Incident Summary #II-1450906-2022 (#30115) (Final)

SUPPORTING INFORMATION	Incident Date		January 2, 2022
	Location		Cobble Hill, BC
	Regulated industry sector		Electrical - Low voltage electrical system (30V to 750V)
	Impact – Injury	Qty injuries	0
		Injury description	N/A
		Injury rating	None
	Impact – Damage	Damage description	Internal electrical components of the dust collector and the branch circuit feeding it were heat damaged.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		At a new wood manufacturing plant, the internal electrical wiring and components of a dust collector and the branch circuit conductors feeding the dust collector overheated causing them to melt. The failure resulted in loss of use of the equipment and required repairs to bring the equipment back into service.
INVESTIGATION CONCLUSIONS	Site, system and components		The site is a new commercial wood manufacturing plant with associated electrical equipment used in the milling, shaping, and assembly of wood products. Wood dust collection machines and associated dust collection ducting equipment are installed in the production areas and are intended to manage dust produced by the equipment used in the manufacturing process. The dust collection equipment is configured to serve multiple pieces of wood dust producing manufacturing equipment at the same time and has a pneumatic dust filter cleaning system that is intended to keep the filters clean during operation. The main service of the electrical system at this site is rated at 1200 Amp (A), 120/208 Volt (V), 3 Phase (PH), 60 Hertz (HZ) that feeds multiple 120/208V, 3PH, 60HZ sub distribution systems within the wood manufacturing facility. From the sub-distribution system there are multiple feeders and branch circuits which run to each equipment location where they are connected to the machines in the production areas. The dust collector machines are configured to be connected to a 40A, 208V, 3PH circuit breaker within the sub-distribution equipment. The connection to the equipment was made with field installed multi-conductor #8 Awg (American wire gauge) SOOW type copper flexible cable (rated at 35A, BC electrical code table 12) which was connected to a multi-conductor #10 Awg AWM type flexible cord in a junction box at the machine location (cable was supplied with the equipment). The dust collector has a manufacturer's name plate rating of 11KW, 230V, 32A, 3PH, 60HZ. The blower motor within the dust collector equipment has name plate ratings of: • 11KW, 230V, 50HZ, 35.3A or; • 11KW, 265V, 60HZ, 30.8A.

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The dust collector was marked with a “CE” certification mark that is not recognized in British Columbia for certification as an approved electrical product (Image 1).

In cases where equipment from other countries (in this case, Austria) has a certification mark that is not recognized for use in BC, an evaluation is required to be performed by a recognized certification body. If evaluation criteria are acceptable a label from that certification body is applied to the product.

The dust collectors in this case had been evaluated and labeled with a “QAI” label that is a recognized approval mark in BC. The certification mark is required to be on the equipment for a qualified individual to connect the electrical equipment and the manufacturer’s name plate ratings are to be followed when connecting the equipment to ensure the proper rated branch circuit and overcurrent protection are installed (Image 1).

The evaluation and approval process are intended to ensure that the electrical product meets an appropriate standard for electrical safety for use in BC. Safe and proper operation of the electrical equipment relies on the equipment meeting the appropriate approval standard criteria.

Electrical equipment is designed and approved to be connected to an electrical system with the appropriate voltage, current, and frequency ratings indicated on the manufacturer’s name plate data to operate as intended and prevent the equipment and components from overheating due to excessive current that can exceed the equipment’s internal component rating or the branch circuit rating.

For proper operation of electrical equipment, the voltage supplied needs to be within allowable tolerances from the electrical service and distribution equipment, and all the way down to the branch circuit level. Over voltage or low voltage supplied to equipment can cause the equipment to operate outside its normal parameters and can result in overloading and overheating. Excessive current can raise the temperature of components and branch circuits above their intended safe operating levels and cause equipment to malfunction, deform or melt, and eventually fail to operate, or potentially start on fire.

