

Incident Summary #II-1508420-2023 (#31812) (FINAL)

SUPPORTING INFORMATION	Incident Date	February 10, 2023	
	Location	Kamloops	
	Regulated industry sector	Electrical - Low voltage electrical system (30V to 750V)	
	Impact	Qty injuries	1
		Injury description	Burns to the right hand, bruising to the hips and right thigh.
	Damage	Injury rating	Minor
		Damage description	A three phase 400 Amp distribution panelboard sustained melting and fire damage to the neutral and all three-phase bussing and to all branch circuit conductors within the electrical panel.
		Damage rating	Major
	Incident rating	Major	
	Incident overview	An arc flash occurred on an energized 400-amp, 208 volts, 3 phase distribution panel in the electrical room of a hotel. A maintenance worker was replacing a circuit breaker that supplied power to the lighting in a common area. The arc flash injured the worker, damaged the bus bars, and caused fire damage to the branch circuit wiring.	
INVESTIGATION CONCLUSIONS	Site, system and components	<p>The hotel has a 600 Volt, 200 Amp, 3 phase electrical service supplied from utility power. The service terminates in a 200 Amp 3 phase rated fused main disconnect switch installed within a restricted access room. The switch is capable of being locked in the off position to de-energize all electrical equipment on site.</p> <p>The main disconnect feeds into a splitter box that supplies a 600 Volt 100 Amp 3 phase fusible disconnect which then supplies a 600 – 120/208 Volt, 112.5 KVA distribution transformer. The fused disconnect is capable of being locked in the off position to de-energize the transformer and all connected electrical equipment.</p> <p>The 112.5KVA transformer supplies a 208 Volt 400 Amp rated distribution panelboard within the same restricted access room with the transformer and disconnect switch. This panelboard supplies various connected electrical loads throughout the hotel.</p> <p>In the distribution panelboard there is a noncurrent carrying mounting rail to secure the non-energized side of the branch circuit breakers to the panelboard. On the energized side of the branch circuit breakers there is a metal bracket which secures to the energized bus bars with a factory provided screw. This factory provided screw is a specified length #2 Robertson machine screw which is in place with each circuit breaker.</p>	

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<p>Failure scenario(s)</p>	<p>In the evening prior to the incident some lighting fixtures within a common area of the hotel were reported to be not operational to the front desk worker. At 6:30 am a maintenance worker started the daily shift with instructions from the front desk worker to repair the lighting in the area. The worker, who does not hold an industry qualification in respect of electrical work, tried to reset a tripped circuit breaker, but was unable to do so as the circuit breaker was not secured in place. The worker did not de-energize the electrical panel before proceeding to remove the panel cover. Once the panel cover was removed the circuit breaker fell out of the panel. The worker noticed that the circuit breakers metal mounting bracket had visible heat damage, the worker also noticed a Phillips wood screw, which was once holding the circuit breaker in place, was still secured to the energized bus bar.</p> <p>The worker used a drill with a Phillips bit to remove the incorrect screw, this caused an accidental line to line shortage of the existing screw between two energized bus bars. The energy discharge from the arc flash ionized the surrounding air, the resulting heat caused severe melting of the 3-phase bus bars and to the branch circuit wiring within the panelboard enclosure. This release of electrical energy burnt the workers hand, face and knocked him to the floor.</p>
<p>Facts and evidence</p>	<p>Electrical component observations</p> <ul style="list-style-type: none"> • The electrical panel, bus bars, circuit breakers and branch circuit wiring had been completely damaged from the arc flash and fire. • The bus bar termination point had melted metal on the lugs from the bus bars above. • The fusible disconnect supplying the transformer and panelboard had a blown fuse in the “A” phase. • The circuit breaker being replaced no longer had the metal mounting bracket which is factory provided to secure the circuit breaker to the bus bar. • The transformer had been electrically disconnected and had the cover removed after the fire suppression efforts. • A cordless drill was found beside the electrical panel with a burnt Phillips bit and the remains of a Phillips screw head melted to the drill bit. <p>Statement from the injured worker</p> <ul style="list-style-type: none"> • They received notification from the front desk to repair the lights. • The worker does not hold an industry qualification in respect of electrical work. • They removed the panel cover without de-energizing and locking out the equipment. • They tried to remove the screw still attached to the energized electrical bus bar. • The arc flash burnt his hand, face and knocked him down to the floor. • A co-worker extinguished the fire with a fire extinguisher. • Once the fire was extinguished, he then disconnected the 100-amp electrical supply to the transformer and panelboard. • The worker was then driven to the hospital. • The worker had noticed this branch circuit breaker has had ongoing issues, repeated tripping, and buzzing/ humming noises. <p>Statement from the regional manager</p> <ul style="list-style-type: none"> • He was on site at the time of the incident.

