution panel board.</p> <p>The 347/600V system from the transformer to the main panel board utilizes a ventilated bus duct system consisting of a factory-made assembly of solid bus bar conductors in a steel enclosure suspended from ceiling of electrical room.</p> <p>The central distribution panel board contains a main breaker, utility metering and multiple breakers to feed power for electrical components throughout the facility.</p>	
	Failure scenario(s)	<p>A 3" electrical, PVC conduit had recently been installed under an asphalt parking lot to provide power for new EV chargers. During this installation, a pressurized irrigation line was unknowingly damaged.</p> <p>The 3" electrical, PVC conduit terminates in an in-ground junction box complete with steel lid, in a grass boulevard just beyond the parking lot. The 3" PVC is run underground to a point where it emerges from grade, runs vertically approximately 24", and is then surface mounted horizontally under an overhang and penetrates the electrical room wall just below the ceiling slab, terminating in a 12" x 12" steel box mounted to the ceiling with the opening facing down.</p> <p>At approximately 4 am on May 14, 2021, the irrigation system was called to run. It is probable that the damaged irrigation line failed, and pressurized water was escaping underground. This water filled the in-ground electrical junction box. The steel lid contained the water in the box and the pressure forced the water into the 3" PVC conduit system. The water pressure was sufficient to overcome the underground portion, the vertical rise and ultimately the complete run back to the electrical room where the water was forced past the cover on the 12" x 12" steel box.</p>	

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	<p>This steel box is located directly above the 600 Volt, 2000 Amp bus duct feeder that runs from the high voltage transformer to the central distribution panel, housing circuit breakers feeding power to the facility.</p> <p>Water poured onto the bus duct and central distribution panel, causing a short circuit between 2 of 3 phases. It is very likely, this short caused 2 of the main 25KV fuses on the incoming high voltage lines to blow.</p> <p>When the fuses blew, power to the facility was lost and caused the irrigation system to shut down.</p> <p>It is very likely the event happened with very little infiltration of water as the only evidence was a small puddle on the electrical room floor.</p> <p>Upon testing by the responding electrical contractor (qualified individual), it was found that the 25KV to 600V transformer had suffered a catastrophic failure due to the short between phases.</p> <p>A back up generator was brought in. The utility metering was removed, thereby isolating the system from the faulty transformer and bus duct system. Before energizing the main distribution centre, testing was performed by the electrical contractor on the central distribution panel, which subsequently failed. The issue was traced to moisture infiltration into the equipment and breakers. At this time the water was attributed to moisture as there was still no evidence of a major water event. The equipment was dried using fans and heaters until test results were satisfactorily met.</p> <p>The generator was started and energized with all the distribution breakers in the OFF position and then breakers turned on 1 by 1. When one particular breaker was energized there was a strange sound and water began pouring out of the electrical room steel box, onto the (de energized and isolated) bus duct. That breaker had energized the irrigation control, which was still set for 4 am and restarted the irrigation cycle.</p> <p>The emergency stop on the generator was immediately pressed to shut off all power. Junction box covers were removed on the 3" conduit system back to the in-ground junction box and everything was soaking wet.</p> <p>The irrigation system was disabled, and the generator restarted with no further events.</p>
<p>Facts and evidence</p>	<ul style="list-style-type: none"> - EV charger electrical conduit installation spring, 2021. Including civil work to trench under parking lot to an in-ground electrical junction box in grass boulevard (photo group 1) - At this time, a pressurized irrigation main line, which runs under the curb at the boulevard, was unknowingly damaged by excavator - Irrigation system timed to run at approximately 4 am, May 14, 2021 for first time since EV conduit excavation - Power failure in main electrical room shortly after 4 am, May 14, 2021 - Electrical contractor (qualified individual) receives emergency call for power failure - Contractor finds 2 of 3 high voltage fuses are blown - Contractor tests high voltage 25KV to 600V transformer and finds faults on 2 windings due to short circuit (photo group 2) - Contractor sources, and has generator brought to site - Contractor disconnects utility metering equipment and isolates main distribution panel from damaged transformer and bus duct systems - Contractor tests central distribution panel before energizing and finds failing test results - Contractor traces issue to moisture in main distribution panel and breakers - Cause of moisture is not certain at this time - Fans and heaters are used to dry equipment until test results are acceptable

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	<ul style="list-style-type: none">- Temporary generator is connected to central distribution panel with all breakers in OFF position- Distribution breakers energized 1 by 1- Irrigation system is energized and starts up to complete watering cycle- The damaged irrigation conduit, adjacent to the EV charger in-ground junction box, floods boulevard from beneath the electrical box. The steel lid on the box prevents water from escaping upward- The 3" PVC, EV charger conduit system (photo group 3), is pressurized back to the electrical room- The ceiling mounted, 12" x 12" steel junction box in the electric room fills with water and pours past the cover (photo 4)- Water lands on bus duct (photo group 5), and top of central distribution panel- Contractor immediately presses emergency stop on generator- Investigation by contractor determines EV charger conduit system and associated junction boxes filled with water- Irrigation system is shut down and generator started with no further events
Causes and contributing factors	<p>It is highly probable that the damaged irrigation main, once pressurized, flooded the EV charger in-ground junction box complete with steel lid. The lid stayed in place, forcing the water pressure into the 3" PVC conduit system and back to the electrical room. The water was forced out of the ceiling mounted junction box and onto the bus duct system and central distribution panel. The water created a phase to phase short circuit, which in turn blew 2 high voltage fuses and resulted in catastrophic transformer failure, and undetermined damage to panels, breakers and bus duct systems.</p>



Photo group 1 – in ground EV charger junction box

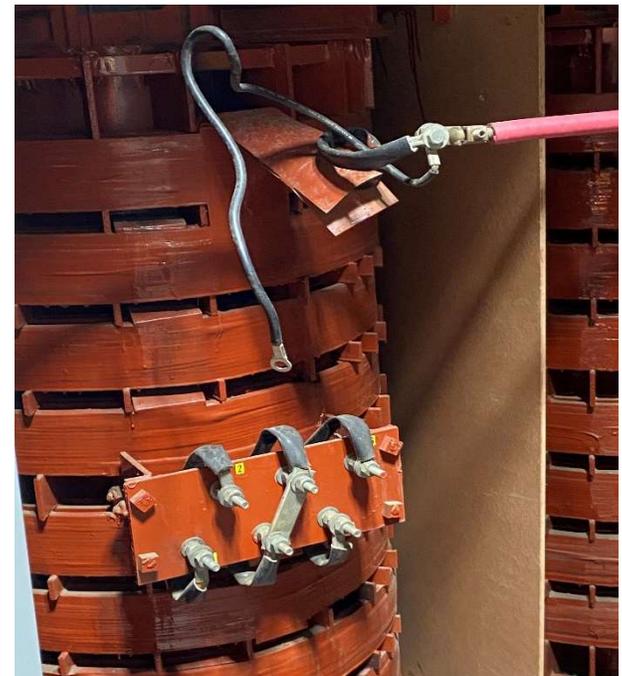


Photo group 2 – 25KV transformer



Photo group 3 – EV charger conduit system



Photo 4 – EV electrical rm box
above bus duct

Photo group 5 – bus duct entering central distribution panel below
bus duct

