

Subject: Incidents Affecting LRT Vehicles and Services

File Number: ACS2023-TSD-ENG-0021

Report to Transit Commission on 12 October 2023

Submitted on September 29, 2023 by Renée Amilcar, General Manager, Transit Services Department

Contact Person: Richard Holder, Director Engineering Services, Transit Services Department

613-580-2424 ext. 52033, Richard.holder@ottawa.ca

Ward: Citywide

Objet : Incidents touchant les véhicules et les services du TLR

Numéro de dossier : ACS2023-TSD-ENG-0021

Rapport présenté au Commission du transport en commun

Rapport soumis le 12 octobre 2023

Soumis le 29 septembre 2023 par Renée Amilcar, Directrice générale, Services de transport en commun

Personne-ressource : Richard Holder, Directeur des Services du genie

613-580-2424, poste 52033, Richard.holder@ottawa.ca

Quartier : À l'échelle de la ville

REPORT RECOMMENDATION

That the Transit Commission receive this report for information.

RECOMMANDATION DU RAPPORT

Que la Commission du transport en commun reçoive ce rapport pour information.

BACKGROUND

The purpose of this report is to review the incidents and investigations undertaken by the City and RTM since 2022 to mitigate potential impacts to O-Train service caused by severe weather.

The report reviews the findings of the current investigations and sets out short- and long-term actions to mitigate the effect of severe weather on our light rail system in order to increase rail service reliability.

DISCUSSION

The Confederation Line LRT Project from Blair to Tunney's Pasture is designed, constructed and maintained by Rideau Transit Group through a P3 Partnership with the City of Ottawa. The light rail vehicles, systems and associated infrastructure are built to withstand the climatic conditions reasonably expected in Ottawa. In the winter of 2022/2023, there were two occurrences that are considered either rare or stretched the capability of the system.

Lightning strike event details

In the late evening of July 24, 2022, a thunderstorm rolled through Ottawa. During the storm, a lightning strike with an estimated current of between 30kA and 100kA touched down in the vicinity of Hurdman Station, between the Riverside Drive bridge to the east, and the Rideau River bridge to the west. The location was confirmed by an Environment Canada tracking system. The flash from the strike was captured on wayside CCTV and the footage showed that the strike energy exited the system north of Lees Station.

The electrical current from the lightning was conducted by the upper cable of the overhead catenary system (OCS), called the messenger wire. When a lightning strike happens directly to the OCS wires, flashover at the grounded metallic structures, including poles, is almost certain. A flashover occurs when the dissipated energy from a lightning strike, or other power surge, causes a high-voltage short circuit made through the air between exposed metal or other conductors.

In this instance, the path of least resistance was located at the messenger wire support under the south side of the HWY 417 overpass. At this location, the messenger wire was severed by the excessive voltage and heat generated due to a flashover from the messenger wire to the grounded infrastructure on the bridge. With the supporting messenger wire severed, the live OCS fell to the guideway, causing further arcing that damaged rail at three locations. With tension lost in the OCS, two balance weight assemblies fell to the ground. As a result of the lightning strike and the subsequent

damage to the system, there was a loss of power to the OCS and operations were stopped. As designed, the feeder breakers in Traction Power Sub Stations 4 and 5 tripped, which sent notifications to the operations centre, along with alarms for loss of power at Lees Station.

Rideau Transit Maintenance (RTM) and its contractors assessed the situation and began to secure the area and the downed OCS contact wire was cut into manageable lengths.

On July 25, equipment and support contractors were mobilized from Alltrade in Toronto, and the following repairs began on July 26, continuing through July 29:

- A section of messenger wire was spliced and adjusted where the wire was severed under the 417 overpass at Lees Station.
- Approximately 900 metres of OCS contact wire were installed and adjusted.
- Damaged components of the balance weight assemblies were replaced.
- The OCS supports under the 417 overpass at Lees Station were replaced, and the mounting bolts for this assembly were also modified/adjusted to maximize clearance from the messenger wire to the grounded supports.
- RTM and its contractors repaired the three damaged rail sections.

Mitigation plans for lightning

In the original design of the system, surge arrestors were integrated into the OCS construction. Surge voltages and currents created on the OCS wires as a result of a lightning event are discharged to the ground through these devices. The OCS system is protected by these arrestors fitted to poles where the 1500V Direct Current (D.C.) substation cables terminate onto the OCS. Additional arrestors are also fitted at the Traction Power Substation (TPSS) locations to protect the equipment and systems contained within.

In response to the lightning strike, a study was completed by RTM and EXP Services Inc. (an engineering firm) with a subsequent report developed that describes lightning strike phenomena and their effects on Light Rail Transit (LRT) OCS. Pertinent information regarding the lightning intensity, strike attachment, surge voltages, currents, energy, entry to and exit from OCS and insulation coordination was provided as part of this report.

Subsequently, the report examines the requirements in the Project Agreement (PA) concerning the surge arrester application, clearance, and grounding requirements.