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	<ul style="list-style-type: none"> • Shortly after 9am he received a phone call alerting him of the incident and that the fire department was on site. • He drove the injured work to the hospital. • He did not instruct the worker to open the electrical panel. <p>Statement from the fire department representative</p> <ul style="list-style-type: none"> • The main electrical disconnect switch was found to be in the on position. • The fire department de-energized the main electrical service. <p>Arc flash characteristics</p> <ul style="list-style-type: none"> • An arc flash is the light and heat produced as part of a type of electrical explosion or discharge that results from a connection through air to ground or another voltage phase in an electrical system. • The severity of the arc flash is dependant on the available voltage and current as well as the time it takes to clear the fault. • An arc flash ionizes the surrounding air which causes extreme heat, light, sound, and pressure from the electrical equipment. The arc flash can cause severe burns as well as hearing and vision damage to people in the area. • The arc flash can reach temperatures up to 35,000 degrees Fahrenheit. <p>Requirements to deenergize</p> <ul style="list-style-type: none"> • In accordance with the Technical Safety BC Directive issued pursuant to the Safety Standards Act and BC Electrical Code Rule 2-304 (link below): <ul style="list-style-type: none"> ○ No repairs or alterations shall be carried out on any live equipment except where complete disconnection of the equipment is not feasible in a de-energized state. ○ https://www.technicalsaftybc.ca/regulatory-resources/regulatory-notice/directive-bc-electrical-code-section-2-general-rules
<p>Causes and contributing factors</p>	<p>The contributing factor of the incident is that a worker with no electrical qualifications was attempting to replace a circuit breaker in an energized panelboard without de-energizing and locking out the equipment.</p> <p>An additional contributing factor to the injuries and damage sustained was that the circuit breaker being replaced was not originally installed with approved mounting hardware as per the manufacturer's installation requirements.</p>

