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25 April 2020

Delivered via Email

City of Ottawa

110 Laurier Avenue West
Ottawa, ON K1P 1J1

Our Reference:	RTG-OTT-00-0-LET-0938
City Reference:	OTT-RTG-LET-0543
Project Agreement Reference:	N/A

Attention: Michael Morgan
Director, Rail Construction Program

Subject: RTG Revised Plan

Ottawa LRT Project – Project Agreement, dated February 12, 2013 (“Project Agreement”)¹, between the City of Ottawa (the “City”) and Rideau Transit Group Partnership (“RTG”)

OTT-RTG-LET-0543 (“City April 7 Letter”)

OTT-RTG-RLET-0545 (“City April 20 Letter”)

RTG-OTT-00-0-LET-0925 (“RTG March 31 Letter”)

RTG Plan dated March 31 (the “Original Plan”)

Dear Mr. Morgan:

Please find attached RTG’s updated plan (the “**Plan**”) addressing the comments to the Original Plan contained in the City April 7 Letter. In RTG’s view, the Original Plan was robust and responsive to the requests of the City in the City letters with reference numbers OTT-RTG-LET-0307 and OTT-RTG-LET-0308. Nonetheless, we have further refined and updated the Original Plan to address the new and additional requests contained in the City April 7 Letter. The Plan contains further significant input from major subcontractors and suppliers and we believe that it

¹ All capitalized terms in this letter not defined herein have the meanings ascribed to them in the Project Agreement

reflects a comprehensive and holistic approach to achieving the objectives of the City, which we share. We look forward to an open, collaborative dialogue with the City regarding the implementation of the Plan.

We share the City's goal of ensuring that Ottawa commuters have reliable and consistent service. We refer you to the master schedule included in the Plan, which reflects our good faith estimates of when each individual item within the Plan will be addressed. The system is complex and as such requires a specific approach (including scheduling) to individual items contained in the Plan. We have provided timeline rationales and mitigation strategies for each item in the Plan, and we believe that the Plan collectively demonstrates how increased reliability will be achieved.

RTG was surprised and disappointed by the negative tone in the City April 20 Letter. We strongly reject the accusation in the letter that the Original Plan was deeply flawed and lacked a sense of urgency. Those statements directly contradict statements made by the City itself in the City April 7 Letter, including that the City appreciated RTG's significant efforts in preparing the Original Plan and commended RTG for the considerable detail contained in that the Original Plan. RTG's ability to meet the timing expectations for the Plan imposed by the City while at the same time dealing with the impacts of COVID-19 clearly demonstrates our sense of urgency and our commitment to the Project.

The City April 20 Letter also stated that the System and the service must be "reliable" by no later than August 4, 2020. The letter does not state what the City means by "reliable". Further, no such date was included in the City letters requesting the Original Plan nor in the City April 7 Letter. Imposing this date days before the submission date of the Plan is not fair or reasonable. We acknowledge and appreciate the importance of increased performance reliability. RTG is fully committed to implementing the Plan and achieving increasing system-wide reliability based on the timelines included in the Plan. We are working as fast as possible, and doing so in light of the very challenging circumstances presented by COVID-19.

As detailed in the RTG March 31 Letter and acknowledged by the City in the City April 7 Letter, COVID-19 is and will have a significant impact on the Project and the implementation of the Plan. Unfortunately, given the uncertainty over the duration of social distancing and other measures imposed by governments and the corresponding uncertainty over subcontractor and expert availability, material and parts supply chains, human resourcing and staffing, among other impacts, we do not know exactly how COVID-19 will affect the implementation of the Plan.

However, it is clear that COVID-19 is and will continue to have significant impacts on the Project that both RTG and the City will need to address, and those impacts extend well beyond just health and safety matters. RTG is committed to keeping the City informed on a going forward basis of impacts of COVID-19 on the Project and on the implementation of the Plan. We also acknowledge our obligation to continue to take commercially reasonable steps to mitigate the potential adverse effects of the impact of COVID-19 on the implementation of the Plan and reaffirm our commitment to do so.

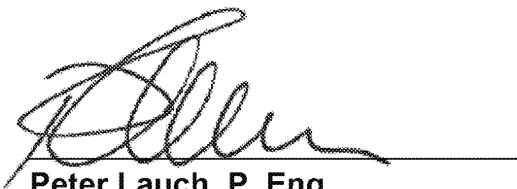
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Please note that our Plan's schedule is based on full-service hours and does not reflect any reduced train service hours or enhanced access to the system. In light of the City's recent offer, RTG wishes to highlight its interest in continuing discussions with the City to explore ways to advance and accelerate some of the items in the Plan by having targeted enhanced access to the system without train service.

RTG has previously stated our position in respect of the City's renewed allegations in the City April 20 Letter regarding the delay in achieving Substantial Completion and Revenue Service and that RTG is in Default, and we simply reiterate here that we dispute those allegations and that good faith Disputes are underway.

We look forward to working cooperatively with the City to both implement the Plan and to address any actual or potential impacts of COVID-19 on the implementation of the Plan.

Regards,



Peter Lauch, P. Eng.

CEO

Rideau Transit Group General Partnership

cc.: City: Gary Craig, Lorne Gray, Troy Charter, and Richard Holder
RTG: Maxime Olivier
OLRT-C: Matthew Slade
RTM: James Messel

Attachments:

- Letter Response - Technical (24Apr2020)
- Confederation Line Major Issue Plan 20200424
- RTG Plan 31March2020 R1 24Apr20
- 20200424-OLRT-REMEDY_RECTIFICATION DRAFT MASTER SCHEDULE Mar.31-2020_Rev.4
- IMIRS Performance Report by Deloitte - RTM Response - Apr22



Comments to Technical Issues raised in City Letter OTT-RTG-LET-0543

RTG has carefully reflected on the comments raised in the City letters of 07 & 20 April 2020.

We have updated the Remedial Plan where appropriate.

We have updated the Master Schedule (further explanation below) and provided a “Major Issue Plan” which will be updated regularly. RTG is committed to keeping the City informed on a going forward basis of impacts of COVID-19 on the Project and on the implementation of the Plan.

Furthermore, we have also addressed the Deloitte Report point by point and presented same in our response.

Schedule

As identified in the first submission of the plan, a revised master schedule has been provided. Moreover, RTG has appointed a dedicated Project Manager to execute the Remedial Plan and a key responsibility will require regular updates of the master schedule and progress reports to the City.

The City had noted that some of the tasks identified in the 31 March schedule extended into 2022. This is still the case, however, the schedule has segregated issues by priority and RTG considers issues with longer timelines not to be safety or service critical, nor do they directly impact restoration of service affecting failures. An example is bogie greasing retro-fit to improve the grease access points to the bogies that will reduce maintenance times.

RTG has assigned priorities to the tasks, with “1” being essential to improve reliability and service. The roll up of Priority 1 items effectively provides the target for overall improved reliability. Priority “2” activities, while important, can be done in parallel with the other tasks but they do not directly affect the reliability improvements the Plan contemplates. RTG strongly believes it is necessary to categorize these priorities in order to expeditiously action these rectifications.

The full impacts of Covid-19 are still not fully understood yet, and the schedule needs to be considered as a living document that will be updated once the longer term effects of the crisis are understood. For example, Alstom has been working on a door isolation fix. They’ve printed 3D models to check viability and interferences, however the parts manufacturer is in Italy, and shut down temporarily. Once reopened, we will have a better understanding of lead times for parts supply and will update the schedule accordingly. There are many more similar examples and RTG is doing everything within its control to manage the crisis and mitigate the impact on the schedule and plan.

As part of managing and reporting to the City the impacts of COVID-19, RTG will regularly update the “Major Issue Plan” provided here. This truncated plan lists the Top 7 items RTG feels will directly impact “reliability”. The Major Issue Plan provides the following for each of the issues:

- Problem
- Cause
- Short term countermeasure(s)
- Solution identified
- Preparation required before implementation
- Unit of progress
- Resources required for implementation
- Rate of progress
- Implementation start date
- Achieved to date
- End date



- Risk of not achieving target
- Risk level identified now
- Risk reduction measure
- Risk after reduction measure

RTG will work with key suppliers, Alstom in particular, to mitigate the impacts of COVID-19. Alstom has reopened their bogie facility in Sorel-Tracy, has partially reopened the CVS assembly and repair plant in Boucherville, and has ramped up assembly work again in Brampton, all in an effort to get elements of the supply chain moving again, but in consideration of the limiting parameters wrought by the crisis. It is not reasonable to assume or speculate when things will be “normal” and RTG will continue to monitor the situation and advise the City as things change/improve.

Resources

The issue of resources is addressed in the Plan. As noted above, RTG has appointed a dedicated PM for the execution of the Plan. RTG is drawing on the expertise of the parent companies, and continues to work with JBA remotely and whose presence at the MSF will be reinstated once the crisis permits.

In the Plan, Alstom has provided additional information on the structural changes put in place to improve efficiencies. Also provided in the Plan are details of staff distribution, as well shift pattern summaries for the technical maintenance and warranty staff. Alstom firmly believe their staffing level increases and improved structure is adequate for the challenges on hand. RTG and Alstom will be happy to provide additional information in a workshop environment with the City to discuss in detail, the resource distribution, core competencies and the day to day planning that is in place.

Despite COVID-19, RTM has recently been adding to their staff with the hire of a new Quality Assurance Specialist, FMTs, and is in the final stages of hiring a Technical Services Manager. Experienced rail industry expertise continues to be provided by the partners, and will be reinforced with the return of JBA to the MSF.

The following are summary responses to the City letter April 07 2020 with more specific details in the revised Plan submission:

Schedule A (07 April 2020 Letter)

1. Inductors

Please refer to the Plan, the Major Issue Plan and Master Schedule. RTG believes the Inductor issue is under control, with Alstom having rectified a manufacturing quality issue. The revised manufacturing process is underway with qualification tests prior to embarking on full scale manufacturing.

Line Inductor Failure Analysis Report Doc # DED0000 Rev A shall be issued to the City as will Failure analysis report LINE INDUCTOR DTR0000377985 Doc # AYD0000561716.

2. OCS – Parafil Failures

Please refer to the Major Issue Plan and the revised Remedial Plan for details. The Major Issue Plan provides details of the issue, the resources required and the estimated rate of progress.

3. OCS – Rigid Rail

Please refer to the Major Issue Plan and the revised Remedial Plan for details. The Major Issue Plan provides details of the issue, the resources required and the estimated rate of progress.

4. Abnormal Pantograph Wear

Please refer to the Major Issue Plan and the revised Remedial Plan for details. The Major Issue Plan provides details of the issue, the resources required and the estimated rate of progress.



Abnormal wear will be mitigated by correct OCS Stagger at certain locations. To determine the locations RTG will carry out a detailed review of OCS & compare current OCS vs design registration.

In addition, a fleet wide inspection of carbon strips will be carried out (as a supplement to the regular inspections). RTG will re-evaluate the pass/fail criteria of the strips based on similar LRV operations.

5. Line Contactor, HSCB, TCMS Logic, Inductors, CVS

Please refer to the Major Issue Plan and the revised Remedial Plan for details. The Major Issue Plan provides details of the issue, the resources required and the estimated rate of progress.

In addition to the software changes underway, Alstom has committed to details of a CVS fix by mid May 2020. The CVS fix has an effect on the upstream and downstream systems and a more robust CVS will mitigate several issues.

RTG will provide an interim report for the CVS failure and convene a meeting with RTG, Alstom experts, and the City to review. (Note: a CVS report/presentation was provided to the City in March – the only addition to the presentation would be the C-16 software addition)

Additionally, Alstom provided some CVS, EBCC/EBCU brake failure and Line Contactor updates in a report provided to RTG and the City 24 April 2020.

6. Switch Heaters

Please refer to the Major Issue Plan and the revised Remedial Plan for details. The Major Issue Plan provides details of the issue, the resources required and the estimated rate of progress.

Any modifications to the switch heaters will be documented and RTG will provide an opportunity for City to review. RTG will review changes with the City, as well as solicit advice from the City in this regard.

7. HVAC

Please refer to the Major Issue Plan and the revised Remedial Plan for details. Alstom is currently testing several modifications, and will share with the City the details of the enhancements once the tests are completed.

8. Vehicle Braking

JBA continues to provide expert support to RTG for the braking issue. Please refer to the Major Issue Plan for details. A draft report (JBAUSA/RTM/023-04-04) has been prepared by JBA which RTG will share with the City, after which a meeting will be convened to review (with Alstom).

9. Vehicle Doors

Please refer to the Major Issue Plan and the revised Remedial Plan for details. As noted above, Alstom has been working on a door isolation fix. They've printed 3D models to check viability and interferences for a more efficient door "isolation" fix. This in addition to the H-Bridge software which is expected to be SIL-2 certified in May.

10. IMIRS

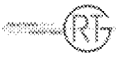
Please refer to remedial Plan and the point by point response the Deloitte report. RTG would be pleased to review the comments and the Plan with the City.

11. GIDS

A software and configuration update for GIDS to prevent spurious detection of snow and small objects and to improve low temperature performance will start to be implemented 02 May. Please refer to the Major Issue Plan and the revised Remedial Plan for details.

12. VOBC

Testing of Thales version 6.01 software is scheduled for the weekend of May 2nd 2020.



13. Vehicle Sanding

Please refer to the Major Issue Plan and the revised Remedial Plan for details.

Newest TCMS software change includes sanding on the middle motor bogie. The implementation of the s/w is underway.

14. Vehicle Compressor

Please refer to the revised Remedial Plan for comments.

15. Vehicle Bogie

The bogie modification described in the remedial plan is not a mission critical issue, but rather a modification to improve accessibility and accelerate maintenance activity. Some details were provided in the Remedial Plan and additional details can be provided via workshop with Alstom experts.

Note that FMI ST6-FMI-007 Upgrade of Bearing boxes and Axle from V4 to V5 on axle beam was issued on 19 April.

16. Vehicle Driver Cab Door

Please refer to the revised Remedial Plan for details.

17. Spare Parts

Please refer to the revised Remedial Plan for details.

18. Staffing Levels

Please refer to the revised Remedial Plan for details.

19. Signal Systems

We believe this is addressed via the imminent CBTC upgrade. Further discussion with the City is required as RTG is confident that there are appropriate resources in place to support the deployment of present and future revisions and changes to the software.

20. Vehicle CCTV

Alstom has indicated that the Version 7 software, due in May, should fix all outstanding issues. The RFI response has already been sent to the City and RTG awaits a response.

21. Vehicle PAPIS

As the City noted, the mitigation and timeline appears to be appropriate and feasible. After implementation, the functionality of the System will be monitored to validate that the mitigation was successful. A formal validation process and timeline will be provided.

22. Next Train Announcements

As the City noted, the mitigation and timeline appears to be appropriate and feasible. After implementation, the functionality of the System will be monitored to validate that the mitigation was successful. A formal validation process and timeline will be provided.

23. Passenger Counting

To confirm the proposed mitigation is appropriate, RTG will provide design information that further clarifies the indicated software deficiency related to the on-board APC passenger counting data issues.

After implementation, the functionality of the system will be monitored to validate the mitigation was successful. A formal validation process and timeline will be provided.

24. Light Maintenance Power

Design is in progress. RTG appreciates the City's comments and as design progresses, will update the City. While the current solution is effective, it is temporary and every effort will be made to expedite the final solution.



25. Yard Operations

The issue is addressed in the remedial plan, however RTG recognizes that additional details are to be provided to the City. Until UTO is in place, the additional training is key and RTG is committed to ensuring understanding and competency is elevated.

Alstom wrote to RTM and OLRTC about the plan to reduce the frequency of resetting trains and it is under review. The plan for UTO is not yet developed as we are months away from starting to test. Once ready, Thales has daytime testing opportunities as that is when the yard is empty.

26. Track Noise and Vibration

Please refer to the Remedial Plan (and Master Schedule).

27. Track Neutral Temperature

RTG advised in the Remedial Plan that an action plan for the Neutral Temperature work will be prepared for May 2020. The memo provided by the Trackwork Engineer of Record clearly details the basis for managing the thermal forces in the Confederation Line track and RTG will follow these recommendations in determining if, and when, stress relief cuts need to be made or plugs need to be installed.

RTG maintains the Confederation Line track to Class 5 standards, including walking/hi-rail inspections, and will review extreme weather procedures for areas of improvement.

28. Winter Operations

Please refer to the Remedial Plan.

29. Station Cleanliness

RTG recognizes these issues as noted in the Remedial Plan. RTG has a resource loaded station custodial maintenance plan and, as detailed in the Remedial Plan, recognizes that certain elements of station cleanliness conditions are not desirable. RTG has pushed its custodial maintenance subcontractor to deliver on their commitments, including addressing vandalism in public washrooms with dedicated resources that do not draw from those tasked with achieving the daily and weekly Standards. RTG has implemented increased monitoring of station cleaning performance and quality and will continue to do so until Standards are met.

30. Tunnel Leaks

This was addressed in the Remedial Plan. RTG (OLRTC) will commence repairs during the upcoming shutdowns assuming material and resource availability is not hindered by COVID-19.

31. Stations - Snow falling on passenger areas

This was addressed in the Remedial Plan. The City has stated that the scope of this item needs to include all stations locations (as this problem is not limited to Hurdman), sign bands, platform glazing, and other locations as previously documented by OCT. RTM will engage the City in discussion on the proposed mitigations.

32. Station Heat Trace

This was addressed in the Remedial Plan. With or without heat trace, RTM is aware of the PA obligations and has not failed in addressing them concerning trace amounts of snow.

Problem	Cause	Short term countermeasure(s)	Solution identified	Preparation required before implementation	Unit of progress	Resources required for implementation	Rate of progress	Implementation start date	Achieved to date	End date	Risk of not achieving target	Risk level identified now	Risk reduction measure	Risk after reduction measure
High numbers of wheel flats occurring after EB's. Flats cause noise and discomfort to public.	Malfunction of emergency braking in low temperature conditions (estimated -10 to -15°C)	Tire turning. Improved weather	Resolve problem with HPU losing hydraulic pressure intermittently after EB application. Improve monitoring of brake pressure to identify any future loss of pressure. EB will then always have the correct pressure	Brake supplier (Wabtec) testing and formulating solution. Relevant material may need to be procured, set up float of HPU and change out as required.	1 LRV hydraulic brake system reworked to prevent issue = 5 HPU's and diagnostic upgrade. HPU changeout and bleeding of system	Wabtec field staff	5 LRVs per month	Week 30 at latest to complete fleet by November (in parallel with line below)		Nov-20	Risk of solution not being ready in time. Float of HPU's and transportation time may reduce rate	Medium	Rework trailer cars first as there is less risk of overbraking in motor cars because of single disk per axle	Low
	Brake demand in emergency brake exceeds likely adhesion level in icy conditions causing wheel slide and flats, especially in trailer cars	Tire turning. Improved weather	Reduce EB brake rate to reduce adhesion requirement when emergency brake occurs to below level commonly seen in winter conditions. Wheels are thus less likely to slide	Requires submission and approval of revised brake rate and assessment against operational safety model for current and future operational requirements	1 LRV hydraulic brake settings changed.	Alstom / Wabtec	5 LRVs per month	Week 30 at latest to complete fleet by November (if rate defined by end of May)		Nov-20	No approval of revised brake rate because of issues with GEBR, signaling or other operational need. Hardware changes might cause longer leadtime.	Medium	Other improvements to prevent flats and low adhesion. Improved wheel turning throughput	Low
	Very low adhesion seen at a number of locations on the guideway in certain weather conditions.	Use of winter mode to reduce brake rate; reduces system performance	Improve adhesion in winter conditions so that service and emergency braking does not result in slide.	Needs input from consultants to survey low adhesion areas first. Then appropriate mitigation to be identified	Not granular. Report to be written, countermeasures to be identified, tested, integrated into winter plan	SNC & NRC SME	TBD	May 2020 first surveys by consultants		Nov-20	It may not be possible or practical to improve adhesion conditions using equipment available	Medium	EB's less likely to result in flats because of improvements to train/adhesion	Low
	Signaling system overspeeding in poor adhesion conditions	Use of winter mode to reduce brake rate; reduces system performance	Add switchable function to Use trailer car brakes for service brake when wheel slide occurs to use available adhesion better in low adhesion conditions.	TCMS software change, change to OBCU and ATC to allow mode to be turned on and off. To be developed and integrated	TCMS software upgrade on LRV and ATC upgrade. Will be linked with other changes to systems.	TBD	TBD	TBD		TBD	Improvements to braking may be insufficient or may affect ATC odometry	Medium	EB's less likely to result in flats because of improvements to train/adhesion	Low
	GIDS system spuriously tripping on trains, animals, snow drift etc. causing EB application and delay	Operator cutting out. GIDS driving in ATPM	Software and configuration update for GIDS to prevent spurious detection of snow and small objects. Also to improve low temperature performance	Test of new settings in all positions and conditions	1 station	OLRT and Alstom 4 person crew	1 station per night 50 minutes per scanner, 10 per shift	May 2nd, 2020	1 of 34 (this includes stations and portals)	Jun-20	GIDS improvement may be insufficient to prevent spurious trips	Medium	EB's less likely to result in flats because of improvements to train/adhesion	Low
	Overspeed, triggered LRV-signal integration issues		Implementation of Thales 6.01 software	Testing Thales version 6.01 software on May 2nd 2020	Whole line upgraded	Thales group x 8 OC Transpo Drivers x4 Alstom Warranty tech x1 OLRT tech x2		June 2020? (provisional on testing)		Jun-20	EBs will continue to occur when overspeed is detected erroneously.	Medium	EB's less likely to result in flats because of improvements to train/adhesion	Low
	Incorrect sand causing inefficient use of sanding system and or blockages	Increased inspection during adverse weather to ensure availability of sanding system	Procure sand in accordance with spec	sand supplies kept at safe low level in order to transition. Climatic conditions are favorable for gradual transition	supply chain in progress of establishment	Alstom	Full silo delivery expected	TBD		TBD	adverse weather sanding issues will persist	medium	Other improvements to prevent flats.	Low
	Sanding only available on lead motor axle	N/A	Newest TCMS software includes sanding on the middle motor bogie	TCMS software change	4 X SU/2 X MU	Alstom	6 LRV per day	April 16th 2020	4 X SU	May-20	Low adhesion contributor, low adhesion persistence	low	Other improvements to prevent flats.	Low
Random OCS breakage causing service suspension & uneven pantograph wear	Failure of Parafils due to degradation of interface between synthetic material and termination body.	Repair / replace degraded items	100% inspection with sample testing of interface between synthetic material and termination body. If satisfactory then clean, wrap and seal existing terminations	Submission of inspection and test process (presently drafted) with success/failure criteria	By termination group	10 person crew with 4 high rail trucks	Inspection - 20 /day Test - 1 week	May 2nd, 2020		Nov-20	Degree of failure wider than priority zone[s]	Medium	Pre-emptive stock of made, or part-made Parafils assemblies	Low
	Failure of Rigid Rail	Inspection / rectification	Changed process for removal / refitting of shunt straps to avoid catch point. Ongoing maintenance. 30-day check after disturbance	Submission of revised process / evidence of refresher training	By shunt strap position	10 person crew with 4 high rail trucks	1 Rigid Track section per week	March 1st 2020		Apr-20	none known	Low		
	Grooving of pantograph head carbon causing premature wear	Increased inspection/replacement of pantograph carbons	Correct OCS Stagger at discrete locations	detailed review of OCS & compare current OCS vs design registration	X times identified areas	10 person crew with 4 high rail trucks	2 positions / day	May 2nd, 2020	N/A	Nov-20	continued increased pantograph wear/bounce or issue with carbon	Medium	Reconsider carbon/pan head	low
Switch failure caused by icing, causing service delay and suspension. Center duct has now been fitted to switches to de-ice switch heel	Inadequate heat output	Manual de-icing and maintainers standing by	1) Insulate center duct 2) Investigate the use of rail trace heating 3) Investigate the use of crib heaters	1) Install remaining center (x10) ducts and add insulation to all (x26) 2) In discussions with Switch heater manufacturer to supply a design proposal 3) In discussions with Switch heater manufacturer to supply a design proposal	1 Switch & heater	OLRT x4 and subcontractors	2 unit per week	August 8th, 2020	16 center duct, without insulation	Oct-20	some disturbed switches may still exist if we have an early snow fall	Low	Manual de-icing and maintainers standing by	Low
	Failed heaters not identified in time before failure	Manual de-icing and maintainers standing by	Improve SCADA monitoring of switch heaters	Test the existing SCADA points to validate why it does not produce an alarm when CB1, CB2 of MS1 is tripped.	1 Switch & heater	OLRT x4 and subcontractors	10 unit per week	August 8th, 2020		Oct-20	some disturbed switches may still exist if we have an early snow fall and the switch heater has an undetected failure	Low	Manual de-icing and maintainers standing by	Low
	Ineffective snow clearance	Manual de-icing and maintainers standing by	Implement nozzle angle recommendations by switch heater supplier.	Modify the track hardware that interfere with proper nozzle alignment.	1 Switch & heater	OLRT x2	26 units per week	May 9th, 2020		May-20		Low		
	Failed switch heater requiring intervention	Manual de-icing and maintainers standing by	Install additional man-gates to allow technicians faster access to rectify fault condition whilst minimizing service interruptions.	Strategically select new man-gate locations to better service switches	Man gate	Fencing contractors	TBD	TBD		Oct-20	Longer time for technician to get to a faulty switch or switch heater	Low		
Rooftop flashovers of line inductors, caused by winter brine contamination of inductor. Line contactor welding caused by high current. OCS tripping and affecting service.	Cracks in inductor encapsulation allowing electrolytic conduction to earth when water/ brine enters inductor compartment.	New waterproof inductor ventilated cover and enhanced insulation channel to improve creepage at base of inductor	Rework of line inductor with improved design and process. Revised line inductor on target. delivery and installation June-2020	Review and approval of new inductor design and manufacturer process. Delivery of sufficient inductors to start replacement program	1 LRV (replacement of 3 inductors one per propulsion inverter)	Sesto/Alstom	5 LRVs per month	Jun-20		Jan-21	further line inductor failures/flashover/Arcing occurrences/ subsequent CVS failures Roof access may slow down implementation. Need for implementation will be assessed as mitigation could be enough (test ongoing).	Low		
	Lack of detection of the fault causes eventual contactor welding	None	Review of propulsion logic to detect when there is a combination of undervoltage and overcurrent and provide appropriate isolation of inverter New line contactor revision as well as pre charge contactor management proposal 4/22	Review, testing and approval of revised line contactor/new logic in propulsion inverter. Improvement launched for new build. Require approval for retrofit.	per traction case	Alstom/Sesto	3 LRVs per month	Jun-20		May-21	further line contactor & pre charge contactor failures	low		

Problem	Cause	Short term countermeasure(s)	Solution identified	Preparation required before implementation	Unit of progress	Resources required for implementation	Rate of progress	Implementation start date	Achieved to date	End date	Risk of not achieving target	Risk level identified now	Risk reduction measure	Risk after reduction measure
	Failure of 2 LRV trains because of single HCSB opening	None	Fix to TCMS software to permit movement with single HCSB opening. Change request has been tested and validated. Evaluation of the results of the global software. Development of software subjected of the successful validation	Already incorporated in TCMS	1 LRV upgraded (assuming compatibility between modified/unmodified software)	Alstom	4-5 LRVs per night	May-20	4 X SU/2 X MU	Jun-20	further difficulty recovering train during flash over event/major PCE fault	Low		
Passenger door failures	Firmware lockout of motor control when doors are obstructed by passengers.	Attendance by technical staff in service with associated service disruption	Upgrade to motor H-Bridge control to incorporate pushback functionality [combined with input debounce]	Proposed software upgrade has been tested satisfactorily. SIL certification awaited	1 LRV [14 x DCU]	Alstom / Wabtec	3 LRVs per day	May 11th 2020		Jun-20	delay to SIL approval	Low		
	Firmware input glitch detection of door inputs causing random doors not opening	ERO awareness - use of manual open command	Upgrade to input debounce [combined with H-Bridge]	Proposed software upgrade has been tested satisfactorily	1 LRV [14 x DCU]	Alstom / Wabtec	3 LRVs per day	May 11th 2020		Jun-20	delay to SIL approval	Low		
	Difficulty manually closing doors when defect with doors occurs, resulting in major delays because of no door interlock cut-out	Attendance by technical staff in service with associated service disruption	Revision to mechanical design of door operator. Facility needed manually to achieve over-center lock.	Proposed solution has yet to be demonstrated	1 door operator	Alstom / Wabtec	2 door operator per day	July 1st 2020		Dec-20	solution may prove insufficient. Difficulties in implementation. Customer may not approve procedure	Medium	Reduction in door faults will require less isolation	Low
CVS (auxiliary converter) high failure rate, loss of spares and LRV availability	Consequential CVS failures owing to short circuit on line	Reduction in inductor flashovers because of countermeasures	Simulate failure mode and identify suitable protection methodology	Carry out OCS short circuit test while monitoring CVS internal voltage/current	1 LRV all CVS upgraded (2 CVS)	SNC SME's Adetel/Alstom	1 LRV per day	TBD		TBD	Measurement Equipment / Test not to produce sufficient results for concluding	High	Review spare levels and repair times to prevent stock shortage	Low
	IGBT failure owing to transient overloading of devices	None	Software upgrade to limit IGBT loading during supply interruptions	Test and validate software on train and integrate with TCMS.	1 LRV all CVS upgraded (2 CVS)	Adetel/Alstom	2 LRVs per day	May 15th 2020		Jun-20	Risk of not fully solving the CVS failures	High	Review spare levels and repair times to prevent stock shortage	Low
HVAC	Defects in system affecting summer cooling	Test/Check fleet during pre-summer inspection	Deficiencies addressed during HVAC section of 100K inspection. Increased HVAC filter replacement to maximize air flow	Obtain baseline after maintenance activities	1 LRV	Alstom Maintenance	2 X LRV per 100K inspection 5 day turnaround	Mar-20	7 X SU		Further HVAC faults in hot weather	Medium	Manual door operation to conserve energy	Low
	Additional requirement for cooling during the summer	Test/Check Fleet check during pre-summer inspection	For the passenger saloon: • The passenger HVAC temperature set point must be set at 16C as seen last summer • Automatic Mode (Self Service Mode) of the Door For the Cab: Adhesive Solar Film Protection . The booster diode change improves the temperature of the air in cab (by increasing the flow)	Define adhesive film surface.	1 LRV	RTM/Alstom	1 LRV per day - passenger saloon and diode 1 LRV per day for the solar film	May-20	Booster Diode done for the 8.2V / Tested for the 10V but not applied	Jul-20	Hot cabs in hot weather; Material supply	High	Manual door operation to conserve energy	Medium

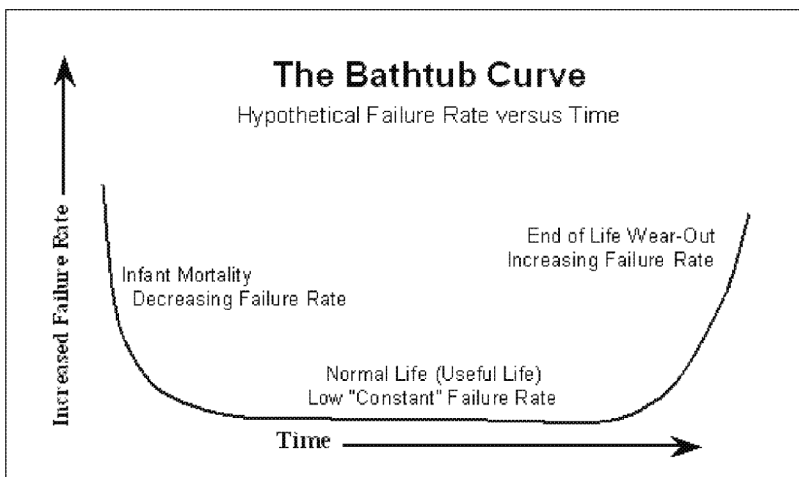


City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
a)	"The City requires a fully compliant System that includes the requisite number of Vehicles to provide the necessary Service Levels under the PA. RTG committed to providing 15 double Vehicle Consists ("Trains") a plan and schedule for the Provision of 15 operational Trains"	RTG/OLRTC RTM/ALSTOM

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>There have been several contributing factors related to Vehicle and Infrastructure issues contributing to shortage of the targeted service levels of 15 trains for service, which include:</p> <p>Reliability of the System</p> <ul style="list-style-type: none"> - Rolling Stock (Vehicles) - OCS - Infrastructure <p>These key areas have also contributed to cascading impacts on resourcing and supply chain particularly in the safety levels of spare parts related to rolling stock</p>	<ul style="list-style-type: none"> - Outputs from JBA Consultant Services - Outputs from Reliability Task Force Teams <p>Each individual response for the Remedy/Rectification plan, items (1-14) refer to a containment and mitigation method, process or interim technical solution as a means of mitigating further impact to reliability and availability so that longer term solutions can proceed uninterrupted to resolution and are necessary to stabilize and control impact of defects.</p>	<p>Expediate Increase of Vehicle Roster (LRV 37,38,39,40)</p> <p>Execution of all critical solution proposals/rectifications that are directly linked to reliability and availability improvements, more notably failures affecting service availability:</p> <ul style="list-style-type: none"> Vehicle Power Systems Vehicle Traction Power Systems Vehicle Braking Systems OCS – Failures and Panto Interface Track Maintenance <p>(but not limited to all items (1-14))</p>

Background/Summary

RTG along with its entities have been diligently working around the clock to bring a level of service that the citizens and ridership of Ottawa deserve. The Confederation Line System has incurred several impacts related to reliability of assets, essentially impacting targeted vehicle availability requirements. The system and vehicles are experiencing defects that are not uncommon in the Industry in relation to bedding in period. A typical Reliability Curve for a system like the Confederation Line and the stages of stability is illustrated in the graphic. Moreover, compounding the issue is timing and complexity of the failures as such that they are overlapping and essentially creating more difficulty in bringing timely resolutions.