The dust collectors are connected to wood dust producing equipment through a network of ducting and gates that can be opened or closed depending on which equipment is in operation. The dust collector operation can be affected by this interconnected system by the number of machines connected, the type, diameter, and length of the ducting as well as the size, type, and amount of dust being collected. This can affect the demand for the equipment and the associated current drawn by it.

The dust collection system has filters that filter wood dust from the air flowing in the ducting system. A pneumatic self-cleaning system is designed to keep the filters clean. Proper operation of the filter system is important to prevent clogged ducting and potential overloading of the blower motor system.

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Failure scenario(s)	The name plate rating of the dust collector equipment is 230V, 32A, 60HZ, 3 PH and the name plate rating on the blower motor within the dust collector is 230V, 35.3A at 50HZ, and 265V, 30.8A at 60HZ. The equipment branch circuit was connected to a 208V, 40A, 3 Pole circuit breaker. A flexible cord with #8 Awg conductors rated at 35A were connected to the equipment at a junction box. When connected to a 208V, 3 PH 60HZ system the equipment that is rated to operate at 230V, or 265V had a moderate increase in operating current which was measured up to 36A on an example machine of the same model at the site. Similar currents present in the damaged dust collector likely resulted in overloaded electrical conductors and components. The dust collector was operating during production to remove dust from the wood manufacturing process. Multiple pieces of equipment were connected to the dust collector through an interconnected ducting system. Additional machines connected to the dust collection system can create a greater demand on the dust collector blower motor. It was stated that the dust collector's pneumatic filter cleaning system had not been operating as intended and that the system at times was operating with clogged air filters which can reduce the air flow within the system and create a greater demand on the dust collector blower motor. During operation, the dust collector was tripping the 40A circuit breaker. The equipment operators observed heat damaged internal electrical wiring, and a contactor within the dust collector equipment, as well as heat damaged branch circuit conductors and connections in the external junction box used to connect the equipment. The dust collector was manufactured in Austria and had the "CE" approval mark on the name plate rating label. The equipment was evaluated under the SPE-1000 model code and approved for use in BC by QAI, a certification and approval agency.

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Facts and evidence	Safety Officer observations at the site and from photos and information supplied by the electrical contractors that were hired by the owner and the manufacturer to assess and repair the damaged equipment: • Utility provided electrical system was 120/208 Volt, three phase, 60 HZ. • The supplied connection to the equipment was a 208V, 40A, 60HZ, 3PH electrical system. • The name plate rating on the dust collector is 230 Volt, 32A, 60 HZ, 3PH, 11KW (Image 1). With a name plate rating of 32A normal practice would be to install a 40A branch circuit. • The dust collector user manual states “Electricity supply only in authorized field of + or – 10% of network”. With a name plate of 230V this would indicate a range of 207V – 253V is acceptable according to the manufacturer. • Dust collector equipment internal blower motor nameplate rating (Image 2): - 11KW, 230V (delta connection configuration), 50HZ, 35.3A, 3PH. - 11KW, 265V (delta connection configuration), 60HZ, 30.8A, 3PH. • Thermal camera Photos from the contractor showing a contactor from an example machine of the same model in operation at the same site showing a temperature of 136 degrees Celsius (Image 3). • Heat damaged contactor from the dust collector (Image 4). • Heat damaged internal wire way and conductors from the dust collector (#12 AWG copper) (Image 5 and Image 6). • Heat damaged flexible cord supplied with the machine for connection in the junction box was #10 AWG copper (Image 7). • Heat damaged field installed flexible cord branch circuit cable for connection in the junction box is #8 AWG copper which is rated at 35A (Image 7). • Melted wire connectors in the connection box (Image 7). Electrical contractor correspondence with the owner, distributor, and manufacturer regarding assessment and repair of the damaged dust collector equipment: • Electrical current testing of the equipment after repairs were made and testing of a similar machine in use at the facility was performed. The size of the internal wiring, electrical contractors, and terminal blocks do not appear to be properly sized based on the current that was being measured compared to the current ratings printed on the components. The equipment showed signs of being overloaded and overheated. Temperature measurements were taken using thermography which showed equipment was in some cases running as high as 136 degrees Celsius while in operation (Image 3). • Through testing it was determined that during operation the dust collector, or an example unit at the same site was at times drawing 35.4A and up to 36A which is more current than the 32A that it was rated for based on the manufacturers name plate rating. • The external electrical branch circuit wiring and wire connectors in the equipment connection junction box and the dust collector internal wiring and electrical components showed signs of overheating and melting (Image 4, Image 5, Image 6, Image 7). • The dust collector pneumatic filter blaster may not have been functioning properly which may have resulted in clogged dust filters during operation. This combined with opening multiple duct sliders to service more machines can increase the demand on the dust collector and may increase the current draw of the equipment.