Provided below are the mitigations from the RTM and EXP Services Inc. report:

- Perform an OCS design options study to evaluate the re-grading of OCS wires at these locations to achieve greater clearances.
- Perform regular earth resistivity tests at every pole fitted with surge arresters.
- Perform regular earth resistivity testing of all grounding installations associated with under bridge bonding.
- Perform an insulation coordination and surge protection study to characterise and then improve the surge performance of the system, to include the specification of any changes that are required, specification of any new material to be procured and derivation of the installation requirements / particulars.
- Perform a study to identify means to rapidly improve the grounding of masts equipped with surge arresters, such that the resistivity to ground does not exceed 5 Ohms.
- Perform a study to establish if there are any viable types of messenger wire support that could be fitted in place of the pulley supports that offer improved insulation and clearances.
- Conduct annual clearance measurements at all locations where the installed OCS conductors are less than the 130mm clearance in the Project Agreement and at locations where any insulating cladding has been applied to the conductors.
- Remove metallic cladding from bridges where the OCS wire clearances are not compliant to the PA – this removes the present risk of a severe DC arcing fault from occurring and facilitates inspection and testing of the support grounding.
- Fit all supports with PA-compliant grounding if they are not already so equipped.

Current status

As part of the repair procedures, technicians repaired the messenger wire pulley supports at the location where the clearance to the grounded structures created vulnerability to a flashover. The pulley supports were modified to increase the air gap between the live OCS conductors and the grounded bridge structure. This adjustment helps reduce the chance of flashover in the event of a future lightning strike.

The report by RTM and EXP was provided on June 28, 2023, just prior to the unplanned shutdown. It noted a lack of LRT (or wider railway) specific standards and recommended guidelines and that there is little published data available on the lightning effects and design experience from other transit agencies. The City will continue to work with RTM and follow up on the recommendations from the EXP report and RTM will provide an implementation plan by the end of October.

Freezing rain event details

On January 4, 2023, between 10 and 11 p.m., Environment Canada reported around four millimetres of freezing rain per hour at Ottawa airport. An ice storm, comprised predominantly of freezing rain and drizzle, lasted well into the next day. Temperatures during the time of accumulation were -0.4 degrees Celsius. Unseasonably warm temperatures also resulted in sections of open water on the Rideau River that normally would have been frozen. This, combined with colder air, created moist fog, which condensed and froze on the cold metal of the OCS between Hurdman and Lees stations. This unique combination of factors may have caused greater ice buildup in this area than elsewhere on the system, immobilizing trains just east of Rideau River where high moisture content was observed. Additionally, there was ice buildup within the maintenance yard, further exacerbating RTM's ability to keep trains mobile.

Revenue service was partially shut down between uOttawa and Tremblay stations from January 6 until January 10 inclusively. Recovery trains were dispatched to tow immobilized trains and were moving very slowly due to icy conditions. The accumulation of ice on the OCS cables caused arcing that resulted in three breaks in the contact wire. Rescue operations were halted, and RTM mobilized for ice removal and inspection. Over the following week, approximately 5,600 metres of OCS wire were cleared of ice by hand and visually inspected. The OCS breaks were repaired and immobilized trains were recovered and returned to the Maintenance and Storage Facility (MSF).

RTM undertook repairs and replaced contact wires, broken hardware and adjusted catenary support systems. Train testing was performed on the evening of January 10, and the LRT system returned to service on January 11.

Mitigation plans for freezing rain

Following the freezing rain events, an OCS Working Group was created between the City of Ottawa, RTM and external experts including Exp. Services Inc. to review lessons learned and to plan short and long-term mitigations.

Immediately implemented mitigations

The following mitigations were implemented immediately after the freezing rain events that occurred in January.

Increase installation of winter pantographs on LRVs in service

Winter carbons are specialized pantograph contact strips with heaters and a brass surface that are more capable of scraping ice off the contact wire. However, the winter carbons also accelerate the wear of the copper contact wire and are only deployed when an ice event is anticipated to mitigate the risk of ice build-up. They are effective

when the accumulation of ice is relatively slow but are challenged by high levels of ice accretion.

Monitor alignment for ice buildup and arcing

Maintainer staff are dispatched to attend areas where ice build-up is expected with TSD staff participating, as necessary. The status in different locations across the line can also be monitored through both CCTV footage and reports from Electric Rail Operators (EROs).

Monitor train diagnostic computer systems, in real-time

In the event of anticipated ice formation, RTM monitor the trains for wheel slip; Operators can also detect this and report occurrences to the TOCC.

Short-Term mitigations for freezing rain – Q4 2023

Deployment of anti-icing treatments on the contact wire in advance of freezing rain

Anti-icing chemicals work by adhering to the contact wire and preventing ice formation during freezing rain or other winter precipitation events. The working group has contacted other agencies that use this method of pre-treatment such as the Toronto Transit Commission (TTC) and Waterloo and RTM is exploring options to deploy anti-icing products in advance of freezing rain. RTM is preparing an Implementation Plan and testing is anticipated in October with a system ready for deployment during the winter of 2023/2024. It is anticipated that application will be targeted to problematic areas, for instance between uOttawa and Hurdman stations.

