

Incident Summary #II-1464040-2022 (#30333) (FINAL)

SUPPORTING INFORMATION	Incident Date	November 5, 2022	
	Location	Chilliwack	
	Regulated industry sector	Electrical - Low voltage electrical system (30V to 750V)	
	Impact	Qty injuries	0
		Injury description	N/A
		Injury rating	None
	Damage	Damage description	Damage to the electrical service equipment, and damage to an exterior wall of a detached shop.
		Damage rating	Moderate
	Incident rating	Moderate	
Incident overview	A manual transfer switch for a generator failed resulting in a small fire in a detached shop that destroyed the transfer switch, and a 200-amp 120/240-volt panel. The fire also damaged the exterior wall that the transfer switch and panel were mounted to.		
INVESTIGATION CONCLUSIONS	Site, system and components	<p>The site consists of an overhead 200-amp 120/240-volt single phase utility service to a detached shop on a rural farm property. From the utility meter on the exterior of the shop, the service conductors enter into a 200-amp 120/240 fused service switch on the building interior, then into a 200-amp 120/240-volt rated generator manual transfer switch, and then into a 200-amp 120/240-volt electrical panel (Image 1).</p> <p>The 200-amp panel feeds power to a 40-amp 240-volt sauna, as well as 15-amp 120-volt general duty receptacles and lighting throughout the detached shop. There is a 125-amp 240-volt breaker that feeds a house, and another 125-amp 240-volt breaker that feeds another smaller shop.</p> <p>The generator manual transfer switch has a hard-wired electrical cable with a 50-amp 240-volt rated male cord end at the other end of it. In the event of a power outage, the cord end is plugged into a 50-amp 120/240-volt receptacle on a generator that is protected by a 240-volt 50-amp breaker. The manual transfer switch is then switched from the top (utility power) position to the bottom (back up power) position to provide power to the 200-amp panel.</p> <p>The generator used is what's called a power take off (PTO) generator. This type of generator is attached to a shaft on the back of a farm tractor, and the tractor engine is used to power the generator. The generator itself can provide a maximum of 25 Kilowatts of power in a back up situation.</p>	

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<p>Failure scenario(s)</p>	<p>During a power outage the PTO generator was used to power up the 200-amp electrical panel. The manual transfer switch cable was connected to the 50-amp receptacle on the PTO generator, and then the transfer switch was manually switched to the bottom (back up power) position. During the power outage there were no problems powering up the connected electrical loads. A few hours later the utility power was restored, and the generator was no longer required. The transfer switch was manually put back into the top (utility power) position, and the 200-amp panel was then powered by the utility again. Approximately an hour after the transfer switch was returned to the top (utility power) position, a fire started with the source of ignition being the transfer switch.</p>
<p>Facts and evidence</p>	<p>Interview with the farm manager:</p> <ul style="list-style-type: none"> • The electrical service to the detached shop also feeds a house and another smaller shop building. • When the fire happened power was disconnected by a neighbour electrician who came and pulled the utility meter out of the enclosure socket. • The fire department attended site to make sure the fire was fully extinguished. <p>Interview with property caretaker:</p> <ul style="list-style-type: none"> • Has lived on the property for 12 years. The last time the transfer switch was used was at least five to six years ago because the power rarely goes out for long periods of time. There were no problems the last time the generator was used. • The manual transfer switch is approximately 40 years old. • About an hour after the utility power was restored, he was in the shop and noticed that the switch was sparking and smoking and a fire had started, • He tried to put the fire out with an extinguisher, but it kept reigniting because the power was still on. • A neighbour who happens to be an electrician was driving by and saw the fire. He stopped and pulled the utility meter out of the socket to disconnect power to the building. • Fire department attended site a few minutes later and made sure the fire was completely out. • It was noted that the switch was in the down position. The caretaker stated that the fire department must have moved the switch because it was in the top position when the fire started. <p>Examination of the manual transfer switch after the incident (Image 2, Image 4 and Image 5):</p> <ul style="list-style-type: none"> • The handle on the outside of the switch is connected to a bar on the inside of the switch that pivots knife blades between the top (utility power) position, and the bottom (back up) power position. • The top right jaw for the knife blade was significantly bent, and the knife blade was likely not making good contact with the jaw when returned to the top position. • The top right jaw insulator was missing, and the likelihood of the jaw bending is greater with the insulator missing. • The right and left knife blades are designed to function simultaneously and both be in the same position. • The right knife blade pivot point that is attached to the back middle of the enclosure is bent, and the right knife blade is lower than the left blade when the switch is moved up. This suggests that the right blade was not fully engaged into the top right jaw at the time of the incident.