RTG recognized immediately that in order to stabilize the situation it would require an injection of specialists and acted swiftly to bring in industry specialists from around the globe and other similar projects similar in scope with experience in dealing with the type of failures the line was experiencing.

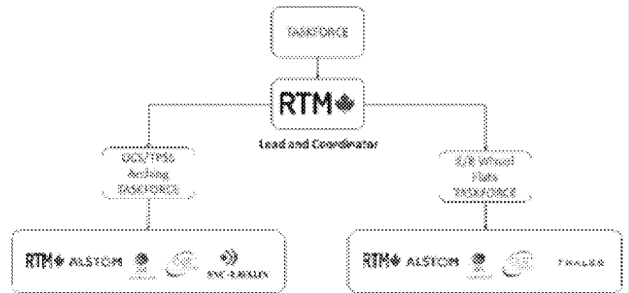


City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
a)	"The City requires a fully compliant System that includes the requisite number of Vehicles to provide the necessary Service Levels under the PA. RTG committed to providing 15 double Vehicle Consists ("Trains") a plan and schedule for the Provision of 15 operational Trains"	RTG/OLRTC RTM/ALSTOM

Subject Matter Specialists

An initiative to form Reliability Task Force Teams with assembled specialists was put in place and the objectives were clear, establish root cause, recommendations for mitigation and containment for long term solutions, and permanent fix rectification. Two key areas were the focus of the groups based on the concentrated area of grouped failure points:

1. OCS Arcing Taskforce
2. E/B Wheel Flats Taskforce



In February of 2020, RTG secured subject matter specialists JBA consulting, to assist the organization in providing sustainable service levels back to normal and steady state. JBA has had an immediate impact with their participation by providing their expertise on the 2 two key task forces assembled.

They have also contributed in providing process efficiencies such as their Visualization Management process which have now been adopted as normal business practice related to key communications interface and day-to-day operational needs.

JBA made several key recommendations and findings utilizing best practice fault finding exercises such as Pareto analysis, and Fault/Cause/Remedy (FCR) applications, including identifying top 10 reliability inhibitors to the system and vehicles. The City's remedy and rectification requirements are very much in line with RTG's perspective on the issues to date affecting the reliability of the system.

	Reliability		Maintainability (TTR)		Availability
	Constant		Decreases		Decreases
	Constant		Increases		Increases
	Increases		Constant		Increases
	Decreases		Constant		Decreases

RTG recognizes that the focus on improving reliability has a distinct correlation with improved availability and supplementary maintainability of the assets, from adequate resourcing and healthy supply chain (refer to image above). This interrelationship is directly linked to RTG's methodology for execution of the remedy/rectification plan requirements from the city as a success measure in providing 15 double vehicle consists (Trains).

RTG has summarized 7 key activities associated with success of the execution of the plan necessary to support the objective of 15 operational trains:



City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
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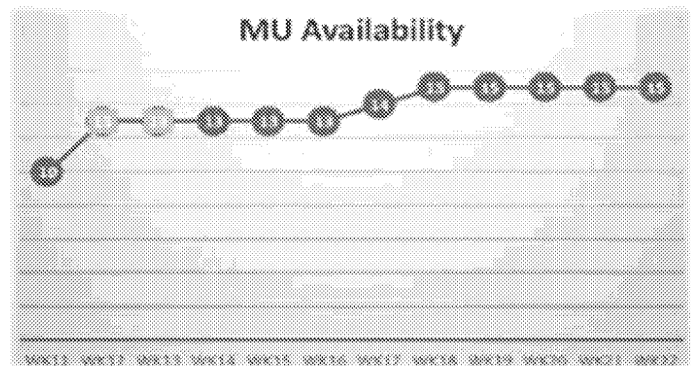
1. Expedite Increasing Vehicle Roster (LRV 37,38, 39,40)

City Mandate

- 14 trains in service as of June 1, 2020 during morning peak, 1 hot standby, at the handover and maintenance spare
- 15 Trains in service as of August 4th, 2020 during morning peak, 1 hot standby, at the handover and maintenance spare
- The "MU Availability" Chart below was generated prior to the COVID restrictions – it will be updated pending the expiration of the government-imposed restrictions.

Accelerate acceptance of the LRV's

- LRV 37 and 38 now part of the Roster
- LRV 39/40 could be in revenue service on Week 22 upon APS deliveries



LRV37-LR40 Status

- Dynamic Run completed for LRV37 (Oct 25th,2019)
- Dynamic Run completed LRV38 (Oct 30th,2019)
- Dynamic Run completed for LRV39 (Feb 12th,2020)
- Dynamic Run started for LRV40

Maintenance Spare Requirements

- 1MU - Preventative Maintenance
- 1MU - Corrective Maintenance
- 2SU - Retrofit

2. Expedite and Rectify all System failures affecting availability as priority

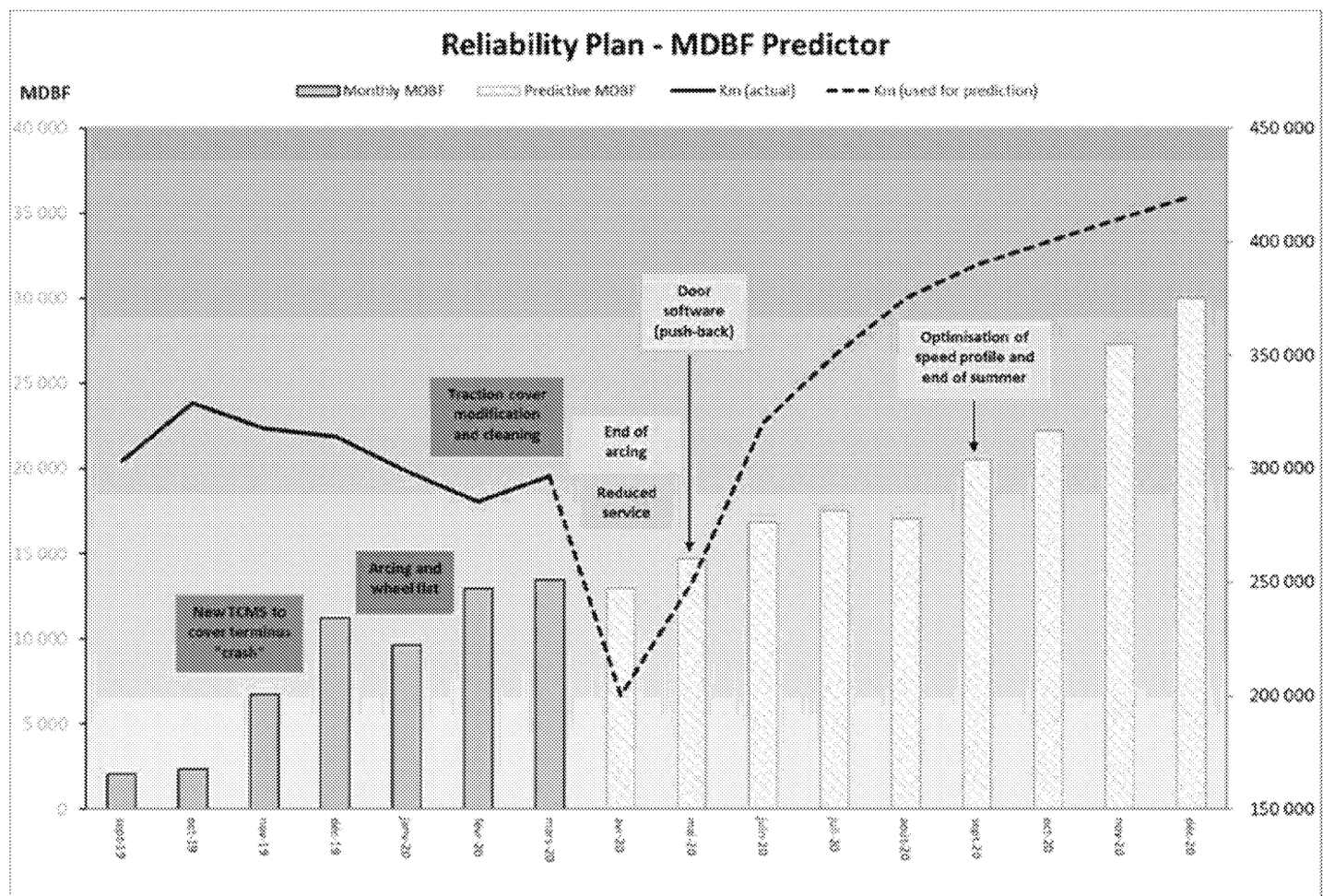
- Each response in the plan has been carefully examined to ensure the best results possible are reflected as an outcome to root cause and rectification.
- The Master Schedule is defined by two levels (Priority 1 and 2) Priority 1 rectifications are directly linked to system failures affecting availability and will be RTG's focus and priority. RTG considers the Priority 1 schedule grouping to be the most impactful reliability inhibitors and must have the attention of all of our staff from every level of the organization to expedite these Priority 1 rectifications identified in the plan and schedule.

3. System (including vehicle) Reliability Forecast Growth Curve

- The growth curve is necessary to monitor and track the predictors and ongoing reliability trends, this will be monitored and updated routinely through the rectification timeline and as a go forward initiative with our ongoing interaction with the OC Transpo.



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RTG considers the rolling stock service affecting related failures to be the focus and priority in translating information pertaining to the reliability curve, as they naturally contribute to a higher percentage of the impact on reliability and availability of trains for service.

The Growth Curve represented currently in the plan (image above), is primarily focused on the predictors associated with rolling stock. The predictors are representative of the forecasted modifications, software enhancements and planned fixes associated with the key rolling stock vehicle systems identified in the plan.

The curve is a conservative representation at this stage that still considers nominal failure rates and accounts for a certain level of progressive improvement based on the timing predicted for the key vehicle systems (e.g. Inductors, Passenger Door Mods etc.).

Other System predictors related to Infrastructure, Communications, Signalling will be populated as we refine the schedule timelines and supply chain assumptions. Furthermore, there are key software (Thales 6.0, GIDS etc.) that are imminent, and the curve representation would benefit from an actual vs a forecast update to the curve.

The infrastructure related fixes associated with stagger, parafils and securement of OCS components are primarily isolated failures and will not resonate in the curve due to the lower percentage impact, however they are of the upmost priority



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in expediting resolution due to their potential catastrophic nature of the their system service affecting failure impact (service shutdown , length of time to recovery etc.) and mobilization related to these activities are already in play.

RTG will work with JBA, who will take lead on continued monitored and development of the Reliability Curve as we mature through the execution of the plan.

4. **Stabilize Resourcing** (refer to Rectification City Reference 12b) vi.)

5. **Stabilize Supply Chain** (refer to Rectification City Reference 12b) vii.)

6. **Institute an Internal Governance structure**

An internal steering committee that has direct lines to key working groups through a single point of contact (Project Manager) responsible for the execution of the plan.

7. **Master Schedule**

- For monitoring and tracking purposes all the independent schedules for each of the remedy/rectification items (1-14) will be rolled-up into one Master Schedule for direct oversight and governance of the actions. This is critical to ensure responsible entities and leads and working groups are engaged and obstacles are removed for a path to their success.
- The Master schedule will be monitored and tracked by RTG governance committee and the Project Manager.
- The Master Schedule as stated, will be divided into 2 levels and rectification activities associated with immediate impact to increased availability will be prioritized accordingly.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Active Containment and Mitigation																								
Increase Vehicle Roster																								
LRV 37 & 38 (City approval)				X																				
LRV 39 & 40 (City approval)					X																			
Remedy/Rectification requirements																								
Finalize Master Schedule (Refinements)				X																				
Execute Rectification Actions	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Finalize Reliability Forecast Growth Curve				X	X	X																		
Stabilize resourcing/supply chain				X	X	X	X	X	X															
Train increase to 14 (tbc)						X																		
Full 15 trains (tbc)								X																

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



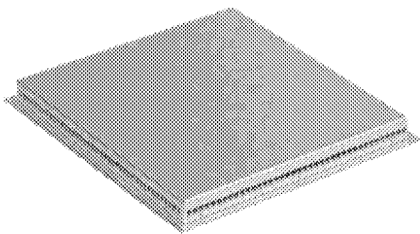
City Ref.	Remedy/Rectification Requirements		Responsible Entity & Lead
b)	Other Requirements - The city requires that RTG take the necessary steps (1-14) in the Rectification Notice and that's its plan and schedule include measures to address the following items:		RTG/OLRTC RTM/ALSTOM
b)1.	Vehicle Power Systems – Power System Inductor Failures	<i>Due to an identified defect in the manufactured units appears to be partly mitigated with an insulating cover and modified cover the inductor units. The city requires that RTG provide full technical details including drawings of the implemented changes to the Vehicle, schedule for replacement of the inductors, and signoff by the Engineer of Record on all completed and planned Vehicle Configuration changes.</i>	ALSTOM
Problem Statement		Containment & Mitigation	Solution Proposal/Rectification
<p>A short circuit causing consequential failure leading to Line inductor failure</p> <p>Several root causes to be addressed:</p> <ul style="list-style-type: none"> - External inputs (Contaminants) - Line inductor design and quality issues 		<ul style="list-style-type: none"> - Increased maintenance (cleaning) regime to prevent further tracking to ground path by removing contaminants, - Temporary cover to protect the Line Inductor - U channel in the bottom to reinforce isolation 	<ul style="list-style-type: none"> - Validation of the new cover as well as the box arrangement - Replace temporary cover with permanent - Quality improvement in Line Inductor manufacturing
Background and Summary			
<p>During the investigation into arcing and flash overs, Taskforce identified multiple contributors to the failures:</p> <ul style="list-style-type: none"> - Contaminants: pantograph dust, copper particles from the OCS, conductive fluids for de-icing the roads, water ingress - Design flaw with respect to creepage distances in the Inductor compartments. <p>The mitigation completed to date was communicated ((RFI-P) - ALS - 1111) and includes:</p> <ol style="list-style-type: none"> 1. A new inductor cover (drawing 1), which prevents water and outside pollution from falling directly on the terminals and windings of the line inductor. 2. A reinforcement of the creep and strike distance between the inductor and the magnetic shield below the inductor by addition of a fiber reinforced plastic channel referred to as a "U Channel" over the magnetic shield (drawing 2) 3. In addition, Alstom is working with the supplier of the inductor, and has developed improvements to the inductor itself, that improve the creep and strike distance to a level to eliminate the issues observed in service. These modifications are planned to be implemented on the next units manufactured by the supplier, in conjunction with the new enclosure cover and reinforced insulation under the inductor (drawing 3). <p>To confirm the robustness of the mitigations in place, Alstom intend to use the original inductor with the mitigation (u-channel) test to destruction and compare to the new design to establish margins.</p> <p>Following several recurrences of the same issue in January and February during icy conditions, the revised cover in unpainted form (for the sake of expediency), has been implemented already on all Stage 1 vehicles as a temporary remedial solution. During summer 2020, there will be a swap out of the temporary covers with painted ones, and at that time, there will be a final inspection and the traction case configuration level will be changed. The additional U Channel (isolators) is under implementation in conjunction with the cleaning of the traction case (see schedule below)</p>			



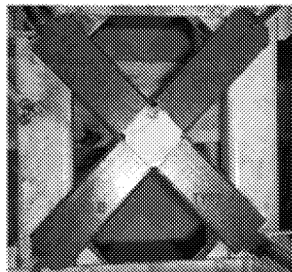
City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
b)	Other Requirements - The city requires that RTG take the necessary steps (1-14) in the Rectification Notice and that's its plan and schedule include measures to address the following items:	RTG/OLRTC RTM/ALSTOM
b)1.	Vehicle Power Systems – Power System Inductor Failures	ALSTOM

The improvement development (3rd point) is being followed closely with the vendor including quality control, validation and characterisation tests performed on the parts. At this stage, no dynamic test are deemed necessary however should Alstom decide otherwise, it will be done as part of a Stage 2 LRV DPICO.

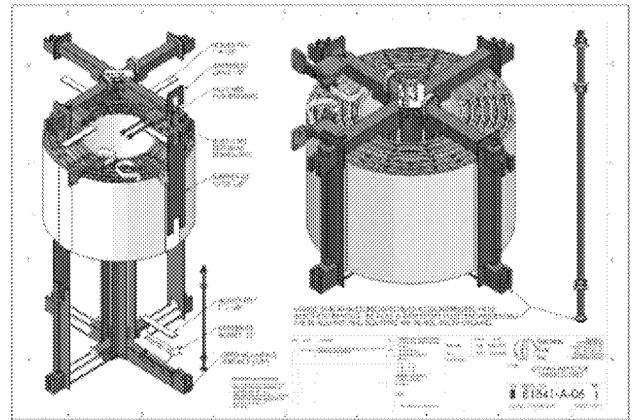
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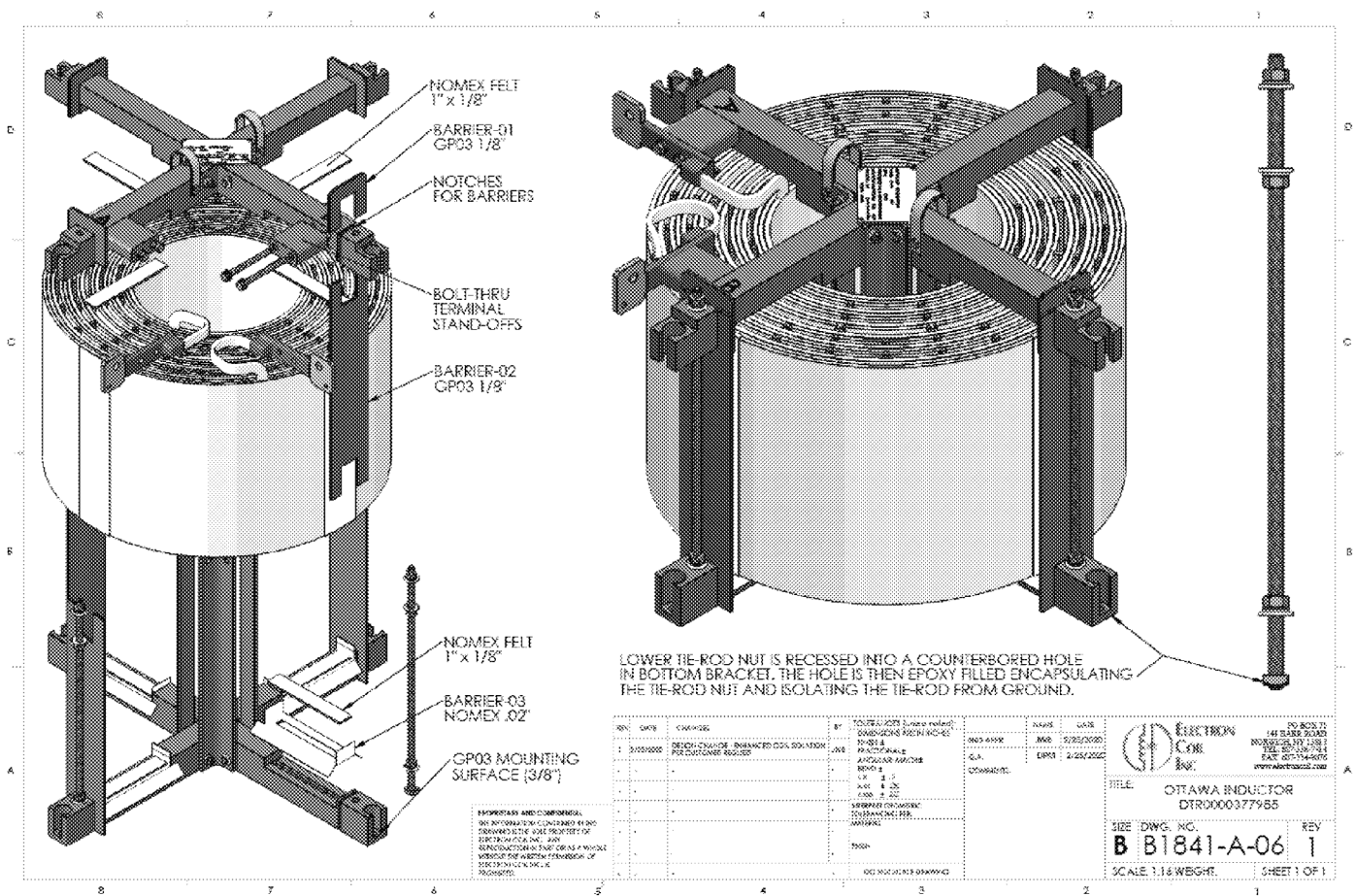
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City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
b)	Other Requirements - The city requires that RTG take the necessary steps (1-14) in the Rectification Notice and that's its plan and schedule include measures to address the following items:	RTG/OLRTC RTM/ALSTOM
b)1.	Vehicle Power Systems – Power System Inductor Failures	ALSTOM

Revised Inductor:

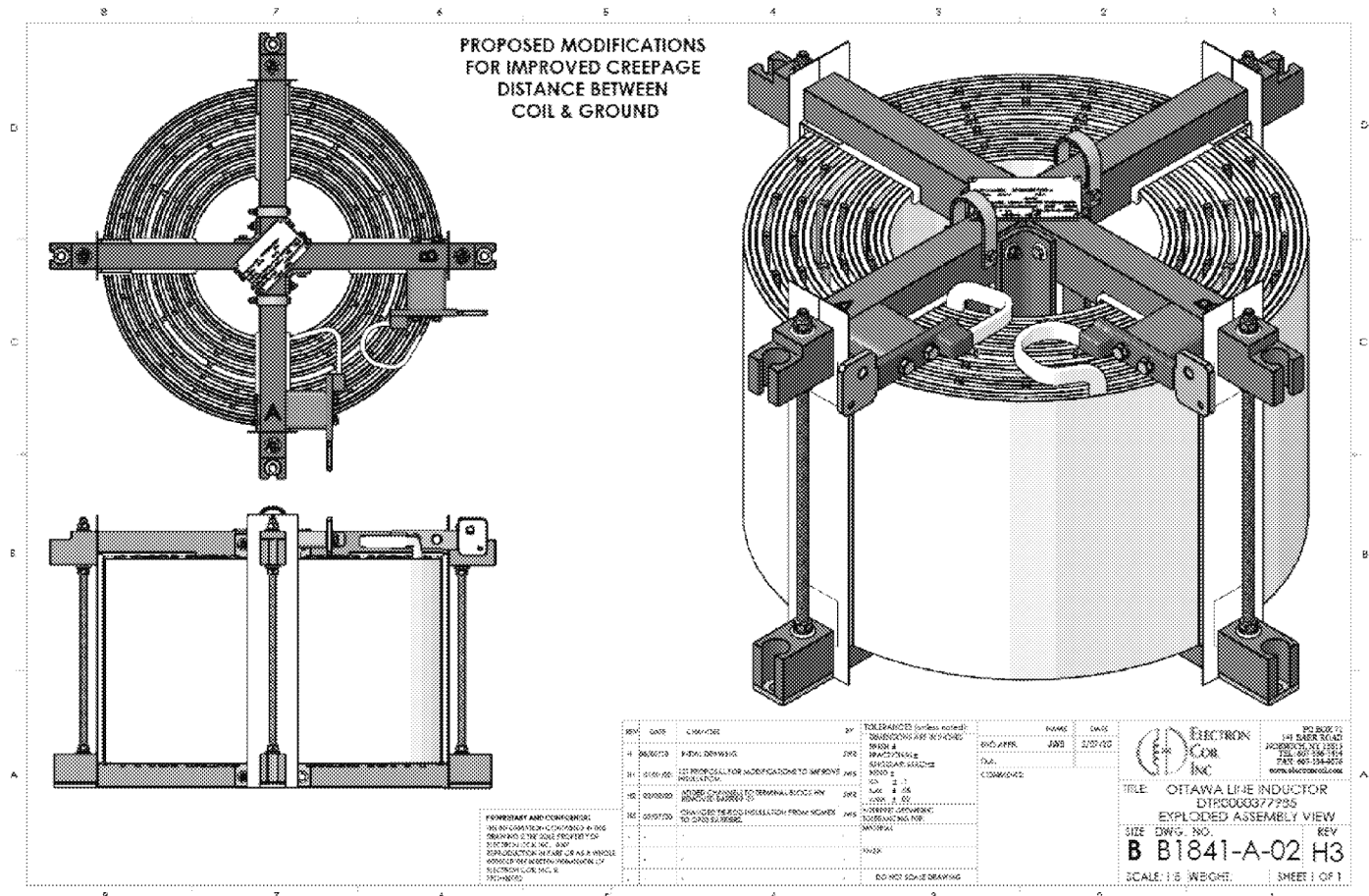


Line Inductor Failure Analysis Report Doc # DED0000 Rev A shall be issued to the City as will Failure analysis report LINE INDUCTOR DTR0000377985 Doc # AYD0000561716



City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
b)	Other Requirements - The city requires that RTG take the necessary steps (1-14) in the Rectification Notice and that's its plan and schedule include measures to address the following items:	RTG/OLRTC RTM/ALSTOM
b)1.	Vehicle Power Systems – Power System Inductor Failures Due to an identified defect in the manufactured units appears to be partly mitigated with an insulating cover and modified cover the inductor units. The city requires that RTG provide full technical details including drawings of the implemented changes to the Vehicle, schedule for replacement of the inductors, and signoff by the Engineer of Record on all completed and planned Vehicle Configuration changes.	ALSTOM

Revised Inductor:



Retrofit Schedule Constraints

There are 3 inductors per LRV, Retrofit Team capacity forecast is 1 LRV per day due to the following constraints:

- Works duration 7h per train, including testing but without train move, requiring 3 techs and 1 crane operator
- LMB for Roof access with crane – there is only 1 crane per LMB (and for safety reasons, even if 2 LRV can occupy 1 LMB, the crane cannot travel over the technicians working on the roof)
- Having 2 LMBs used for this activity would jeopardize the maintenance & warranty needs for the LMBs

Forecasted Schedule - Vendor Capacity, delivery of 4 new inductors per week when full production launched, therefore, 5 LRV (15 inductors) will be exchanged per month.



City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
b)	Other Requirements - The city requires that RTG take the necessary steps (1-14) in the Rectification Notice and that's its plan and schedule include measures to address the following items:	RTG/OLRTC RTM/ALSTOM
b)1.	Vehicle Power Systems – Power System Inductor Failures	ALSTOM
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Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Containment/Mitigation																								
Interim (vented Lid) Top Cover(unpainted)		X	X																					
Cleaning of compartment and Inductors			X	X																				
Replacement of Top Cover (painted)					X	X	X	X	X															
Qualification of Improved Inductors				X	X																			
Dynamic test (if needed)						X																		
Replacement of Inductors							X	X	X	X	X	X	X	X										
Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.																								



City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
b)2	<p>Overhead Catenary System (OCS) – Wire Failures (Parafils)</p> <p><i>Immediate Technical Modifications are required to be undertaken to increase the reliability of the OCS. The failure mode wherein “Parafil” support the members are causing the catenary wire to drop is a known issue that was encountered during testing and commissioning. As this is a known issue, the City’s expectation is that this issue be resolved and actioned quickly. The City requires that RTG provide full technical details on the plan for rectification, schedule dates and installations, and sign-off by the Engineer of Record on the modified configuration.</i></p>	OLRTC

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>There is a known issue where the parafil are being corroded and damaged due to electrical tracking. This is increased in the winter by the weather and the ‘misting’ from adjacent roadways.</p>	<p>Inspection of every parafil and assess the level of corrosion, replacing those that are of concern.</p> <p>Seasonal Maintenance regime to align with winter conditions (misting) will be reviewed as per O.E.M.</p>	<p>The designer will review the current design and alternative solutions. If the designer believes a material change is required, any redesign will be approved by an EOR. Timeframe will be dependent on material availability and track access to make any required changes. 6 – 12 months.</p>

Background

The OCS system includes cantilevers as part of the support system. The Cantilevers include parafil ropes which are a common component in many OCS systems. Over the past two years there have been a few incidents involving parafils failing. Every incident that has occurred has been a result of corrosion. The corrosion is a result of two key issues:

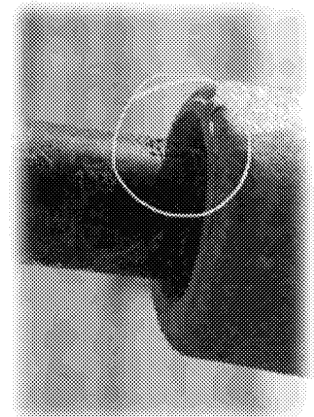
- 1) de-icing misting from adjacent roads;
- 2) electrical tracking from ice and aforementioned de-icing chemicals.

The corrosion results in heavy pitting of the parafil rope sleeves and the metal fittings, the adjacency of the roads and salting and pre-wetting agents are contributing to the corrosion of the parafil and fittings.

The parafil issue is restricted to specific locations of the guideway, this issue does not exist in all locations, (e.g. no parafil issue in the MSF). For the potential replacement, the designer accepted to increase the parafil diameter in this area to have a large safety factor, even though not required by the design.

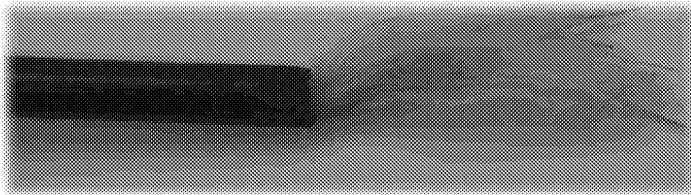
Samples of the parafil assemblies will be removed from service between Blair and Cyrville (the area where the OCS has been in service the longest and exposed to more de-icing chemicals due to its proximity to the Hwy-174) and tensile strength tests will be performed. The results of these test will reveal if there is need to replace additional Parafil or simply the ones exhibiting visible corrosion.

