Incident Summary #II-1512769-2023 (#32371) (FINAL)

SUPPORTING INFORMATION	Incident Date		February 21, 2023
	Location		Sun Peaks
	Regulated industry sector		Electrical - High voltage electrical system (greater than 750V)
	Impact – Injury	Qty injuries	0
		Injury description	N/A
		Injury rating	None
	Impact – Damage	Damage description	High voltage transformer damaged by snow grooming machine, limiting chairlift operational time by nearly a week.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		While a snow grooming operator was clearing a recent snow fall at the base of a ski hill chairlift, a high voltage 25KV (25,000 volt) pad mount oil filed transformer was struck by a snow grooming machine, inflicting damage to the high and low voltage components of the transformer, releasing a portion of the oil filled component.
INVESTIGATION CONCLUSIONS	Site, system and components		**Site and Facility** The ski hill has 13 lifts, including 3 high speed quad chairlifts, 4 quad chairlifts, and 6 surface lifts. Providing 138 trails, including 19 glade areas offering 4270 acres of terrain. To operate the ski hills electrical system, differing voltages may be required per the equipment employed. As many voltages may not be readily available by the supply authority due to geographical location, transformation of voltages is mandatory. High voltage (HV - greater than 1000 volts) is utilized in electrical systems for transmission purposes with the higher system voltages allowing transport of power over greater distances with fewer efficiency losses. HV transformers are used to convert high voltages to low voltages (less than 1000 volts) for typical facility power needs. The chairlift and lift station building receives its supply power from the secondary side of the HV transformer, distributing power to the applicable loads. **High Voltage System / Transformer** The subject transformer is a 150 KVA 3 phase pad mounted PTI (Partner Technologies Incorporated) transformer. The primary incoming voltage is 25,000 volts (V) and has a secondary voltage rating of 600Y/347 V. The secondary side of the transformer has a 3 conductor #2 Teck90 cable which supplies 600 volts to the chair lift base building and associated electrical equipment.

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	Grooming Equipment Snow grooming equipment is widely used around the mountain for day-to-day maintenance, this equipment is vital to ensure riding conditions are optimal. This equipment is operated by facility staff to move, pack, and flatten snow for local trails and areas accessed my mountain users. The snow grooming machines can create a pattern know as a corduroy, which is a highly sought after surface for skiers and snowboarders. Snow groomers usually operate outside of ski hill hours to limit the interference with the ski hill occupants. Snow grooming machines can vary in size, shapes, and models.
Failure scenario(s)	Near the start of a second scheduled workday, a snow grooming operator with 15+ years experience was tasked with clearing a recent snow fall at the base of the ski hill chair lift, also known as the “head trap”. The “head trap” is the roped off section near the base of the chairlift that limits the downhill user’s ability to come in proximity with the occupants loading at the chairlift station. After completing the assigned task, the grooming operator was moving forward on an upward trajectory exiting the designated area while looking over their right shoulder observing the machine components and corduroy, at that moment the transformer was hit, inflicting damage to the transformer’s components. Enough force was applied to the high voltage transformer, that the equipment was shifted nearly 12 inches on the concrete pad. This movement inflicted moderate damage to the internal components, later rendering the transformer inoperable. The primary damage occurred on the high voltage H2 connection point, damaging the bushing, allowing oil to leak from the transformer. Additional damage was also observed on the exterior of the transformer and the jacket / armour of the secondary low voltage cable supplying power to the chairlift building.
Facts and evidence	**Electrical component observations** Transformer Damage • Visible damage was present on the upper righthand corner where the grooming machine contacted the transformer (Image 2). • Visible damage was present on the lower front compartment which provides access to the primary and secondary cables (Image 3). • The high voltage H2 cable termination point was damaged (Image 4). • The outer jacket and armour of the 600-Volt secondary cable was damaged during the shifting of the transformer (Image 5). • Leakage of transformer insulating and cooling oil (Image 6 and Image 7). Equipment Protection • Flagging and/or mechanical protection was not provided around the high voltage transformer to limit access around the equipment. **Statements** Snow Grooming Operator Statements