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	Manufacturer and the manufacturer's technical representative's correspondence with the owner: • The dust collector equipment is not being supplied with the appropriate voltage. This has likely resulted in the overloading and overheating problems associated with this equipment. This later resulted in the installation of a transformer installed to raise the voltage from 208V to 230V. • It was stated that the equipment name plate rating voltage is 230V and the voltage connected to the machine was too low. This was the cause of the extra current draw and overheating of wiring and components. It was later stated that the equipment can operate on 208V (Image 1). • The dust collection equipment is not being properly used or maintained which is contributing to the overloading condition.
Causes and contributing factors	The cause of this incident is likely due to the dust collector branch circuit conductors, and internal electrical wiring and components being exposed to currents that they were not rated or designed for. The overload condition possibly occurred because the voltage supplied to the dust collector equipment was 208V which is lower than the equipment name plate rating of 230V and the blower motor name plate ratings of 230V at 50 HZ and 265V at 60 HZ. Several factors may have contributed to lower than anticipated voltages including a varying supply voltage, and/or voltage drop on service, sub-feeder, and branch circuit conductors that supply the electrical equipment. The #8 Awg flexible cord conductors used to connect the dust collector in the junction box were rated at 35A and the current drawn from an example machine of the same model at the site was measured at 36A. This resulted in overheating and melting of the conductor insulation and connections within the junction box. The BC Electrical Code requires branch circuit conductor ampacity to be sized appropriately based on the size of overcurrent protection to properly protect conductors from overcurrent and overload. In this case the size of the overcurrent device was a 40A breaker. A contributing factor may be the dust filter cleaning system within the equipment not operating as intended and leading to extra demand on the equipment and/or increased demand on the equipment related to the number and type of dust producing pieces of equipment connected to the dust collection system.

Image 1 - Dust collector electrical name plate and approval label.

Image 2 - The blower motor nameplate shows 230V at 50HZ or 265V at 60HZ. The system voltage supplied to the machine was 208V at 60HZ. In general, supplying a lower voltage to a motor increases the current that is drawn and results in additional heating of the motor as well as other related equipment such as internal equipment wiring, contactors, branch circuit conductors, terminations, and connections.

Image 3 - Infrared photograph showing 136 degrees Celsius temperatures measured at the motor conductor terminations at the control contactors within another identical machine at the site.

Image 4 – Heating damage to the internal contactor of the dust collector control equipment.