Subject Matter Specialists from the OCS arcing task force have confirmed that one of the contributing factors related to the failure mode was corrosion along with other factors that are inline with enhanced protective sheathing as a mitigation measure. (As see photos)



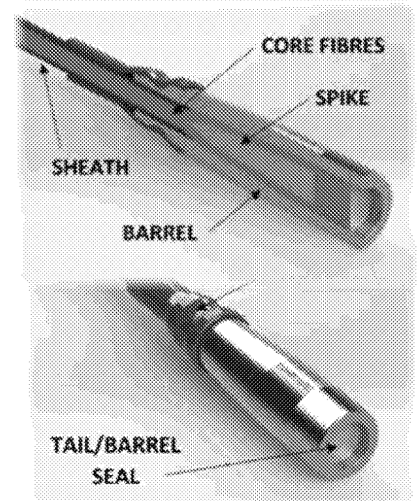


City Ref.	Remedy/Rectification Requirements	Responsible Entity & Lead
b)2	<p>Overhead Catenary System (OCS) – Wire Failures (Parafils)</p> <p><i>Immediate Technical Modifications are required to be undertaken to increase the reliability of the OCS. The failure mode wherein “Parafil” support the members are causing the catenary wire to drop is a known issue that was encountered during testing and commissioning. As this is a known issue, the City’s expectation is that this issue be resolved and actioned quickly. The City requires that RTG provide full technical details on the plan for rectification, schedule dates and installations, and sign-off by the Engineer of Record on the modified configuration.</i></p>	OLRTC



The designer has been provided with the recommendations from the Specialists and they include the following:

1. Inspect all PARAFIL rope terminations for excessive corrosion or signs of wear
2. Those parafils that have previously been replaced should have their rubber sleeves removed to inspect for corrosion penetration. Note that this inspection was performed on April 16th, 2020 on three replacement parafils that had rubber sleeves installed and the results showed no corrosion beneath the rubber sleeves.
3. Replace all PARAFIL ropes that have signs of corrosion with a design utilizing manufacture recommended sealed termination (e.g. as per photo).
4. All Parafil terminations not replaced from the step above, need to be retrofitted with a rubber sleeve and the barrel needs to be silicone sealed. A retrofit procedure (work instruction) has been developed in conjunction with the termination manufacturer.
5. Keep a photographic record of condition with a date stamp
6. Regular ongoing maintenance inspections, enhanced in advance of winter
7. All parafil shall be cleaned, as per the maintenance manual

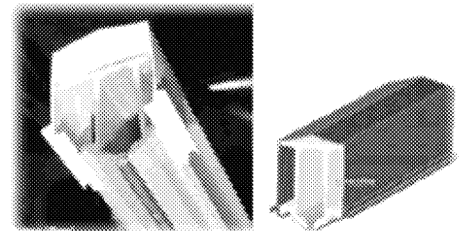
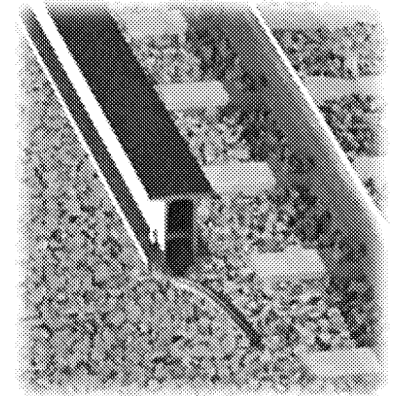


Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Preliminary Inspection (Report)			X																					
Full System Analysis				X	X	X																		
Mitigation – Prioritize and Replace Key Areas						X	X																	
Reconcile Findings and complete all Repairs							X	X	X	X	X	X												
Institute Supporting OEM Maintenance				X					X															

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity	
b)3	<p>Overhead Catenary System (OCS) – Wire Failures (Rigid Rail Failure)</p> <p><i>Immediate technical modifications are required to be undertaken to increase the reliability of the rigid rail system. The recent failure where the catenary wire was ripped out of the rigid rail needs a modification so as to prevent a repeat of this occurrence. As this is a known issue, the City expects that this issue be actioned and resolved quickly. The city requires that RTG provide full technical details on the plan for rectification, schedule dates and installations, and sign-off by the Engineer of Record on the modified configuration.</i></p>	OLRTC	
Problem Statement		Containment & Mitigation	Solution Proposal/Rectification
<p>One single event with rigid rail has occurred to date. The incident was not a result of 'known issue' or poor reliability. There are 3 potential causes to the event that occurred;</p> <ol style="list-style-type: none"> 1) Loose fixing in the soffit of the station; 2) Bent contact wire due to previous repeated installation and removal of shunt straps; 3) Pantograph adjustment on the LRV. 		<p>RTM has undertaken an inspection of the rigid rail to verify that the installation is fit for service. RTM will change the procedure for the installation and removal of shunt straps in rigid rail locations. RTM will ensure the appropriate maintenance regime is being followed. Pantographs are being regularly inspected for condition and adjustment.</p>	<p>Maintenance of the rigid rail to be adhered to as per the O&M manual provided by OLRTC. No requirement for design change, review or EOR signature.</p>
Background			
<p>Rigid rail is not "unreliable". It is a static element that does require frequent maintenance and inspection. At the free end of every rigid rail section there is a 'tail' of contact wire that bends up towards the soffit. This ensures that the pantograph never interacts with an end of contact wire. During regular repair and maintenance, shunt straps have been temporarily attached to the tail of the rigid rail. Whilst this is not an issue and is an acceptable practice, care must be taken during the installation and the removal of the straps to ensure that the tail is not pulled downwards creating a potential "catch" point with a pantograph. Refresher training is needed on the correct procedure and care required when installing and removing shunt straps to rigid rails. As well, any tails that look to be in misaligned should be immediately reported.</p> <p>The rigid rail maintenance regime requires the mechanical fixings, nuts & bolts, to be regularly checked for tightness and correct torque. The rigid rail and the fixings are made from a variety of metals and therefore they all react to the temperature fluctuations differently. Sections of the rigid rail have been in service for several years and should not be regarded as 'new' at the RSA date.</p> <p>After the event at St Laurent, RTM undertook an inspection of the rigid rails and has ensured that all fixings are tightened to specification. This is an ongoing maintenance activity that will continue for the next 30 years. RTM will re-review current OEM documentation and ensure the maintenance regime is adhered to through increased Quality and Auditing of Maintenance pertaining to these Assets.</p> <p>Taskforce will assess the feasibility of a rigid rail protective cover (off the shelf product) as another means of protection against corrosion as an enhanced method and protection against the elements this alignment is exposed to.</p> <p>In addition, a review of maintenance practice is currently under examination to ensure that there are no gaps in O.E.M. requirements as outlined below.</p>			




Maintenance Checks – After 3 months of operation

these are the following activities:

Adjust the torque of bolts

Check all the supports Electrical adjustments

-Height, staggers, overlaps levelling

Rigid Supports: the manual for Preventative Maintenance states:

Review the torque of bolts

Review the status of bolts and galvanized surfaces

Review the adjustments of heights, cants, and staggers

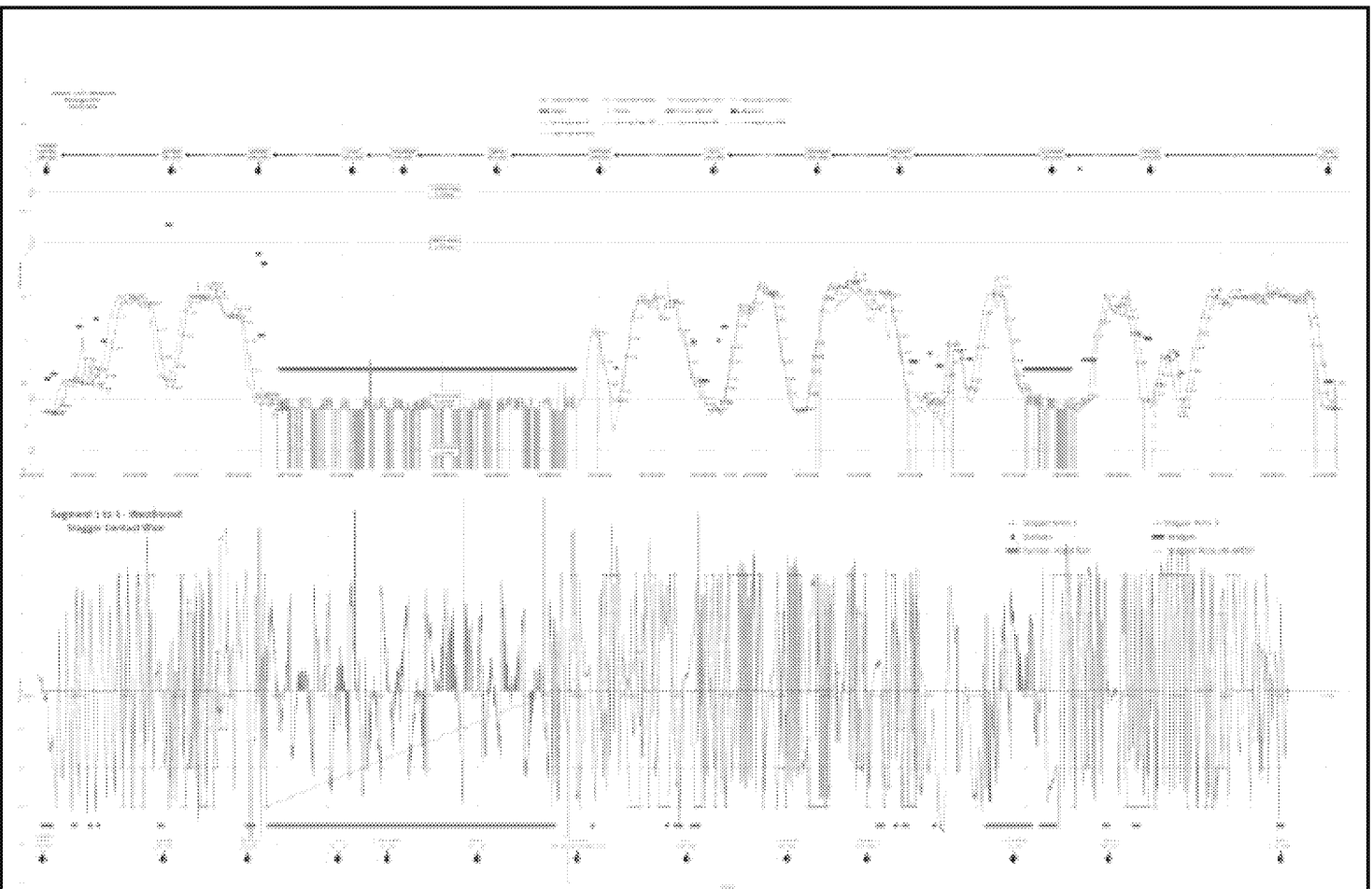
Bell insulator with sliding hanger clamp

Review the torque of bolts. The Allen bolts of hanger clamp have a special torque of 22 Nm”

Remedy/Rectification Activity Schedule	2020											
	1	2	3	4	5	6	7	8	9	10	11	12
Contamination/Mitigation												
Mitigation (Inspection)		X	X									
Investigating Rigid Rail Protective cover			X	X								
Briefing/Training of Power techs			X									
Supporting OEM Maintenance Regime			X									
Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.												



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)4	<p>Overhead Catenary System (OCS) – Pantograph Integration</p> <p><i>The carbon strips on the Vehicle pantograph have significant groove patterns indicating that the overall design and installation of the OCS including the stagger has not been designed correctly and/or installed correctly and/or maintained correctly. A full survey of the existing system needs to be undertaken to validate that the current configuration of the system meets the design specifications. In addition to the verification of the general arrangements, the City needs confirmation that OCS wire transition sections, section insulators, and transitions from wire to rigid rail are working correctly and not causing undue arcing. The City requires that RTG provide full technical details on the outcomes of this review including results of the survey, details and installation dates for corrections or repairs, and signoff by the Engineer of Record that current condition of the system meets the design criteria.</i></p>	<p>OLRTC</p> <p>Alstom TASKFORCE</p>
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>Issue with the OCS stagger installation, evidenced by the pattern of wear on the pantograph carbon strips.</p>	<p>Replace heavily grooved Carbon strips. Remove Bronze "sliders" (winter season coming to end). Continue preventative maintenance to ensure Pantograph spring tension is set correctly.</p>	<p>RTM to ensure that the OCS is within the maintenance tolerances as identified within the O&M manual provided by OLRTC.</p>
Background		
<p>As part of the ongoing root cause analysis formed by the outputs of the High Voltage Arcing Taskforce, several Subject Matter Specialists (SMS) from the Taskforce have contributed to surveying and analysing the OCS in two key areas:</p> <ol style="list-style-type: none"> 1. Electrical Line Voltage Assessment 2. Mechanical (Stagger and Mechanical Fastening) assessment <p>SNC/Atkins SMS's recently concluded their electrical survey of the OCS Line Voltage Parameters on March 26th, extracts below are from their findings as submitted to the Taskforce.</p> <p>Assessment of compliance of OCS Line voltages against international standards Findings Report – March 26th 2020</p> <p><i>"In order to investigate whether excessive voltage events were occurring, Light Rail Vehicle (LRV) 23 was equipped with a slow speed (200 samples per second) data logger and a high speed 2GS/s digital oscilloscope that is capable of identifying short, transient events of less than 5ps in duration. Identical measuring equipment was deployed at TPSS4 (near Lees Station), measuring the overhead line voltage on both East and West lines. The data gathered was then assessed against the following International Standards:</i></p> <ol style="list-style-type: none"> 1. IEC60850; "Railway Applications; Supply voltages of traction systems 2. EN50124-2; "Railway Applications; Insulation co-ordination, part 2; protection against overvoltages. 3. EN50119; "Railway Applications; Fixed installations, Electric traction overhead contact lines <p><i>The complete review of the results indicates that no voltages above those mandated in the first two standards have been recorded to date and the contact loss measurement complies with the earlier edition of the third when contact loss was specified directly – the present issue of the standard makes that methodology optional. Accordingly, it is concluded that the performance of the infrastructure follows the Project Agreement and the cited standards therein."</i></p> <p>OCS Surveys - Mechanical Stagger</p> <p>Several surveys of the OCS infrastructure have been conducted, initially by a third party systems engineer firm and more recently as part of the HV Arcing Task Force, as a participant in the Taskforce, Alstom utilized their OCS Tracer and Health Hub data system to survey and record the current OCS installation for height and stagger compliance. In addition, Subject Matter Specialists that form part of the Taskforce also conducted a preliminary line recording (pro-cam) of the OCS and Vehicle Interface and reported similar findings.</p>		



The recent surveys concluded that there are locations pertaining to the OCS alignment that will benefit from adjustment to allow for more “stagger”, specifically in the rigid rail sections.

Several recommendations from the submitted surveys to the Taskforce include;

- Full system Inspection of the areas highlighted by the survey
- Prioritization of arcing points related to insufficient stagger
- Adjustments required to improve stagger
- Repair any deficiencies found during inspection
- Preventative Maintenance regime in compliance with O.E.M. requirements

Rectification initiatives for Parafil Inspection and adjustments to stagger and height should be aligned as parallel activities. In addition, supplementary engineering hours (longer maintenance window) need to be considered to expedite these initiatives.

Further investigation is being undertaken by Taskforce to review the Pantograph Maintenance procedures and maintenance records to validate the following:

- Appropriate spring force tension preventative maintenance procedures meets O.E.M. requirements and interface specifications with OCS Overhead.
- O.E.M. requirements, conditions and frequency for brass insert (also know as “slider” in the industry)



Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Preliminary Inspection (Report)			X																					
Full System Analysis				X	X	X																		
Mitigation – Prioritize and Replace Key Areas						X	X																	
Reconcile Findings and complete all Repairs							X	X	X	X	X	X	X											
Institute Supporting OEM Maintenance (Seasonal Maintenance) requirements				X					X															
Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.																								



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)5	<p>Traction Power System Integration - Itemize Failure Modes, deem method to test and repair Line Contactors (LC), Auxiliary Power Units (APU), High Speed Circuit Breakers (HSCB), and TCMS</p> <p><i>Additional onboard unit issues related to power systems including line contactors, auxiliary power units (CVS) and high-speed circuit breakers (HSBC) require detailed assessments related to recent failures. For each of these items, the City requires that RTG itemize the failure Modes, identify the means to test and repair these units, detail any unintended TCMS or control logic issues related to operation of this equipment, e.g. TCMS prevents a train from moving when one vehicle has an activated HSBC, confirm the appropriate spares, are on site and confirm technical changes that are required to improve the reliability of equipment. The City requires that RTG provide full technical assessments on the failure modes, schedule for corrections or repairs, and sign-off by the engineer of Record on the configuration changes.</i></p>	ALSTOM

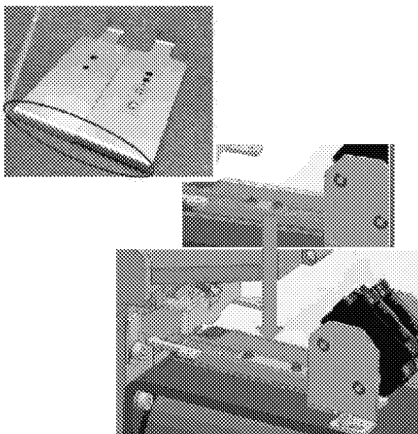
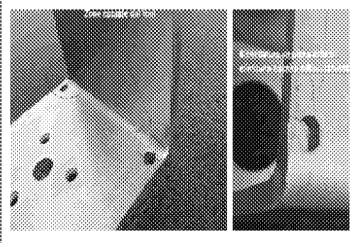

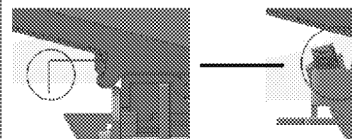
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>Main Root cause of these components' failures are addressed in the arcing task force</p> <p>This section treats the APS (also known as CVS), Line contactor, HSCB consequences as well as the TCMS correction</p>	<p>APS under scrutiny with additional protection via software C14 and new PC board to minimize the repair</p> <p>HSCB interlocking is leading to towing/pushing procedure in case of arcing</p>	<p>Arcing task force to tackle the initial root cause</p> <p>Implement an improved APS (tbc) New MPU/DDU/APC/EVR software package available for interlocking.</p>

Background

Arcing Task Forces to end up with solution, action plan and completion of the implementation to eradicate the initial root cause.

For the vehicle components, in addition to the line inductor described above, an update follows here:

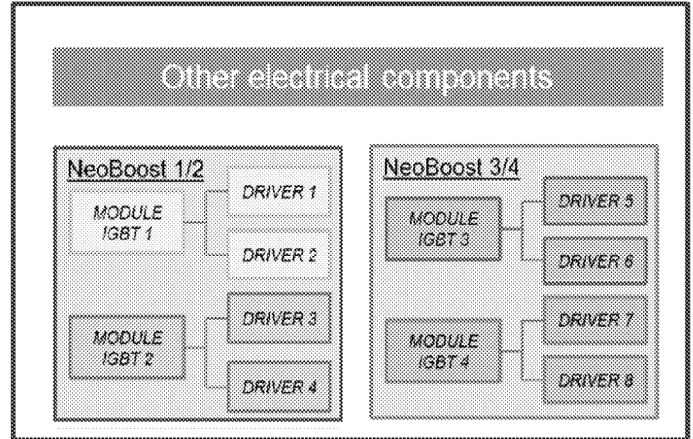
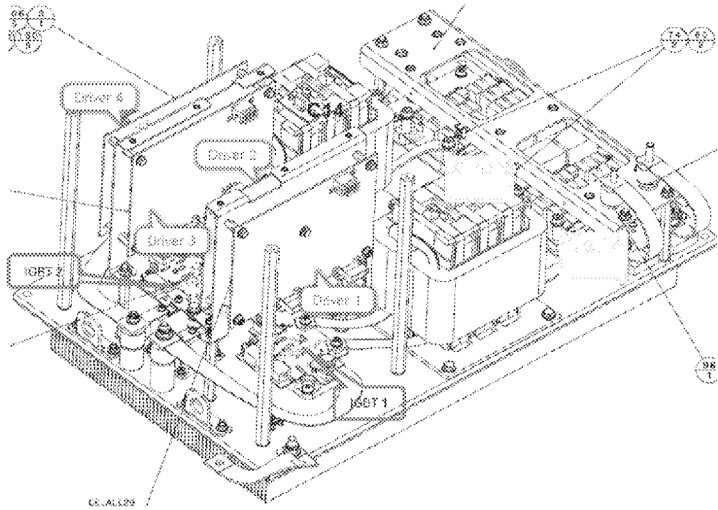
- a) With respect to the **Line Contactor** becoming stuck, Alstom identified two (2) separate and independent causes,
- Line contactor mechanism has been improved to avoid mechanical issue. These improvements were presented and shared with the City end of February via (RFI-P) - ALS – 1111.

<p>1. MODIFIED THE AUXILIARY CONTACT ACTUATOR (CHANGED LENGTH OF SHOES AND EDGE REDUCTION TO AVOID BOTTOM FRICTION)</p> 	<p>2. ADDED A STEP IN MANUFACTURING PROCESS OF ELECTROMAGNET FRAME TO PRESS LOCALLY THE INTERNAL RADIUS IN CORRESPONDANCE OF ITS FIXING POINTS</p> 	<p>4. INVERTED THE FLEXIBLE POTENTIAL JOINT BETWEEN CONTACTOR BODY AND ARC CHUTE. THIS MODIFICATION HAS BEEN INTRODUCED BY TELARC ON ALL TL SERIES CONTACTORS AND CONSEQUENTLY APPLIED ALSO TO OTTAWA PROJECT BECAUSE OF OBSOLESCENCE OF PREVIOUS VERSION OF COMPONENTS (CONTACTOR BODY AND ARC CHUTES).</p>  <p>THIS MODIFICATION HAS BEEN CONSIDERED NOT MANDATORY BY AT GESTO BECAUSE IT DOESN'T HAS IMPACT ON THE FUNCTIONING OF THE CONTACTOR. SO IT WILL NOT BE IMPLEMENTED ON 18629ES UNITS THAT WILL BE UNDER REPAIR/UPGRADE.</p>
<p>3. MODIFIED THE RETAIN LATCH SYSTEM FOR ARC CHUTE</p> 		

- it has been observed in service that when there is a flash over of the line inductor, the Line contactor tips become "kiss welded" leading to a true stuck closed condition. While the cause of this is still under investigation, the mitigation of line inductor flash over events eliminates this occurrence from happening.



b) With respect with the **Auxiliary Power Unit (APU)**,



Software Mitigation

- C14 software version to limit overvoltage & overload PC board is being prepared and scheduled for installation (in conjunction with the City). In parallel the root cause analysis exercise via Taskforce for a permanent solution is active.
- C15 software Beta successfully tested, Log files under analysis and validation.
- C16 software is ongoing, Static and dynamic tests to be done with C16 in Ottawa.

Note that the SNC/Atkins survey and technical report has concluded that the “arcing” issues and in particular the CVS failures is not associated with any disturbances or transients from the wayside distribution systems. Rather the issue is centered on the vehicle power distribution system and that is the focus of the ongoing investigation.

c) Forecasted next steps and testing for root cause analysis for CVS failures

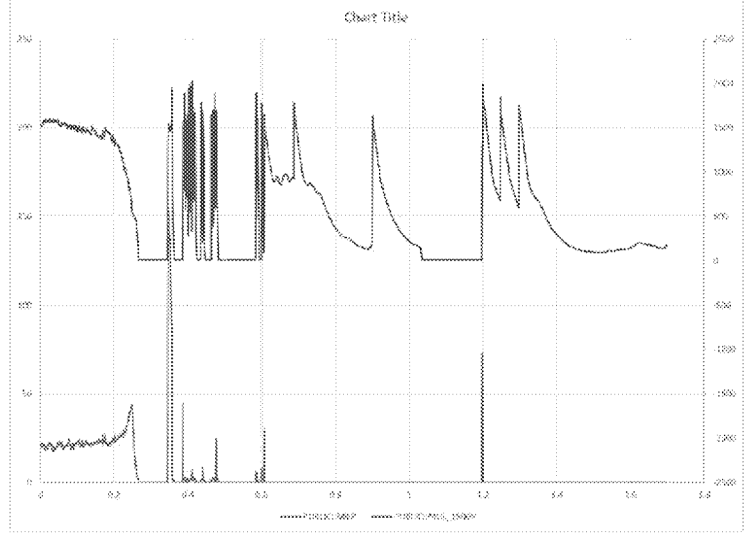
System level Tests Catenary/TPSS and CVS involving more details from Task Force system level coordinators that include, full scale arcing test while monitoring CVS (simulating ice) and short circuit test while monitoring CVS.

- Simulate 3 varying degrees of icing and monitor the behavior of the CVS,
- Utilize 6 voltage probes a recorder that can measure at speeds of up to 10 MHz over 16 channels.
- Measure not only line voltage but also the voltage across each of the 4 IGBT bridges that are in series, and the stability of the DC link with respect to ground.
- Test each of the 3 varying degrees of simulated icing for one day each, with time in between for review and analysis and at least one day in reserve for retesting and adjustment.
- Simulate short circuit (OCS Icing), there is a good body of evidence CVS units fail when there is an OCS flash over. We should record what happens at least under those conditions.



Data from one captured icing event

April 07-08 overnight, 2019 - The CVS shut down after the first major interruption, no indication of a failure in this event and the CVS restarted once power was reapplied to the train.



Additional Measures

- Test Bench of CVS has been transferred to Canada. All the necessary tests can be done locally.
- All the repairs of the defective CVS will be locally increasing remarkably the delivery time.

d) With respect to the integration and the interaction of the **TCMS, HSCB, and the Traction Line inductor and Line Contactor**, Alstom advised the following, all of which has been explained and presented in past meetings and or correspondence.

The fundamental interrelation is the following:

- In the event that there is a detected line contactor stuck closed condition, the Vehicle HSCB must be commanded open as a safety containment. This is part of the normal function of the HSCB on any rail vehicle. At present, the TCMS software blocks traction authorization if any HSCB is open. This leads to the case where a multiple unit becomes “stuck” on the track, for a line contactor failure, and has to be removed using the towing / pushing mode (depending on which LRV has a failed HSCB), to remove the train from service.

Alstom identified this issue, and has made a correction to the TCMS software (MPU), which is currently under regression testing on a pair of vehicles (testing plan shared with OLRTC/RTM), so that the failure of a line contactor in future will lead to a single degraded condition and train removal, without the need to activate the towing pushing mode. This leads to a significant reduction to all service impacts from the failure.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12												
Line Contactors modification				X	X	X	X	X	X	X														
HSCB interlocking sequence (MPU software)				X	X	X																		
Auxiliary Power Units (CVS) - Software Mitigation				X	X	X																		
CVS Root Cause still under investigation				X	X	X																		
TCMS (addressed under HSCB)				X	X	X																		

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)6	<p>Switch Heater Rectification Plan - Heating Capacity needs to be significantly increased (Hot Air Blowers)/Heat Tracing/Crib Heaters</p> <p><i>The switch heaters on the system appear to have a maximum output of 45kW. By comparison, the switch heaters on the City's existing Trillium Line have a maximum output of close to 120kW. The heating capacity of the existing switch heaters needs to be significantly increased in order to have any opportunity to work correctly in winter. At a minimum, hot air blowers with significantly higher output capacity need to be installed to replace the existing units, heat tracing cables need to be added to the stock rails, and consideration for installation of crib heaters should be undertaken. An integrated solution needs to be implemented in order to bring the solution into compliance with the PSOS. The City requires full technical details on the plan for upgrade, schedule dates for installation, and signoff by the Engineer of Record on this issue.</i></p>	OLRTC
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>Frequency of switch disturbances due to weather events. City perception that the switch heaters are not effective.</p>	<p>Winter planning protocols have evolved throughout the winter season to address snow and ice creating disturbed switches.</p> <p>Maintenance regime is being refined to ensure the heaters are in working order ahead of any weather event as part of RTMs "Adverse Weather Protocol Plan" that involves "boots on ground" resourcing allocation. Refer to City reference response (b) 14 v. Winter Operations) for more details.</p>	<p>OLRTC has engaged the supplier and has modified the ductwork. OLRTC has also engaged a heat trace supplier to look at potential supplementary heating in conjunction with the modified ducting. Installing propane, as per Trillium Line, could be an option, but it would require City consent to have storage tanks in residential areas. OLRTC is of the opinion that the modified ducts, additional heat tracing and improved winter maintenance will be sufficient. Modifications to the ductwork will be signed off by Spectrum, this may or may not be an EOR but will have the OEM guarantee. Any additional heat tracing, if deemed required after the study is completed, will have the necessary design documentation.</p>
Background		
<p>The Spectrum switch heaters are an engineered supplied 3rd party product. Electric forced air switch heaters are a common industry solution used around the world, and Spectrum is one of the industry's oldest suppliers with installation of same or similar heaters operating in conditions comparable to that of Ottawa.</p> <p>The installed Spectrum Model 5HP Hot Air Blower was designed for use on both interlocking and mainline switches. These switches are generally larger than the #8 and #12 found on the Confederation Line. Some of their clients include:</p> <ul style="list-style-type: none"> • Canadian National, Lachine, QB (recently ordered 3 more units) • Canadian Pacific, St. Paul, MN • Canfor Pulp, Prince George, BC • CSX, Salaberry de Valleyfield, QB and many U.S. installations • Irving Oil, St. John, NB • Norfolk Southern, many U.S. installations • Union Pacific, many U.S. installations <p>RTGEJV, OLRTC and RTM executed due diligence during the design phase before we agreed on electric heaters and proceeded to the supply specification.</p>		



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)6	<p>Switch Heater Rectification Plan - Heating Capacity needs to be significantly increased (Hot Air Blowers)/Heat Tracing/Crib Heaters</p> <p><i>The switch heaters on the system appear to have a maximum output of 45kW. By comparison, the switch heaters on the City's existing Trillium Line have a maximum output of close to 120kW. The heating capacity of the existing switch heaters needs to be significantly increased in order to have any opportunity to work correctly in winter. At a minimum, hot air blowers with significantly higher output capacity need to be installed to replace the existing units, heat tracing cables need to be added to the stock rails, and consideration for installation of crib heaters should be undertaken. An integrated solution needs to be implemented in order to bring the solution into compliance with the PSOS. The City requires full technical details on the plan for upgrade, schedule dates for installation, and signoff by the Engineer of Record on this issue.</i></p>	OLRTC

The switch heaters, as designed and installed are compliant with the PA and effective when coupled with a corresponding and robust winter management plan. Regardless, there will be weather events when the switches become overwhelmed by snow and ice. OLRTC, with the supplier, Spectrum, have been investigating options to improve the efficiency and effectiveness of the existing heaters.

The heaters cannot have their kW output increased as the power supplies at the stations and the cables to the heaters will not support an increase. Propane fired units are a potential alternative, however this would require gas tanks to be located along the guideway, with new access gates and security measures. Furthermore, some of these would need to be in residential areas and may result in the railway not meeting the NFPA requirements, which were deterrents during the design phase. RTG is a willing participant to discuss this further with the city as required and has asked members of Task force to review from a feasibility perspective.



Modified Duct Work

OLRTC with Spectrum has identified that a modified duct arrangement and some additional insulation will enhance the performance of the existing system whilst further directing the heat to the areas that it need it the most, the heel blocks.

The modified ductwork as seen in the photo, is configured to direct the heat near to the heel blocks, which are the more sensitive locations. The adjacent track can clearly be seen as having snow in the four foot compared to the switch area fitted with the heating duct. To date, 16 switches have now had this type of duct fitted, there is further planned installation of insulating material to the duct to reduce the heat loss through radiance. All mainline, open air, switches will be modified before the next winter season. 26 in total.

Enhanced SCADA Monitoring

OLRTC recently discovered that the SCADA monitor was not implemented properly. The proper status when a unit trips is not reported to the TOCC. This enhanced SCADA monitoring would send a group alarm to TOCC if any of the following three conditions occur:

- a. CB1 trips, loss of 22.5kWatts of heat
- b. CB2 trips, loss of 22.5kWatts of heat
- c. MC1 trips, loss of the blower



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)6	<p>Switch Heater Rectification Plan - Heating Capacity needs to be significantly increased (Hot Air Blowers)/Heat Tracing/Crib Heaters</p> <p><i>The switch heaters on the system appear to have a maximum output of 45kW. By comparison, the switch heaters on the City's existing Trillium Line have a maximum output of close to 120kW. The heating capacity of the existing switch heaters needs to be significantly increased in order to have any opportunity to work correctly in winter. At a minimum, hot air blowers with significantly higher output capacity need to be installed to replace the existing units, heat tracing cables need to be added to the stock rails, and consideration for installation of crib heaters should be undertaken. An integrated solution needs to be implemented in order to bring the solution into compliance with the PSOS. The City requires full technical details on the plan for upgrade, schedule dates for installation, and signoff by the Engineer of Record on this issue.</i></p>	OLRTC

Work instructions will also be written to dispatch crews immediately to rectify the switch heater issues or man the switch and clear the snow manually if required, until the switch heater is brought back on-line.

Additional Man-gates

In an effort to mitigate revenue service delays should a switch heater trip, additional guideway man-gates will be installed. These man-gates would ensure guideway technicians get to the troubled switch heater faster to prevent it going disturbed.

Side Nozzle adjustment

During a site visit to review the center duct addition this past February, Spectrum engineers noted that the side air nozzles were slightly misaligned. They noted "Proper alignment would be aiming the nozzle at the web of the stock rail. Track hardware was preventing proper alignment." Modifying the side nozzles or track hardware to allow the nozzles to be angled tighter to the web of the rail will direct more of the heat towards the heel blocks, as intended.

Heat Trace and Crib Heater Options

OLRTC has also met with a vendor that supplies heat trace via electrical tape to the web of the rails. The electrical system, as installed, has the potential to support this further additional heating and further investigation is underway. Power budgets are being developed and a recommendation will follow the analysis.

