Revised on February 13, 2025

Incident Summary #II-1672194-2024 (#44242) (FINAL)

SUPPORTING INFORMATION	Incident Date		January 31, 2024
	Location		Prince George, British Columbia
	Regulated industry sector		Electrical - Low voltage electrical system (30V to 1000V)
	Impact – Injury	Qty injuries	1
		Injury description	A worker received a shock from damaged electrical cable feeding an overhead crane. The worker was treated for injuries but weeks later passed away possibly due to complications from the treatment. **Cause of death (COD) is not determined by Technical Safety BC. The BC Coroners service conducts their own investigation to determine COD.*
		Injury rating	Fatal
	Damage	Damage description	A flexible cable was damaged, exposing an energized conductor.
		Damage rating	Moderate
	Incident rating		Severe
	Incident overview		At an industrial facility, a flexible electrical cable, feeding an overhead 5-ton crane, sustained damage to the outer jacket exposing an energized copper conductor. A worker was operating the crane using the control pendant, and while looking over the lifting bay received an electrical shock.
INVESTIGATION CONCLUSIONS	Site, system and components		The facility has a 5-ton overhead monorail electric crane that is used on an infrequent basis to transport heavy items and equipment to the floors located above. When the crane is operated, it is connected via a 4-conductor copper SOOW-type extra hard usage flexible cable to a receptacle connected to a 3 phase 600V 60A fused disconnect. The crane can travel along a curved monorail on the top floor. Movable cranes require the power feeder cable to follow the trolley along the rails. This can be typically done using conductor bars, festoon cable systems, or flexible cables with a take-up device. • A conductor bar system uses solid bars as electrical conductors that run the length of the crane travel and collectors which travel along the length of the bars as the crane moves supplying power to the crane. • A festoon cable system uses wheels and trollies to store and control the electrical cable to ensure moving equipment receives a proper power supply while in motion and protects the cable from possible mechanical damage from equipment movement. • Flexible cables with a take up device use a spring loaded or motor driven cable reel to release, retrieve, and store conductor cables when the mobile overhead crane is in use. The CSA C22.1 Canadian Electrical Code Part 1 contains the following clauses applicable to the installation and operation of the overhead crane: • 2-200 states that general electrical equipment shall be installed and guarded so that adequate provision is made for the safety of persons and property and for the protection of the equipment from mechanical or other damage.

Incident Summary #II-1672194-2024 (#44242) (FINAL)

	• 2-300 states that for maintenance and operation, all electrical equipment shall be kept safe and in proper working condition, and infrequently used electrical equipment is maintained for future service and shall be thoroughly inspected before use in order to determine its fitment for service. • 40-004 states that insulated flexible electrical conductors directly supplying electric cranes, where a flexible connection is essential, are required to have a take up device as necessary to prevent damage to the cable and to keep it clear of the operating floor. • 76-010 states that feeders for temporary wiring shall be protected at all times from mechanical damage. Employees who operate the crane at the facility complete an internal crane safety training session. Employees also complete a field level risk hazard assessment (FLRHA) document prior to daily work tasks. The crane also has a pre-use daily inspection checklist and typically receives an annual certification, inspection and safety check by a qualified crane contractor. The part of the electrical system at the facility, that the crane is connected to, is an ungrounded 600V delta system with ground fault detection. Electrical faults to ground will not necessarily trip the overcurrent protection thus making equipment or processes more reliable. The ungrounded system will have a ground fault that will not trip a breaker but will indicate that there is a ground fault on a display.
Failure scenario(s)	The crane at the facility is typically inspected and serviced by qualified crane contractor annually. It had last been inspected November 17, 2022, and had remained in service while being overdue for its next inspection since Nov 17, 2023, just over two months prior to the incident. The electrical feeder cable for the crane was not permanently wired to the electrical system and instead used an industrial pin-and-sleeve style plug end that was plugged into a receptacle at a 600V 3ph 60A disconnect that is also occasionally used for other equipment at the facility such as welders and a heated pressure washer (Image 4 and Image 5). The feeder cable for the crane did not have a festoon cable or other take up device as required to prevent damage to the cable and to keep it clear of the operating floor. There was no specific or dedicated location to wrap up or store the power cable for the crane. The cable was run along the floor to the edge of the lifting bay, then draped over the handrail into the lifting bay, up to the crane to retain the flexibility required. At some point in time the supply cable for the crane had become damaged near the metal handrail. The outer jacket of the cable had been sliced exposing one of the 600V electrical conductors (Image 7 and Image 8). The employees' task the day of the incident was to use the crane to lift two long bars from the main floor up to the third floor. The employee operating the crane had received crane training and had completed an FHRLA that day but had not completed the documentation for the pre-use crane daily inspection checklist. The pre-operational checklist included condition inspections of multiple crane components but does not include a checklist item for the condition of the power cables. The damaged feeder cable and exposed electrical conductor went unnoticed by the employee operating the crane. While another employee was rigging the bars for the crane to lift on the main floor, the second employee was leaning over a handrail watching operating the crane using the pendant controller.

