# Incident Summary (Reference #5604145) Final

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| SUPPORTING INFORMATION | Incident Date | | | *August 27, 2016* |
| | Location | | | *Boston Bar* |
| | Regulated industry sector | | | Passenger Ropeway, Above Surface Ropeway |
| | Impact | Injury | Qty injuries | *2* |
| | | | Injury description | *Person 1 sustained an injury to their little finger. Person 2 sustain an injury to their elbow.* |
| | | | Injury rating | *Minor* |
| | | Damage | Damage description | *Surface damage to the bottom exterior of the one of the cabins, hinged platform at the docking area was bent by impact with the cabin. An end of carrier travel the spring buffer became over-compressed and jammed in the compressed position.* |
| | | | Damage rating | *Minor* |
| | Incident rating | | | *Minor* |
| | Incident overview | | | Carriers entered the upper and lower stations without reducing speed, the carriage sheave assembly of the carrier made contact with the end of travel spring buffer with a significant amount of force. The resulting excessively abrupt stop caused the cabin of the carrier to swing forward and becoming lodged with a hinged flip down platform that is attached to the loading dock. 2 occupants in the cabin sustained minor injuries.<br><br>Due to the hard contact with the spring buffer, the carriage sheave assembly was lifted out of its correct configuration with the track rope (uphill portion of the cabin carriage sheave wheel assembly and the track rope brake had lifted up and above the track rope) with the track rope brake closed. The hard contact also caused the spring buffer to over compress and jam in its compressed state.<br><br>The ropeway was then restarted and the cabin was run the entire ropeway length with staff not realizing the misconfiguration of the carriage sheave assembly and track rope brake. |
| INVESTIGATION CONCLUSIONS | Site, system and components | | | *A double reversible ropeway (single track-rope) with a carrier cabin capacity of 28 plus 1 attendant per cabin (2 carriers on the ropeway).*<br><br>*Ropeway control room is located at the drive station. An operator is required to be in position at the operating room where they can observe and monitor the cabin as it enters the docking area.*<br><br>*The ropeway is equipped with a control system that will establish carrier position and will automatically slow the ropeway prior to carriers entering the docking stations to ensure a smooth docking and appropriate stop at the stations. The controller system is not equipped with a permanent memory or alternative means to maintain information of the carrier position when power is cut to the control system. As a result, after a power outage, it is necessary to operate the system in a manual mode until a cycle is completed such as that the system can re-establish the travel limits of the ropeway system.*<br><br>*The carrier carriage sheave assembly consist of an 8 wheel sheave assembly with the cabin hanger suspend from a center pivot point of the carriage sheave assembly. A hydraulically opened, spring actuated, track rope brake is located within the carriage sheave assembly. The track rope brake has a brake position switch which is intended to verify that the brake is open. Actuation of this switch will cause the ropeway to stop. The point of actuation of this switch is* |

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| | | *adjustable. The track rope brake can be actuated by the track rope actuation handle which is located inside the cabin.*<br><br>*A spring buffer system is provided at the travel limits of the carrier travel. The buffer is intended to engage with the end of the carriage sheave wheel assembly. A set of rolling guides which rest against the top and underside of the track rope are utilized in positioning the spring buffer. Limit switches are utilized in actuating a stop if the buffer becomes over-compressed.* |
| | Failure scenario(s) | *Failure of the control system to be switched from automatic to manual after power outage.*<br><br>*The carrier entered the docking area at an excessive speed resulting in the excessively abrupt stop.*<br><br>*Thereafter, It was not detected prior to reoperation that:*<br><br>• *The sheave carriage and track rope brake had lifted up and come out of the proper configuration with the track rope.*<br><br>• *The track rope brake was closed and situated above the track rope.*<br><br>• *The spring buffer was jammed in a compressed position.* |
| | Facts and evidence | Order of events:<br><br>*Statements provided by operating and maintence staff indicate that:*<br><br>• *During public operations a utility power outage resulted in the ropeway stopping. After a brief period (estimated 10-15 minutes) power was restored. Upon the restoration of power, maintence staff reset the ropeway control system (required after a power outage). An operator at the control room then restarted the ropeway without switching the system from automatic mode to manual mode.*<br><br>• *The carriers continued to travel at their normal speed and then failed to slow as the they approached the docking area. Witness statements indicate that the operator had their back turned away from the docking area as the carrier approached and failed to notice that it had not slowed.*<br><br>• *Carrier 1 approaching the top station was occupied by 17 people including the cabin attendant and another staff member. Carrier 2 approaching the bottom station was occupied by 7 people and a dog. The attendant of carrier 1 realizing that it was not slowing down as it approached the docking area pulled the track rope actuation handle.*<br><br>• *Carrier 1 swung forward and up causing it to become lodged on top of a hinged flip down platform attached to the docking area. The cabin attendant hand was caught in the track rope brake actuation handle causing injury to their hand as the cabin came to an abrupt stop. Another staff member on board the cabin also fell and injured their elbow. No injuries report to the occupants of carrier 2.*<br><br>• *Maintence staff pried the cabin off of the hinged flip down platform allowing the cabin to level and occupants to exit the cabin. After the occupants of carrier 1 had* |