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	<ul style="list-style-type: none">The heat pattern on the inside of the switch shows evidence of high heat on the top right side due to a cable connector missing, most likely from being melted.
Causes and contributing factors	<p>Based on the available evidence it is very likely that the fire was caused by a poor connection at the contact surfaces between the right knife blade and the top right jaw of the manual transfer switch due to a misalignment. The heat generated from the high resistance of the poor connection was hot enough to melt the insulation from the conductors inside of the switch, and then the conductors shorted out on the metal enclosure of the switch. It is very likely that the bare conductors contacting the metal enclosure created an arc that started the fire.</p> <p>A contributing factor for the incident may be:</p> <ul style="list-style-type: none">A lack of maintenance on the switch to make sure that all internal parts were intact and that the knife blades were functioning as required.

Image 1



200-amp overhead service to detached shop:

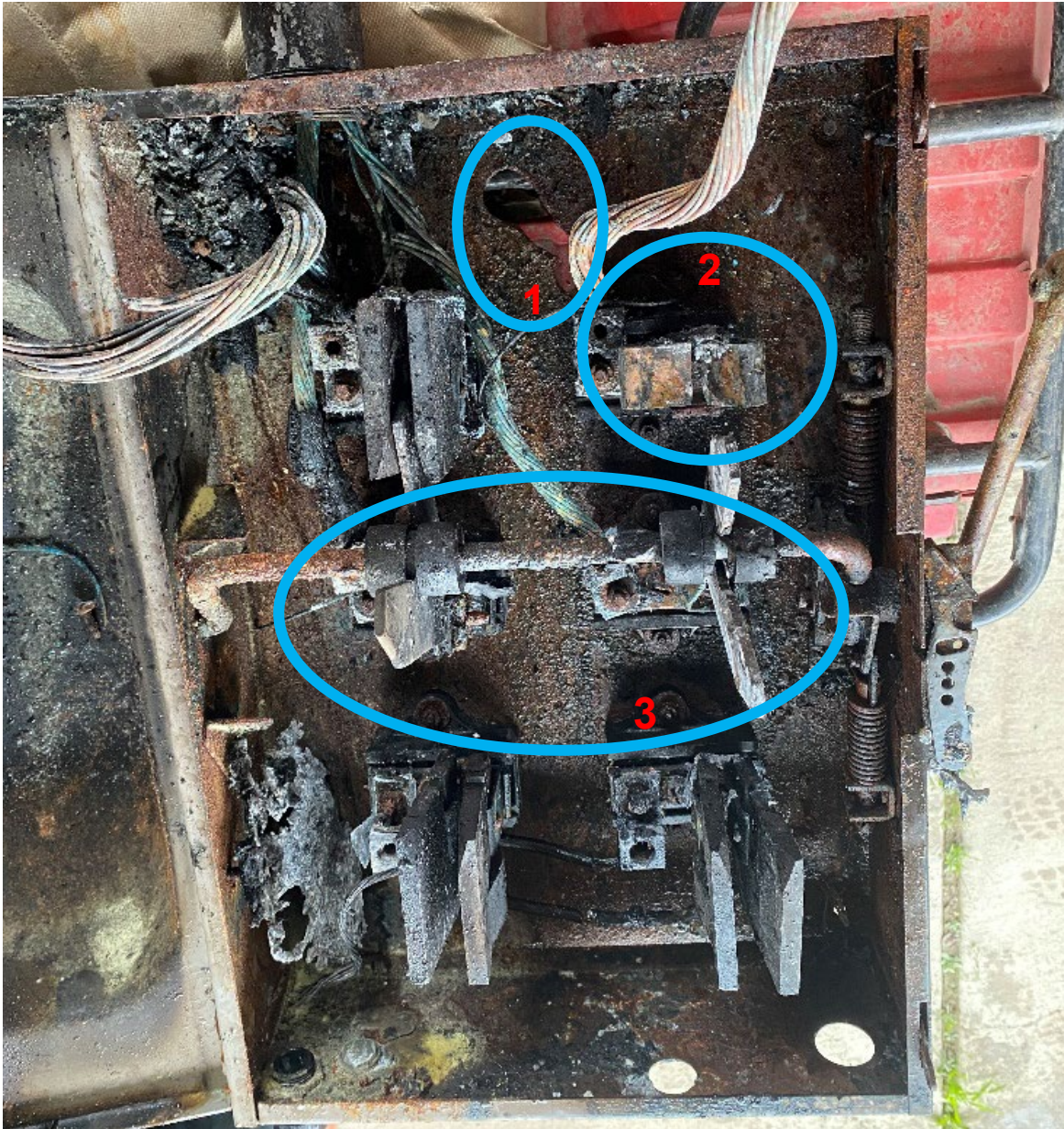
1. Utility overhead conductors.
2. 200-amp meter enclosure.

