Incident Summary #II-1280282-2021 (#24876) (FINAL)

SUPPORTING INFORMATION	Incident Date		October 12, 2021
	Location		Richmond
	Regulated industry sector		Elevating devices - Elevator
	Impact – Injury	Qty injuries	0
		Injury description	N/A
		Injury rating	None
	Impact – Damage	Damage description	Plastic devices in control space closet were damaged from heat. Damaged thermostat, drywall, and smoke alarm.
		Damage rating	Minor
	Incident rating		Minor
	Incident overview		A fire ignited in the elevator closet control space, resulting from a premature failure in the variable frequency drives' power components.
INVESTIGATION CONCLUSIONS	Site, system and components		A mid-rise apartment building that houses two passenger elevators of the electric traction type. The installation is of the Machine-Room-Less type, where the elevator's electric motors are installed in the hoistway, and the controllers are housed in a remote closet located on the premises. The controller cabinet houses the variable frequency drive. The variable frequency drive is a device normally used in motor control applications. They are internally equipped with power electronics that are exclusively designed for smooth speed regulations of three phase motors. The controller comes equipped with a bank of resistors known as the braking resistors (Photo 1). The braking resistors are used in conjunction with the drive's internal brake transistor. The brake transistor in the drive acts like a switch, that turns on and off. When an electric current switches the brake transistor on, it allows excess energy to be routed across the braking resistors (Photo 2). Under normal operation, when the elevator is in the motoring state with no load up or full load down, the motor will act as a generator. Energy being generated by the motor, when it's overhauled, is fed back to the drive's DC Bus Link. The drive's DC Bus normally stores energy that is generated by the drive. The additional energy being fed from the motor during deceleration eventually reaches the bus voltage limit, where the braking transistor is then switched on. The excess energy being generated by the motor is shunted across the braking resistors. The braking resistors dissipate the excess energy by converting it to heat. If the braking transistor were to fail, there is a possibility that the failed transistor would allow an abnormal amount of voltage across the braking resistors. This high volume of voltage across the resistors could lead to drive overload failure or possibly a fire. The resistors are not rated for continuous duty cycle. For this reason, the drive manufacturer recommends an external thermal switch be mounted in the brake resistor cabinet; this would turn off voltage to the resistor in the event of failure of the internal braking transistor, thus shutting the elevating unit down.

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Failure scenario(s)	The braking transistor shorted, therefore allowing excessive voltage to be dumped on the braking resistors continuously. This caused the braking resistors to excessively heat up. A technical bulletin was issued from the manufacturer regarding transistor shorts related to the equipment installed.
Facts and evidence	**Site visit November 04, 2021** • Performed an inspection for new drive replacement (different model than original), new braking resistors and verified fire recall operation after smoke detector was replaced. • Noticed that top layer of drywall behind the resistor cabinet appeared to be damaged by heat as it appeared to be scorched (Photo 3). • Noticed that smoke detector for the controller closet had been removed due to damage caused by fire. • Caretaker stated that the smoke detector melted but activated the fire alarm (Photo 5). • Noticed that the thermostat in the closet was functional and ventilation fan was also operational. • Received a Mechanical Engineering letter confirming that the current ventilation was adequate for the installation and compliant with the B44-07 requirements for keeping temperature within the range specified by the equipment manufacturer. • Noticed that controller had no external thermal switch connected in order to monitor the braking resistor temperature. • Confirmed drive was installed between 2016-2019 • Mechanic stated that the paint of coat around the resistor cabinet had been burned off as a result of the heat. Received a copy of a Technical Bulletin from the controller manufacturer. Bulletin confirmed that drives installed with their controllers between 2016 and 2019 have potential issues with the power modules that could result in premature failure of the drive. The technical bulletin strongly recommends adding a monitoring circuit if replacing a drive with an identical unit.
Causes and contributing factors	It is very likely that a premature failure in the drive's power components resulted in an abnormal and continuous voltage flow to the braking resistors. The continuous voltage flow may have likely resulted in an extreme rise of heat created within the resistor cabinet. It is very probable that any combustible material above or in proximity to the resistor's cabinet would have been affected by its radiant heat. It is plausible that the suggested monitoring circuit, referenced by the drive manufacturer in the technical bulletin, could have prevented the overheating of the resistors.