A second option under review is to install crib heaters between the ties under the heel blocks. This option could keep the ground warm and allow the melted snow to dissipate into the ground instead of freezing at the heel blocks.

Switch Heater Management

Additionally, protocols and procedures are in progress to improve the management of the snow events and switch heaters. The switch heaters can be controlled remotely from the TOCC and they could be adjusted to run longer than the snow sensor currently in use. As part of the snow management plan the switch heater could be switched ON 2 or 4 hours prior to a snow event to ensure the area is well heated thus preventing an accumulation of snow.

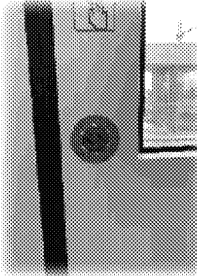


City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity																						
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Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Containment & Mitigation																								
Ducting & Insulation		X	X	X	X	X	X	X	X	X														
Adverse Weather Plan (refer to city ref b12 v.)								X																
Research for Other Alternatives (Gas and Heat Trace)					X																			
<p>Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.</p>																								

City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)7	<p>Vehicle HVAC - Supplementary Heating and Cooling of the Operator Cab area</p> <p><i>Despite assurances that the heating on the system works correctly, supplementary heating had to be added to the vehicles to improve the interior driver cab temperatures this past winter. Similarly, the cooling system needs to be corrected to ensure that Vehicle and Vehicle driver cabs are cooled correctly during hot summer temperatures. As this is a known issue, our expectations are that this issue is actioned and resolved quickly. The City requires that RTG provide full technical details on the upgrade to bring the HVAC and supporting systems into compliance with the PSOS, schedule dates for the upgrade, and signoff by the Engineer of Record on the planned changes.</i></p>	ALSTOM
Problem Statement		Solution Proposal/Rectification



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)7	<p>Vehicle HVAC - Supplementary Heating and Cooling of the Operator Cab area</p> <p><i>Despite assurances that the heating on the system works correctly, supplementary heating had to be added to the vehicles to improve the interior driver cab temperatures this past winter. Similarly, the cooling system needs to be corrected to ensure that Vehicle and Vehicle driver cabs are cooled correctly during hot summer temperatures. As this is a known issue, our expectations are that this issue is actioned and resolved quickly. The City requires that RTG provide full technical details on the upgrade to bring the HVAC and supporting systems into compliance with the PSOS, schedule dates for the upgrade, and signoff by the Engineer of Record on the planned changes.</i></p>	ALSTOM

<p>HVAC and supporting systems are not in compliance with the PSOS</p>	<p>To minimise heat/cool dispersion within the vehicle, apply the “self service mode” for passenger’s door system.</p> <p>This can be used selectively to have all Doors open at PEAK as they do currently and open in self/service mode during off-peak.</p>  <p>Temporary use of supplemental heat source (winter) and temporary fans (summer)</p>	<p>Technical review of discomfort related issues with the Air Comfort System (HVAC)</p> <p>Apply Root Cause (fault/Cause Remedy) solutions to improve the comfort level for all season exposures.</p> <p>Provide configuration changes - Some modifications have been tested and need to be implemented (see technical details); Improved heating and cooling efficiency within the driver cab.</p>
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Background

The City notes that RTG has acknowledged that the System not compliant with PA in this respect. Requiring the use of supplementary heaters and fans for another cycle of seasons is not acceptable. If capacity of cooling and heating is insufficient and the current design is not compliant as stated, a more in- depth plan is required. This plan will require confirmation of the available kW capacity available and identify the upgrades required to increase capacity of the system.

Response
 A more in- depth rectification plan is in progress with Alstom engineering and will be presented to the City. That notwithstanding, Alstom maintains that ss per *design* the capacity of the cooling and the heating is sufficient. Alstom underlines that the doors operating in auto mode, does not facilitate the cooling down or heat retention of the saloon and therefore the cab. An option to consider is the initiation of the “on demand door opening” function (at least at off peaks) which would mitigate lost ambient temperatures and sustain the required temperature longer, preventing the system from cycling over too frequently.

ThermoKing control which requires regular resets while in operations by an ERO or Alstom Technician (the City requires an explanation as to why this keeps occurring and a timeline for the resolution of this issue) and windshield defrosting (using cab heater) is insufficient to keep windshield clear during certain weather conditions.

Response
 Regarding the ThermoKing control: 1 controller failed on LRV 27 on March 23rd, and the ThermoKing control was then replaced. No other controller presented issues. The regular reset of the ThermoKing control was the (inappropriate) default response of the rovers and ERO when the cab heating was not functioning, while the root cause was the APS/CVS failures.

Windshield defroster, 2 type of issues were observed



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
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1. During the episodes of APS (CVS) failures, hence cab heating not functioning, a few cases of visibility obstructed by condensation were reported.
2. During periods of icy rain, frost tended to build up on the opposite (inactive) cab – when the ERO changed cabs, the thickness of the layer of frost would then require significant time to melt once defroster was activated.

This is now addressed by a software modification, that can leave the defrosting and heating turned ON in the inactive cab. Furthermore, Alstom tested the defroster function, in March 2020 – hereunder some images.



Beginning of the test

End of the test

In addition to increasing the heating capacity and cooling capacity of the system, details on all the various design enhancements need to be provided to the City in a detailed FMI with all supporting documentation

Response

As mentioned, Alstom is currently testing several modifications, and will share with the City the details of the enhancements once the tests are completed. Listed below are actions to date and scheduled enhancements. The report on Defroster Comparison Test was provided to the City via eBuilder 16 April 2020.

Heating - Passenger Area

- The floor heater issues have been repaired (relay connections issues in some vehicles have been completed) - **Completed**
- The passenger HVAC temperature set point is set at 19°C - **Completed**



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)7	<p>Vehicle HVAC - Supplementary Heating and Cooling of the Operator Cab area</p> <p>Despite assurances that the heating on the system works correctly, supplementary heating had to be added to the vehicles to improve the interior driver cab temperatures this past winter. Similarly, the cooling system needs to be corrected to ensure that Vehicle and Vehicle driver cabs are cooled correctly during hot summer temperatures. As this is a known issue, our expectations are that this issue is actioned and resolved quickly. The City requires that RTG provide full technical details on the upgrade to bring the HVAC and supporting systems into compliance with the PSOS, schedule dates for the upgrade, and signoff by the Engineer of Record on the planned changes.</p>	ALSTOM

Heating – Operator’s Cab

- a mechanical mod must be applied to improve thermal insulation just behind the heater – **Scheduled**
- the sensor position must be improved for better heater monitoring – reading is inappropriate.

Cooling - Passenger Area

- The passenger HVAC temperature set point to be set at 16°C.
- Ensure HVAC unit preventive maintenance is complete (such as filters, cooling agent).

Cooling – Operator’s Cab

- Increase the air flow via the booster (diode at 8.2V to be replaced by 10V diode). (Tested but not implemented)
- Improve the air flow direction towards the windshield via a mechanical modification of the booster duct
- Addition item: implementation of sun protection (adhesive film) on the top of windshield is foreseen.

C-Improvement in term of system’s operation

- MPU modification to ensure heater and booster in the non-activate cabin - **Done**
- Modification of the heater panel and driver desk button (to have the correct information) - **Done**
- Operational instruction to clarify how to use the heater and the booster – **Done**
- Update Operator Manual – **To be scheduled**

Seasonal Maintenance Regime Protocols

In addition, RTM will review all the necessary maintenance practices associated with assets that require additional and more frequent servicing based on seasonal conditions (“Winterization/Summerization” Programs)

E.g. (Summer HVAC Filter Increase filter replacement regime). These programs will be governed by established calendar dates for each program to start and finish and will be incorporated into the M&R Maintenance Plan.

Remedy/Rectification Activity Schedule	2020												2021											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Modification for Heater Insulation								X	X															
Sensor Relocation								X	X	X	X	X												
Change Booster Diode (10V)					X																			
Booster Duct Modification						X	X																	
Adhesive Film Protection					X	X	X																	
Driver manual Upgrade						X																		
Develop (Winter/Summer) Seasonal Maintenance Activity procedure						X	X																	
Roll-out Training for Trades							X	X																

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)8.	<p>Vehicle Braking Systems – Integration Issues:</p> <p><i>A series of different scenarios appear to be contributing to a high incidence of wheel flats on the fleet. The braking system appears to be suffering from a series of specific issues and contributing factors which are leading to wheel flats on the trailing bogies. The City requires that RTG provide a Root Cause analysis of the cause of failure modes, action plan and schedule for rectification, and sign-off by the Engineer of record. As the City understands this issue, based on information provided by RTG, a partial list of causes for these wheel flats as follows:</i></p> <ul style="list-style-type: none"> <i>i. Faulty valve(s) in the braking units;</i> <i>ii. Overly aggressive emergency brake rate for the vehicle;</i> <i>iii. Overspeed conditions triggered vehicle-signal integration issues;</i> <i>iv. Sanding systems not working correctly due moisture and icing conditions;</i> <i>v. False positive activations of the guideway intrusion detection system (GIDS);</i> <i>vi. Incorrectly configured and calibrated brake - load weight management system;</i> <i>vii. Overly aggressive emergency brake rate application for the trailing bogie;</i> <i>viii. Operation of the vehicle in ATPM triggering overspeed conditions; and</i> <i>ix. Limited effectiveness of the of the slip-slide control system</i> 	TASK FORCE

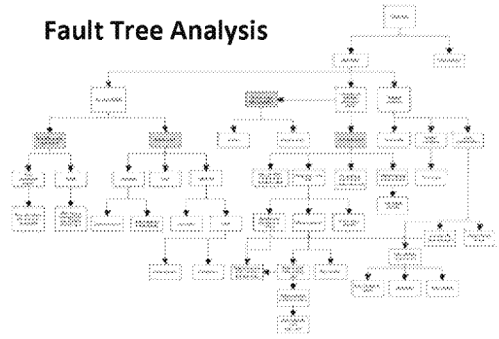
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>Due to the complexity of the vehicle and signalling interfaces there has been a high number of wheel flats contributed to Emergency brake applications.</p>	<p>Forming of the E/B Wheel Flats Taskforce JBA Consultant Service</p> <p>Contingency wheel lathe for wheel flat maintenance</p>	<p>Institute key recommendations from JBA and Taskforce root cause and fault tree analysis to mitigate EB applications that result in wheel flat conditions</p>

Background/Summary

Extensive analysis to determine root cause has been the focus of the Taskforce and technical expertise from JBA. The teams have been working diligently to bring resolution to one of the most complex interfaces of systems, signalling and vehicle. A fault tree analysis was used to drill down to the root cause and categorize the various conditions contributing to high triggering events related to wheel flat conditions.

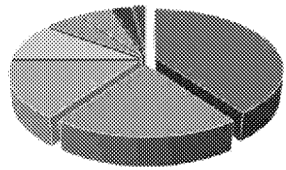
The taskforce through exhaustive analysis have prioritized the fault conditions with recommendation that when implemented will begin to ween of the high level of wheel flats, with the understanding a system of this design has protective safety features that are designed to apply Emergency Braking (e.g. Overspeed conditions, spin “slip” slide conditions, GIDS activations).

Fault Tree Analysis



Findings

- i) **HPU malfunctions are provoking only a small fraction of the wheel flats caused by EB application.** HPU under scrutiny by vendor with results to be reported to the wheel flats and EB task force - HPU issues attributed more to brake faults than wheel flats and make up a small number of faults.
- ii) and vii) **Aggressive Emergency Brake** - The choice of brake rate was clearly challenged by Alstom in design phase, in order to meet PA requirements excessive brake rate was applied to trailer bogeys during EB event. Relaxation or



- 4 / 18 - Aggressive Brake and Trailer Bogie
- 36 - Overspeed vehicle signalling integration
- 9 - GIDS Activations
- 18 - Overspeed - ATPM Operator
- 6 - Spin Slide
- 1 - HPU Valve



change to the PA specification could be considered as the Confederation Line does not run on a public road with automobiles as originally intended.

- iii) **Overspeed conditions triggered vehicle-signal integration** issues; Mitigation through Thales speed profile improvements in v6.1. Split of EB by location and by date have been analyzed. Then Alstom could support an ATO/Brake tuning campaign if one is required.
- iv) **Sand spec** under review with suppliers. TCMS S/W 1.2.5.9 includes sanding in the middle-motored bogie during an EB. Enhanced monitoring of sanding equipment during inclement weather
- v) GIDS system issue— response addressed in item 11) of this Plan.
- vi) There is no evidence to suggest that there is a systemic issue with respect to **the load weight compensation**, or brake calibration. The measured vehicle loads and brake cylinder pressures, in most cases are within reasonable limits of tolerance and do not lead to excessive brake forces being applied to the wheels. (Enhanced Procedure related to levelling after wheel truing newly enforced)
- viii) The **operating mode ATPM** is greatly depending on driver behavior. Overspeed is defined by VOBC system, which is outside Alstom's scope. The train is only reacting as required by specification. (recommendation already provided to and agreed by OC Transpo operations)
- ix) **Slip slide effectivity** has been demonstrated and validated during type test. It needs to be recognized that slip slide control can only make effective use of the available adhesion and cannot increase the performance beyond the available adhesion. Slip slide control is not enabled during an EB application, this is to support the vehicle in achieving the design emergency brake rate.

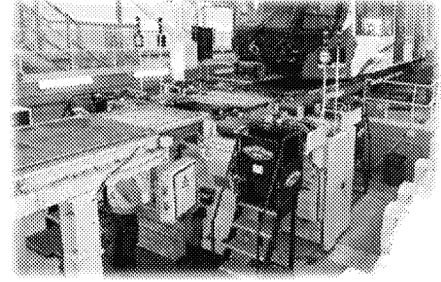
TASK FORCE current Recommendations:

1. **Train** – Failures/Faults in brake system are being closely monitored by Wabtec; results shared with Task Force
2. **Emergency Brake Rate – (PBEB)** Review train specification with regards the Project Agreement. Possible proposals for train and/or system modification in order to decrease aggressive EB rate on trailer bogies, as well as optimise available adhesion leading up to and during an EB event. There are different possible approaches with respect to modifications of the hydraulic system on the train currently under review of the task force as this will have the largest impact on reducing/eliminating wheel flats.
3. **Thales v6.1 Software Implementation** – Reduction of EBs due to overspeed. Aggressive testing schedule to be proposed for the month of April.
4. **Sand** – Utilization of the correct sand in line with the initial specification. Sand deployed to middle motored bogie during EB event in TCMS S/W 1.2.5.9 (refer to Sanding System response in item 12) of this Plan).
5. **GIDS** – Adjustment of GIDS parameters to reduce nuisance trips. Proposal in progress for Firmware modification and adjustment to parameters for scan rate (refer to in item 11) of this Plan).
6. **Track Adhesion** – Key low adhesion areas to be checked, track expertise and inspection required.
7. **ATC System** - Accelerating and Braking Profile – especially in extreme cold, inclement weather conditions, trial amendments to operating protocol regarding localized brake type (type I & II rate) implementation at worst adhesion sites.
8. **Operation of ATPM** - Emergency brake applications when the driver is transitioning out of ATP-M back into ATO mode. Recommendation to switch back to ATO when stopped at a station provided to, and agreed by, OC Transpo operations.
9. **Slip Slide Control** – Slip slide control is effective during normal service braking but is disabled during EB event as designed. Refer to Task Force Recommendation 2 for EB management.



Wheel lathe Maintenance

Belfast MSF has the capability to provide 2 operational wheel lathes and has instituted the activation of 2 wheel lathes during the fall and winter seasons when wheel flat conditions are more vulnerable. Training has been maximized by skill set to ensure multi-users on all shifts can operate these complex pieces of machinery.



In addition, RTM has increased its maintenance frequency checks as part of new seasonal maintenance protocols to ensure all critical supporting equipment for service availability are monitored more frequently.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
GIDS software upgrade - RTM				X																				
Implement Thales v6.1 software				X	X																			
Vehicle tuning campaign					X	X																		
Brake rate review, change request, then 3 to 4 months lead-time forecasted				X	X	X	X	X																

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



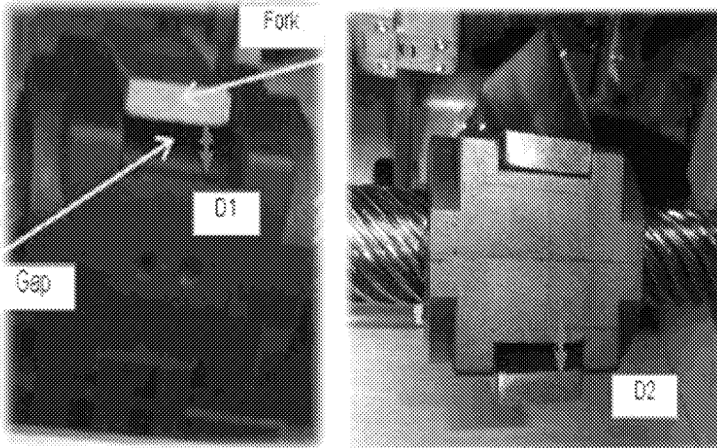
City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)9.	<p>Vehicle Door Performance</p> <p>Based on the performance of the doors in the first four months of service, it was evident that the design of the doors did not meet the requirements of the Project Agreement. The City requires confirmation that the planned software to correct the motor overcurrent failure mode "H-bridge" solution has been safety certified and installed on the fleet of vehicles. Further, the City requires that RTG provide a root cause analysis and action plan to eliminate the incidents where the doors on a trailing vehicle do not open automatically. The mechanical isolation process of faulted doors need to be evaluated and revised as it has proven to be undependable. The City requires confirmation that the door mechanisms that are currently preventing front-line staff from successfully isolating a door in fault has been rectified and modified door mechanisms are installed on the fleet. Lastly, the City requires that RTG provide an updated door isolation procedure to be in place that allows an ERO to quickly and easily isolate the doors and remove a Vehicle from service without cutting out the VOBC.</p>	ALSTOM
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>Push-back functionality to be added (not part of the specification)</p> <ul style="list-style-type: none"> - Door not opening in some instances due to bouncing of train line vs DCU (not reported during Trial Run) - Difficulties of door isolation 	<p>Passenger's Information Campaign. (Please Don't Hold Doors – labels)</p> <ul style="list-style-type: none"> - Door opening command through driver's desk button and/or self-service mode. - Technician briefing. 	<p>See technical details with 2 main proposed modification streams:</p> <ul style="list-style-type: none"> - Software upgrade for Push-back and door not opening in trailer - Hardware FMI solution for door isolation.
Background/Summary		
<p>There are 2 proposed modifications in the software and hardware that are directed at addressing the door related delays that we anticipate will stabilize the door system reliability to industry norm. These modifications are focused to address customer behavior of holding doors that translate into consequential door failures.</p> <p>1. Software modifications</p> <p>Alstom is introducing the Door SIL-2 software v1.40, which will address the two following door failure modes:</p> <p>Doors randomly not opening (trailer unit, both units, or just one door)</p> <p>a. Door not opening in trailer vehicle has been characterised and is due to bouncing effect between relays and Door Control Unit (DCU). The Door system supplier is incorporating a protection within the next software release.</p> <p>Solution consists in debouncing the trainline signal by adding a tempo at the Door Control Unit (DCU) level.</p> <p>Push-back (H-bridge overload)</p> <p>b. The door system has been exposed to passenger behaviour, that result in forcing doors open, this can cause a door motor over current fault.</p> <p>Solution consists of instituting a "Push Back" function allowing auto reset of the door (3 consecutives instances before going into a fault condition). This has been added to the system specification and will be part of next software release.</p> <p>Progress</p> <p>The engineering version has been bench tested , in static and in dynamic mode (train launch during engineering hours) and is satisfactory. The package has been submitted by the door supplier to its assessor, review is ongoing, target for supplier to have the release note and certification is end of April.</p> <p>Note : Documentation presenting the changes has already been submitted and approved by the City.</p>		



2. Hardware modifications – Door Isolation

The improvement is based on 2 axis:

- Avoid any desynchronization between the door leaves, (even the smallest one desynchronization)
- Modification of the Lefthand Crank to ensure that the pin properly engages in the crank hole

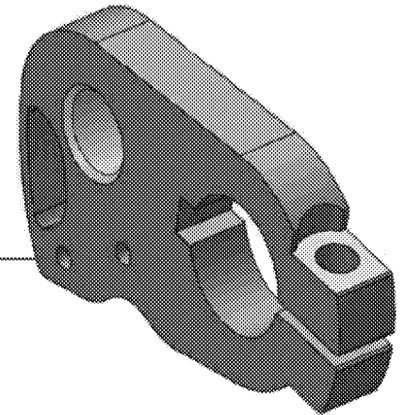


Inspect the Drive Screw Coupling Gap – GO-NO-GO criteria, dismantle and repair.

Inspect FORKS with objective GO-NO-GO criteria and replace defective forks with modified replacement.

Modification of the Left Hand Crank :

- New part (not a modification of the installed part)
- Slotted hole size limited by :
 - Presence of the holes at the bottom (mounted part)
 - Looseness in the mechanical lock (while electric status = OK)
- Validation steps :
 - By model /calculation
 - Mounted on test rig
 - Mounted on a train



Progress

Desynchronization

FMI 36,37,38 already submitted and approved by the City
Implementation ongoing (approx. 1 LRV/day – 6 LRV done)

Crank modification

1st version of revised part is installed on all doors of LRV 40 for testing – good results
2nd version of revised part with enhancement is expected

3D printing for prototyping and validation (before launching full production) - prototype expected before end of April.
FMI will be released once final design is tested and approved.

COVID_19 impacting lead time of final parts (subcontractor plant is closed) – estimation of 6 weeks best case scenario to receive final parts after re-opening of the plant.



3. Other

- For door isolation, 3 Field Modification Instructions (FMI) has been presented and will be submitted to the Change Control Board of RTM. The implementation over the fleet will take approximately 2 months.
- Incorporate any gaps or deficiencies in the procedure, revise, circulate and provide refresher training for Operator's.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Door software documentation to assessor			X																					
SIL2 certification					X																			
Implementation over the fleet					X																			
FMI implementation for Door isolation					X	X																		
Operation review (door procedure workshop)							X																	
Door Isolation & Recovery Procedure revision							X																	
Door Isolation & Recovery Refresher Training								X																

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City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)10	RTG/RTM Performance Reporting – Information Management Incident Reporting System (IMIRS) <i>The process for recording, capturing and reporting on quality failures and other required reporting elements including importantly Schedule 20 performance adjustments remains flawed and requires significant manual intervention.</i>	RTM
Problem Statement		
<p>Significant manual adjustments on Daily Operating Report (DOR), Performance Monitoring Report (PMR), and Payment Adjustment Report (PAR) have resulted from the following process-related issues:</p> <ol style="list-style-type: none"> 1. KPM definitions are subject to differences in interpretation and their applicability to maintenance response events. 2. Inadequate understanding of the KPM regime by those tasked with initiating maintenance service requests and those entering work orders into IMIRS, resulting in many KPM being misallocated to events. Exacerbated by the massive volume of work orders created early on which entrenched some inaccurate interpretations. 3. A period of time with limited agreement on the allocation of Lost KM as PCC or NPCC 	Containment & Mitigation	Solution Proposal/Rectification
	<p>On February 21, RTM provided to the City RTM's interpretation of those KPM for where there is lack of alignment, as well as providing detail on the current understanding of allocation of common Lost KM events. RTM looks forward to receiving a response.</p> <p>KPM work order creation was transferred from the TOCC to the RTM Help Desk, which aligns with the PA self-reporting requirement, in November 2019. This enabled both the party requesting maintenance service (City), and the party creating the work order (RTM) to better align on work order content. Efforts to improve communication of event detail between the TOCC and RTM Help Desk have continued and are beginning to result in more accurate work order asset selection and KPM allocation.</p> <p>As a result of very good collaboration in understanding and defining the interdependencies between Maintenance and Operations, alignment between RTM and the City as to how Lost KM are allocated to PCC or NPCC has improved significantly.</p>	<p>Response from the City, and follow up workshop, to reach consensus on KPM definition interpretation and event applicability.</p> <p>RTM has provided further training to Help Desk staff who are tasked with creating work orders.</p> <p>RTM has also issued an SOP to manage the Temporary Repair Process, to better clarify a process that had not been well understood and managed. Temporary Repairs can be tracked in IMIRS today, but minor configuration changes will be made to better align with the procedure in terms of the relevant work order statuses and timestamps.</p> <p>For general improvement of the quality of work order data, RTM will provide training to persons who create work orders, focusing on clarity of comments and detailing of findings/actions taken.</p> <p>It is the purpose of the Daily Operating Meetings to resolve disagreements on causal allocation (PCC or NPCC) of Lost KM. Where there is agreement on allocation of Lost KM in the Daily Operating Report, RTM and City must reach the point where those portions of the DOR which are not disputed can be signed off. Where there is disagreement, parties should follow the PA-specified dispute resolution process. The City has drafted a "Contract Management" SOP detailing the meetings and reporting framework for the PA performance and payment processes – RTM and the City to align and finalize the document.</p>
Background/Summary		
<p>As further context to the above, the following issues also led to manual adjustments to performance reporting but have since been resolved:</p> <p>Prior to start of revenue service, a fix was implemented in TPMS to correct for missing KM when "Manual Depart" commands were initiated by TOCC for trains. Subsequent to this fix, consensus was reached between RTM and City/OCT representatives at the Daily</p>		



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)10	RTG/RTM Performance Reporting – Information Management Incident Reporting System (IMIRS) <i>The process for recording, capturing and reporting on quality failures and other required reporting elements including importantly Schedule 20 performance adjustments remains flawed and requires significant manual intervention.</i>	RTM

Operating Reporting (DOR) Meetings on calculation methods for allocating Lost KM to PCC/NPCC; All Lost KM are now fully explained in the Daily Operating Reports, using these agreed-upon methods.

The introduction of the Amended & Restated PA Schedule 20 revisions in mid-September 2019 resulted in the need for manual calculation and adjustments mid-month for that month. RTM notes that the City request for ongoing mid-month PMR/PAR generation functionality is not a PA requirement as these reports are only due at month end. Regardless, in order to improve transparency, RTM added mid-month draft PMR/PAR generation functionality to IMIRS in November 2019.

The City has made adjustments to the CBTC timetables without issuing revised Service Level detail to RTM reflecting the corresponding changes to Scheduled Revenue KM. As a result, the baseline Service Plan loaded in TPMS differs from the actual implemented Service Schedule. RTM, with agreement from City representatives, has been making manual compensatory Lost KM adjustments to Daily Operating Reports since August 2019. In order to remove this manual work, RTM requires that the City provide updated Service Plans, with Scheduled Revenue KM by operating period, whenever CBTC timetable changes are implemented. RTM and the City would then agree in the Daily Operating Meeting that the changes to the Scheduled KM represented by TPMS are correct.

This above will support aligning the raw IMIRS data to accurately reflect the actual system performance and will reduce the need for RTM to make adjustments which severely complicate the DOR, PMR, PAR processes.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
RTM/City KPM workshop				X																				
IMIRS Temporary Repair config changes							X																	
RTM/City to finalize Contract Management SOP				X																				
Training to persons who create work orders, focusing on clarity and detail					X																			

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)10	<p>RTG/RTM Performance Reporting – Information Management Incident Reporting System (IMIRS)</p> <p><i>On January 8, 2020, the City provided a full detailed assessment of its observations to date on the shortcomings of this system (OTT-RTGLET-0296). It is untenable to rely on the current IMIRS solution for the remaining 28.5 years of the Maintenance Term. The City requires that RTG provide a full technical detail on the plan for upgrade, schedule dates for installation, and plan to test and commission the new system.</i></p>	RTM
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>RTM does not agree that a new replacement system is required. As noted in the response to b)10i), the majority of issues relating to clarity of IMIRS and TPMS data are process related.</p> <p>RTM does not view IMIRS as part of the System Infrastructure, and is not subject to the PA clauses noted in the Deloitte report attached to OTT-RTG-LET-0296. Regardless, RTM agrees that certain gaps identified in the Deloitte report require attention and some of them have already been addressed.</p> <p>RTM sees, as key elements, Gaps #7, #8 and #9 in the Deloitte report describing a need for documentation which details functionality, report calculations, and data sources and data flows, as well as providing additional RTM resources with operational knowledge/training regarding IMIRS.</p>	<p>The Deloitte report was issued around the time of RSAD and RTM will respond to that letter outside of this plan and in the workshops. Since the time of the letter, certain items with which RTM agrees have already been addressed, including: Gap #4 item where TPMS kilometre data accuracy has been improved leading to fully reconcilable lost KM reporting; Gap #6 item where the ability to run draft mid-month Payment Adjustment Reports was added; Gap #10 item where RTM notes that a maintenance and support agreement is in place with the IMIRS supplier.</p> <p>Further, the difference between TPMS KM reporting based on station arrival vs CBTC KM reporting based on departure can result in minor "Lost KM" adjustments of a few KM but it is now identifiable and occurrences are quantified in the Daily Operating Report.</p> <p>In order to maintain continuity in management of IMIRS, RTM has trained a backup for the Performance Analyst role, who is responsible for generation of Daily Operating Reports, including analysis of lost KM. A position responsible for KPM management and coordination with the City to align on PA interpretation has also been established.</p>	<p>Further actions that will be taken to improve IMIRS are: a revision to the formatting of the Payment Adjustment Report, with improved clarity on the variables used in calculation of the Monthly Service Payment; following alignment with the City on KPM interpretation, reference documentation will be updated to support more accurate work order creation and KPM allocation, and IMIRS question sets may be revised accordingly; a cybersecurity audit will be carried out on the TPMS and IMIRS; an IT Disaster Recovery Plan will be developed.</p> <p>As an improved internal reference, and to support transparency with the City, RTM will produce an IMIRS & TPMS Performance Reporting Systems Functional Description document which details system functionality, key user roles, data tables, data flows, configuration parameters, interfaces (TPMS, Alstom's GSI CMMS), performance report calculations. While this documentation will primarily address items raised in Gaps #7 and #8, some points from other gaps will also be spoken to.</p>
Background		
<p>RTM collaborated with the City in development of IMIRS, with the IMIRS plan going through several revisions under the formal comments review process.</p> <p>The Daily Operating Report format and content were worked through and revised several times in workshops between RTM and the City.</p> <p>Several demonstrations of TPMS and IMIRS were done collaboratively with the City throughout development. The early discrepancies in vehicle KM allocation were addressed prior to start of revenue service, and the lost KM allocation process was agreed with the City</p>		



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)10	RTG/RTM Performance Reporting – Information Management Incident Reporting System (IMIRS) <i>On January 8, 2020, the City provided a full detailed assessment of its observations to date on the shortcomings of this system (OTT-RTGLET-0296). It is untenable to rely on the current IMIRS solution for the remaining 28.5 years of the Maintenance Term. The City requires that RTG provide a full technical detail on the plan for upgrade, schedule dates for installation, and plan to test and commission the new system.</i>	RTM

and has been working effectively. TPMS data is validated during the preparation of each Daily Operating Report, with a reconciliation of Scheduled KM and Actual KM as part of the lost KM causal analysis.

Please see “IMIRS Performance Report by Deloitte - RTM Response - Apr22” which provides a detailed response to the Deloitte Report titled “Assessment of Systems and Data Systems supporting the Confederation Line Payment Mechanism”

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Issue IMIRS & TPMS Functional Description document							X																	
Reformatted Payment Adjustment Report							X																	
TPMS and IMIRS cybersecurity audit							X																	
RTM IT Disaster Recovery Plan							X	X																

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.