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| | | *been removed from the cabin the occupants of carrier 2 were also allowed to exit the cabin.*<br><br>• *Maintence staff then opted to restart the ropeway sending carrier 1 down to the bottom station. The operator at the control room reported to maintenance staff of an unusual sound as the ropeway was operating and notified maintenance staff. Maintenance staff at the bottom station noticed that the 4 uphill sheaves of the carriage sheave assembly of carrier 1 were not turning as it approached the bottom station (sheave wheel were not in contact with track rope).*<br><br>• *Upon further inspection of the carriage sheave assembly, maintenance staff noticed that the track rope brake was closed with the brake pads sitting on top of the track rope rather than being open with the brake pads around either side of the track rope. Maintence staff then re-opened the brake and the carriage sheave assembly settled down onto the track rope with all 8 wheels sitting on the top surface of the track rope.*<br><br>• *Staff then attempted to restart the ropeway and run carrier 1 back uphill. It was then realized by staff that they were unable to restart due to the end of travel spring buffer at the drive station being in a jammed compressed position with the limit switch detecting over compression in the tripped position.*<br><br>*Further physical evidence related to order of events*<br><br>• *At the incident inspection rub marks were identified on the track rope approximately 1 m before the normal docking position and marking on the track rope brake pads. This would be consistent with the likelihood that the track rope had applied prior to the ropeway coming to a complete stop. This provides evidence that the cabin 1 attendant actuated the track rope brake as the cabin approached the docking position.*<br><br>• *CCTV video of the cabin becoming lodged with the docking deck, Scuff marks on the bottom of surface of cabin 1, and damage to hinged drop down platform provide evidence of the dynamics of the incident.*<br><br>*Other evidence related to cause and contributing factors:*<br><br>• *The operating contractor was not able to produce a documented procedure that indicates that the operating system need to be switched to manual mode after a power outage. Operators were expected to simply remember that this was a part of the restarting procedure.*<br><br>• *A P.Eng conducting a review of incident, identified that buffer spring guide rollers which locate the position of the buffer to the track rope to have excessive clearance on the underside of the track rope in comparison to manufacturers specifications.*<br><br>• *In conducting the incident inspection, annunciation of the track rope brake position switch was confirmed to be functional, however it is suspected that the adjustment of the actuation threshold of the switch were not within the normal operating parameters.* |
| | Causes and contributing factors | |

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| | | • *A very likely cause of the carriers entering the docking areas at an excessive speed is that the control system was not switched to manual after the power outage occurred.*<br><br>• *A contributing factor in regards to not switching the control system to manual after a power outage may have been, that there was no written procedures to reference that indicate that this was a requirement.*<br><br>• *A very likely cause of the carriage sheave assembly lifting up and out of configuration with the track rope was the excessive speed and the subsequent hard impact with the spring buffer. A contributing factor is that the excessive clearance of the spring buffer guide rollers could have caused the spring buffer to lift upward with the impact of the carriage sheave assembly. This in turn causing the uphill end of the carriage sheave assembly to lift upward and off of the track rope.*<br><br>• *The track rope brake position switch being out of adjustment or failure of the circuit to detect that the track rope brake was closed was a very likely cause in it being possible to operate the ropeway with the track rope brake closed.*<br><br>• *An intermittent failure of the spring buffer over-compression limit switch or the associated circuit, is a possible cause as to why initially the ropeway could operate with the limit switch in the tripped position.* |

*Carriage Sheave Assembly and Spring Buffer*

*Track Rope Brake Situated in Correct Position Around Track Rope*