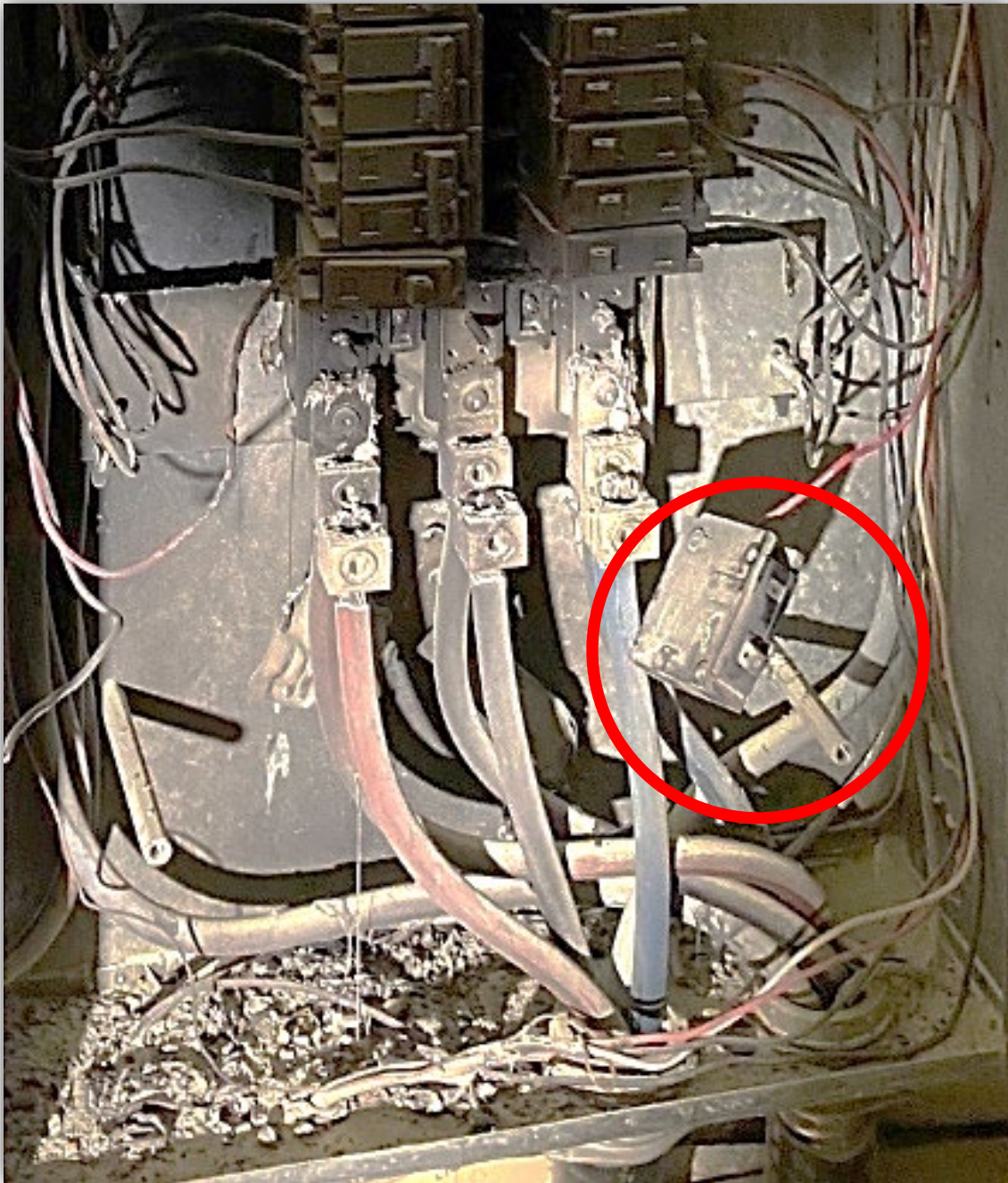


Image 1 – Condition of the 400-amp panel board after the incident. [RED] Faulty breaker.