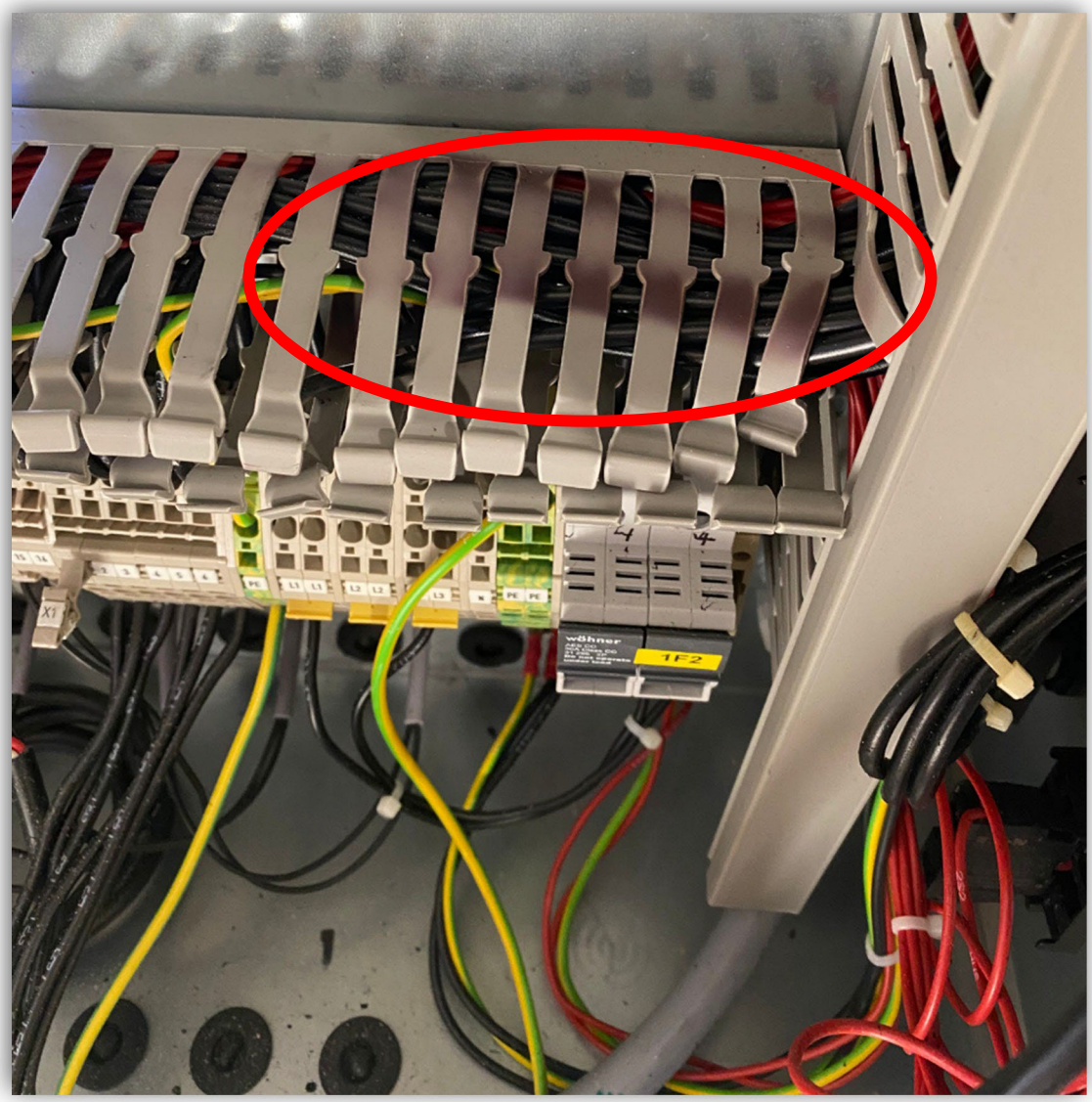

Image 5 – Heating damage to the plastic wire way inside the dust collector control equipment.

