Incident Summary #II-1316263-2022 (#25833) (FINAL)

SUPPORTING INFORMATION	Incident Date		January 16, 2022
	Location		Interior
	Regulated industry sector		Passenger ropeways - Above surface ropeway
	Impact – Injury	Qty injuries	0
		Injury description	Passenger apprehension & displeasure
		Injury rating	Minor
	Impact – Damage	Damage description	Intermittent electrical connection/failure
		Damage rating	Minor
	Incident rating		Minor
	Incident overview		Passengers forcibly jostled within swaying gondola cabins from ropeway abruptly stopping in an excessively short distance from maximum operating speed.
INVESTIGATION CONCLUSIONS	Site, system and components		Passenger ropeway is equipped with enclosed carriers, gondola cabins. The gondolas detach/attach to the circulating haul rope as they enter stations for easier, safe, and efficient loading and unloading of passengers. A conveyance system, synchronized to the haul rope ensures carriers are precisely transported within the stations. This operation requires the use of a counter-sheave with two sensors (Image 1), as part of the safety monitoring system to verify carrier speed and spacing within the stations. Ropeway is equipped with three separate brake systems, service brakes, emergency brakes and rollback brakes. The service brake actuates at the gearbox input from the prime mover. The emergency and rollback brakes actuate on the main drive sheave bullwheel. The rollback brakes must be capable of stopping the ropeway if unintended reverse motion occurs and hold the maximum design load. The same counter-sheave for carrier conveyance in stations is utilized to detect a rollback and initiate the safety system to apply brakes.
	Failure scenario(s)		The safety monitoring system detected a rollback fault while the ropeway was operating in a forward direction which then applied the emergency and rollback brakes resulting in the ropeway coming to an abrupt stop.
	Facts and evidence		<u>As reported by Duty Holder</u>: • Station adjustments were made the night before, after closing from the previous day's operation • Ropeway was having carrier spacing issues an hour into daily operation • Maintenance personnel were dispatched to the top and bottom station to determine issue • During a carrier spacing fault stop the counter-sheave at the top station was determined to be out of position

Incident Summary #II-1316263-2022 (#25833) (FINAL)

	• Upon repositioning of counter-sheave, personnel discovered a securing bolt unable to properly tighten. • Counter-sheave properly positioned, securing bolt replaced and lift restarted to full operating speed. • Moments after the ropeway had a very dynamic stop at full operating speed as there was minimal deceleration and all brakes were applied. • A rollback fault was annunciated, even though ropeway was operating forward direction. • Ropeway re-started at a slower speed and again moments later a rollback fault stopped gondola abruptly. • Ropeway passengers were unloaded at a slower operating speed. • Passengers reported extreme carrier swaying online. • Gondola cabins and ropeway inspected for damage • Wiring was checked and counter-sheave sensors replaced – Rollback fault condition that triggered the dynamic stop has not occurred since. <u>Ropeway Statistics</u>: • Counter sheave has two sensors A & B, forward operation A-B-A-B-A-B… • Rollback fault, control system must detect counter-sheave sensors four times in reverse, B-A. • Counter-sheave sensors are integral to the station carrier spacing system. • Rollback fault initiates Rollback and Emergency brakes to apply immediately, and service brake applies at zero-speed. • Complete Rollback sensor disconnection activates, sensor loss fault – Emergency brake applies and Service brake at zero speed. • 2002 ropeway capacity increased to current limits. • 2002 Acceptance test Rollback brake setting, and 2002 brake Operations Manual have contrasting values – lower value at acceptance test. • 2017 Load test Rollback brakes torque values were not recorded. • Brakes tested and inspection completed by operator according to manual. <u>CSA Z98:</u> • Rollback brake must actuate on drive sheave (bullwheel) or haul rope. • Rollback brake must actuate within 500 mm of bullwheel circumference movement of unintended reversal. • Electrical components shall be inspected annually and maintained in a good state of repair. <u>Manufacturer</u>: • With ropeway operating forward, personnel simulated a rollback fault by repeatedly reconnecting the counter-sheave sensor wires multiple times per second. • Through testing able to confirm intermittent sensor failure or intermittent wiring connection, repeatedly reconnecting sensor wires multiple times per second, can create the condition of activating a false rollback fault. • Modified programming to not apply rollback fault brake logic if ropeway operating forward direction at 1 m/s or greater.
Causes and contributing factors	It is likely an intermittent sensor or wiring fault caused the ropeway to stop, abruptly jostling passengers within the swaying gondola cabins. Rollback brakes being adjusted tighter than necessary along with maintenance personnel performing station adjustments and troubleshooting carrier spacing issues possibly contributed to the event.

Image 1 - Station counter-sheave