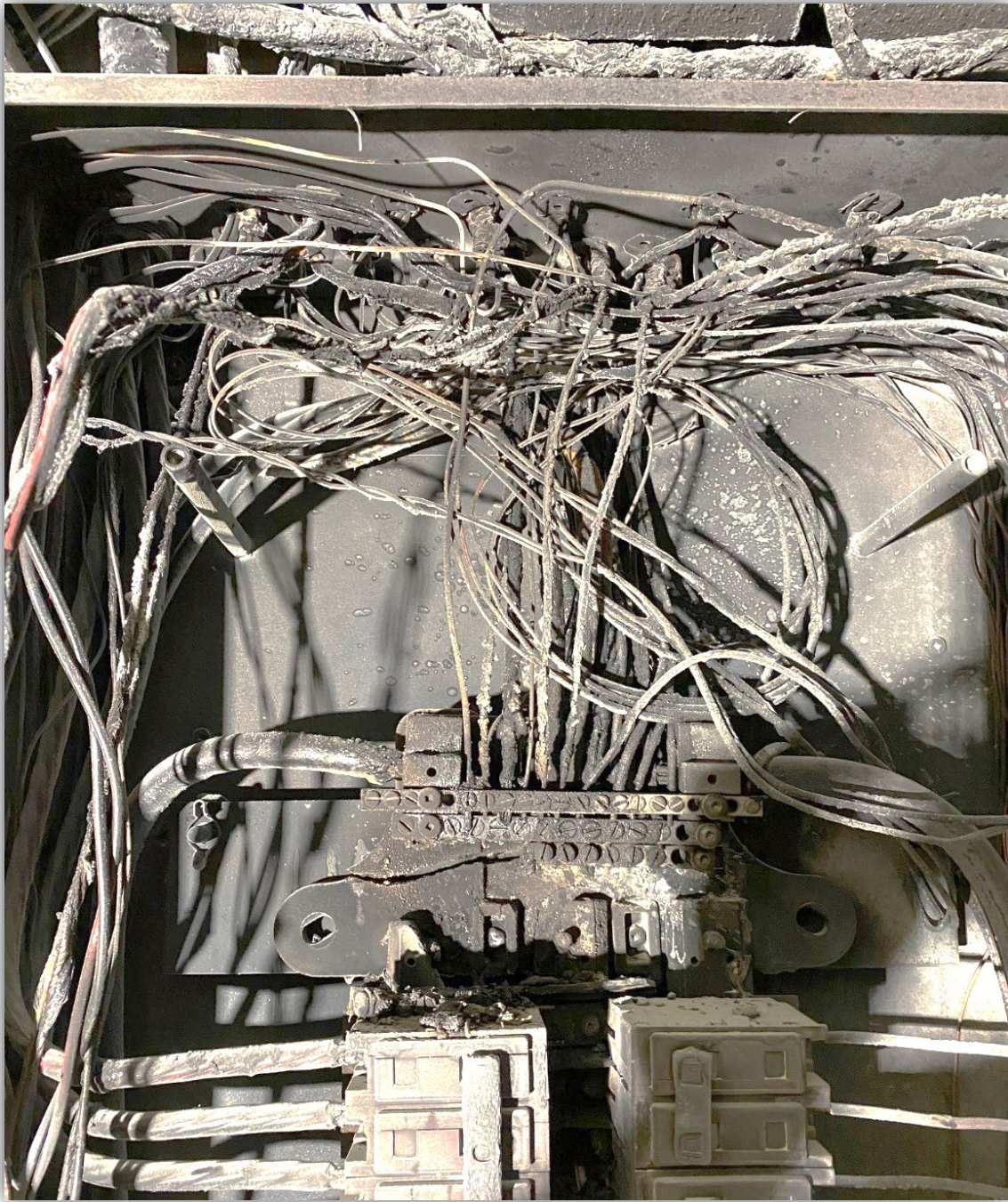


Image 2 – Heat damage to the neutral bus bar and branch circuit conductors.

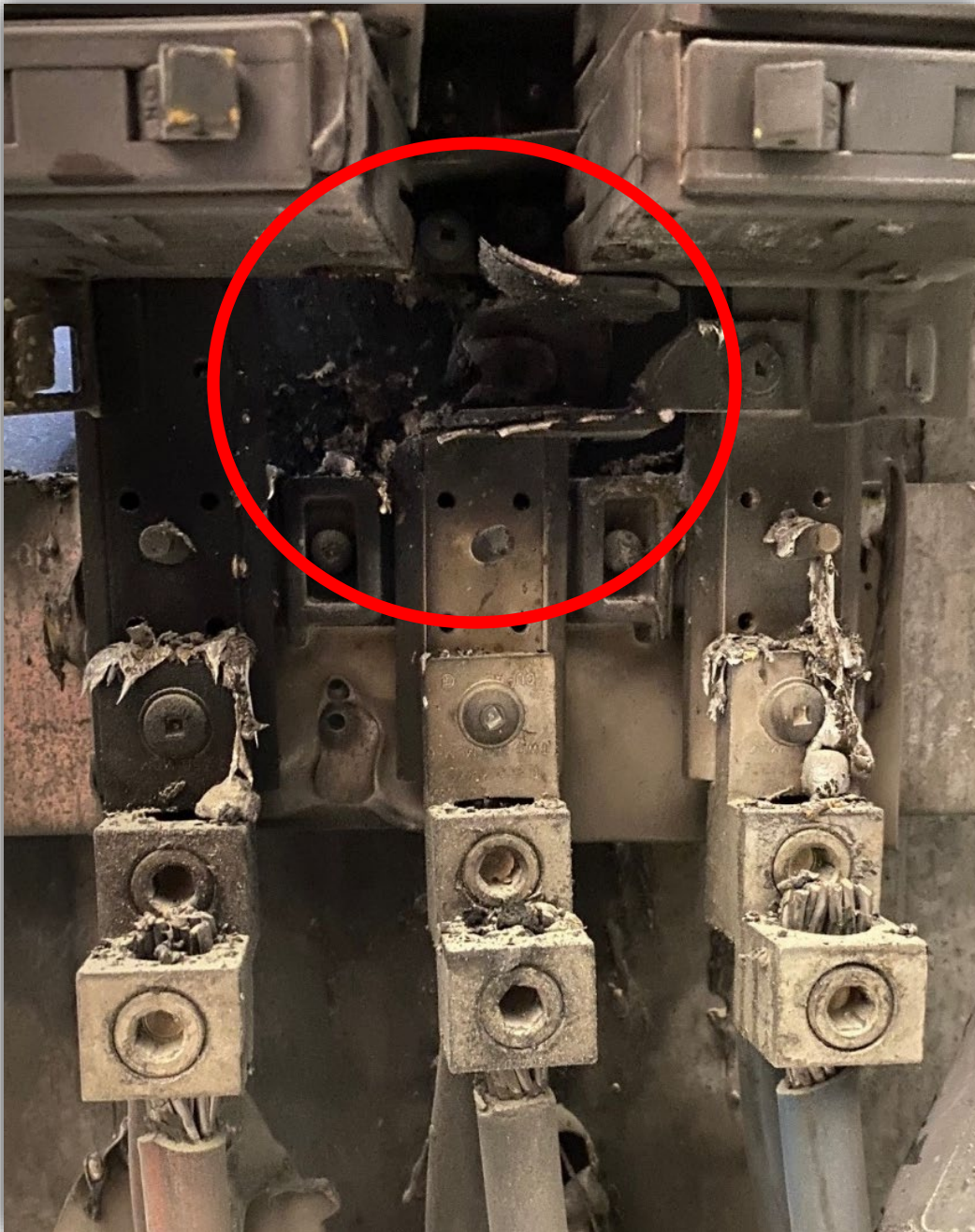


Image 3 – Melted metal on panelboard feeder termination point. [RED] Point of contact between equipment and worker.