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- The snow grooming operator was working the second shift of a 4-day rotation, a couple hours into a 10-hour shift between 5-6PM the incident occurred. At the time of the incident, visibility was clear, and daylight was still present. However, an abnormally high amount of snow had recently fallen over the past 48 hours.
- The operator was tasked with clearing the recent snow fall located at the base of the ski hill chairlift. This task had been successfully completed by the operator numerous times during the year at a variety of chair lifts around the mountain without incident. However, this time, the operator indicated they made an honest mistake and lost spatial awareness of the transformer. The operator stated they had just completed the snow removal task and was exiting the “head trap” area, and said they were in the process of moving forward uphill while looking over their right shoulder observing the back pans and grooming pattern when the groomer struck the top right corner of the transformer. The operator declared they had full line of sight and were aware of the transformer and its position but thought they were going to miss it while exiting the area.
- The operator would best define themselves as a "winch" operator and explained this task was not a common nor well liked job as you are working close to the chair lift. These grooming machines can be more challenging to operate in tight spaces as they have two tracks which work independently of each other. The operator indicated that a "Nordic" machine was selected for use by a supervisor due to its proximity to the lift. The operator declared this would not have been their preferred machine and indicated that other machines located on the mountain would be more suited for this task. The selected "Nordic" machine has additional pans located on the back of the machine and operators must be more vigilant and aware of the pans to not incur damage. The operator declared these pans can also block/limit your view when using your mirrors. The operator stated they were constantly checking the back pans positioning to ensure damage was not inflicted.
- The operator stated the incident could have been avoided if a smaller more appropriate machine was selected and if flagging or bollards were in place to limit access near the transformer.

Attending Ski hill Site Personnel and Electricians Statements

- A snow grooming machine bumped the 150KVA high voltage transformer located at the base of the ski hill chairlift, damaging numerous components of the transformer.
- The snow grooming machine contacted the upper right side of the transformer, causing it to shift nearly 12 inches on its concrete pad.
- The high voltage transformer was de-energized to allow for the required field repairs.
- The transformer leaked a portion of its oil component, environmental assessment and clean-up will be required.

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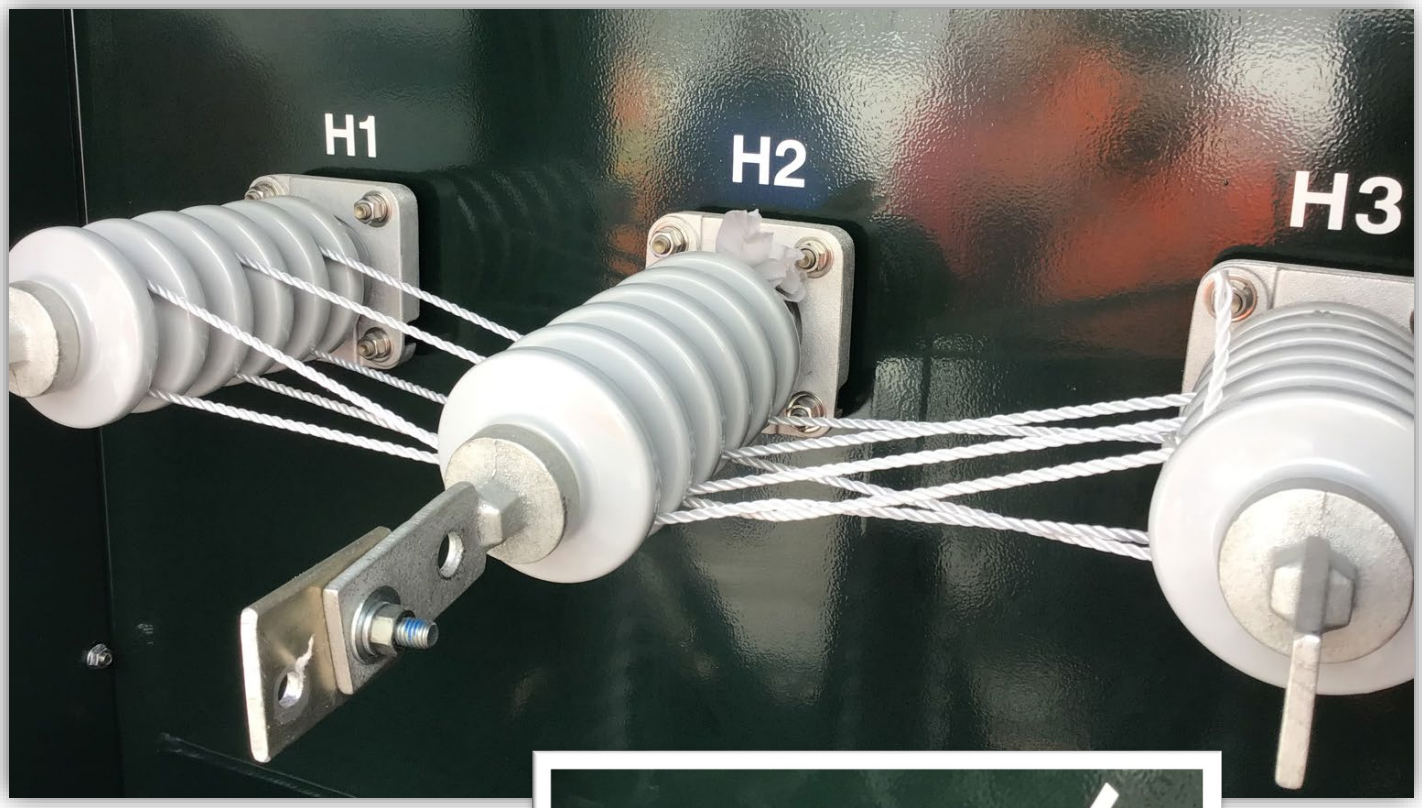
Causes and contributing factors	It is highly likely that an element of human error has played a significant role in the reported incident. The snow grooming operating was looking over their right shoulder observing the machine components and grooming pattern, while moving forward on an upward trajectory towards the high voltage transformer. Spatial awareness was lost, inflicting damage to the transformer's components. Lack of flagging and/or mechanical protection provided around the high voltage transformer has made this incident possible. Additional contributing factors include: • An abnormally deep amount of snow was surrounding the non-protected transformer. • The large size and length of the snow grooming machine may have contributed to the incident.