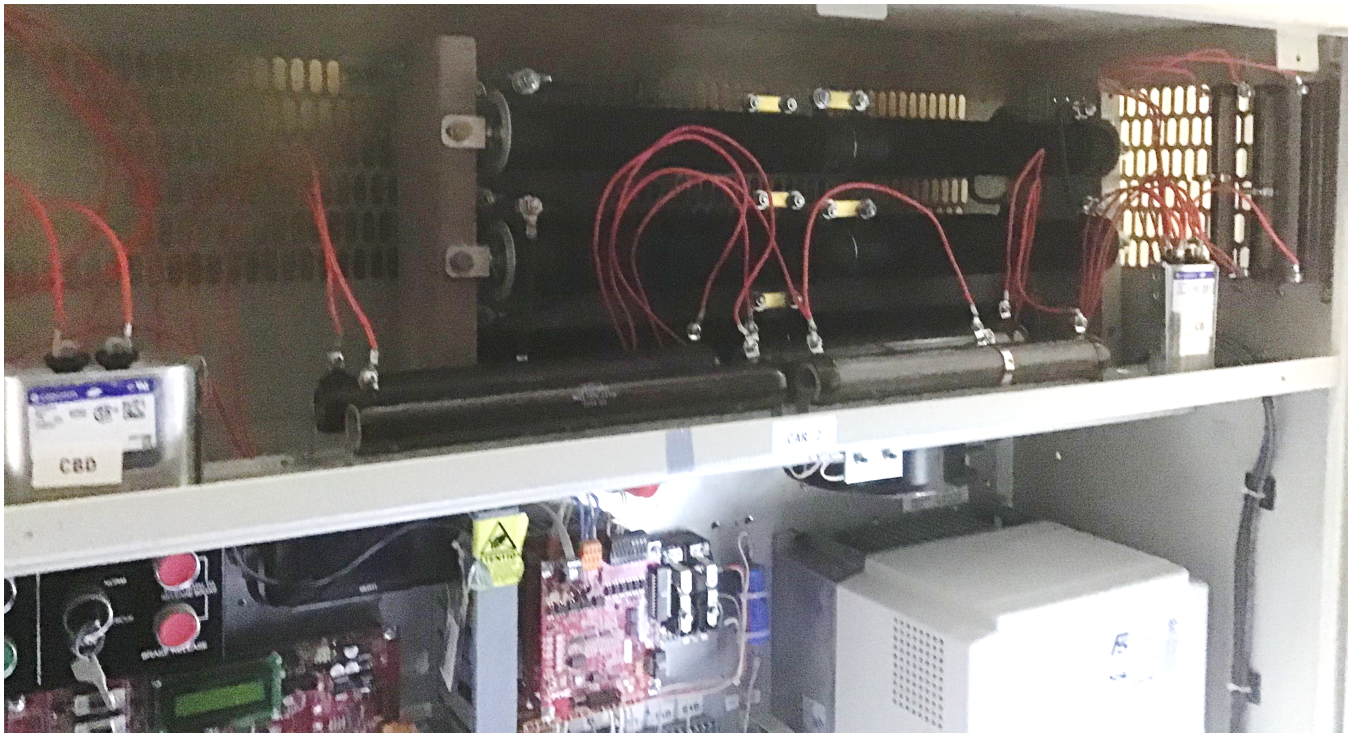

Photo 1: The braking resistors inside it's cabinet that sit on top of the controller.

Photo 2: The original braking resistors that were replaced after being affected by the transistor failure.

Photo 3: The top layer of drywall located behind the resistor cabinet that appears to have been scorched by radiant heat.