Incident Summary #II-1672194-2024 (#44242) (FINAL)

	The employee received an electric shock from the exposed conductor on the damaged cable and fell backwards. The employee was attended to and administered first aid. The employee was in cardiac arrest and was administered a shock with an automatic external defibrillator (AED). The medical event was believed by the other employees at the time to be cardiac related, and the possibility of an electric shock was not known until the employee was in the hospital and informed that they were certain that they had received an electric shock from the handrail.
Facts and evidence	Statements • A contractor working in the area stated they witnessed the employee operating the crane fall back away from the handrail onto the ground and was unresponsive. • An employee who spoke with the victim later in the hospital stated that the victim told them that they had received an electrical shock when they grabbed the metal handrail. • An electrical employee from the facility stated that when they examined the crane feeder cable after the incident it was connected to the electrical disconnect receptacle and was draped over the handrail. It had a damaged outer jacket and an exposed energized conductor which was within one foot of the metal handrail. Site observations • The area surrounding the incident location was very wet and dirty with lime dust from the industrial prosses at the facility. • A mobile welder and an electric heated pressure washer were observed in the area that had the same male plug on their feeder cabled that could be connected to the same 600V 3ph disconnect that the crane was connected to. • The crane feeder cable was observed with a damaged outer jacket and an exposed conductor. • The damage to the cable did not appear recent as the internal portions of the wiring that were exposed from the slicing damage were dirty from the surrounding environment and lime dust they were exposed to. • The location of the cable damage and exposed conductor was in close vicinity to the metal handrail the employee stated they received an electrical shock when they touched. • The crane was not provided with a means to prevent damage to the feeder cable which was run along the ground to the disconnect. • A metal holder was observed next to the disconnect and plug receptacle containing the crane logbook and pre-use checklist as well as a sticker showing the last certification date and expiry date from the qualified crane service contractor.

Incident Summary #II-1672194-2024 (#44242) (FINAL)

	• The pre-use crane inspection report book had last been filled out on October 5, 2023. • The disconnect had a 60A fuses installed on all three phases.
Causes and contributing factors	It is highly likely that the power feeder cable was damaged, and the exposed energized conductor contacted the metallic handrail energizing it and causing an electric shock to the employee when they contacted the handrail. Contributing factors to the incident include: • The electrical feeder cable for the crane not having the required protection, made it more likely for the cable to be damaged exposing an energized conductor. • The overdue crane certification by the qualified contractor may have identified the damaged cable if it had been damaged at the time of the inspection. • The ungrounded 600V delta system would allow the circuit to remain energized instead of tripping an overcurrent device as it may have done in a grounded system. • The FLRHA failed to identify the damaged cable prior to use. • The Pre-use crane inspection was not documented prior to use and does not include a checklist item for condition of the feeder cable.