Damaged service equipment inside the detached shop:

1. 200-amp fused service switch.
2. 200-amp manual transfer switch.
3. 200-amp combination panel.
4. Cable for generator is out of the bottom of transfer switch.



Image 2 - The damaged manual transfer switch.



1. Hole in the back of the metal enclosure where the conductors shorted after the insulation melted.
2. Bent and damaged jaw.
3. Knife blades not in unison due to bent pivot point.

Image 3 – Similar style manual transfer switch.



1. Knife blades.
2. Knife blade pivot point.
3. Insulator with the jaws in between.
4. Handle on outside of switch to change the knife blades between top and bottom positions.
5. Metal bar that is connected to handle on the outside of switch to move knife blades up and down.

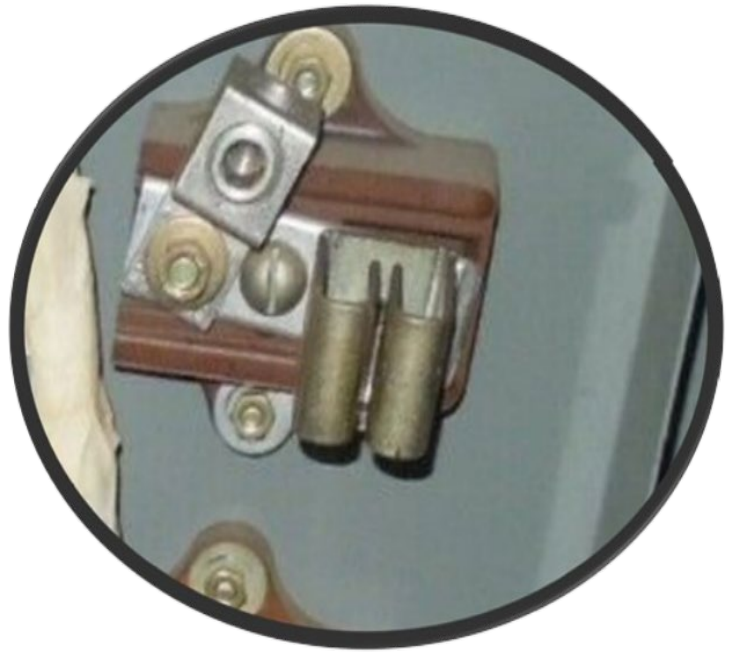


Image 4 – [Top] Damaged transfer switch bent jaw. [Bottom] Similar transfer switch normal jaw.