Image 1 – Nordic groomer, front blade (**A**) and back pans (**B**).

Image 2 – Damage to upper right corner of the transformer where the snow groomer made contact.

Image 3 –The H2 connection point has been pulled down from force.



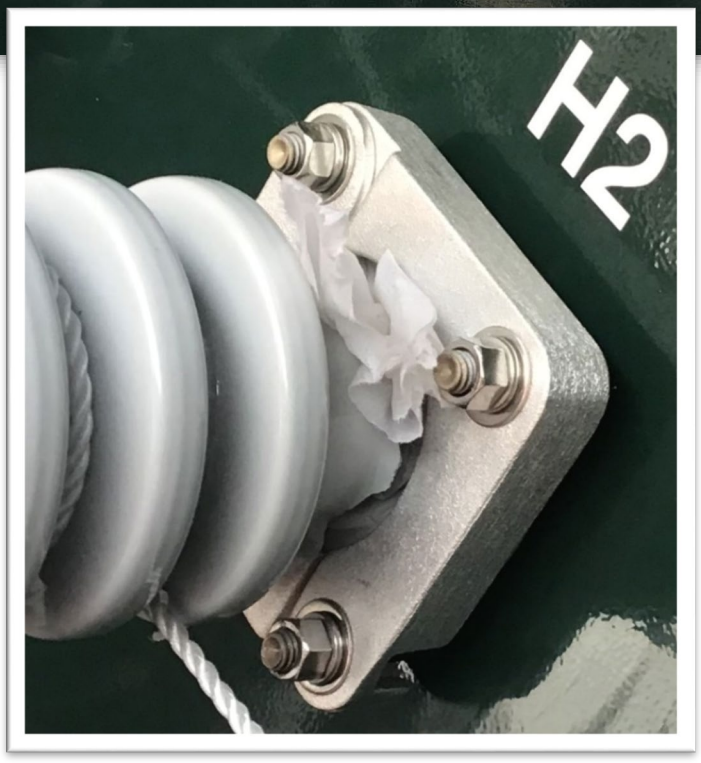


Image 4 – Internal H2 bushing damage.

Image 5 – External damage to the secondary cable assembly.

Image 6 – Transformer oil leakage.

Image 7 – “Head Trap” area (**RED**) and transformer oil leakage area.