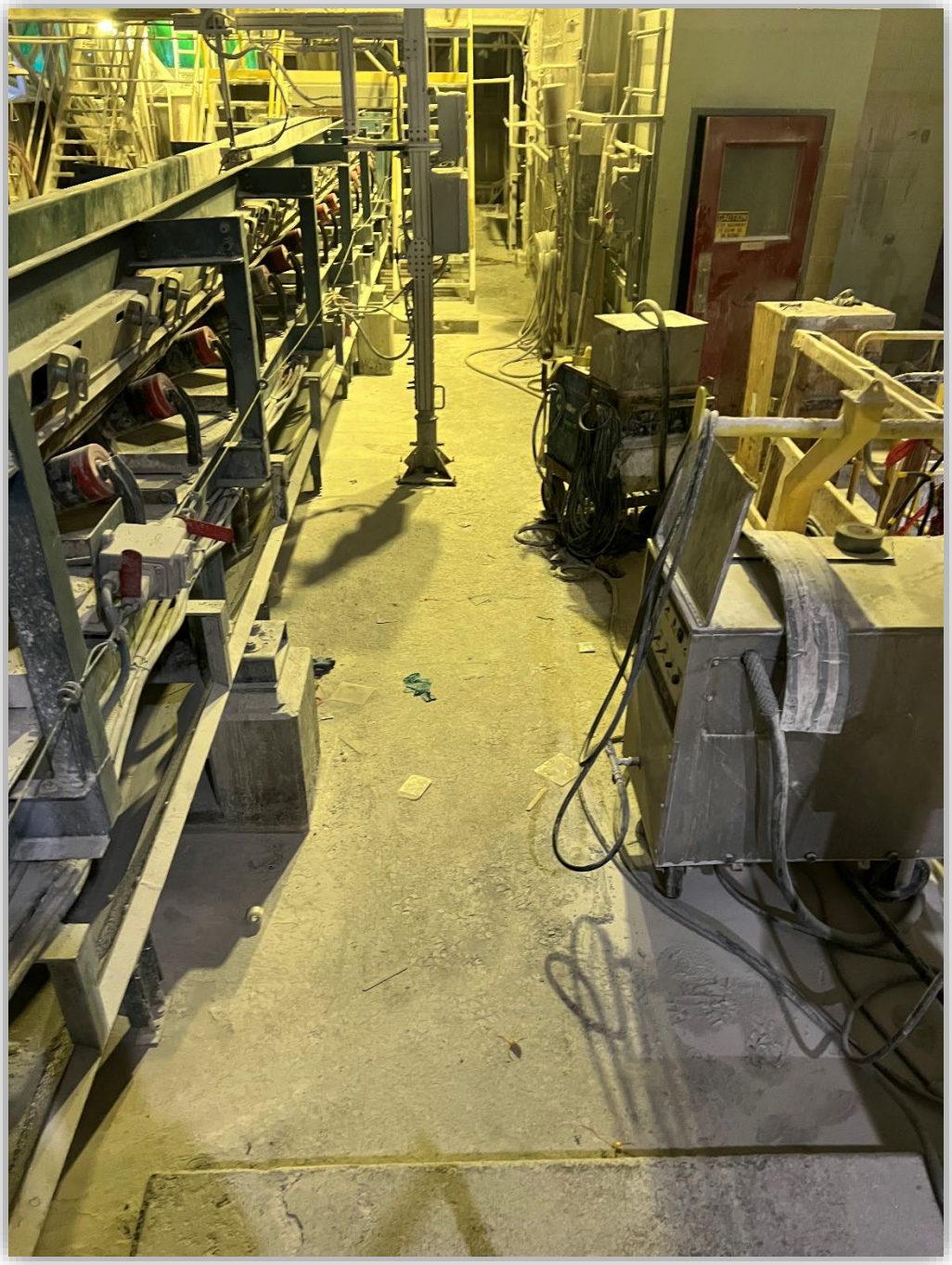

Image 1 – Area of work and equipment. Floor opening and overhead crane located on the right-hand side over the handrail.

Image 2 – Crane lifting bay with damaged cable and control pendant in the approximate location and position when the incident occurred.

Image 3 – Approximate location and position of injured worker while operating crane. (*Situation recreated by another worker after the incident*).