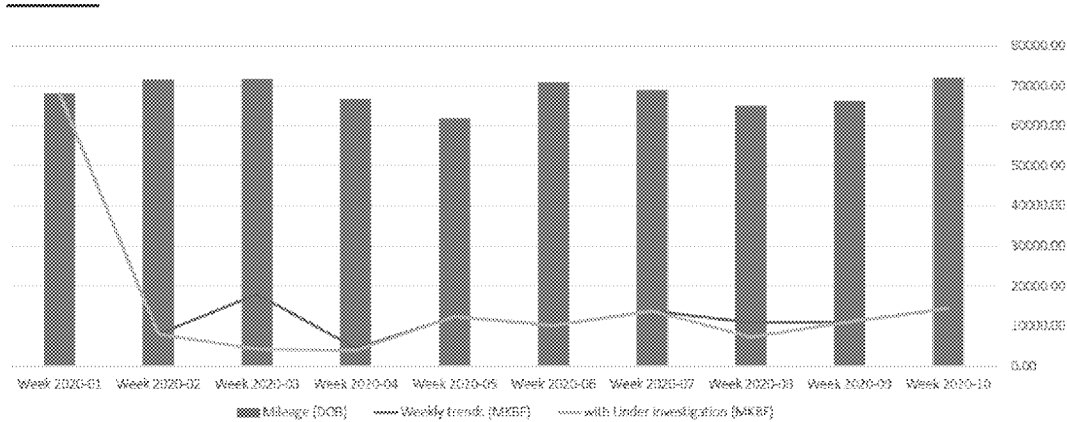


City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)10	RTG/RTM Performance Reporting – Information Management Incident Reporting System (IMIRS) <i>Additionally, there are numerous required reports that RTG is to submit to the City that remain outstanding as outlined in Schedule 15-3, including but not limited to custodial maintenance plans, preventative maintenance, corrective maintenance, and monthly reliability and maintainability reports.</i>	RTM
Problem Statement Containment & Mitigation Solution Proposal/Rectification		
<p>Certain reports outlined in Schedule 15-3 are incomplete or not being provided to the City per the timelines.</p> <p>The Maintenance and Rehabilitation Plan, which is comprised of the Custodial Maintenance, Corrective Maintenance, and Preventive Maintenance Plans, is a key document but is not an output of IMIRS.</p>	<p>As discussed by RTM and the City prior to start of revenue service, the City being provided with real-time access to IMIRS work orders, with enhanced sort/filter and data extract capabilities, was suitable compliance to the 'Monthly Activity Report' and 'Daily Report' requirements detailed in Schedule 15-3 Article 1.8, as these are effectively work order summaries.</p> <p>The weekly MRS report currently provides a reliability centred analysis of Vehicle failures, including MDBF and recognition of service affecting status.</p>	<p>The data presented in the MRS will be developed into a monthly vehicle reliability report.</p> <p>Monthly reliability and maintainability reporting to be developed for the infrastructure elements called out on the PA.</p> <p>RTM will work with JBA Consultants to review the asset attributes tracked in IMIRS, including fault codes, and consider enhancements to improve reliability and maintainability data management, mitigation of defects, and support of a FRACAS.</p> <p>A workshop with RTM and the City to align on what events are to be recognized as a Service Affecting Failure is also required.</p> <p>RTM will prepare a revised Maintenance and Rehabilitation Plan.</p>
Background		
<p>The weekly MRS forum presents a detailed picture of vehicle reliability issues, and actions being taken to mitigate/rectify. The graph below is a sample output from that forum displaying MDBF for certain service affecting failures.</p>		



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)10	RTG/RTM Performance Reporting – Information Management Incident Reporting System (IMIRS) <i>Additionally, there are numerous required reports that RTG is to submit to the City that remain outstanding as outlined in Schedule 15-3, including but not limited to custodial maintenance plans, preventative maintenance, corrective maintenance, and monthly reliability and maintainability reports.</i>	RTM

2020 – Weekly trend for main events (>5 minutes service affecting failure)

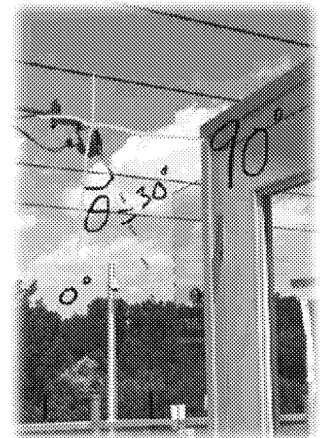


Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Workshop on Service Affecting Failures criteria					X																			
Start providing preliminary monthly reliability and maintainability reporting						X																		
Review IMIRS attributes and identify gaps						X																		
Detail and implement IMIRS attribute enhancements							X	X	X	X														
Prepare a revised Maintenance and Rehabilitation Plan							X																	

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)11	<p>Guideway Intrusion Detection System (GIDS) -</p> <p><i>The City continue to experience emergency brake activations on trains due to GIDS intrusions where there is no observable cause or intrusion, i.e. false positives. These scenarios were occurring prior to the winter season and have continued to occur after weather events even when there is no snow accumulation and/or blowing snow. The reliability of this system is so poor that this equipment is routinely disabled at the request of RTG as a preventive measure against false EB's. The City requires that RTG provide a root cause analysis of the failure modes, action plan and schedule for rectification of the issues, and signoff by the Engineer of Record.</i></p>	OLRTC TASKFORCE
Problem Statement		
<p>Number of false positive trips is causing concern and disruption to the operations. Known firmware issue within the scanner heater.</p>	<p>Enhanced maintenance of GIDS fields of scanning. Regular maintenance checks to ensure GIDS is operating optimally.</p>	<p>GIDS firmware update available, this will prevent the scanner heaters from generating faults and reduce the "nuisance" alarms (false positive trips).</p> <p>Thales Software ready for installation</p>
Background		
<p>The detection system uses a Sick LMS5xx series laser scanner to detect human like shape and allow trains and small object (280mm or less) to enter the Guideway undetected.</p>		
<p>Detection is performed from above, higher than the train, by a laser scanner configured to scan in a pendular downward motion. The scanned area spans from -5 deg to 185 deg from the horizontal and perpendicular to the train movement. The scanner performs distance readings at a frequency of 50Hz, at an interval of 0.5 deg and up to a maximum distance of 80 meters from the scanner. OLRTC and the Wheel Flat Task Force have identified two key actions and other recommendations to improve the performance of the GIDS:</p>		
<p>Key Actions:</p> <ol style="list-style-type: none"> 1. Upgrade firmware to V1.50.9 to fix a known issue with internal heater causing false alarms. (Health alarms are bypass until firmware upgraded), this will further address nuisance EB's contributing to Wheel Flats. 2. Software Upgrade (SW) - Increase the response time to 600msec for all outdoor intrusion fields (not the L & R train detection fields) to minimize snow squall detection also an E/B mitigation improvement to address wheel flats. 		
<p>Other recommendations:</p>		
<ol style="list-style-type: none"> 1. Limit train minimum speed to 5km/h when entering any stations or tunnels. Never stop trains within 10 meters of the scanners. No restriction exists when exiting those same locations. 2. Keep all scan area perimeters clear of debris, grass or snow. 3. Winter Profile calibration will be required if snow is not cleared regularly at each snow fall. 4. System should be bypassed during engineering hours (maintenance). 5. Clean the scanner glass every 6 months – sooner if you are getting health alarms 		
<p>An important note to consider is that a slow train can cause the train to EB because it violates item 1 above, and though it will only be traveling at low speed can also cause a train on the opposite track to EB. The opposite train will most likely be</p>		





travelling at higher speed. The chance of this happening is low but not impossible. This used to be more frequent when arriving trains were causing the trip but this has been corrected by increasing the scanner angle to 30 degrees from the vertical. Software and firmware upgrades are scheduled for April 2020 (pending access and the impacts of COVID).

Problem:

GIDS system spuriously tripping on trains, animals, snow drift etc. causing EB application and delay

Short term countermeasure:

Operator cutting out GIDS driving in ATPM, manual intervention during snow storm as required.

Solution:

Software and configuration update for GIDS to prevent spurious detection of snow and small objects. Also, to improve low temperature performance.

Implementation:

02 May start date; end June finish.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Software and Firmware Upgrade					X	X	X																	

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)12	<p>Additional Vehicle Issues - A series of additional incomplete or required modifications program have been noted by our operations team which required resolution in order to ensure the success of RTG's maintenance team moving forward. The City requires corrective action plans to bring them to resolution:</p> <p>i) VOBC Reliability: The Operation of double car Trains has the benefit of having redundant VOBC's which has masked reliability issues with the performance of the individual units. Additional analysis and demonstration of these units is required in order to demonstrate the capability to provide weekend service using single car operations.</p>	OLRTC THALES

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
VOBC halts are occurring more regularly than expected and more frequently than deemed acceptable.	Currently the railway is operating with double car consist, thus providing VOBC redundancy. OCT operations could improve the response time to any VOBC halts.	Known issue that will be resolved with Thales software update that has been available since October 2019.

Background/Summary
<p>The VOBC is reliable.</p> <p>The VOBC halt is a known issue and there is a fix already planned in Thales Software version 6.1. We have seen this issue before generally at the Tunney's end of the system.</p> <p>Thales has identified that there may be a CBTC system wide issue with handling radio comms in certain conditions. Thales has confirmed that these were momentary comm losses that were not impacting revenue service and it was not necessary to remove trains from service.</p> <p>The Software update is scheduled for May 2nd and immediate monitoring of performance will be gauged from the installation date to confirm improvements related to VOBC Halts.</p> <p>Investigation has found there are really only three trains that were causing the real issue with a half dozen more with sporadic occurrences.</p> <p>For two out of the three nuisance trains, the problem went away during the week of sampling the information.</p> <p>At this time, it is still unclear if the issues with these three LRVs is an on-board wiring issue or a CBTC equipment or system issue.</p> <p>While a more detailed accounting effort of every train experiencing comm losses could be done, it appears the great majority of comm losses has occurred amongst three trains (1, 13 and 15) with a sprinkling over a few other trains.</p> <p>Ongoing investigation and trend analysis points more to an isolated vehicle issue than an equipment issue, particularly in the case of three LRVs: 1, 13 & 15. LRV 15 appears to have an ongoing (repeated) issue so warrants a more detailed check of the vehicle and the network wiring. RTM to investigate these repeater trends in more detail for these particular vehicles.</p>

OCT
TABLE 0604 V.015

Availability Calculation -- On Board

There are 2 train configurations, one with 1 VOBC (8 trains) and one with 2 VOBCs (16 trains). The assumed condition is 11 Reliability and Availability (%)

Overall reliability of the CBTC Train Control System shall be such that the predicted availability, availability is 99.99% or greater. Availability calculations shall be based on the formula:

$$Availability = \frac{MTBF}{MTBF + MTTR}$$

Where:

- MTBF = Mean Time Between CBTC System Functional Failures and
- MTTR = Mean Time to Restore CBTC System.

MTTR includes repair crew travel time and time to replace failed parts not the time it will take to repair the failure.

The CBTC Onboard Equipment shall meet an overall requirement of 850,000 km mean distance between consecutive failures.

Single VOBC Trains:

Functional Failure Rate = 27,5200 failures

MTBF = 1/Total Failure Rate = 1/27,5200 = 36,338 km

Given an average speed of 34km/h for a train, the mean distance between consecutive failures is: 94 km/h * 36,338 hr = 3,420,000 km

Availability = 819,999 / (819,999 + 36,338) = 95,58% (36,338 + 1,5) = 89,869%



Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Investigate Repeat Vehicles (if req'd)				X	X																			
VOBC issues to be addressed in 6.1 s/w				X	X	X																		

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City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)12	<p>Additional Vehicle Issues - A series of additional incomplete or required modifications program have been noted by our operations team which required resolution in order to ensure the success of RTG's maintenance team moving forward. The City requires corrective action plans to bring them to resolution:</p> <p>ii) Sanding System: Selection of the appropriate sand media, maintenance practices, pertaining to servicing Vehicles. Plan for any retrofits or modifications to this subsystem.</p>	ALSTOM

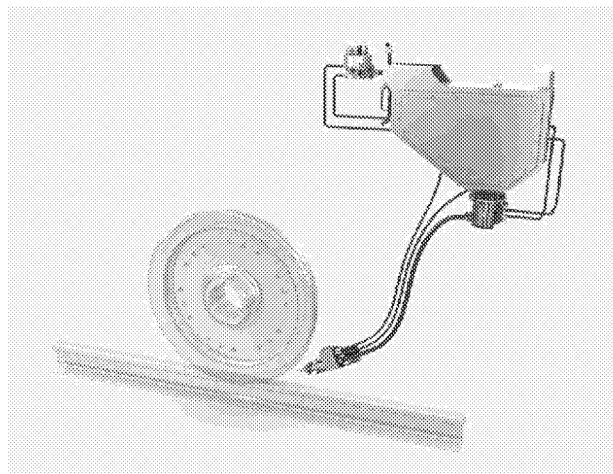
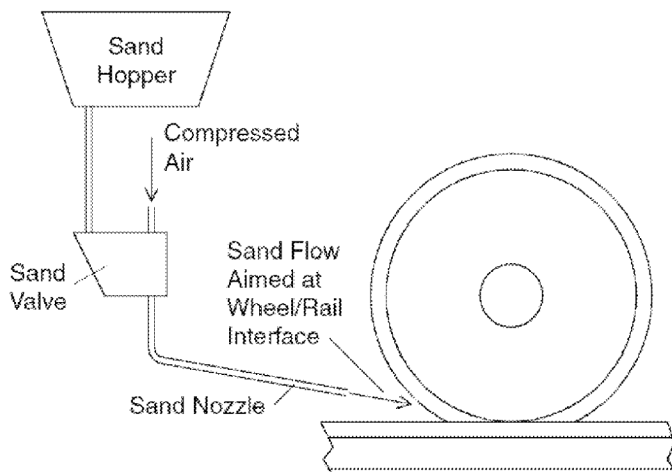
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
The sand that has been used to date is not compliant with the grain shape and grain size with Alstom's procurement specification ADD000939214. The grain size and shape lead to clogging of the sand delivery system.	<p>Seasonal Preventative Maintenance Regime (as described in city reference b14 v.) during adverse weather events (winter snow and slush) to prevent sand nozzles from clogging due to heavy build up of snow and slush) will be incorporated into Adverse Weather plan as Winter Storm fighting initiatives</p> <p>Snow Guards around sand nozzles</p>	<p>Alstom is responsible to specify and procure the sand: Procure the specified sand media and institute tighter controls when delivering sand to the vehicle.</p>

Background

Rolling Stock Sanding System

The main adhesion enhancer used on railway networks world- wide is sand. Sanding is used in train operations to improve adhesion in both braking and traction. In braking, it is used to ensure that the train stops in as short a distance as possible automatically when the ERO selects emergency braking or some instances manually activated based on rail conditions.

The sand is supplied from a hopper (see e.g. of configuration below) mounted on the train. Compressed air is used to blow the sand out of a nozzle attached to the bogie and directed at the wheel-rail contact region. It is important to note that sand delivered to the sand hopper and nozzle should be kept moisture free and mitigation of water (snow/slush) ingress. This contact point is exposed to slush and snow in winter conditions and is a known industry challenge due to the close proximity of the nozzle to interface with the wheel in order to ensure the appropriate amount of sand is directed and disbursed for correct wheel/rail adhesion.





Sand Delivery System to the Vehicle

The existing sanding system is a hermetically sealed system designed with two air dryer units to prevent build up of moisture in the system to avoid contamination of the sand (wet, clogging sand). Sand is delivered and connected to the sand silo for loading, when the sand is demanded from the sanding service pumps, (as shown in the photo) it is drawn from the silo into local holding tanks ready to service the vehicles.

RTM considers the sanding system to be a service supporting critical asset and conducts daily visual inspections of the system to ensure it is working properly. Both RTM and OEM sanding system provider conduct preventative (daily to annual) routine maintenance to the system as per the OEM Manual. Due to the nature of the complexity of the system the OEM supplier performs more in-depth maintenance related to dust compression and sand pump valve maintenance.

RTM has not had any major problems with wet sand delivered from the system and considers any issues related to wet sand are primarily related to winter conditions and the backlash of snow and slush into the sand nozzles, as the wheels transverse through the rail channel. This is a known industry challenge maintaining the sanding nozzles on an LRV vehicle under these harsh winter conditions.

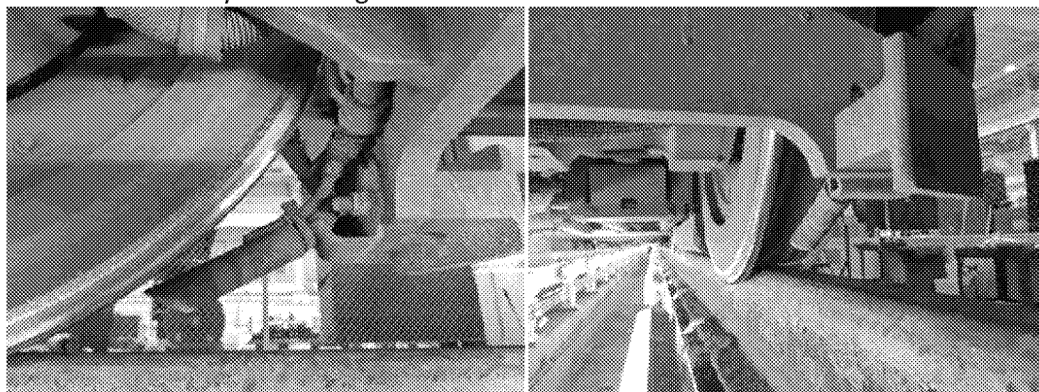
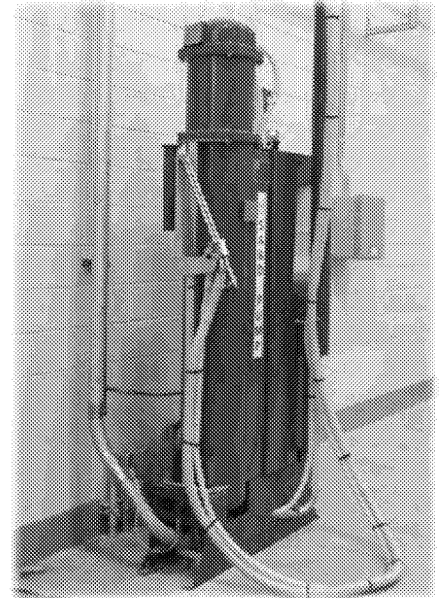
Enhancements in Quality Checks

RTM is considering the possibility of additional checks on the quality of the sand as it explores the technology related to moisture and dryness testing at critical stages of the sand loading process. Further, they are investigating a certification process, as the VM explores new a supplier to meet their specification, that will validate the sand delivered meets a level of criteria acceptable before being loaded into the sand system.

RTM is fully aware of the importance in ensuring the system for the sand is kept at temperature and dry and will continue to monitor the system and rectify any issues that arise expeditiously.

Sand Specification

Quality and sand grain size are factors related to sand clumping in the sand nozzles (refer to photo below). The finer the sand, the increased potential for clumping and clogging. Currently, the VM is seeking to improve the quality and grain size of the sand in an effort to mitigate sand clumping that can block the flow of sand to the wheel and prevent proper adhesion necessary for braking in winter conditions.



The Vehicle Maintainer (VM) is pursuing alternate sand suppliers to ensure that correct granular sand size meets their specification. This has been a challenge as there are very few suppliers in Canada that can meet the required criteria. Once a supplier is selected that meets the specification, Sand Media will be introduced to the Sand delivery system in time for seasonal conditions.



Seasonal Maintenance Regime

In addition, RTM and the VM will introduce as part of the Seasonal Maintenance Regime activities associated with Adverse Weather Protocol an Industry Best Practice preventative maintenance activity for clearing “clogged sander nozzles”. Based on Adverse weather criteria this activity will be triggered under conditions when snow and slush accumulation is imminent. The practice will involve maintenance personnel to ensure sander nozzles are clear of obstruction, prior to entering service and at the end of service reduction.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Sand Delivery System Inspection (Daily)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Procure the Correct Sand				X	X																			
Expend remaining sand by next winter season					X	X	X	X	X	X														
Ensure new sand media is loaded into the fleet										X	X													
Preventative Maintenance Adverse Weather Regime to include Sander nozzle clearing										X														

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City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)12	<p>Additional Vehicle Issues - A series of additional incomplete or required modifications program have been noted by our operations team which required resolution in order to ensure the success of RTG's maintenance team moving forward. The City requires corrective action plans to bring them to resolution</p> <p>iii) Compressor Performance: Recent concerns regarding level boarding at the platforms and general reliability issues with the Compressor issues need to be addressed. Details of any planned improvements to the System are required. RTG's previous proposal to remove every other compressor shall not be progressed until the reliability of the compressor improves. This issue is particularly concerning as it our understanding that stage 2 fleet vehicles have been modified in that there is no longer a redundant compressor in each Vehicle, and as such any compressor failures on the Stage 2 fleet will directly result in an immediate service impact.</p>	ALSTOM

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
IOS's recorded in relation with Air Supply perceived as compressor issue.	Continued Preventative Maintenance Program and monitoring of vehicle fault process	Continue monitoring. No immediate action required

Background

Recent Failure Analysis as reported in the weekly MRS meetings and indicate that there have only been 2 faulty compressor events since the start of Revenue Service:

- On 19/12/2019 one compressor removed from LRV08 with a pressure sensor faulty (vendor expertise analysis ongoing)
- On 27/12/2019 one compressor removed from LRV27 due to internal leak on the compressor (vendor expertise analysis ongoing)

More information regarding the above 2 issues will be shared as soon as the components are returned from the vendor. Note that there is no link between these two failures as they appear to be isolated.

As noted, there have only been 2 compressor faults. There is a misunderstanding since the compressor faults based on the information available via the DDU, end up being related to a fault with some other aspect of the system. The pareto below shows the various groupings.

NFF/ Reset - For most events a simple reset of the train is performed and/or the system is checked and no fault is found. A portion of these events quite possibly could be related to faults with the CVS and also nuisance alarms which may need to be addressed by better alarm management.

CVS faults – in these cases a genuine fault with the CVS was identified and the fix consisted of either resetting the CVS or replacing it.

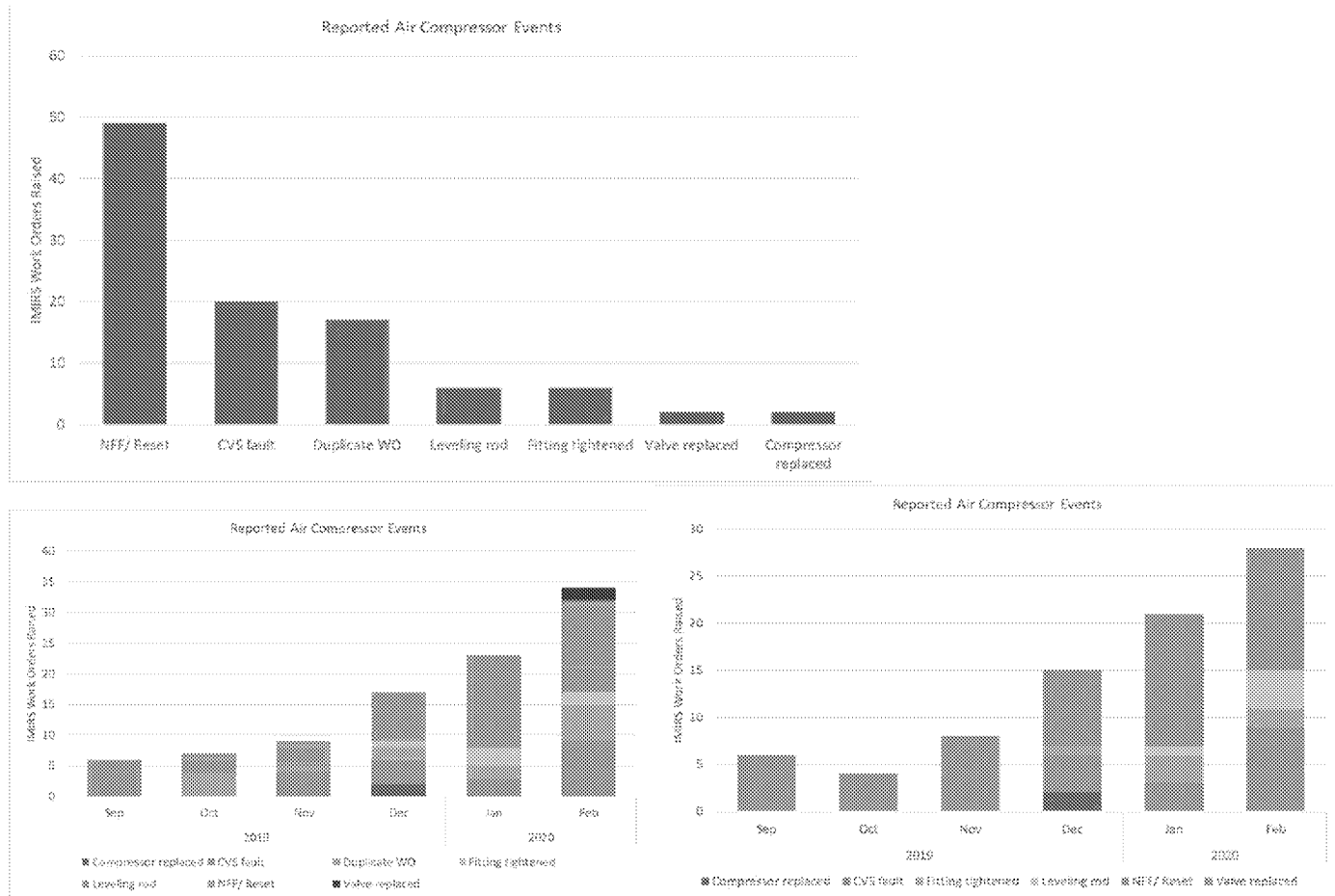
Duplicate WO – Self explanatory. OCTranspo used to raise a separate work order for each IOS code but as the IOS codes are all related to the same issue, the response from the tech ends up being a cut and paste from the original work order. These can be ignored.

Leveling Rod – On a few cases the leveling rods were stuck in one of the extreme positions which affected the system charging with air. The rods were either adjusted or changed.

Fittings tightened & values replaced – these were mechanical issues whereby fittings from hoses, pipes, valves, etc. were found to be leaking and were subsequently tightened. A portion of these would fall into the NFF/ Reset category.



The impression is influenced by the fact that numerous Air Supply IOS are raised (125 events since Revenue Service) due to parking on a super elevated curved track, duplicates, Auxiliary Power Supply events (air supply is a consequence) and some air piping leak.



• *City Comment: It should be noted that an issue which presents as a compressor fault may not be due to the compressor itself. However, that issue must still be addressed to solve the problem. A “No Trouble Found” is still an issue that needs to be addressed and the high number of NFF work orders suggests there are additional issues.*

Alstom are also tackling technical topics leading to “Air Supply IOS” such as levelling rod adjustment and fittings. PARETO for “Air Supply” is part of the reliability analysis the vehicle supplier is doing.

• *City Comment: Parking a train on a super elevated curve should not result in a compressor issue and identifies poor system integration of the compressed air.*

This exported constraint is rather typical with an air levelling system and was part of the design review. Alstom state that there is no issue with the compressor itself and the system recovery. The issue is an IOS about “Air Supply” is raised to the operator.

• *City Comment: RTG is reminded of Knorr’s statement that the compressor being used is not applicable for vehicles with air suspension.*

Per Alstom this allegation is completely wrong and they have declined to provide further comments. (RTG will schedule a small group discussion with the City)



- *City Comment: IOS12 is continually seen while in operations which as per the Alstom IOS code document, is listed as the loss of one compressor. Even though the result may not be a compressor replacement, the continual faults while in operations is concerning and should not be occurring.*

The meaning of IOS 12 has been explained to OCT operators and the one occurring everyday at the connector (LRV parked on super elevated track) is not a concern. The other ones have been technically explained by a loss of Auxiliary Power Supply. If the City is willing to change the approach defined during the design phase (IOS shown to the driver via DDU), Alstom will support this discussion.

- *City Comment: Adjustments to fitting rods or leaky valves needs to tracked and assessed for reliability improvements - this is not acceptable normal operations.*

Please see answer to first bullet point.

Train architecture:

Alstom explained in 2018 the “one compressor + air tank” configuration to ensure PA compliance in specific conditions. Alstom documented this change with calculation notes and simulations shared with OLRT and the City.

To fulfill the requirements, Alstom needs to deploy this solution on stage 1 trains. This configuration is part of Stage 2 configuration and has been implemented on the first stage 2 trains.

Air type test report have been provided to the City recently (ADD0000939042-C TS17 Air system report rev C).

Vehicle Supplier will provide RAMS and functionality in line with this configuration.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Type test report			X																					
Retrofit on Stage 1 vehicles (to be organized)																								

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)12	<p>Additional Vehicle Issues - A series of additional incomplete or required modifications program have been noted by our operations team which required resolution in order to ensure the success of RTG's maintenance team moving forward. The City requires corrective action plans to bring them to resolution:</p> <p>iv) Bogie Retrofit: The city requires details of the bogie retrofit and a schedule to complete the fleet.</p>	ALSTOM

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>An improvement plan was needed to add a new greasing point onto the existing design of the axle for improved accessibility (no impact on ongoing maintenance regime)</p> <p>This is a lessons learned modification (return of experience) with this supplier on other projects such as Istanbul, TTNG, etc.</p>	<p>Alstom has launched the retrofit as soon as possible after Revenue Service start.</p>	<p>Install new grease fittings for improved Ergonomic Access</p> <p>See details with FMI-007 and retrofit plan.</p>

Background

Note that FMI ST6-FMI-007 Upgrade of Bearing boxes and Axle from V4 to V5 on axle beam has been submitted to the City.

The Modification Program is applicable to LRV 1 to LRV 44.

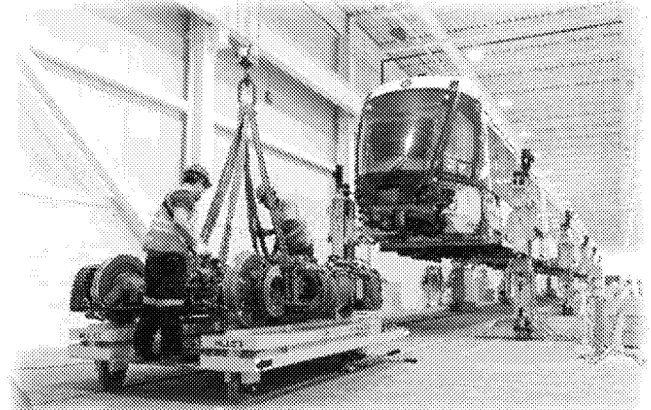
Current Status as of March 24th:

- LRV07, LRV17, LRV05, LRV19, LRV09, LRV22, LRV31, LRV27 completed.
- LRV 16 & LRV 11 remain levelling.
- LRV26 under retrofit (new bogies to install).

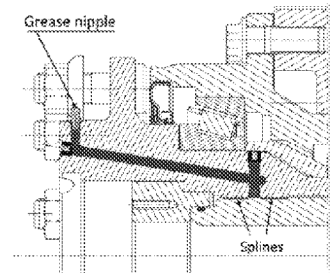
The capacity is set for one LRV per week synchronising supplier, Sorel-Tracy and retrofit team.

The Maintainer is looking at possibility ramping up to increase from 1,5 LRV per week (not confirmed).

This is not a mission critical issue, but rather a modification to improve accessibility and accelerate maintenance activity.



The spline design has therefore been improved
 - with cambered teeth to minimize local bearing pressure and grease extrusion
 - with an additional grease nipple accessible from the exterior



Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Bogie Retro-fit Program	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)12	Additional Vehicle Issues - A series of additional incomplete or required modifications program have been noted by our operations team which required resolution in order to ensure the success of RTG's maintenance team moving forward. The City requires corrective action plans to bring them to resolution: v) Driver Cab Door Program: The City requires the permanent solution for the cab door modification along with a schedule to complete the fleet. (Acrylic Doors are not acceptable as the long-term fix).	ALSTOM

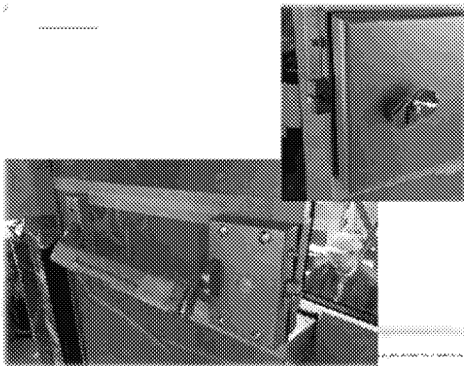
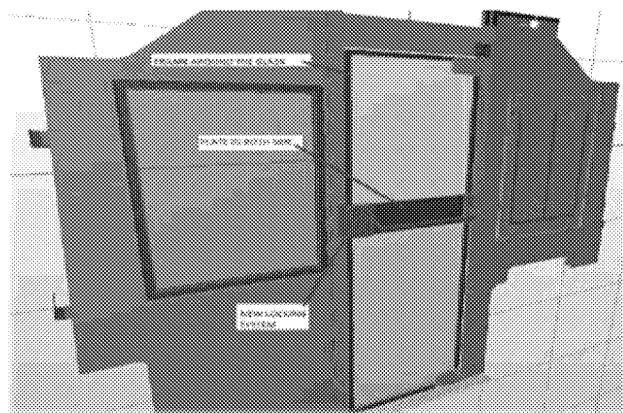
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
Acrylic Doors are not acceptable as the long-term fix	To start Revenue Service, waiver to use Acrylic cab doors was granted and should be considered as temporary containment.	Validate the solution which covers the improvement as well as the new request by the City for the locking device. Install new doors.