Installation of an LRV-mounted OCS monitoring system

The City has provided direction to RTM to explore an OCS monitoring system that can be installed on a light rail vehicle (LRV). This system would provide real-time data and video of the contact wire/pantograph interaction and will help assess OCS conditions during a freezing rain event. The system will also be useful to monitor the condition of the OCS system year-round and will trigger preventative maintenance. These systems are self-powered with solar and battery and require minimal modifications to the LRV.

There are two key components of the proposed monitoring system; a vehicle-mounted camera and an accelerometer attached to the pantograph. The camera can provide real-time video footage to the maintainers, while the accelerometer collects data from the pantograph when anomalies are detected. The camera footage can be paired with the accelerometer data to pinpoint the location of any faults with the OCS infrastructure.

In addition to an LRV mounted system, research is ongoing into the feasibility of a camera system mounted in one of the maintenance bays at the MSF. This would allow for an alternate view of the pantograph system, as well as the other systems mounted on the top of the train. Viewing these could assist in determining if there is any additional wear from freezing rain on the line.

Non-electric recovery vehicle

RTG is engaged in contract discussions with a supplier for a rental diesel rail car mover (also known as a shunter) that can perform short distance LRV moves in the event of a power outage. Trials of the diesel rail car mover as well as a Recovery Plan with procedures for its use are anticipated in October 2023 with readiness for deployment in the winter of 2023/2024.

Improved weather forecasting

RTM is working with WSP (an engineering firm) for improved weather reporting along the alignment. RTM is expecting to receive detailed weather reporting with sufficient advance notice to implement the freezing rain mitigations such as deploying anti-icing product and winter carbons.

Long-Term mitigations for freezing rain – 2024

Explore heat tracing the contact wire at vulnerable locations

RTM has investigated the option of adding a heat tracing cable to the contact wire. They are working with a North American supplier that needs certification for a 1500V system. This solution will not be ready for deployment for this coming winter (2023/2024) as the process is ongoing. Winter of 2024/2025 is targeted for implementation.

Weather stations

Options are still being considered for micro-climate weather stations at key locations in the alignment. One example is at the Rideau River Bridge between Hurdman and Lees stations. A weather station would be a more accurate way of gauging changing weather conditions on the line, which could aid in improved reactions to ice events. The feasibility of this option will be based on the experience of the winter of 2023/2024 with the planned improvements to weather forecasting.

Stage 2 implications

Most of the mitigations to deal with freezing involve improvements to maintenance procedures that will apply to the east and west extensions. At this point, it is not anticipated that heating cables will be required for the Stage 2 work, but this will continue to be assessed based on the experience of Stage 1.

FINANCIAL IMPLICATIONS

There is no financial implication to receiving this report for information.

LEGAL IMPLICATIONS

There are no legal impediments to receiving this report for information.

CONSULTATION

OC Transpo continues to consult with RTM and the engineering firms identified in this report with the goal of mitigating and preventing future issues affecting O-Train system service reliability related to severe weather.

ACCESSIBILITY IMPACTS

OC Transpo recognizes that O-Train Line 1 closures such as the ones outlined in this report have an impact on people with accessibility needs. Accessibility has been integral to the development of Ottawa's light rail transit network, including the design of the R1 replacement bus service. Designated on-street R1 bus stops have been selected to ensure a safe, direct and accessible exterior path of travel from the adjacent O-Train stations, and to accommodate boarding by customers with a wide range of abilities. The buses servicing these stops are the same as those providing conventional service citywide, and include the same accessibility features, including ramps, two spaces for persons using mobility devices, high-contrast grab bars and handholds, automatic audible and visual next stop announcements, and audible exterior announcements of route and destination.

ASSET MANAGEMENT IMPLICATIONS

OC Transpo's assets are identified as one of the five pillars in the 5-Year Roadmap. In the coming years, OC Transpo will be adding all the Stage 2 O-Train extensions and their associated properties, vehicles, infrastructure and technologies required to operate these new systems. OC Transpo's new and existing assets will be maintained and managed through systematized departmental administrative processes. As noted in the Roadmap, one initiative, the Core Business Review, will identify all key assets to ensure that Transit Services is making the best use of each of them.

RISK MANAGEMENT IMPLICATIONS

The risks associated with severe weather affecting the O-Train system and how to manage them are outlined in this report.

TERM OF COUNCIL PRIORITIES

The 2023-2026 Term of Council Priorities include:

- A city that is more connected with reliable, safe and accessible mobility options.
- A city that it is green and resilient.

DISPOSITION

The City will continue to work with RTM to implement the short- and long-term mitigations outlined in this report.