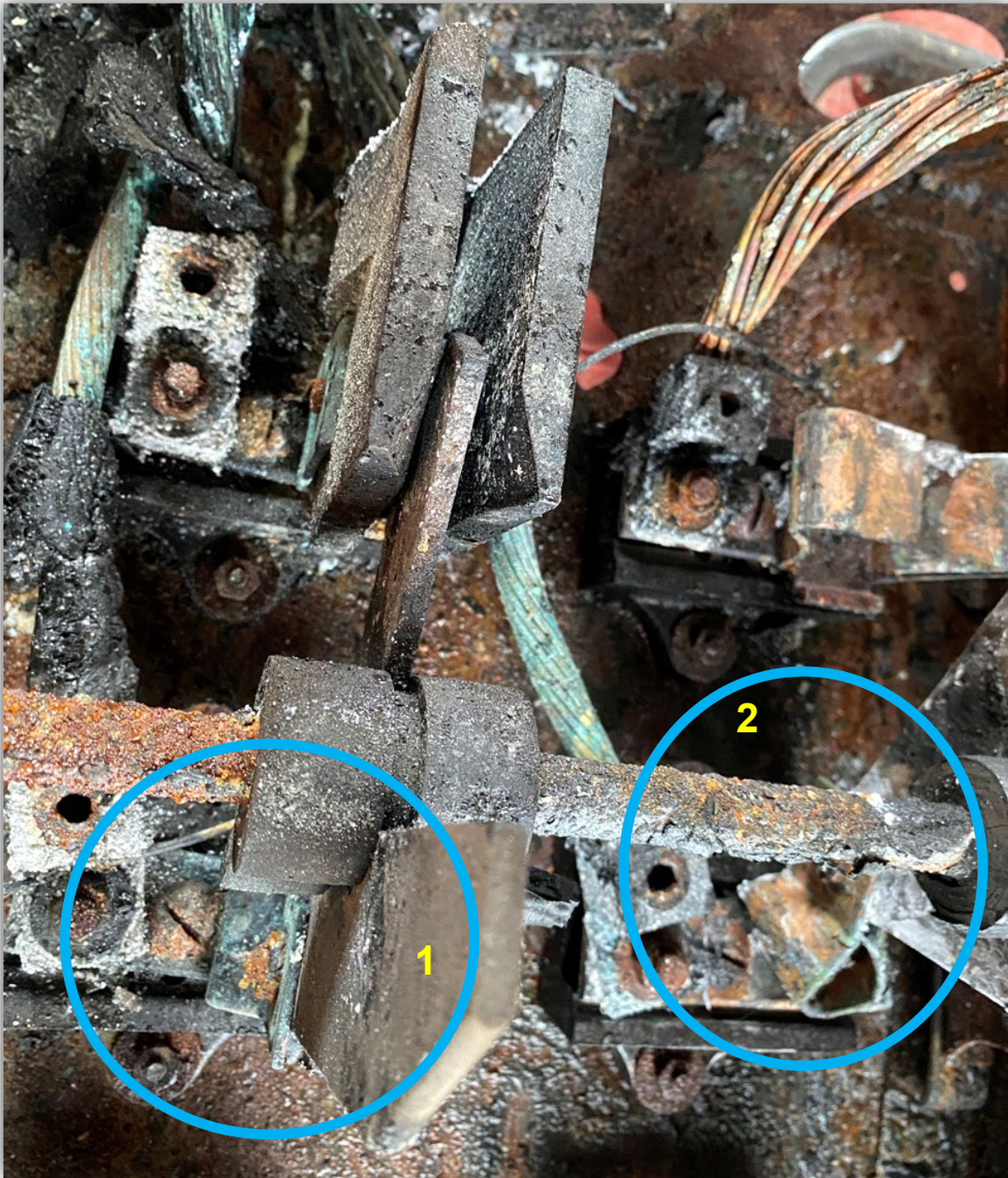


Image 5 - Close up of knife blade pivot points in damaged transfer switch. [1] Normal knife blade pivot point. [2] Bent knife blade pivot point.