Background

New cabin door compatible with the existing cab partition wall keeping the same interfaces has been developed and presented to OLRTC/RTM and the City.

Key enhancements:

- Frame around the glass
- Plate in both side on the middle of the door
- New stopper for the panic bar (on the lock itself)
- New lock from Barat supplier (already approved by SNCF)
- New mechanism for the internal door lock
- New "property" keys (room side)



Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
2 nd Prototype				X																				
Fatigue Test of New Door						X																		
Launch Serial Production						X																		
First batch of parts scheduled in Ottawa										X														
Fleet Retrofit (Scheduled 4 LRVs per week)										X	X	X	X											
Completion of "in-use" vehicle retro-fit													X											

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)12	<p>Additional Vehicle Issues - A series of additional incomplete or required modifications program have been noted by our operations team which required resolution in order to ensure the success of RTG's maintenance team moving forward. The City requires corrective action plans to bring them to resolution:</p> <p>vi) Spare Parts Stock Levels: Scavenging of parts and insufficient supply chain: The City requires RTG to provide a plan and schedule to restore the full fleet to service and additional investments to ensure stocking levels are appropriate.</p> <p>vii) Staffing Levels: Based on recent experience, due to reliability or other reasons, we understand that a shortage of qualified technical staff is hampering RTG's ability to deliver the required number of vehicles to service. The City requires a plan to level set the staffing to properly accommodate the ongoing inspection requirements and backlog of deficiencies, modifications, and repair work to the vehicle fleet.</p>	ALSTOM
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>High levels of multiple component and failures have taxed the existing vendor supply chains, which have led to "part borrowing" from maintenance spare vehicles.</p>	<p>Daily Critical Parts Review</p>	<p>Root cause to failures stabilizing stock levels back under control</p> <p>Service effecting failure critical parts tracking process in place</p> <p>Visual management daily meeting supply chain update</p>
Background/Summary		
<p>vi) Spare Parts Stock level</p> <p>The most critical part shortages have been primarily contributed to overlapping epidemic failures on 3 components of the vehicle, they include Line Inductors, CVS, and Smoke detectors. Unfortunately, failure of these components further aggravated service availability, compounding the issue pertaining to stock levels. The plan independently refers to improvements for these components and their status of reliability improving which in turn is already stabilizing the supply chain in relation to the following:</p> <ul style="list-style-type: none"> - Line inductor the crisis with Inductors and CVS was unprecedented, and impossible for the supply chain to forecast; the established safety levels for stocked parts were unable to support the high rate of failure for such a rapid duration of failure. As described in section 1b) of the plan, there is now a process in place to recover; and a permanent solution, supply chain has stabilized and the situation is back under control. - Auxiliary Power Unit (CVS) similarly as described for Line Inductor shortages, the supply chain stock levels were unable to keep up with the rate of failure and commercial issues with the OEM were also hampering supply. The VM has managed to divert some of the repairs to a Canadian subcontractor as a means of keeping supply chain moving. The situation requires special attention and VM Procurement is fully involved at the highest levels of the organization to ensure progress of the recovery plan. Additionally, the VM have ensured through their supplier, 6 CVS to be delivered per month. As we progress in stabilizing the supply chain for CVS, we are actively pursuing in parallel root cause initiatives through the Task Force to have a permanent fix in place for the CVS. - Smoke detectors shortage is now under control with more than 60 in stock as well as a process to reconfigure them, and an improved maintenance process (while HVAC filters are cleaned, the detectors are protected or removed thereby avoiding contamination). 		



Expediting and Sourcing

On a daily basis North American Sourcing Management for the VM, follows up with the critical suppliers to ensure quality and on time delivery. In particular, due to the impact of COVID_19, there is heightened awareness and communication, which is necessary to understand the impact of ETA changes and other methods of delivery to keep supply chain stable.

For safety/service critical parts (e.g. CVS, Line Inductors) There are daily meetings involving Senior Management of NAM regarding CVS local supplier, Line Inductors and Contactors in coordination with Sesto and Hornell and the suppliers, Meetings with other related key component suppliers are held on a weekly basis.

In addition, there is daily visibility on the status of parts during the daily visualization management meeting, the status and ETA timelines for part deliveries are communicated and actioned daily.

Supply Chain Process

The maintainer, also in collaboration with RTM, developed an internal process to track the status of service affecting critical parts list (as noted in the graphic below). RTM continues to monitor the VM and their progress in sustaining and developing processes that support a healthy supply chain through the QMS and auditing. A recent audit completed by RTM indicates internal supply chain processes are in order, further reflecting the epidemic failures of the components described above are the major contributing impact to the safety stock level depletion. All which are on the path to rectification as described in the plan.

	M	M	M	M / A	A	A	A	A
	W11	W12	W13	W14	W15	W16	W17	W18
CVS (REPAIRED & TESTED)	2	1	0	0	0	0	0	0
CVS (NEW from TM4)	0	2	1	0	1	1	1	1
SUB-TOTAL	2	3	1	0	1	1	1	1
CVS (REPAIRED & NOT TESTED*)	0	3	3	2**	0	0	0	0
SUB-TOTAL	0	3	3	2	0	0	0	0
TOTAL	2	6	4	2	1	1	1	1

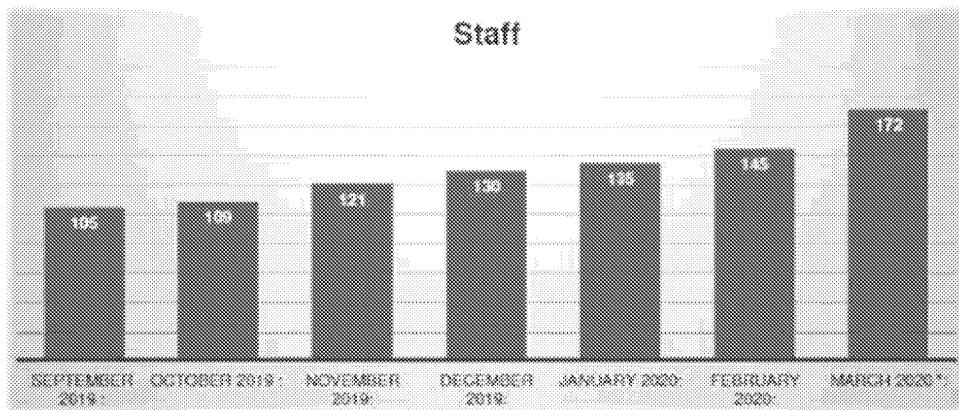
Continued reliability improvements will contribute to a healthy and stable supply chain, however, in the wake of this unforeseen event of COVID_19 globally, Alstom are receiving more and more communications of suppliers struggling, more specifically those overseas due to plant shutdowns and flight restrictions. In some cases, certain key sub suppliers have shut their plants down with no timeline in sight as to start-up. As COVID_19 restrictions continue so does our ability to sustain a healthy supply chain.



Staffing Levels

RTM has examined their current Organizational structure and the requirements necessary to support all of the activities associated with their internal plans, JBA recommendations and the Remedy/Rectification Plan. In addition, all key stakeholders ALSTOM/OLRTC/RTM have come to the same conclusion that resourcing to support the execution of the plan will require a collaborative approach.

The Vehicle Maintainer (VM) since revenue start-up has continued to increase staffing as demonstrated in the graphic below ("Staff"). Since September 2019 resourcing has increased by more than 60%. The VM has made adjustments in structure and alignment with operational and maintenance demands.



The VM has recognized the changes in resource demand from an organizational structure perspective and has recently made changes to Manager and Supervisor level staffing to support the organization from a balanced workforce outlook. More importantly, the VM has removed any reference of a delineation in the organizational change (supplier – maintainer) by centralizing the entire organization under one Operations Director. As referenced in the two Org charts (before and after) below.

The VM launched recruitment campaigns in line with the org chart with an added Service Operations Director as well as adding rail experienced Supervisors to strengthen middle-management layers that were a gap.

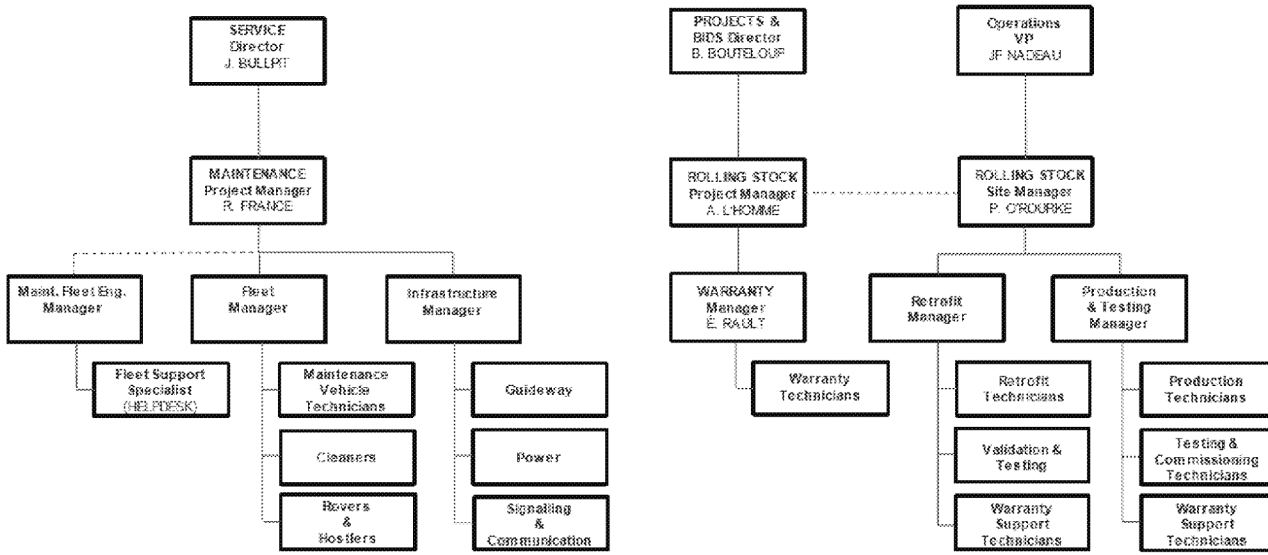
The VM has recognized and responded to the resource distribution concerns by examining the organization internally and addressing gaps associated with resourcing conflict between the split organizational structure. The new structure improvements include:

- One point of accountability (Service Operations Director)
- Centralization approach (one Team)
- Balanced resources (Reallocation of resources when business priorities shift)



Below is a “before” Alstom Organization Chart:

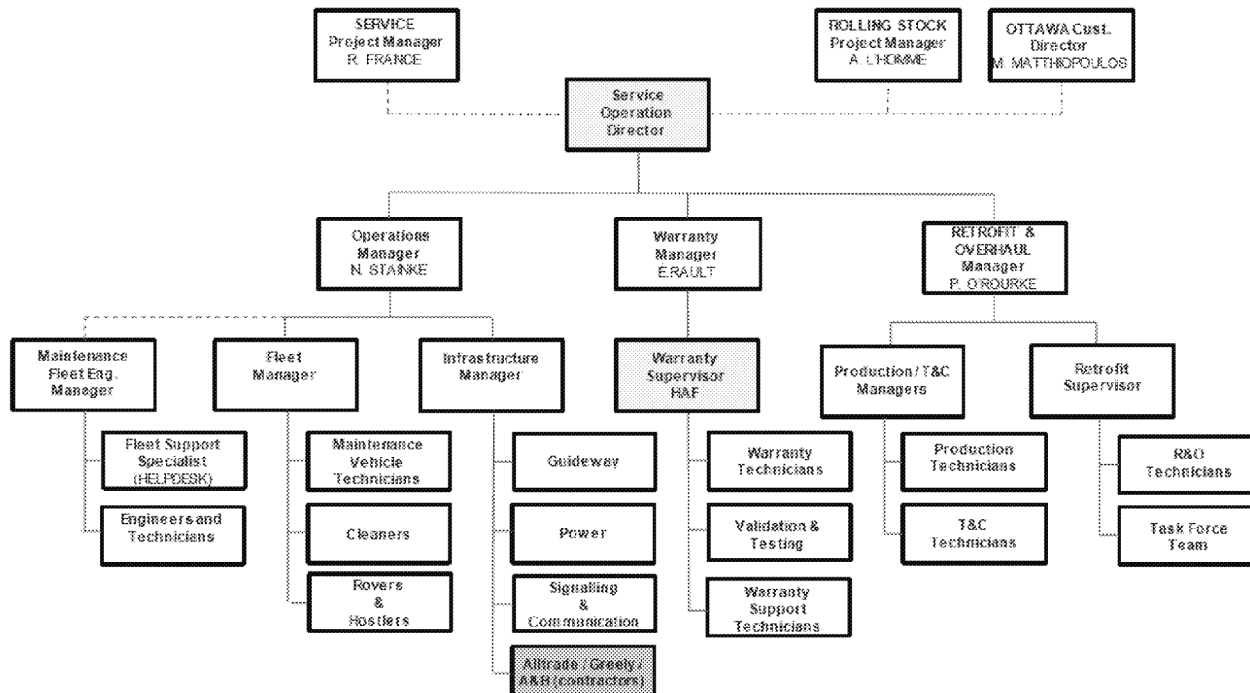
Ottawa MSF – Organization as of Nov. 2019
(excluding all support functions)



The “after” Alstom Organization Chart is below:



Ottawa MSF – Organization (excluding all support functions)



Each of the Management Teams are defined in more detail in the following tables and are monitored for vacancies to ensure staffing levels are maintained.

VM - MANAGEMENT TEAM STAFFING PLAN

DEPT.	#	POSITION	STAFF	ACTUAL HEADCOUNT	TARGETED HEADCOUNT	HEADCOUNT VARIATION	H.A.F. OPENED
MANAGEMENT TEAM	A	OPERATIONS SERVICE DIRECTOR	STAFF	1	1	0	0
	B	CUSTOMER DIRECTOR	STAFF	1	1	0	0
	C	PROJECT MANAGER	STAFF	1	1	0	0
	D	DEPUTY PROJECT MANAGER	STAFF	1	1	0	0
	E	PROJECT ADMIN	STAFF	1	1	0	0
	F	EHS MANAGER	STAFF	1	2	1	1
	G	PERFORMANCE MANAGER	STAFF	1	1	0	0
	H	OPERATIONS MANAGER	STAFF	1	1	0	0
	I	MMS MANAGER	STAFF	1	1	0	0
	J	TRAINING COORDINATOR	STAFF	1	1	0	0
	K	TRAINING SPECIALIST	STAFF	1	1	0	0
	L	SC&W MANAGER	STAFF	1	1	0	0
	M	SUPPLY CHAIN & WAREHOUSE OP.	-	4	5	1	0
	N	DOCUMENTATION ENG.	STAFF	1	1	0	0
	O	PROJECT CONTROLLER	STAFF	0	1	1	1
	P	PROECT QUALITY & SAFETY MGR.	STAFF	1	1	0	0
	Q	CONTRACT MANAGER & ADMIN	STAFF	0	2	2	1
	R	HR BUSINESS PARTNER	STAFF	1	1	0	0
	S	IS&T BUSINESS PARTNER	STAFF	1	1	0	0
	T	MAINTENANCE ENG. MANAGER & ENGINEERS	STAFF	9	9	0	0
TOTAL (Except support functions)				29	34	5	3



VM – WARRANTY TEAM STAFFING PLAN

DEPT.	#	POSITION		ACTUAL HEADCOUNT	TARGETED HEADCOUNT	HEADCOUNT VARIATION	HAF OPENNED
WARRANTY	A	MANAGER	STAFF	1	1	0	0
	B	SUPERVISOR	STAFF	0	1	1	1
	C	WARRANTY TECHNICIANS	-	12	15	3	4
	*D	VALIDATION & TESTING	-	0	2	2	0
	*E	WARRANTY SUPPORT TECHNICIANS	-	10	10	0	0
	F	VIE	STAFF	1	1	0	0
	G			0	0	0	0
	H			0	0	0	0
	I			0	0	0	0
	J			0	0	0	0
	K			0	0	0	0
	L	WABTEC SUPERVISOR	CONT.	1	1	0	0
	M	WABTEC TECHNICIANS	CONT.	11	11	0	0
TOTAL (Except support functions)				24	30	6	5

VM – MAINTENANCE TEAM STAFFING PLAN

DEPT.	#	POSITION		ACTUAL HEADCOUNT	TARGETED HEADCOUNT	HEADCOUNT VARIATION	HAF OPENNED
MAINTENANCE	A	MANAGER	STAFF	1	1	0	0
	B	SUPERVISORS	STAFF	5	6	1	2
	C	PLANNER	STAFF	1	2	1	0
	D	MAINT. VEHICLE TECHNICIANS	-	24	24	0	0
	E	TEMPORARY MV TECHNICIANS	-	0	15	15	0
	F	CLEANERS	-	12	12	0	0
	G	TEMPORARY CLEANERS	TEMP	0	5	5	0
	H	ROVERS	-	16	16	0	0
	I	HOSTLERS	-	24	24	0	0
	J	HELPDESK / DATA CLERK	STAFF	2	2	0	0
	K					0	0
	L					0	0
	M					0	0
TOTAL (Except support functions)				85	107	22	2

VM – INFRASTRUCTURE TEAM STAFFING PLAN

DEPT.	#	POSITION		ACTUAL HEADCOUNT	TARGETED HEADCOUNT	HEADCOUNT VARIATION	HAF OPENNED
INFRASTRUCTURE	A	MANAGER	STAFF	0	1	1	0
	B	SUPERVISORS	STAFF	1	2	1	2
	C	GUIDEWAYS	-	12	12	0	0
	D	POWER	-	8	8	0	0
	E	SIGNALLING & COMMUNICATION	-	8	8	0	0
	F					0	0
	G					0	0
	H					0	0
	I					0	0
	J					0	0
	K	ALLTRADE	CONT	0	0	0	0
	L	GREELEE	CONT	0	0	0	0
	M	A&B	CONT	0	0	0	0
TOTAL (Except support functions)				29	31	2	2

VM – RETROFIT TEAM STAFFING PLAN



DEPT.	#	POSITION	ACTUAL HEADCOUNT	TARGETED HEADCOUNT	HEADCOUNT VARIATION	HAF OPENED
RETROFIT	A	SITE MANAGER	1	1	0	0
	B	PROJECT MANAGER	1	1	0	0
	C	ADMIN	1	1	0	0
	D	ENG & INDUSTRIAL ENG.	6	6	0	0
	E	PLANNER	1	1	0	0
	F	SC MANAGER	1	1	0	0
	G	WAREHOUSE	3	3	0	0
	H	PROD. SUPERVISOR	1	1	0	0
	I	RETROFIT SUPERVISOR	1	1	0	0
	J	PROD. TECHNICIANS	3	3	0	0
	K	RETROFIT TECHNICIANS	14	14	0	0
	*L	WARRANTY SUPPORT TECHNICIANS	10	0	-10	0
	M	TESTING TECHNICIANS	5	5	0	0
	N	QUALITY MANAGER & TECHNICIANS	5	5	0	0
O	EHS	1	1	0	0	
P	MAINTENANCE	1	1	0	0	
Q		0	0	0	0	
TOTAL (Except support functions)			55	45	-10	0

VM – MAINTENANCE TECHNICIAN SHIFT PLAN

The following provides a resource leveled plan for the VM's technicians.

TECHNICIANS		SHIFT	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	
INFRASTRUCTURE	GUIDEWAY	Day	3	5	5	5	5	3	3	
		Night	5	5	5	5	5	5	5	
	POWER	Day	2	2	2	2	2	2	2	
		Night	1	1	1	2	2	1	1	
	SIGNALIZATION	Day	2	2	2	2	2	2	2	
		Night	2	2	2	2	2	2	2	
MAINTENANCE	MAINTENANCE VEHICLE	Day	4	4	4	4	6	4	4	
		Afternoon	4	4	4	4	6	4	4	
		Night	4	4	4	4	6	4	4	
	SERV. & CLEANING	Day	2	2	4	4	4	2	2	
		Night	7	7	8	8	8	4	7	
	HOSTLER	Day	5	5	5	5	5	5	5	
		Afternoon	1	1	1	1	1	1	1	
	ROVER	Night	8	8	8	8	8	8	8	
		Day	3	3	3	3	3	3	3	
	ROLLING STOCK	WARRANTY	Night	0	4	4	4	4	4	0
Day			3	3	3	3	3	3	3	
ROLLING STOCK	RETROFIT - BOGIES	Afternoon	3	3	3	3	3	3	3	
		Night	3	3	3	3	3	3	3	
		Day	0	6	6	6	6	6	0	
	RETROFIT - WAVE2	Afternoon	0	0	0	0	0	0	0	
		Night	0	0	0	0	0	0	0	
		Day	5	8	8	8	8	8	5	
		Afternoon	5	6	6	6	6	6		
		Night	5	0	0	0	0	0		
			5472	72	88	91	92	98	83	72



External Support

The Canadian Engineering Director for the VM resides in Montreal is supported with on call subject matter experts covering all the subjects including but not limited to Traction, Braking System, power supply, maintenance/industrial systems, etc., In addition there is localised specialist support that reside in Ottawa to support the organization.

Furthermore, there is continuous offshore team support in Hornell -USA, Charleroï's -Belgium, Sesto-Italy and the Citadis Platform in Paris Head Quarters supporting the project on a daily basis. Suppliers, are also available to be on-site and have participated frequently contributing to the Reliability task forces. However, COVID_19 has limited any physical on-site activity.

Rectification Plan Resourcing

A dedicated RTG Project Manager has been appointed to execute the Plan.

OLRTC/RTM are discussing the logistics of the merger of OLRTC resources under RTG as one unified team so that actionable items of the plan can be effectively managed and resourced more efficiently. The timelines for permanent solutions will require many interactions over the next year and it is imperative that RTG utilizes every opportunity to expand its capabilities.

Further, each company in the RTG Partnership has and remains fully committed to providing any additional technical and or operational and maintenance staffing to further support the delivery of this plan. An Internal Remedial Plan Steering Committee will be formed with key working groups in order to execute all of the activities as safely, effectively and efficiently as possible. The focus of the steering committee will be to align resources with actions and to parallel activities for timely rectification.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Operation Director Recruitment				X																				
Strengthen Supervisory Positions				X	X	X																		
Forming of the Steering committee					X																			
Forming of RTG/RTM/OLRTC resource working groups					X																			
Subject Matter Specialist Support				X	X	X	X																	

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)13	<p>Additional System Issues: A series of additional incomplete technical issues related to systems have been noted by our operations and planning teams which require resolution in order to ensure the success of the maintenance team moving forward. The City requires that RTG provide corrective action plans and schedules to bring them to resolution:</p> <p>i) Signals System: A series of technical issues exist which require an update to the Thales software systems. A detailed rollout plan is required in order to advance the implementation of the updated software.</p>	<p>OLRTC</p> <p>Thales</p>

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
OCTranspo, through revenue service operations, has identified issues with the CBTC system. The issues are not safety related but do have an impact on overall performance of the system.	The system is fully operational and in passenger service. There are a number of work arounds currently in place.	Test and Commission revised CBTC software versions 6.0 and 6.1

Background

Thales had some CBTC upgrades in place and ready for field testing in SW Build 6.00 since early November. THALES will install the new Software release the weekend of 02/03 May 2020.

Installation of this new software should alleviate most, if not all of the CBTC related issues that have been observed, but this cannot be guaranteed until after the SW update is installed. A suggested installation schedule is as follows but will necessitate complete closure of the system over the weekend proposed: **(note that a detailed plan has been provided for the City's review)**

Sat, May 2, 2020:

- 07:30 – 08:00 – 4 coupled train sets perform Guideway sweep
- 08:15 – same 4 coupled train sets one each positioned where Thales personnel will board trains at stations: TUN, UOT, TRE and BLA
- 08:30 – 18:30 Install Build 6.1 software:
- Zone Controllers (TUN, UOT, TRE, BLA, MSF)
- VOBC (5 Coupled Trains)
- ATS (2 Central SRS, 5 Local ATS, 2 BCC WS, 2 YCC WS, 3 TOCC WS)
- Install 18 Guideway Tags (9 on each track at PTSTTs)
- Execute Testing

Sun, May 3, 2020:

- 07:30 - 08:00 – 4 coupled train sets perform Guideway sweep
- 08:15 – same 4 coupled train sets one each positioned where Thales personnel will board trains at stations: TUN, UOT, TRE and BLA. NOTE: These start stations may change depending on where testing left off the previous day.
- 08:30 – 18:30
- Execute Testing
- Revert Test software to Revenue software:
- Zone Controllers (TUN, UOT, TRE, BLA, MSF)
- VOBC (5 Coupled Trains)
- ATS (2 Central SRS, 5 Local ATS, 2 BCC WS, 2 YCC WS, 3 TOCC WS)
- Uninstall 18 Guideway Tags (9 on each track at PTSTTs)

* NOTE: The start stations may change depending on where testing left off the previous day



Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Testing				X	X																			
Safety Validation						X	X																	
Final Installation								X																
<p>Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.</p>																								



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)13	<p>Additional System Issues: A series of additional incomplete technical issues related to systems have been noted by our operations and planning teams which require resolution in order to ensure the success of the maintenance team moving forward. The City requires that RTG provide corrective action plans and schedules to bring them to resolution: (i. through v.)</p> <p>ii) CCTV Wayside Onboard Vehicle: The current system that provides the operator with a view of the platform edge remains unreliable and unproven. The centralized software systems that manage the distribution of video to the vehicles is still not working and it is unclear that the current architecture will ever work. It may be required to implement a localized, station-based control system in order to simplify the solution and make it more robust.</p> <p>iii) Public Address and Passenger Information System: There is an outstanding task to test and demonstrate that the onboard public address and passenger information systems work reliably in normal service operations and in diversion scenarios.</p>	ALSTOM OLRTC
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
The ERO cab CCTV of the train doors and platform interface have not been displayed reliably.	Platform Spotters were deployed by Alstom to supplement the automated system in case of poor reliability.	New onboard software version to overcome the loss of Mission input. Alstom is writing new software for the HSDR system
Background		
<p>Through interface meetings, it became apparent that the performance of the system could be improved through changing the inputs selected from the CBTC system.</p> <p>At present there is a mitigated software version deployed on the fleet, version 6.3. The software will improve the situation with "no mission", it will also improve the lag for that occasionally occurs when the screens populate within the driver's cab.</p> <p>Alstom is now in the process of rewriting the software for testing and releasing at the end of May. Then validation and demonstration before implementation in June.</p> <p>Mitigation Plan is in place with spotters as the system was not demonstrated when starting revenue service in September 2019. Reduction of the coverage of spotters under discussion with City (as the remaining dysfunction is linked to "Loss of Mission" input in 2 specific stations (Bayview and Cyrville).</p> <p>All functionalities have been demonstrated and to the exception of the "no mission" issue the system is working as per design.</p> <p>Alstom is also working on IOS (fault) management to filter the information and ensure only "accurate" faulty equipment is managed in future software release (nothing functional).</p> <p>Meetings and review of system performance are ongoing with all parties, including the City.</p>		



Remedy/Rectification Activity Schedule	2020												2021											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Safety Review with City – necessity of spotters				X																				
New software release (change VOBC variables)					X																			
Validation and dynamic test						X																		
Implementation over the fleet						X																		
Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.																								



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)13	<p>Additional System Issues: A series of additional incomplete technical issues related to systems have been noted by our operations and planning teams which require resolution in order to ensure the success of the maintenance team moving forward. The City requires that RTG provide corrective action plans and schedules to bring them to resolution:</p> <p>ii) Next Train Arrival Messaging: The reliability of the countdown messages on the platforms is still unreliable and the related provision of this same information through a real-time data feed to the City appears incomplete.</p> <p>iii) Passenger Counting System: RTG has not provided the required daily summary reports of passenger counts through a real-time data feed to the City.</p>	RTM OLRTC THALES
Background/Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>iv) The PIDS on the station platforms have been inconsistent in the information that they display.</p> <p>v) Passenger counting information is not being transmitted to the City</p>	N/A	<p>iv) Thales software version 6.01 will resolve the prediction issues on the PIDS.</p> <p>v) Alstom revised APC software will resolve passenger counting data issues. RTM can then configure the post-processing software and commence passenger count reporting.</p>
Background		
<p>iv) Next Train Arrival</p> <p>Thales has a SW update in SW Build 6.01 to amend incorrect PIS information when trains are on diversions. The two issues are:</p> <p>a) Eastbound trains on LN04 (short turnback at the Hurdman pseudo-station) showing as out of service. Fixed in B6.01 (CCP00433043)</p> <p>b) Incorrect prediction times when running headway regulation with the primary turnback closed. Fixed in B6.01 (CCP00434788)</p> <p>Thales SW Build 6.01 will be deployed as per b13) above.</p> <p>v) Passenger Counting System</p> <p>There are ongoing issues with the integrity of the onboard APC data which is then transmitted from the vehicles to a wayside server at the MSF at the end of each day. This must be resolved to enable accurate passenger count reports to be generated and included in the Daily Operating Report. Alstom's software update timeline which will address the for the on-board APC issues software is shown below. Following this update, Alstom will validate the communication of the APC data from each Vehicle to the wayside server at the MSF.</p> <p>Once the accurate APC data from the Vehicles data issues are resolved is being reliably transferred to the MSF server on a daily basis, RTM will be able to retrieve the clean raw passenger counting data from the MSF server and finalize configuration of the Acorel (APC supplier) proprietary post-processing software. Once the software is configured, passenger count figures will can start to be added to the Daily Operating Report.</p>		



2 groups :

A. MPU / DDU / EVR

B. APC

→ If one software of a group fails, the other software group can still be deployed

Static non-regression done

Engineering hours – Night of Thursday, March 26th / 27th

Deployment on 1 train during off-peak hours – Friday, March 27th

Deployment on 2 trains during the day : Sat and Sun March 28th and 29th

Deployment on the fleet starting Monday, March 30th

Go / No go

AT monitoring



GO from the City

GO from the City

GO from the City

→ Test requests sent (REQ0012 – Rev.C)

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Thales v6.1 update (as per section b13))				X	X																			
Vehicle APC software updates				X																				
Vehicle to wayside APC data and comms validation				X	X																			
RTM APC software configuration, commence passenger count reporting				X	X	X																		

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.

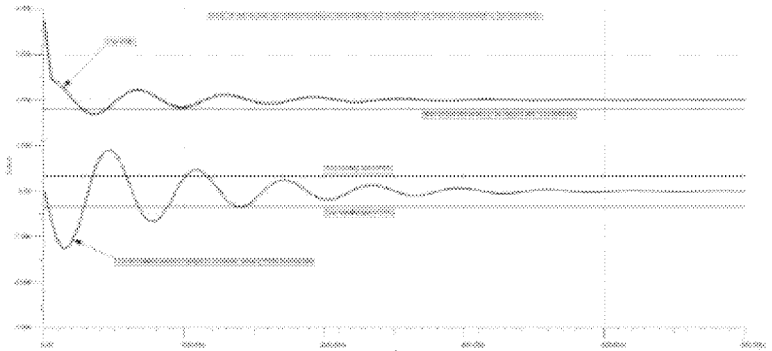


City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
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Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>Light Maintenance Bays in the MSF have experienced multiple disruptions to operations as a result of blown fuses interrupting OCS power to the maintenance bays. The disruptions have caused limitations in efficiencies for delivering trains to the bays that require maintenance.</p>	<p>RTM has developed and implemented (March '20) an interim procedure based on recommendations from subject matter Specialist investigation. This procedure will enable the maintainer to effectively utilize the Maintenance Bays without the interruptions related to the technical issues that will essentially require a permanent solution.</p> <p>The procedure has been reviewed to ensure employee safety protocols are not altered, nor any further damage to LMB OCS equipment. In addition, RTM has completed all repairs to rail car movers including securing a temporary Rail Car Mover solution that will continue to allow ALSTOM to move disabled cars in and out of the LMB sections without disruption and efficiently.</p>	<p>Replace Fused Design: Permanent Technical Solution New Stinger Panel with the following options:</p> <ol style="list-style-type: none"> 1. DC high speed circuit breakers 2. Fully rated load breaking DC Contactors <ul style="list-style-type: none"> - Technical Working Committee determine best option (ALSTOM/RTM/OLRTC) - Design Architecture Drawing Approval - Full Scale Prototype & Testing - Certification and Sign-off Record of Engineer - OEM Manual/Procedure revisions and Training
Background		
<p>As per SMS "Initial Report into MSF Stinger Panel Damage & Recovery Options February 24th, 2020</p> <p>It is understood that a number of fuse and contactor failures occur during the summer months – these being ascribed to "excessive current" or the use of the non wash mode for vehicle movements (where the permissible current draw is understood to be higher).</p>		



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During late November and December 2019 as the winter weather closed in, more LMB OCS fuse failures occurred as a number of issues with the train's onboard 1500V DC electrical equipment increased. Several vehicles have either arrived in the shop with existing faults or latent faults (such as ice entry into traction equipment cases which subsequently thaws and causes an electrical short), or have been powered up via the OCS in the LMB while the vehicle is still under a fault condition. This leads to overcurrent conditions on the LMC OCS circuit and an increased occurrence of blown fuses.