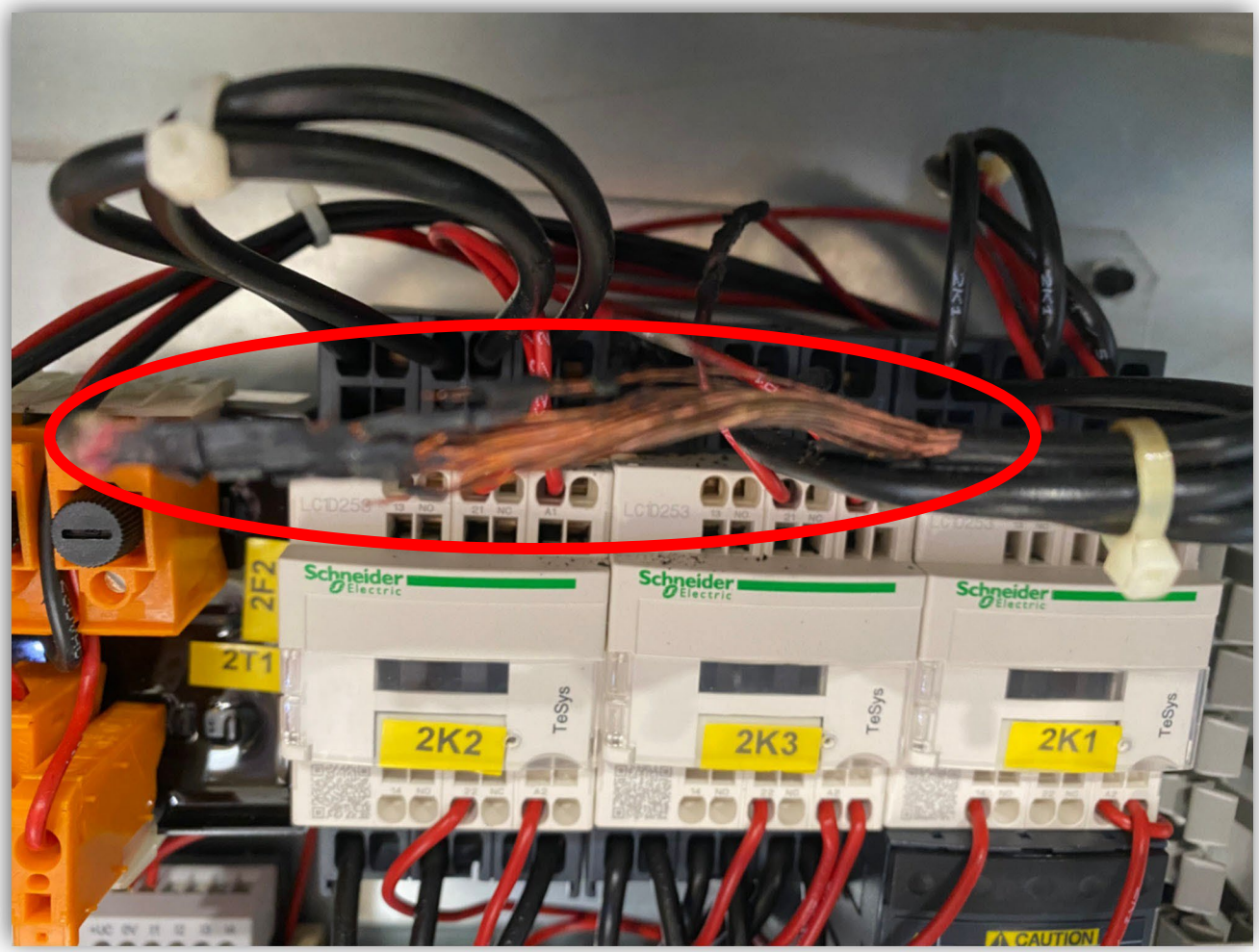

Image 6 – Heating damage to the insulation on the conductors inside the dust collector controls section.

Image 7 – Heat damage was observed at the dust collector branch circuit supply connection junction box. The red, black, and white conductors of the #8 Awg SOOW flexible cord entering from the top were used to connect the dust collector in the junction box and are rated at 35A based on the BC Electrical Code. The black conductors are #10 Awg AWM flexible cord that come with the dust collector and are rated at 40A in this application. An example dust collector at the same site was at times drawing currents of 35.4A – 36A when measured during operation.