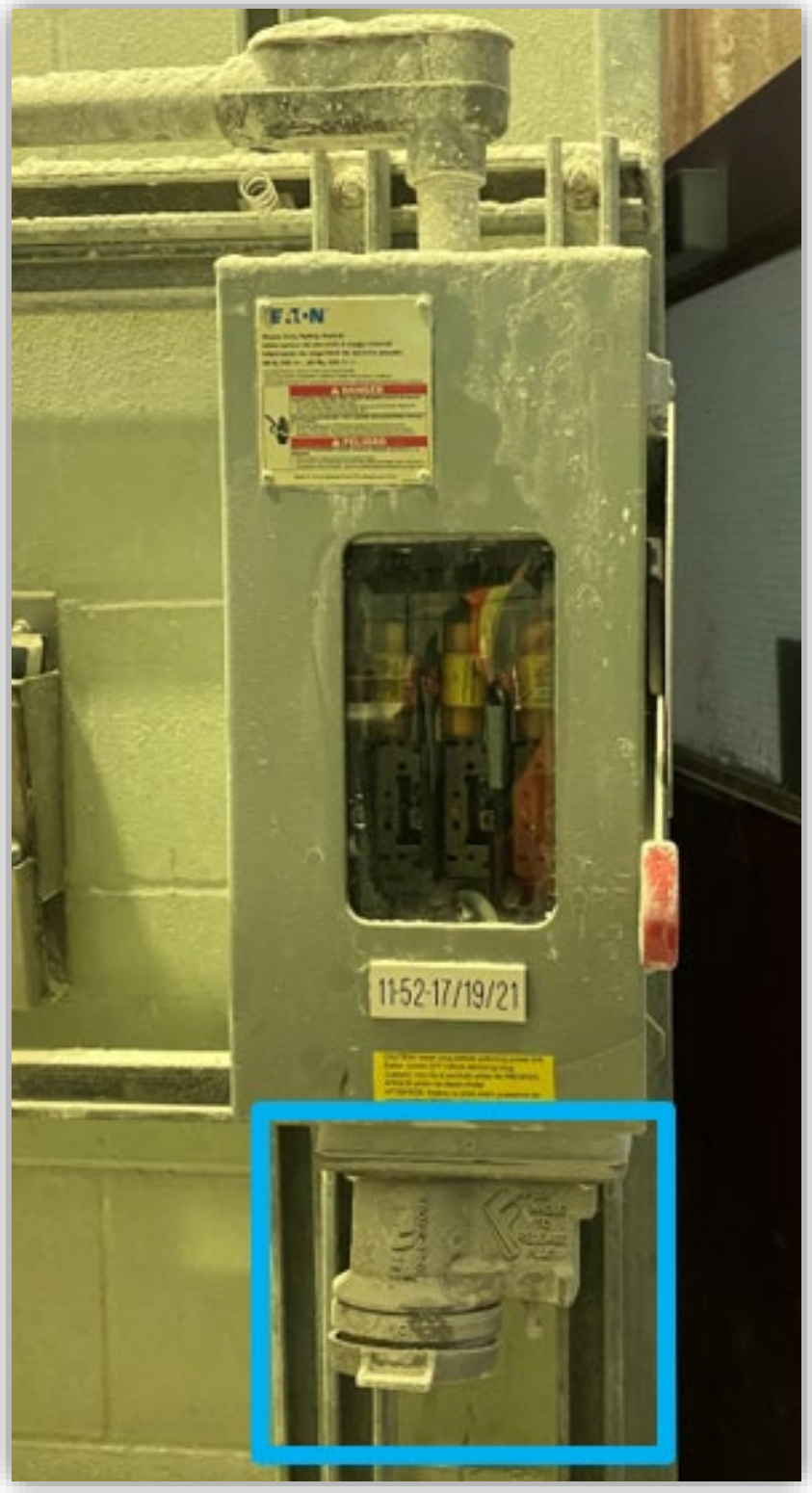

Image 4 – 600V disconnect used for the overhead crane. The crane electrical cable plug was inserted into the receptacle located at the bottom of the disconnect (box).

Image 5 – Plug end of the crane feeder cable disconnected from the receptacle after incident.

Image 6 – Crane operation pendant and damaged electrical cable on the handrail of the floor opening and overhead crane operation.