As part of the findings and testing an attached plot explains the fault condition:

The simulation of currents and voltages of a single train traction converter filter and the shop stored electromagnetic energy being released by an inadvertent contactor operation, or a fuse operation. It easily explains and demonstrates why the overvoltage occurs, why the fuse blows and then causes the consequent downstream damage. This explains why contactors and other metalwork within the panel are subject to flashover during fault events.

The combination of fault current; the need to ensure protection discrimination; the associated requirement for fast operating fuses; and stored electromagnetic energy in the train; translates that the present equipment is unlikely to be adaptable and repairable to provide a design to suit these fault conditions.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mitigation Procedure	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REPLACED Existing Fused LMB Design																								
Technical Working Committee					X	X																		
Design Architecture & Drawing Approval						X	X	X																
Full Scale Prototype and Testing							X	X	X	X	X													
System Certification & Engineer Sign-off												X												
OEM Manuals and Procedural Revisions											X	X												
Training Roll-out											X	X												

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City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)14	<p>Additional Infrastructure Issues: A series of additional technical and organizational issues related to infrastructure and infrastructure maintenance have been noted by our operations team which require resolution in order to ensure the success of the maintenance team moving forward. The City requires that RTG provide an action plan and schedule to bring these issues to resolution:</p> <p>a) Maintenance Facility Yard: There has been a number of TSB reportable rail occurrences in the yard which is concerning and needs to be addressed in a permanent fashion.</p>	RTM ALSTOM
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
<p>a. Recorded to date there have been 6 TSB reported incidents 3 of which were in the MSF Yard, all isolated cases and unrelated to each other.</p> <p>2020-01-24 – Minor Contact with 2 LRV's during Launch Sequence</p> <p>2019-12-12- Rail Car Mover</p> <p>2020-02-23 - Derailment of OCS Hi-Rail in the Yard</p>	<p>a. All 6 incidents reported were investigated and corrective actions put in place that included Communication campaign to all staff, safety lessons learned reminders, and Operational/Safety Bulletins RTM-OP-BLN-532 and RTM-OP-BLN-541.</p> <p>RTM is already tracking several actions associated with Incident Reporting, Safety Culture and Operational Yard Maneuvers in their own Internal "Deficiencies Affecting Service Availability" Action Plan.</p>	<p>Reportable Incident Workshop (RTM/OC Transpo/TSB)</p> <p>RTM/ALSTOM workshop challenges and risks related to movement of rail-borne equipment in the Yard</p> <p>Procedural/Training Gap Analysis</p> <ul style="list-style-type: none"> - Launch Process - Derailment & Vehicle Recovery - Hand-over Platform Protocol <p>Implementation of new Procedures and Training</p> <p>Develop Governing Body "Rail Safety Group Committee" (RSGC)</p>
Background		
<p>RTM has a contractual obligation to report all rail-related incidents to OC Transpo's Safety, Compliance, Training & Development (SCTD) group. Reports and notifications are sent to OC Transpo's SCTD as per RTMs Incident Notification Matrix, (approved by OC Transpo's Chief Safety Officer (CSO)). OC Transpo notifies TSB of all rail-related incidents.</p> <p>All Incidents to date have been reported and corrective measures instituted, moreover, RTM recognizes that additional enhancements to procedures and training related to the nature of these incidents require an operational gaps analysis review. RTM has itemized actions related to incident reporting, launch maneuvers etc. as per of their</p>		



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own internal “Key Deficiencies Affecting Service Availability”- Action List as presented to their EXCO on March 07, 2020.

Remedy/Rectification Activity Schedule	2020												
	Scheduled Completion	1	2	3	4	5	6	7	8	9	10	11	12
Mitigation/Containment of Current Incidents	Complete	X	X	X									
RTM/ALSTOM workshop challenges/risks for movement of rail-borne equipment (Yard)					X								
Procedural Review					X	X							
Revisions to existing procedures							X	X					
Training Gaps Analysis						X							
Training Curriculum revisions							X						
Training Refresher roll-out								X	X				
RTM/Alstom “Rail Safety Group Committee”					X	X	X	X	X	X	X	X	X

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City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)14	<p>Additional Infrastructure Issues: A series of additional technical and organizational issues related to infrastructure and infrastructure maintenance have been noted by our operations team which require resolution in order to ensure the success of the maintenance team moving forward. The City requires that RTG provide an action plan and schedule to bring these issues to resolution:</p> <p>ii. Maintenance Facility Yard: A plan for UTO Operations in the Yard may help to reduce these incidents.</p>	OLRTC

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
The UTO operations in the yard have been protracted as a result of a number of issues.	RTM is managing the yard with hostlers moving vehicles under the direction of the YCC and supervisory staff.	Install equipment, test and commission.

Background and Summary

UTO

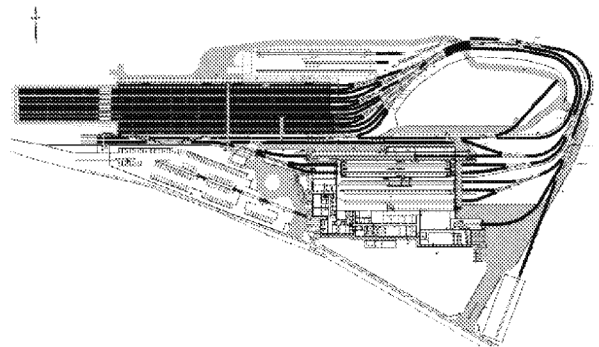
All of the wayside equipment that is available is already installed in the yard. At present the only outstanding equipment to install is the WRU's which are coming from China (already delayed due to Covid19) and the Zone Controller.

UTO in the yard progress is restricted by the testing and installation of the mainline CBTC software. The Zone Controllers all have to have the same software version due to the boundaries. The UTO in the yard is reliant on the mainline software being at 6.1. Until such time as the mainline is updated and operational, the development of the software for the UTO is limited.

There is also a requirement for the staff in the YCC and the yard to be trained in UTO operations. Events have proved that training, and then not operating, results in a requirement for retraining due to lack of knowledge retention.

Additionally, UTO operations in the yard will have an impact on the ability to move commissioned and non-commissioned trains.

Timescales for having the yard fully commissioned in UTO are therefore dependent on the access to the mainline to update the CBTC system, plus that access regime during the day in the yard. At present the UTO function in the yard is at least 12 months out. From the implementation of SW Build 6.1 on the mainline.



Remedy/Rectification Activity Schedule	2021												2022											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mitigation - Current yard Operation	X	X	X	X	X	X																		
UTO estimated integration						X	X	X	X	X	X													
Procedural Review (Working Group)						X	X																	
Update YCC Operational Manuals							X	X																
Revisions to existing procedures for UTO							X	X																
Training Curriculum revisions for UTO							X	X	X															
Training roll-out for UTO									X	X	X													
Safety Certification											X													

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)14	<p>Additional Infrastructure Issues: The City requires that RTG provide corrective action plans and schedules to bring these technical issues related to additional infrastructure (i. through viii.) to resolution.</p> <p>ii. Track Maintenance - Noise & Vibration - The level of noise and vibration that is felt by Trains traveling through the Hurdman S-curves appears to have been left unchecked by maintenance staff. The noise and vibration in this area need to be assessed by RTG in order to reasonably confirm compliance with the Project noise and vibration limits.</p>	OLRTC

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
There have been reports that the Curve entering Hurdman station, experiences of high levels of noise and vibration (which is not unusual for an LRT system).	The Citadis Spirit Vehicle is equipped with Self Lubricating System designed to disburse a rail wheel interface media to mitigate noise levels. RTM track inspection and localised hand lubrication	OLRTC to investigate existing noise levels (N&V Specialists) and provide recommendations for a maintenance application

Background

Further, investigation has concluded the requirement to engage Noise and Vibration Specialists to accurately capture noise levels through proper instrumentation. Tests will verify dB Noise levels as they apply to complying with the PA. The analysis will allow all the key stakeholders to determine the correct course of action (if required) to implement noise mitigation strategies and maintenance that are not exhaustive to the following:

- Rail grinding and/or milling
- Wayside Automated Lubricator

The track geometry through the curves at Hurdman includes, as part of the design, super elevation. The noise that is heard in these curves is partly a result of that super elevation. The track and vehicle met the criteria for noise and vibration prior to RSA.



RTM under instruction from OLRTC will undertake some localised track lubrication on the approaches to the Hurdman curves to see if there is an improvement. Once this has been completed, if it is deemed to have improved the situation, then this needs to become a regular maintenance activity. There could also be an option to install additional wayside flange lubricators, although these were not part of the original design and have not been identified as being required.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mitigation – localised track lubrication					X	X		X		X		X												
Secure 3 rd party Noise Specialists						X																		
Instrumentation and Testing Period						X	X																	
Report findings with recommendations based on noise levels (PA Compliant)							X																	
Stakeholder agreement on rectification method (if required)							X																	
Implement noise rectification solution										X														

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b)14	<p>Additional Infrastructure Issues: The City requires that RTG provide corrective action plans and schedules to bring these technical issues related to additional infrastructure (i. through viii.) to resolution.</p> <p>ii. Track Maintenance - Neutral Temperature: RTG's long term plan for management of the rail neutral temperature needs to be revisited. We have encountered rail breaks and an ongoing need to adjust the neutral temperature of the rail. An update on the long-term strategy in this area is required.</p>	OLRTC RTM

Background/Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
Last summer we had rail kinks, and at the beginning of winter there were welds that pulled apart	Stress relief cuts and additional rail last summer. Rail removal in winter	Ongoing monitoring and track maintenance

Background

It is true that the Confederation Line, like most LRT systems, adopts a lower neutral temperature than heavy haul or mixed traffic systems. This is to balance the stresses and minimize the gap size should a rail break occur. The trade off is more compressive stress in the summer and therefore, a more "twitchy" track which requires attention in hot temperatures. This trade off is deemed reasonable because LRT networks have the ability to address track works more readily along their entire ballasted track length as compared to the longer mainline rail networks, and as ride quality considerations are important to for commuter passenger carrying service.

It is not possible to change the neutral temperature without permitting larger rail gaps to creep onto the bridges. Further, a higher neutral temperature would result in increased geometric faults in areas of tight curvature in the winter because reducing stress in the summer increases it in the winter. We do not recommend this approach.

The recommendations of the Trackwork Engineer of Record, per memo REJ-06-0-0000-MEM-0366, on managing the track adjustments to neutral temperature will be followed. An action plan from RTM will be prepared to guide the required works for Spring 2020.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Neutral Temperature Action Plan					X																			
Schedule for rectification					X	X																		
Sign-off by Trackwork Engineer						X																		

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b)14	<p>Additional Infrastructure Issues: The City requires that RTG provide corrective action plans and schedules to bring these technical issues related to additional infrastructure (i. through viii.) to resolution.</p> <p>i. Winter Operations - Staffing: <i>Despite countless meetings and workshops on this issue, there is still an ongoing concern that RTG is not staffing appropriately to deal with winter events and simply reallocates staff within the organization to meet expectations. The strategy to reallocate staff rather than increase staffing levels for major events has not been effective.</i></p>	RTM Alstom

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
Due to the unforgiving Winter Conditions, Assets have been exposed to harsh conditions that intermittently prevent normal operation (e.g. disturbed switch). Resourcing allocation for adequate response time has met some challenges.	RTM developed protocols in the later stages of the 2020 winter season, derived from their Adverse Weather Protocol Draft Plan. The Plan is premised on Industry Best Practice mitigation strategies to protect assets and service from Adverse Weather Conditions, similar to the harsh Ottawa winter climate. New Maintenance Techniques for Switch cleaning and clearing have shown positive results and will be incorporated as standard calls out when certain thresholds are triggered from the plan.	<p>Adverse Weather Protocol Plan</p> <ul style="list-style-type: none"> - Resource allocation for critical asset performance monitoring and response time. - Introduce Asset Condition preservation and snow fighting measures for extreme weather events ('Storm Trains', Switch De-Icer application)

Background/Summary

The weather conditions combined with some asset reliability (switch heaters) issues have contributed in high demands of resources on stand-by for service availability support and protection of assets. This has created several challenges related to disbursement and allocation of resources. These gaps have been flushed out through resource planning reviews 48hours prior to storm events and other storm mitigating strategies as will be further enhanced in RTM's Adverse Weather Protocol Plan that is currently under development.

More importantly, it is important to note that a holistic approach to battle winter storms is a more strategic and tactful method as the Plan will demonstrate and include combining some of the following:

- Staffing matrix defining location and activities
- improved technology (e.g. heater ducts)
- SCADA Monitoring of Switch Heaters
- innovative methods (snow blower packs) for clearing snow
- activity triggered criteria based on objective definitions of adverse weather from Environment Canada. (As referenced below)
- pre/post maintenance activities



Several of these new strategies have been informally introduced conceptually into RTM's Adverse Weather Protocol Plan and were executed in one of the last heavy snow falls (50cm) that happened in February 24-27th 2020. Positive results from the execution of the plan by activating the key maintenance and resourcing alignment with the Weather condition criteria (see graphic below).



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Success Factors

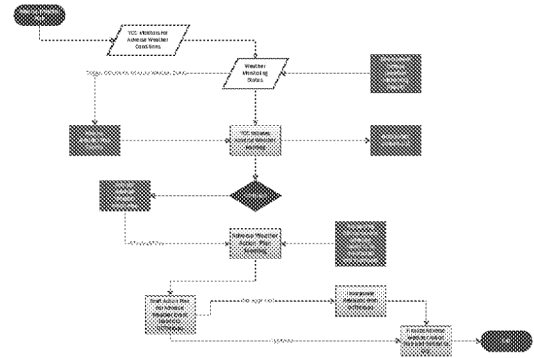
Our most recent major storm event in the last week of February, as noted in the daily operating reports for that week, indicated only one switch failure on Feb. 27.

The plan encompasses all of these tactful strategies noted above and focus will be to remove any subjectivity related to resource assignment and strategic allocation to protect service and assets. Continued development and enhancement of the plan is scheduled throughout the remainder of the year in preparation for a full roll-out in advance of next winter season.

This will encompass crafted workshops with key stakeholders required to manage and control these adverse events to ensure roles and responsibilities are well defined and hierarchy of protocols are established.

Concurrence from the working group will be inputs into the Plan and will be introduced in a full roll-out for next winter season, including strategic staffing. Anticipated improvements in reliability of assets demonstrated in the overall Remedy/Rectification plan in particular vehicle and infrastructure related will further allow RTM to examine distribution of resources more effectively from a planned perspective not reactive.

System Assets	Activities	Weather Event											
		Pre-Event	Event	Post-Event	Event	Post-Event	Event	Post-Event	Event	Post-Event	Event	Post-Event	
Vehicle	Deploy "Storm Teams" Monitor "Storm" "Bridges" Type 2 Braking (Winter) Monitor Flexible Pk	X	X	X	X	X	X	X	X	X	X	X	X
Stations	Rolling Platforms and construction Snow clearing Activate Platform Head Traces Monitor Platform Overhead Heaters Monitor Air Circulation (Space Equipment) Denies Snow - Conductor Services	X	X	X	X	X	X	X	X	X	X	X	X
WFO	Monitor Check of GIS data entry Advanced Snow clearing of Substations Coordinate GIS (post-event weather)	X	X	X	X	X	X	X	X	X	X	X	X
ATP and T&I	Snow clearing and access walkways Salt sand access rail lines Snow clearing ATP weather walkways and for Salt/MS Accessory Walkways Safe Zones (Plants)	X	X	X	X	X	X	X	X	X	X	X	X
Track/Substns	Test all critical switches Clean Mainline switches Clean T&I Switches	X	X	X	X	X	X	X	X	X	X	X	X
Snow Rail Equipment Fenced Air Biscuits S&I Equipment	Perform Operational Service Check Perform Operational Service Check Substation Snow removal test and Goldilocks	X	X	X	X	X	X	X	X	X	X	X	X



Remedy/Rectification Activity Schedule	2020												
	Scheduled Completion	1	2	3	4	5	6	7	8	9	10	11	12
Adverse Weather Protocol Plan		X	X										
Establish stakeholder Working Group					X								
Concurrence on Activation Protocol						X							
Concurrence on strategic and skilled resourcing allocation for service critical assets							X						
Final Version of Adverse Weather Plan								X					
Full roll-out and Training									X				

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity											
b)14	<p>Additional Infrastructure Issues: The City requires that RTG provide corrective action plans and schedules to bring these technical issues related to additional infrastructure (i. through viii.) to resolution.</p> <p>vi. Stations - Cleanliness: appropriation of cleaning and janitorial services to a level of satisfaction comparable to other transit agencies.</p>	RTM											
Problem Statement	Containment & Mitigation	Solution Proposal/Rectification											
There are challenges with the station design, specifically waste disposal collection and vandalism of bathrooms that are drawing on resources and affecting quality of cleanliness. Frequency for monitoring and auditing of cleanliness needs to be increased.	RTM has engaged their cleaning subcontractor their cleaning subcontractor to address the quality of cleaning. Recent events related to COVID_19 have permitted increased levels of cleaning through City Variation but is not sustainable and only directed as an initiative for RTM's Pandemic Protocol.	RTM is working with their cleaning subcontractor to clarify PA Obligations for Cleaning Standards and will reinforce the quality of cleanliness through an enhanced auditing regime. In addition, the cleaning subcontractor is to provide RTM with their revised auditing regime that is aligned with RTM's expectations.											
Background/Summary													
<p>A Workshop and joint Station by Station review with Cleaning Subcontractor President and RTM Facilities Manager flushed out some of challenges encountered by them and their staff, specifically 4 main issues:</p> <ol style="list-style-type: none"> 1. High volume of vandalism in washrooms 2. Volume Size of the Garbage cans are undersized for the capacity of Ridership 3. Staffing Allocation and Supervisory Monitoring <p>Staffing allocation, rotation and overlapping were identified as areas that needed attention, more specifically was an absence of Supervisory coverage and inspection of their staff's work. The walkthrough revealed there were high volumes of vandalism drawing resources away from day-day cleaning activities. Increased resourcing for these events will be part of the subs plan.</p> <p>Expectations were understood and more frequent auditing is underway.</p> <p>Ongoing discussions through more frequent engagement with RTM's sub will include some innovation initiatives:</p> <ul style="list-style-type: none"> • Bar Coding Swipe Card System – Ability to determine staff's location and completion of work at assigned stations. • Enhanced Quality Audit Program - Supervisors to do more quality checks through a more structured auditing process. 													
Remedy/Rectification Activity Schedule	2020												
	Scheduled Completion	1	2	3	4	5	6	7	8	9	10	11	12
Mitigation/Containment (COVID_19 Protocol)	Ongoing	X	X	X	X								
Enhance Cleaning Quality Audit Program				X	X								
Implement Cleaning Quality Audit Program					X	X							
Bar Code Swipe Card System						X	X						
<p>Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.</p>													



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)14	Additional Infrastructure Issues: The City requires that RTG provide corrective action plans and schedules to bring these technical issues related to additional infrastructure (i. through viii.) to resolution.	OLRTC
	vii. Tunnel and Underground Stations - Leaking: Multiple tunnel leaks need to be reviewed and modifications undertaken.	

Background/Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
Ongoing water ingress into the tunnel and underground stations.	Temporary drainage solution installed until late spring when injection can recommence	Further injection of waterproofing materials Continue monitoring

Background

OLRTC has installed a temporary drainage material to divert water away from the crown of the tunnel and to the track bed and drainage system.

The injection materials will continue to be injected once the winter is over. The materials and their performance require higher ambient temperatures than we are still experiencing.

The materials and crews for performing this work, travel from outside of Canada, as such the timeframe for this work cannot be defined at present.

Once the tunnel is injected, remedial works will be undertaken to any station décor that requires repair.

Note that the injection product and installers originate from outside Canada. Given the present situation OLRTC is unable to confirm an exact start date at this time.



Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mitigation (soffit troughing) water management at construction joints	X																							
Grout Injection (TBD)																								

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)14	Additional Infrastructure Issues: The City requires that RTG provide corrective action plans and schedules to bring these technical issues related to additional infrastructure (i. through viii.) to resolution. viii. Above Ground Stations - Roof Design: Safety Concern with falling ice from rooflines onto public areas to reviewed and modifications undertaken.	OLRTC RTM

Background/Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
The City has reported that snow and ice falling from rooflines is a safety concern Predominantly at Hurdman Station due to architectural approved roof design.	RTM has included this in their winter snow clearing scope and installed signs "Watch for falling snow and ice" to clear snow and install signage	Appropriate winter maintenance and signage to continue as part of snow clearing scope

Background

After heavy snow falls there will be areas that need to be maintained. Snow will sit in areas not normally prone to snow accumulation i.e. window ledges, ladder access supports, roof Parapets, and in this case fascia flashing. OLRT-c has installed snow guards everywhere snow will commonly accumulate and is safe to support the load of snow.

Unfortunately snow guards will not work on the Hurdman/Other Fascia, as you do not want to hold up snow this close to the edge. This is nearly a vertical surface, even with a snow guard in place with enough accumulation the snow ledge will fail with ice accumulation.

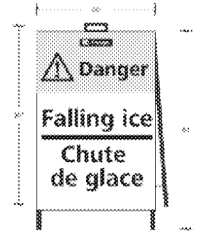
Snowguards are prohibited in the following areas according to the "International Association of Certified Home inspections" as well as RTGEJV engineered design requirements, for safety and warranty purposes.

Snow guards should not be mounted beyond the bearing wall on an extended roof section, as this placement can result in ice damming and roof damage. (As seen at Hurdman)



There should not be more snow guards installed than are necessary, as they will allow too much snow to accumulate and damage the roof. Snow guards should be installed in the critical areas but not necessarily in areas where snow and ice can be released safely onto the ground by gravity and natural warming.

Realizing over hanging snow was a problem RTM increased monitoring at all stations looking for conditions of overhanging snow or icicle formations. Hurdman Station was the only one we RTM had to address this winter. It must be noted that due to station and roof design there are some areas that are extremely difficult to access (refer to photo).



RTM put Signs in place to keep customers aware and away from the areas prone to falling snow/ice.

RTM also adapted a method for overhead lights along the platform edge. These would also accumulate snow and be subject falling near passengers. RTM developed a method to remove snow from these and did so regularly.

Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Continued snow removal	X	X	X							X	X	X	X	X	X									

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
b)14	<p>Additional Infrastructure Issues: The City requires that RTG provide corrective action plans and schedules to bring these technical issues related to additional infrastructure (i. through viii.) to resolution.</p> <p>ix. Platform Heat Trace: Heated areas are continually tripping out due to fault and the final implementation of heat trace locations does not match the design in many places. These areas need to be reviewed and modifications completed.</p>	OLRTC RTM

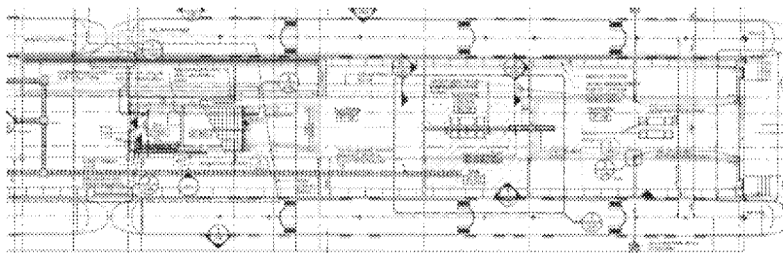
Background/Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
The City has reported that the system keeps tripping out	RTM to clear snow from platforms without heat tracing as per current practice	<p>Review of installation, maintain system and clear snow.</p> <p>Repair Deficiencies on Heat Trace before next winter season.</p>

Background

Heat Trace/Snow Melt to the platforms, was installed as a decision between OLRTC and RTM. This decision was based on the whole life cost of clearing snow from platforms.

RTM continues to ensure platforms are cleared as part of contractual obligations and activities associated with adverse weather protocol initiatives, in particular those platforms that have faulty snow melting. However active snow melt would allow for better disbursement of staffing across the alignment as was intended with the whole life cycle costing savings initiative.

RTM will continue to work closely with OLRTC in advance of the next winter season to have warranty repairs addressed. There is ongoing dialogue with the parties to ensure areas of non-effective heat tracing are identified including marked up drawings to bring clarity to the supplier.



Remedy/Rectification Activity Schedule	2020												2021											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mitigation - Continued Snow Clearing	X	X	X							X	X	X	X	X	X							X	X	X
Warranty Repairs to by supplier				X	X	X	X	X																

Notes: Due to the significance and unpredictability of the COVID-19 Pandemic the total impacts including resource availability and supply chain are not known at time and as such we are not in a position to commit to specific commencement dates. We are advancing the mitigations to the extent possible in the interim and the schedule above includes valid durations, however a fixed schedule will be determined once the delays attributed to COVID-19 are determined.



City Ref.	Remedy/Rectification Requirements	LEAD and Responsible Entity
Pg. 8 Par. 2	<i>The City expects that RTG, in its delivery of its remedial plan and schedule, will identify and disclose any other known issues that it is actively working on to improve the performance of the system and to remedy faults.</i> <i>RTM Maintenance and Rehabilitation Quality Management Plan</i>	RTM – HSQE Manager, RTM - QA Specialist ALSTOM - PrQSM

Problem Statement	Containment & Mitigation	Solution Proposal/Rectification
DOCUMENT and QUALITY CONTROL Document control procedures have not been fully implemented within RTM. RTM and Alstom have struggled to meet the requirements of Schedule 11 due to a lack of resources. Non-conformance processes require improved implementation and reporting structure	Changes to the method and format for saving documents required to demonstrate compliance to ISO standards was completed. Improvements to NCR, internal audit checklist and audit report forms was completed. An updated audit plan was submitted to the City on March 10, 2020	Establish a reporting structure with Alstom regarding non-conforming parts for vehicles and infrastructure. Establish a part inspection program for RTM Complete a review of RTM Quality Management System documentation and processes

Background

RTM has developed a Maintenance and Rehabilitation Quality Management Plan (MRQMP) that details the quality processes that RTM intends to employ in the maintenance and rehabilitation of the system, written in accordance with the requirements of Appendix D to Schedule 11 of the Project Agreement. This plan is intended to outline and describe the quality processes and procedures and supporting systems that will be used in the maintenance and rehabilitation of the Confederation Line, in compliance with the ISO 9001:2015 standard, RTG's Quality Manual, and the provisions of the Project Agreement. This plan will apply to all employees and subcontractors working for Rideau Transit Maintenance.

City Ref.	Business Method Improvement	Rectification Objective	RTM LEAD	2020												
				1	2	3	4	5	6	7	8	9	10	11	12	
b) 14	NCR Conformance- ensure active management processes are in place to manage issuing, tracking and reporting of non-conformance reports (NCR) with respect to vehicles and infrastructure parts, RTM parts and the result of process audits	Review of Non- Conformance SOP				X	X									
		Development of an NCR reporting structure between Alstom and RTM						X								
		Implementation of an RTM incoming inspection program								X	X					
		Training complete								X						
b) 14	Configuration Management All documentation, drawings and standard operating procedures available at the correct revision, with audit trail in place for previous changes	Revisit existing processes					X									
		Identify gaps in documentation					X									
		Develop SOP and Protocols						X								
		Roll-out and Train relevant Staff								X						
b) 14	Quality Control System All activities documented with audit processes to ensure sustainable performance in line with relevant quality requirements/standards as per Schedule 11 of PA agreement	Review existing Quality Management System SOPs and supporting documents			X	X	X	X								
		Addition of RTM Quality Specialist					X									
		Improvement plan created for gaps							X							
		Improvements woven into maintenance regime and Business Methods								X	X	X				
		Training complete								X						
		2020 RTM QMS Audit Plan				X	X	X	X	X	X	X	X	X	X	X
Compliance audit of RTM's QMS by a 3 rd party										X						

OTTAWA LRT PROJECT

REMEDY-RECTIFICATION DRAFT MASTER SCHEDULE March 31, 2020

Activity ID	Activity Name	OLRTC-Responsible Entity & Lead	Schedule Priority	2020												2021					2022						
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
REMEDY-RECTIFICATION DRAFT MASTER SCHEDULE March 31, 2020				-----●-----																							
b) OTHER REQUIREMENTS				-----●-----																							
1. Vehicle Power Systems - Power Systems				-----●-----																							
Inductor Failures				-----●-----																							
04	Containment/Mitigation	ALSTOM	1	-----●-----																							
05	Interim (vented Lid) Top Cover(unpainted)	ALSTOM	1	-----●-----																							
06	Cleaning of compartment & Inductors	ALSTOM	1	-----●-----																							
07	Replacement of Top Cover (painted)	ALSTOM	1	-----●-----																							
08	Qualification of Improved Inductors	ALSTOM	1	-----●-----																							
09	Dynamic test (if needed)	ALSTOM	1	-----●-----																							
10	Replacement of Inductors	ALSTOM	1	-----●-----																							
2. Overhead Catenary System (OCS) - Wire Failures				-----●-----																							
Wire Failures (Parafils)				-----●-----																							
13	Preliminary Inspection (Report)	OLRTC	1	-----●-----																							
14	Full System Analysis	OLRTC	1	-----●-----																							
15	Mitigation - Prioritize & Replace Key Areas	OLRTC	1	-----●-----																							
16	Reconcile Findings & complete all Repairs	OLRTC	1	-----●-----																							
17.1	Institute Supporting OEM Maintenance	OLRTC	1	-----●-----																							
17.2	Institute Supporting OEM Maintenance	OLRTC	1	-----●-----																							
3. Overhead Catenary System (OCS)				-----●-----																							
Rigid Rail Failure				-----●-----																							
20	Mitigation (Inspection)	OLRTC	1	-----●-----																							
21	Investigating Rigid Rail Protective cover	OLRTC	1	-----●-----																							
22	Briefing/Training of Power techs	OLRTC	1	-----●-----																							
23	Supporting OEM Maintenance Regime	OLRTC	1	-----●-----																							
4. Overhead Catenary System (OCS)				-----●-----																							
Pantograph Integration				-----●-----																							
26	Preliminary Inspection (Report)	OLRTC	1	-----●-----																							
27	Full System Analysis	OLRTC	1	-----●-----																							
28	Mitigation - Prioritize & Replace Key Areas	OLRTC	1	-----●-----																							
29	Reconcile Findings & complete all Repairs	OLRTC	1	-----●-----																							
30.1	Institute Supporting OEM Maintenance (Seasonal Maintenance) requirements	OLRTC	1	-----●-----																							
30.2	Institute Supporting OEM Maintenance (Seasonal Maintenance) requirements	OLRTC	1	-----●-----																							
5. Traction Power System Integration				-----●-----																							
Itemize Failure Modes, deem method to test & repair LC, APU, HSCB & TCMS				-----●-----																							
33	Line Contactors modification	OLRTC - ALSTOM - TASKFORCE		-----●-----																							
34	HSCB interlocking sequence (MPU software)	OLRTC - ALSTOM - TASKFORCE		-----●-----																							
35	Auxiliary Power Units (CVS) - Software Mitigation	OLRTC - ALSTOM - TASKFORCE		-----●-----																							
36	CVS Root Cause still under investigation	OLRTC - ALSTOM - TASKFORCE		-----●-----																							
37	TCMS (addressed under HSCB)	OLRTC - ALSTOM - TASKFORCE		-----●-----																							
6. Switch Heater Rectification Plan				-----●-----																							
Heating Capacity Increase				-----●-----																							
40	Containment & Mitigation	OLRTC	1	-----●-----																							
41	Ducting & Insulation	OLRTC	1	-----●-----																							
42	Adverse Weather Plan (refer to city ref b12 v.)	OLRTC	1	-----●-----																							
42.1	SCADA Monitoring	OLRTC	1	-----●-----																							
42.2	Side Nozzle & Access Gates	OLRTC	1	-----●-----																							