Image 8 – Flexible cables used for connection of the dust collector. The lower cable was a #10 awg type AWM cable that came with the dust collector from the manufacturer. The upper cable was a #8 awg type SOOW flexible cord that was installed on site by an electrical contractor for connection of the dust collector.

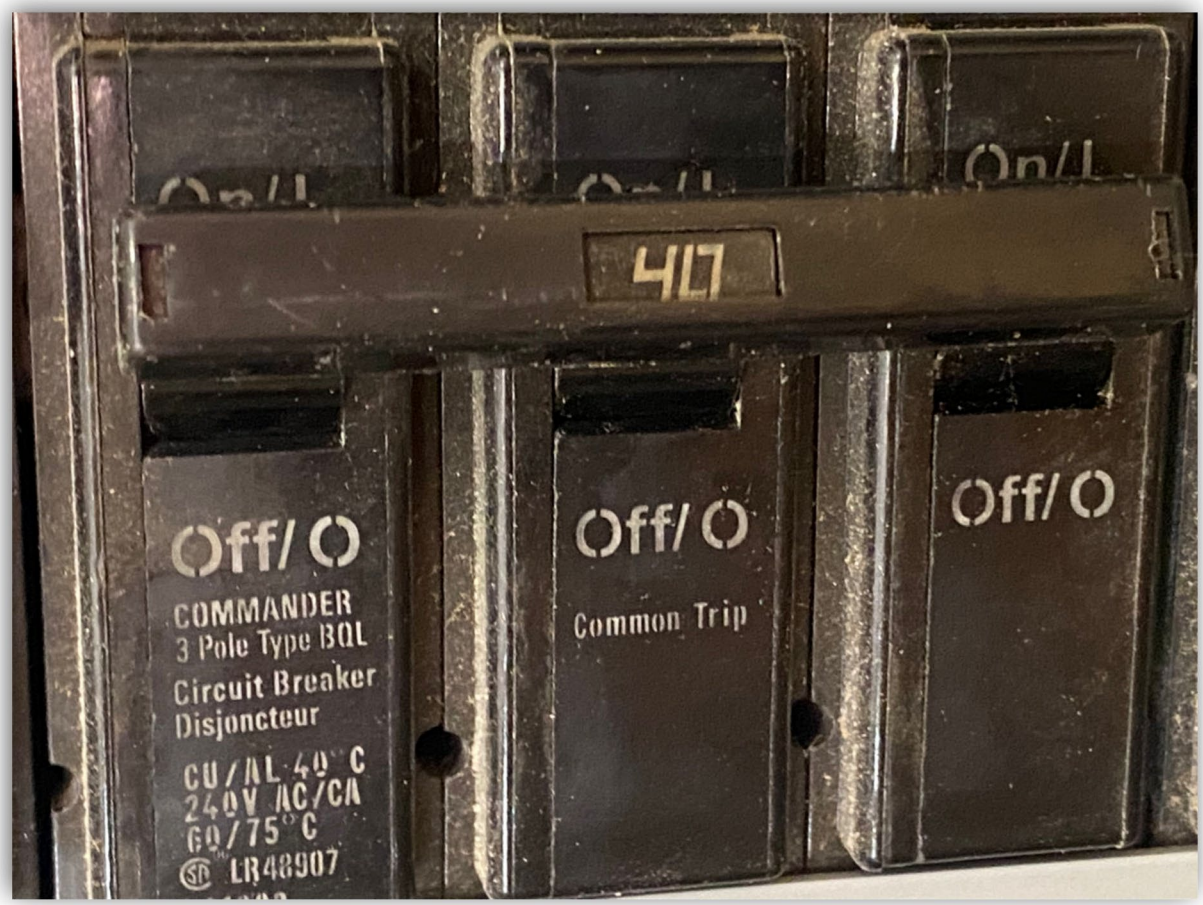

Image 9 – The 40A circuit breaker installed for the dust collector branch circuit.

Image 10 - Example of the dust collector installed at this site. The image was obtained from the manufacturer's website.