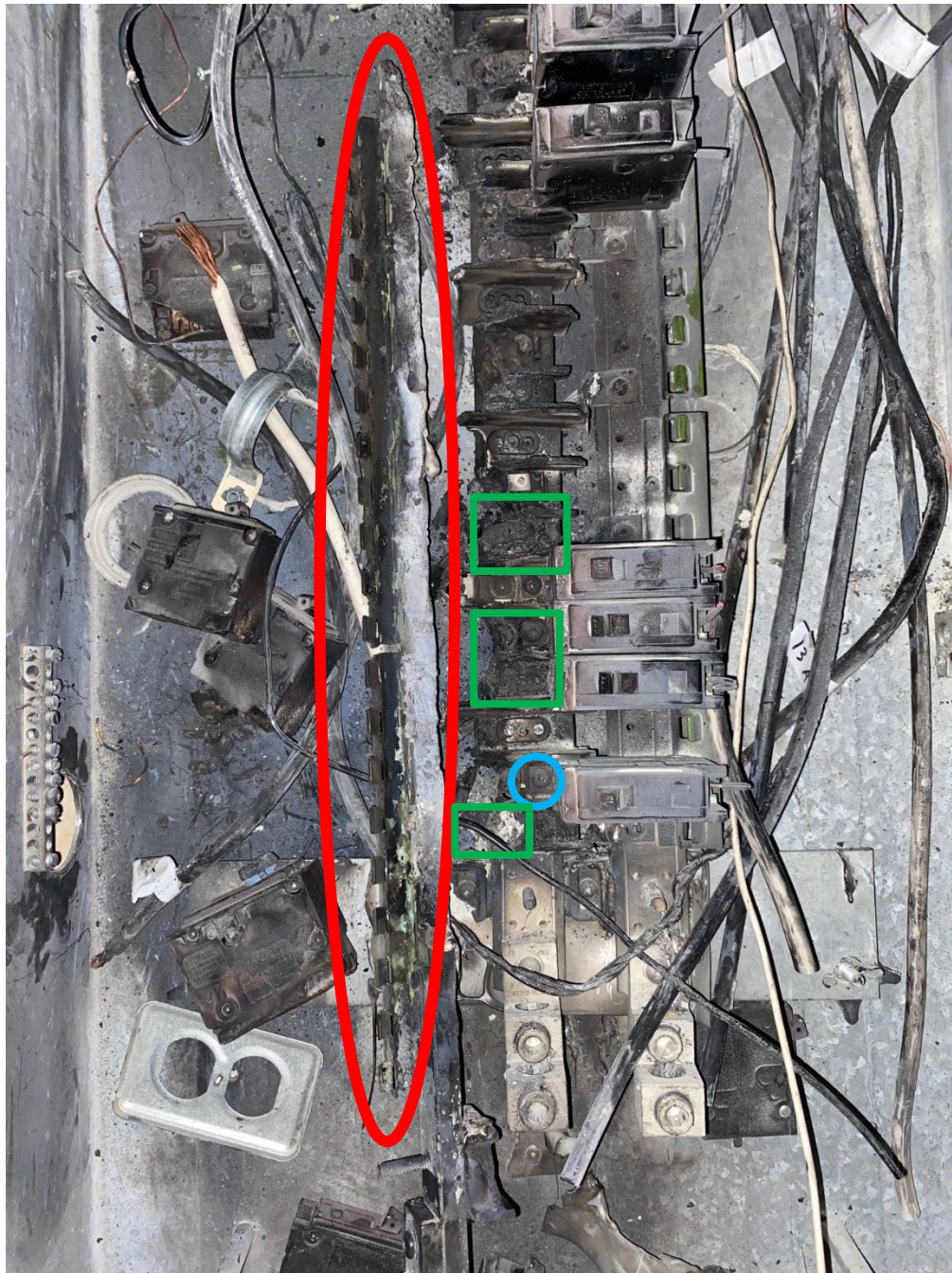


Image 4 – Burnt bus bars after panel removal. [RED] Melting of the “A” Phase bus bar. [GREEN] Melting of the “B” phase bus bar. [BLUE] Factory supplied mounting screw.