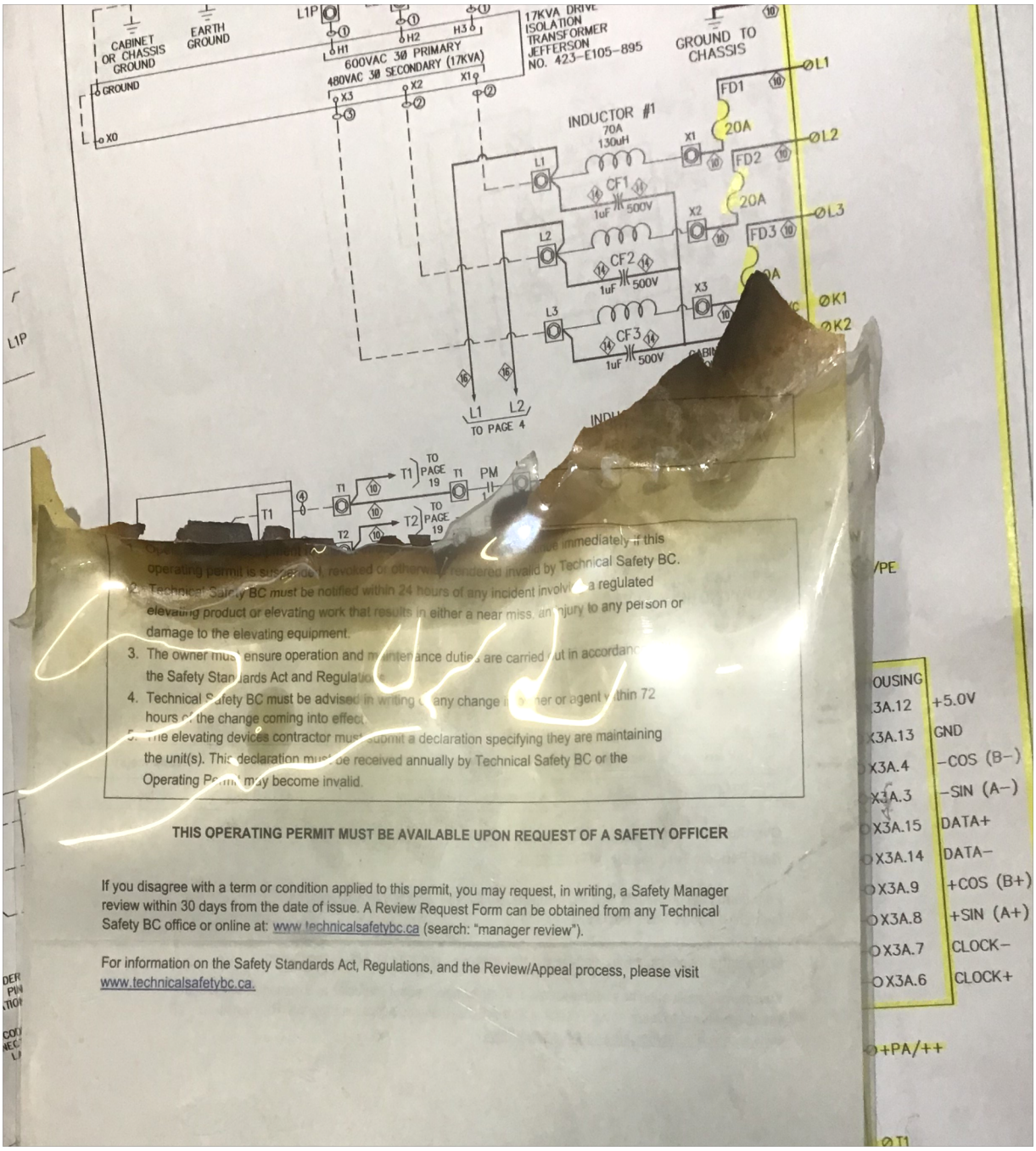

Photo 4: Plastics and other combustible material sitting on top of the resistor cabinet were burned or scorched during incident.

Photo 5: The smoke alarm located in the control space closet and installed directly above the affected resistor cabinet was melted during the incident. The damaged device was removed prior to site visit.