Image 7 - Close-up of cable damage and exposed conductor.

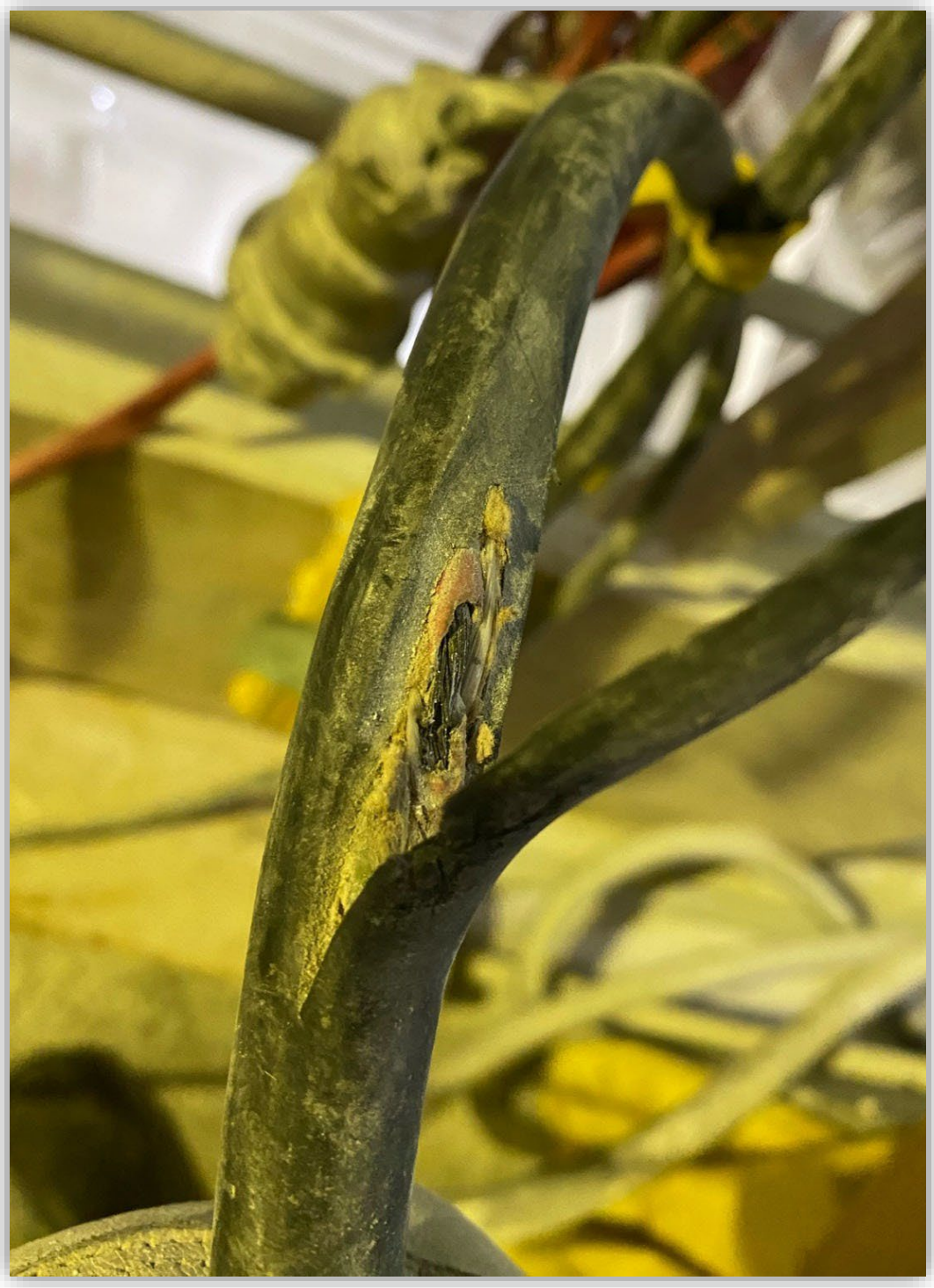

Image 8 - Close-up of cable damage and exposed conductor.