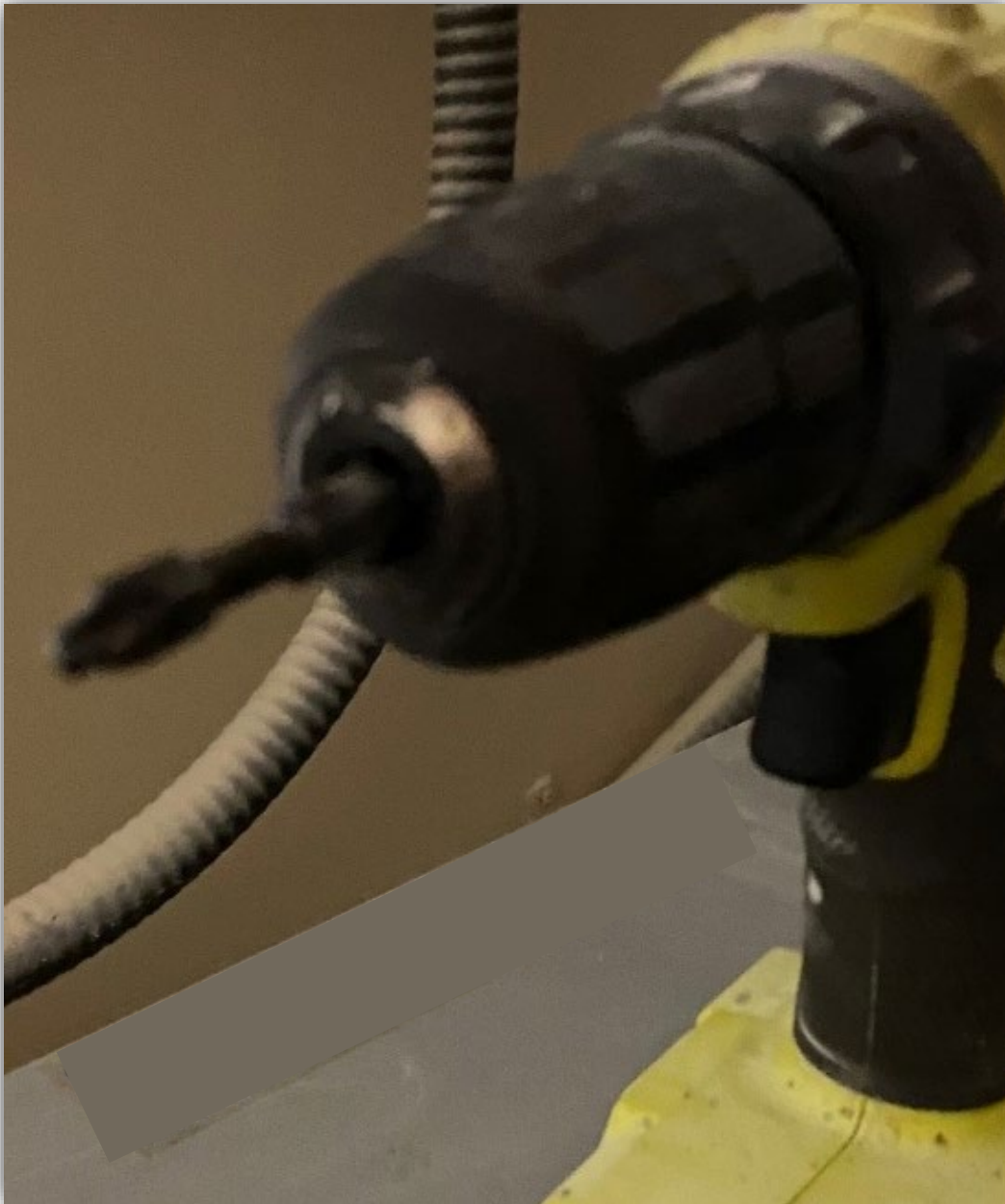


Image 5 – Drill with burnt Phillips head drill bit.



Image 6 – Service disconnect in relation to the damaged electrical panel. [A] Location of the damaged panelboard after being removed. [B] Main service disconnect. [C] Transformer / panelboard disconnect.