OTTAWA LRT PROJECT

REMEDY-RECTIFICATION DRAFT MASTER SCHEDULE March 31, 2020

Activity ID	Activity Name	OLRTC-Responsible Entity & Lead	Schedule Priority	2020												2021												2022											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar									
				Gantt Chart (Month/Day)																																			
43	Research for Other Alternatives (Gas and Heat Trace)	OLRTC	1																																				
7. Vehide HVAC																																							
Supplementary Heating & Cooling of Operator Cab area																																							
46	Modification for Heater Insulation	ALSTOM	1																																				
47	Sensor Relocation	ALSTOM	1																																				
48	Change Booster Diode (10V)	ALSTOM	1																																				
49	Booster Duct Modification	ALSTOM	1																																				
50	Adhesive Film Protection	ALSTOM	1																																				
51	Driver manual Upgrade	ALSTOM	1																																				
52	Develop (Winter/Summer) Seasonal Maintenance Activity procedure	ALSTOM	1																																				
53	Roll-out Training for Trades	ALSTOM	1																																				
8. Vehide Braking Systems - Integration Issues																																							
Misc. Issues																																							
56	GIDS software upgrade - RTM	TASKFORCE																																					
57	Implementation Thales 6.1 software	TASKFORCE																																					
58	Vehide tuning campaign	TASKFORCE																																					
59	Brake rate change request, then 3 to 4 months lead-time forecasted (discussion with City)	TASKFORCE																																					
9. Vehide Door Performance																																							
Misc. Issues																																							
62	Door software documentation to assessor	ALSTOM																																					
63	SIL2 certification	ALSTOM																																					
64	Implementation over the fleet	ALSTOM																																					
65	FMI implementation for Door isolation	ALSTOM																																					
66	Operation review (door procedure workshop)	ALSTOM																																					
67	Door Isolation & Recovery Procedure revision	ALSTOM																																					
68	Door Isolation & Recovery Refresher Training	ALSTOM																																					
10. RTG/RTM Performance Reporting - IMIRS																																							
i.																																							
71	RTM/City KPM workshop	RTM	2																																				
72	IMIRS Temporary Repair config changes	RTM	2																																				
73	RTM/City to finalize Contract Management SOP	RTM	2																																				
74	Training to persons who create work orders, focusing on clarity & detail	RTM	2																																				
ii.																																							
76	RTM to produce IMIRS & TPMS Functional Description document	RTM	2																																				
76.A1	Reformatted Payment Adjustment Report	RTM	2																																				
76.A2	TPMS and IMIRS cybersecurity audit	RTM	2																																				
76.A3	RTM IT Disaster Recovery Plan	RTM	2																																				
iii.																																							
78	Workshop of Service Affecting Failures criteria	RTM	2																																				
79	Provide preliminary monthly reliability & maintainability reporting	RTM	2																																				
80	Review IMIRS attributes & identify gaps	RTM	2																																				
81	Detail & implement IMIRS attribute enhancements	RTM	2																																				
82	Prepare a revised Maintenance & Rehabilitation Plan (Draft, Final)	RTM	2																																				
11. Guideway Intrusion Detection System (GIDS)																																							
False positive activation resulting in unwarranted EB applications																																							
85	Firmware Upgrade	OLRTC - THALES	1																																				
86	Software Upgrade	OLRTC - THALES	1																																				

OTTAWA LRT PROJECT

REMEDY-RECTIFICATION DRAFT MASTER SCHEDULE March 31, 2020

Print Date: 24-Apr-20

Activity ID	Activity Name	OLRT-Responsible Entity & Lead	Schedule Priority	2020												2021					2022						
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12. Additional Vehicle Issues																											
i. VOBC Reliability																											
89	Investigate Repeat Vehicles (if required)	ASTOM	1																								
90	VOBC issues to be addressed in 6.1 Software	ASTOM	1																								
ii. Sanding System																											
92	Sand Delivery System Inspection (Daily)	ASTOM	2																								
93	Procure the Correct Sand	ASTOM	2																								
94	Expend remaining sand by next winter season	ASTOM	2																								
95	Ensure new sand media is loaded into the fleet	ASTOM	2																								
96	Preventative Maintenance Adverse Weather Regime to include Sander nozzle clearing	ASTOM	2																								
iii. Compressor Performance																											
98	Type test report	ASTOM	1																								
99	Retrofit on stage 1 vehicles (to be organised)	ASTOM	1																								
iv. Bogie Retrofit																											
101.1	Bogie Retro-fit Program	ASTOM																									
101.2	Bogie Retro-fit Program	ASTOM																									
v. Driver Cab Door Program																											
103	2nd Prototype	ASTOM																									
104	Fatigue Test of New Door	ASTOM																									
105	Launch Serial Production	ASTOM																									
106	First batch of parts scheduled in Ottawa	ASTOM																									
107	Fleet Retrofit (Scheduled 4 LRVs per week)	ASTOM																									
108	Completion of "in-use" vehicle retro-fit	ASTOM																									
vi. Spare Parts Stock Level vii, Staff Levels																											
110	Operation Director Recruitment	ASTOM	1																								
111	Strengthen Supervisory Positions	ASTOM	1																								
112	Forming of the Steering committee	ASTOM	1																								
113	Forming of RTG/RTM/OLRTC resource working groups	ASTOM	1																								
114	Subject Matter Specialist Support	ASTOM	1																								
13. Additional System Issues																											
i. Signal System																											
117	Testing	OLRTC - THALES																									
118	Safety Validation	OLRTC - THALES																									
119	Final Installation	OLRTC - THALES																									
ii. CCTV Wayside Onboard Vehicle: iii. Public Address & Passenger Information System																											
121	(Safety Review Meeting with City, necessity of Spotters)	ALSTOM - OLRTC																									
122	New software release (change VOBC variables)	ALSTOM - OLRTC																									
123	Validation & dynamic test	ALSTOM - OLRTC																									
124	Implementation over the fleet	ALSTOM - OLRTC																									
iv. Next Train Arrival Messaging v. Passenger Counting System																											
126	Thales v6.1 update (as per section b13)	RTM - OLRTC - THALES																									
127	Vehicle APC software updates	RTM - OLRTC - THALES																									
128	Vehicle to Wayside APC data and comms validation	RTM - OLRTC - THALES																									
129	RTMAPC software configuration, commence passenger count reporting	RTM - OLRTC - THALES																									
14. Additional Infrastructure Issues																											
i. Maintenance Facility - LMB																											
132	Mitigation Procedure	OLRTC - RTM																									

OTTAWA LRT PROJECT

REMEDY-RECTIFICATION DRAFT MASTER SCHEDULE March 31, 2020

Activity ID	Activity Name	OLRT-Responsible Entity & Lead	Schedule Priority	2020												2021												2022						
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar				
133	REPLACED Existing Fused LMB Design	OLRTC - RTM																																
134	Technical/Working Committee	OLRTC - RTM																																
135	Design Architecture & Drawing Approval	OLRTC - RTM																																
136	Full Scale Prototype & Testing	OLRTC - RTM																																
137	System Certification & Engineer Sign-off	OLRTC - RTM																																
138	OEM Manuals & Procedural Revisions	OLRTC - RTM																																
139	Training Roll-out	OLRTC - RTM																																
ii. Maintenance Facility Yard																																		
a. The City has indicated a high number of Transportation Safety Board Reportable Rail Occurrences																																		
141	Mitigation/Containment of Current Incidents - Complete	RTM - ALSTOM	1																															
142	RTM/ALSTOM workshop challenges/risks for movement of rail-borne equipment (Yard)	RTM - ALSTOM	1																															
143	Procedural Review	RTM - ALSTOM	1																															
144	Revisions to existing procedures	RTM - ALSTOM	1																															
145	Training Gaps Analysis	RTM - ALSTOM	1																															
146	Training Curriculum revisions	RTM - ALSTOM	1																															
147	Training Refresher roll-out	RTM - ALSTOM	1																															
148	RTM/Alstom "Rail Safety Group Committee"	RTM - ALSTOM	1																															
b. A plan for UTO Operations in the Yard																																		
150	Mitigation - Current yard Operation - Ongoing	OLRTC	1																															
151	UTO estimated integration	OLRTC	1																															
152	Procedural Review (Working Group)	OLRTC	1																															
153	Update YCC Operational Manuals	OLRTC	1																															
154	Revisions to existing procedures for UTO	OLRTC	1																															
155	Training Curriculum revisions for UTO	OLRTC	1																															
156	Training roll-out for UTO	OLRTC	1																															
157	Safety Certification	OLRTC	1																															
iii. Track Maintenance - Noise & Vibration (Hurdman Curve)																																		
159.1	Mitigation - localised track lubrication	OLRTC - RTM	2																															
159.2	Mitigation - localised track lubrication	OLRTC - RTM	2																															
159.3	Mitigation - localised track lubrication	OLRTC - RTM	2																															
159.4	Mitigation - localised track lubrication	OLRTC - RTM	2																															
160	Secure Air noise Specialists	OLRTC - RTM	2																															
161	Instrumentation & Testing Period	OLRTC - RTM	2																															
162	Report findings with recommendations based on noise levels	OLRTC - RTM	2																															
163	Stakeholder agreement on rectification method (if required)	OLRTC - RTM	2																															
164	Implement noise rectification solution	OLRTC - RTM	2																															
iv. Track Maintenance - Neutral Temperature																																		
166	Neutral Temperature Action Plan	OLRTC - RTM	2																															
167	Schedule for rectification	OLRTC - RTM	2																															
168	Sign-off by Trackwork Engineer	OLRTC - RTM	2																															
v. Winter Operations - Staffing																																		
170	Adverse Weather Protocol Plan	RTM - ALSTOM	1																															
171	Establish stakeholder Working Group	RTM - ALSTOM	1																															
172	Concurrence on Activation Protocol	RTM - ALSTOM	1																															
173	Concurrence on strategic & skilled resourcing allocation for service critical assets	RTM - ALSTOM	1																															
174	Final Version of Adverse Weather Plan	RTM - ALSTOM	1																															

OTTAWA LRT PROJECT

REMEDY-RECTIFICATION DRAFT MASTER SCHEDULE March 31, 2020

Activity ID	Activity Name	OLRT-Responsible Entity & Lead	Schedule Priority	2020												2021												2022											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar									
175	Full roll-out & Training	RTM - ALSTOM	1																																				
vi. Stations - Cleanliness																																							
177	Mitigation/Containment (COVID_19 Protocol) (ongoing)	RTM																																					
178	Enhance Cleaning Quality Audit Program	RTM																																					
179	Implement Cleaning Quality Audit Program	RTM																																					
180	Bar Code Swipe Card System	RTM																																					
vii. Tunnel & Underground Stations																																							
182	Mitigation (Soffit troughing) water management at construction joints	OLRTC																																					
183	GROUT Injection -TBD	OLRTC																																					
viii. Above Ground Stations - Roof Design																																							
185.1	Continued snow removal	OLRTC - RTM																																					
185.2	Continued snow removal	OLRTC - RTM																																					
ix. Platform Heat Trace																																							
187.1	Mitigation - Continued Snow Clearing	OLRTC - RTM																																					
187.2	Mitigation - Continued Snow Clearing	OLRTC - RTM																																					
187.3	Mitigation - Continued Snow Clearing	OLRTC - RTM																																					
188	Warranty Repairs to by supplier	OLRTC - RTM																																					
RTM M&R Quality Management Plan																																							
190	NCR Conformance - Review of Non- Conformance SOP	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
191	NCR Conformance - Development of an NCR reporting structure between Alstom & RTM	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
192	NCR Conformance - Implementation of an RTM incoming inspection program	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
193	NCR Conformance - Training complete	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
194	Configuration Management - Revisit existing processes	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
195	Configuration Management - Identify gaps in documentation	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
196	Configuration Management - Develop SOP & Protocols	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
197	Configuration Management - Roll-out & Train relevant Staff	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
198	Quality Control System - Review existing Quality Management System SOPs & supporting documents	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
199	Quality Control System - Addition of RTM Quality Specialist	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
200	Quality Control System - Improvement plan created for gaps	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
201	Quality Control System - Improvements woven into maintenance regime & Business Methods	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
202	Quality Control System - Training complete	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
203	Quality Control System - 2020 RTM QMS Audit Plan	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
204	Quality Control System - Compliance audit of RTMs QMS by a 3rd party	ALSTOM - PrQSM; RTM - HSQE Manager; RTM - QA Specialist																																					
A) VEHICLES																																							
Active Containment & Mitigation																																							
207	Increase Vehicle Roster	RTG - OLRTC - RTM - ALSTOM																																					
208	LRV 37 & 38 (City approval)	RTG - OLRTC - RTM - ALSTOM																																					
209	LRV 39 & 40 (City approval)	RTG - OLRTC - RTM - ALSTOM																																					
210	Remedy/Rectification requirements	RTG - OLRTC - RTM - ALSTOM																																					
211	Finalize Master Schedule (Refinements)	RTG - OLRTC - RTM - ALSTOM																																					
212	Execute Key Rectification Actions	RTG - OLRTC - RTM - ALSTOM																																					
213	Finalize Reliability Forecast Growth Curve (final inputs from Taskforce and CVS root cause)	RTG - OLRTC - RTM - ALSTOM																																					
214	Stabilize resourcing/supply chain	RTG - OLRTC - RTM - ALSTOM																																					
215	Train Increase to 14	RTG - OLRTC - RTM - ALSTOM																																					
216	Full 15 trains	RTG - OLRTC - RTM - ALSTOM																																					

Deloitte Presentation - Summary of Findings Item	RTM Response
Contractual Obligation #1 - System Documentation Schedule 26: Records Provision, Section 1.3	
1.3 For all software Project Co shall provide sufficient information to allow a complete understanding of the functionality and interface requirements. The level of detail shall be sufficient to permit complete verification of all operational, reliability and safety criteria. All supporting design drawings and specifications shall identify the codes and standards with which the design is compliant. Software shall be formally managed using a source code configuration management tool.	IMIRS is not part of the System Infrastructure. IMIRS requirements are only referenced in Schedule 15-3. Although not a PA obligation, RTM recognizes the need for a comprehensive document which details IMIRS functionality. In this regard, RTM will create an IMIRS & TPMS Performance Reporting System Functional Description document which details system functionality, key user roles, data tables, data flows, configuration parameters, interfaces and performance report calculations.
Contractual Obligation #2 - Quality Management & Control Schedule 11 Quality Management - Appendix D: Maintenance & Rehab Quality Management Plan	
The MRQMP shall include a compliance monitoring process to track compliance with all performance measures. The performance measures compliance monitoring process must clearly describe the approach taken in assessing compliance, and define the frequency and method of monitoring and reporting such compliance. The City shall review Project Co's performance measures compliance monitoring process and may request changes that the City considers appropriate to facilitate the accurate and appropriate monitoring and reporting of compliance with the performance measures and otherwise to meet the requirements of this Project Agreement. Project Co shall promptly implement any such changes requested by the City. Project Co's performance measures compliance monitoring process shall be subject to ongoing review by the City throughout the Project Term.	IMIRS is not part of the System Infrastructure. IMIRS requirements are only referenced in Schedule 15-3.
Details of the Gap:	
There is only limited supporting documentation for a compliance monitoring process to ensure accuracy over TPMS and IMIRS calculations.	Although not a PA obligation, RTM recognizes the need for a comprehensive document which details IMIRS functionality. In this regard, RTM will create an IMIRS & TPMS Performance Reporting System Functional Description document which details system functionality, key user roles, data tables, data flows, configuration parameters, interfaces and performance report calculations.
Contractual Obligation #3 - System Review and Acceptance Testing Schedule 15-3 Maintenance and Rehabilitation Requirements, Appendix A Attachment 14: Operations and Maintenance Interface	Some applicability, as per Schedule 15-3 (see below detail). However, Acceptance Testing is not a requirement for IMIRS.
Project Co, in conjunction with the City, shall develop an Integrated Management Information Reporting System that combines service delivery and maintenance performance information and update this prior to the commencement of Maintenance Services on the Stage 2 East System and Stage 2 West System to incorporate these parts of the System. The plan for developing the Integrated Management Information Reporting System shall initially be provided to the City ten (10) months prior to the Required Revenue Service Availability Date, the scheduled Stage 2 East Revenue Service Availability Date and the scheduled Stage 2 West Revenue Service Availability Date for review in accordance with the review process described in Schedule 10 – Review Procedure.	An IMIRS Plan was submitted to the City, compliant with the Schedule 10 Review Procedure. Several reviews of this Plan were completed, via CRS (Comments Response Sheet), of which the last version "F", was issued Mar 7, 2019. All issues were either "closed" or "awaiting City review", except for Passenger Counts included with the Daily Operating Report, which is still outstanding. The formal CRS process was concluded for IMIRS Plan development though the CRS became a tracker for further development items beyond the Plan itself, and was administered by the City (Glen McCurdy)

Deloitte Presentation - Summary of Findings Item	RTM Response
Details of the Gap:	
There is insufficient evidence of a detailed and adequate acceptance testing plan for the detailed reviews and acceptance of the system.	IMIRS is not subject to Acceptance Testing. Acceptance Testing is a requirement of System Infrastructure, which IMIRS is not a part of.
As per Schedule 10, Project Co shall allow a period of 10 Business Days (or such longer period as the Parties may agree) from the date of receipt for review of and response to each Maintenance Submittal.	As part of the CRS reviews process, several demonstrations were held with the City,
Our understanding from the City was that RTG did not provide a sufficient plan and time for the City to conduct a detailed review of the IMIRS system, hence the current gaps in understanding some of the assumptions embedded into the calculations.	including demonstrations of TPMS functionality (meeting dates Jul 6, 2018 and Sept 28, 2018) and Performance Reports reviews (Meeting dates Mar 8, 2018, Mar 29, 2018, May 4, 2018, June 7, 2018, Jun 20, 2018, Jul 17, 2018, Aug 10, 2018). In addition, Monthly Reports reconciliation workshops were conducted with City representatives on Sep 21, 2018, Oct 5, 2018 and Oct 12, 2018. No issues were minuted during these meetings.
	Note: As a result of the Performance Reports reviews, several revisions were made at City's request and at RTM's expense, even though the original reports satisfied PA requirements.
	For example, the Daily Operating Report went through 7 revisions in format changes; some of these changes were reversed from earlier revisions incurring extra development cost.
	3. Pre-Trial Running of the IMIRS system commenced May 1, 2019, involving OCT, TOCC and RTM Yard Operations staff. City and RTM staff conducted Daily Operating Meetings during this pre-Trial Running period. This facilitated an extended period of "Live" IMIRS evaluations up to and including the Trial Running period.
Gap #1 - Inefficient Data Transfer	Not a PA requirement. However actions to be taken by RTM as noted below.
<ul style="list-style-type: none"> • Data is daily transferred from ATS to TPMS using files generated by the system of origin and imported and imported by the system of destination. 	RTM agrees that there is potential vulnerability in the IMIRS systems to cyber-attack. RTM will therefore conduct a cyber-security audit and develop a Disaster Recovery Plan for its business systems.
<ul style="list-style-type: none"> • In both processes, an automatic FTP (File Transfer Protocol) is used to transfer the files from the system of origin to the system of destination. 	
<ul style="list-style-type: none"> • A standard File Transfer Protocol does not provide any encryption for the data, leaving sensitive information exposed during the transfer process. 	
<ul style="list-style-type: none"> • An FTP server, which operates the data-transfer requests, is usually protected by a single, user-defined password, which is vulnerable to brute force attacks. 	
<ul style="list-style-type: none"> • By using Spoof Attacks (impersonating or assuming the destination address on the corporate network), or by gaining access to the communication port number for a given day (or the port selection algorithm), unintended individuals can download or replace the data being transferred. 	
<ul style="list-style-type: none"> • Aside for external attacks, the materialization of the data into backup files can allow changes in the information before it is imported into the system of destination, generating differences in databases that were intended to be identical. 	
Gap #2 - Insufficient Data Governance Processes	Not a PA requirement.
<ul style="list-style-type: none"> • In TPMS and IMIRS there are several instances of critical information that have material and long-term impacts on the payment mechanism. However, there is currently no formal and documented governance structure or processes to define the mechanisms and interaction points by which the addition or update of this information can be implemented data in neither TPMS nor IMIRS 	Access to payment mechanism data is currently restricted to System Administrator roles. Further, any updates or adjustments to KPM work order deductions or Failure Points can only be made by the System Administrator, based on mutual agreement with the City, as an outcome of the Daily Operating Meetings or Dispute Resolution, as the case may be.
<ul style="list-style-type: none"> • For this information, there is no formality regarding who should authorize, be consulted, or be communicated when changes on it are requested or required 	The IMIRS and TPMS Functional Description Document will provide a description of key user roles.

Deloitte Presentation - Summary of Findings Item	RTM Response
<ul style="list-style-type: none"> • There is no formal policy stating the documentation necessary to support requests to enter or update critical information, nor who should produce or validate such documents. • Currently, there is no formal necessity to register the update of critical information and as a result, it is impossible to track all the changes that have happened and who executed them. • There are no pre-established time-frames to request, analyze, and approve additions of critical information in both TPMS and IMIRS • The operational, financial and legal risk assessment processes regarding the changes in this information are currently unstructured and undocumented. 	
Gap #3 - Manual Interventions	Not a PA requirement.
<ul style="list-style-type: none"> • There are five cases in TPMS and IMIRS, in which critical information is manually inserted and/or updated thru the systems' applications: "Adjusted Revenue Kilometers", "Service Plans", "Financial variables of UASP", "KPM Schedule" and "Deduction Factors" • For all the cases, there is no approval framework embedded in the system to manage and log the authorization for updates or addition of information that can have critical impacts on the payment mechanism. • For all the cases, confidential information related to payment mechanism is currently not encrypted and is entirely exposed and available for edition through the software application. • For all the cases, the log mechanisms for updates are limited, don't capture enough information and are not easily accessible • For all the cases, there is no alert system to communicate updates to pre-determined stakeholders 	<p>Access to payment mechanism data is currently restricted to System Administrator roles. Further, any updates or adjustments to KPM work order deductions or Failure Points can only be made by the System Administrator, based on mutual agreement with the City, as an outcome of the Daily Operating Meetings or Dispute Resolution, as the case may be.</p> <p>The IMIRS and TPMS Functional Description Document will provide a description of key user roles.</p>
Gap #4 - Scheduled and Actual Kilometers Disparity	Fixes have been applied prior to Revenue Service, to address missing stations and revenue KM. See below.
<p>Although "Scheduled" and "Actual" Kilometers are directly compared with each other in TPMS, there is no guarantee that both of these numbers are calculated in the same way, which may generate discrepancies and inconsistencies in the data, as follows:</p>	
<ul style="list-style-type: none"> • Duplication of Stations – In multiple occasions, we noted that the TPMS data duplicated stations for each train. The Actual Revenue Vehicle Kilometers for the duplicated stations are appearing as zero and are not impacting the overall Actual Kilometers.. 	Issue has been corrected. Fix applied 2018-08-24, prior to Revenue Service.
<ul style="list-style-type: none"> • Skipping Stations – In multiple occasions, we noted that the TPMS data skipped stations for numerous train trips. 	Issue has been corrected. Fix applied 2018-08-24, prior to Revenue Service.
<p>Actual Kilometers:</p> <ul style="list-style-type: none"> • Actual Kilometers are calculated automatically by TPMS using as variables the number or trips, Departure Time, "Arrival Time," and the distance between stations. • "Departure Time" and "Arrival Time" are also calculations performed by TPMS using the events "Train is Moving," "Train is Stopped" and "Train is Routed" from ATS. • The calculation of "Departure Time" and "Arrival Time" respect a series of assumptions and specific rules that are embedded in the TPMS logical layer. 	<p>Please reference Daily Operating Reports; With fixes applied, and mutually agreed-upon process with City for calculating "Lost KM" allocation to causes, Lost KM's have been fully explained since October 2018.</p> <p>The difference between TPMS KM reporting based on station arrival vs CBTC KM reporting based on station departure can result in minor "Lost KM" adjustments. This adjustment, when it occurs, is defineable and is reported in the Daily Operating Report.</p>
	<p>Note: Delays in reconciling all Lost KM can be attributed, in part, to City not issuing Service Plan revisions, when service changes were implemented (eg. Increased dwell times).</p>

Deloitte Presentation - Summary of Findings Item	RTM Response
Gap #5 - Imprecise Work Order Questionnaire	How the IMIRS system assigns applicable KPM to a reported failure events is not subject to PA.
<ul style="list-style-type: none"> The current answers contained in IMIRS Work-Orders Questionnaire currently demand users to have extensive knowledge about the Project Agreement and the KPM Schedule to make a choice that correctly reflects the issues faced. 	Challenges with interpretation of the PA KPM were experienced by both the TOCC and the Help Desk. RTM continues to provide further training to Help Desk staff who are tasked with creating work orders.
<ul style="list-style-type: none"> Some of the answers currently available for the users are susceptible to a high degree of subjectivity. In some occasions, users filling Work Orders in IMIRS require clarity on an extensive number of issues occurring in a station, vehicle or track to select answers that will have the intended effect in the Payment Mechanism. 	On February 21, 2020, RTM provided to the City its interpretation of the most common KPMs. RTM awaiting a response. Agreement on KPM applicability is needed to address "clarity" issue.
<ul style="list-style-type: none"> Some of the currently available answers use business terms and sophisticated technical language that are not necessarily known by front-line professionals The answers for most of the questions are not MECE (Mutually Exclusive and Collectively Exhaustive), resulting in situations that can not be entirely reported with a single work order Not all the critical decisions related to Work Orders are currently associated with the questionnaire mechanism, forcing users to decide between terms that are not intuitive or easily distinguishable 	Question Sets ("Questionnaire") can be improved for greater clarity and better repeatability, with feedback from the Help Desk Operators, Daily Operating Reporting meetings and with agreement from City on KPM interpretation.
	The process to address incorrect KPM allocation arises from the Daily Operating Reporting meetings, with the result that the City and RTM either agree on the appropriate KPM for the work order event, or there is disagreement and the matter is resolved through the PA-specified Dispute process. When there is mutual agreement on adjustments to be made work order KPM's, Lost KM allocation, or Station Availability, the Daily Operating Report is adjusted and reissued for that operating day and for sign-off.
Gap #6 - Limited Validation Mechanisms	No specific PA references address IMIRS data validation methods and/or processes.
<ul style="list-style-type: none"> TPMS and IMIRS possess multiple instances of critical data that are inserted in the system via manual inputs, and in all cases, both systems accept any positive number as a valid value. 	TPMS data validity is checked daily, as part of the preparation of the Daily Operating Reports. This involves a reconciliation of Scheduled KM and Actual KM, as part of the "Lost KM" causal reporting.
<ul style="list-style-type: none"> Neither system possesses any mechanisms or reports to validate if the results of the calculations are within a pre-determined range of reasonable values. There are no checkpoints in the data-flow to check for consistency in the numbers, allowing even clearly suspicious values to be perpetuated until the end of the payment mechanism calculations. In the case of issues in the data transfer from ATS to TPMS or from TPMS to IMIRS, there are no quality control features in place to alert users about the absence of values in mandatory fields for the Payment Mechanism 	Assessments and validations done by the City, in comparing ATS to TPMS reported kilometers is no longer necessary. TPMS fix applied prior to Revenue Service has resulted in fully reconcilable Lost KM reporting. City personnel have persisted in this reconciliation activity beyond what was necessary to confirm TPMS and ATS are fully reconcilable.
<ul style="list-style-type: none"> There are no reports specifically designed to check partial or final results for consistency with previous time periods of time or any other benchmark numbers. There is currently no way to request a simulated "Payment Adjust Report" in IMIRS for a period inferior to a month, eliminating the possibility of validating financial deductions from Work Orders on a daily 	Fixed 2018-12-03. Due to the application of Schedule 20 revisions in mid-September, the capability to run mid-month Payment Adjustment Reports was added. Although split-month reporting is not a PA requirement, the cost for this additional development work was borne by RTM.
Key Examples:	
<ul style="list-style-type: none"> If an update in the "Annual Service Payment" is done in IMIRS after the payments for 	Updates are infrequent (once per year) and tables are only accessible by a single IMIRS role -

Deloitte Presentation - Summary of Findings Item	RTM Response
that year have started, the system will accept the new value and prompt no alerts even though it is a clear violation of the payment mechanism logic	the System Administrator. Given the control and frequency, risk should be deemed acceptable.
<ul style="list-style-type: none"> In the case a problem happens, and the data transfer files from TPMS to IMIRS contains no value for "Actual Kilometers", the file will be imported normally and no alerts will be prompted 	There exists automated error notifications from TPMS and IMIRS which are triggered by file transfer errors. Further, the daily evaluation and preparation of the Daily Operating Report will identify data errors.
<ul style="list-style-type: none"> There is no current way to validate the number of Service or Quality failure points and dollar deductions on a daily basis without the usage of an external spreadsheet 	This reporting is not a PA requirement. However, this validation is possible with data extract from IMIRS into Excel, if/when the need arises.
Gap #7 - Limited System Documentation	Although this is not a PA obligation, RTM recognizes the need for a comprehensive document which details IMIRS functionality, interfaces, report calculations, data sources and data flows.
<ul style="list-style-type: none"> From a system design and development perspective; both TPMS and IMIRS have limited system documentation. For both systems, the only existent document is the User Manual. 	A IMIRS & TPMS Performance Reporting System Functional Description document will be created by RTM which details IMIRS functionality, interfaces, report calculations, data sources and data flows. This document,
<ul style="list-style-type: none"> Even though these User Manuals include more information than what is commonly found in documents focused on the final user day to day operations, they are insufficient to provide clarity about critical components of the systems, such as their logical layers, database schemas or calculation mechanisms. 	in conjunction with the IMIRS User Manuals will provide the needed information to support training of new IMIRS "Super Users" and System Administrators.
<ul style="list-style-type: none"> A complete set of system documentation that is typically expected from similar developed software solutions would include the following documents, none of which exists for either IMIRS or TPMS: 	
<ul style="list-style-type: none"> Entities Relationship Diagrams (ERD) – to show the Database components and their integrations 	
<ul style="list-style-type: none"> Extract, Transform and Load Diagram (ETL) – to show the data transferred and transformed from ATS to TPMS 	
<ul style="list-style-type: none"> Sequence Diagram – to show the process flows across the system 	
<ul style="list-style-type: none"> Reports and Metrics Dictionary - to show how what calculations and data conversion are done in each report 	
<ul style="list-style-type: none"> Version Control Log – To indicate the currently deployed system version and show the history of changes, including features and bugs corrected in each version 	
Gap #8 - Limited Knowledge Transfer	Although this is not a PA obligation, RTM recognizes the need for a knowledge capture and transfer for the benefit of all IMIRS users.
<ul style="list-style-type: none"> There is currently no formal Knowledge Management process to assure that the knowledge about the operation as a whole and the usage of both IMIRS and TPMS will be perpetuated in the long-term. 	
<ul style="list-style-type: none"> There is no training plan in place to guarantee that new professionals can learn how to operate both systems correctly. 	The existing User Manuals form the basis of IMIRS training and have already been successfully utilized for training new users.
<ul style="list-style-type: none"> There is no formal process established to train other users in operations that are inherently manual and demand expert knowledge, such as the NPCC Kilometers Calculations. 	
<ul style="list-style-type: none"> There are no tools in use to capture and share the feedbacks of the users, nor the knowledge they gained during the daily usage of the software, 	
<ul style="list-style-type: none"> There are no documents or process in place to teach members of the management team how to read and interpret reports of both TPMS and IMIRS. 	A IMIRS & TPMS Performance Reporting System Functional Description document will be created by RTM which details IMIRS functionality, interfaces, report calculations, data sources and data flows. This document,
<ul style="list-style-type: none"> The manually executed backup for data transfer from ATS to TPMS and from TPMS to IMIRS are not documented or embedded in any training program. 	in conjunction with the IMIRS User Manuals will provide the needed information to support training of new IMIRS "Super Users" and System Administrators.
Gap #9 - Insufficient Reports on TPMS and IMIRS	All contractual reporting functions are available. Additional reports are not a contractual obligation.
<ul style="list-style-type: none"> Both systems currently contain only a limited number of reports that are not sufficient to allow users and other stakeholders to have a comprehensive understanding of the information. 	
<ul style="list-style-type: none"> There are no Reports in TPMS to trace the "Departure Time" and "Arrival Time" back to its original data 	

Deloitte Presentation - Summary of Findings Item	RTM Response
source in ATS, making it impossible for users to validate the information.	
<ul style="list-style-type: none"> The Reports on IMIRS are focused on final results, with no current reports showing step by step calculations of some critical variables of the payment mechanism. 	The City has been provided with real-time access to IMIRS, with ability to export IMIRS data from work order screens to Excel. Users with understanding of Excel spreadsheets will be able to sort, filter and sum KPM work order deductions and failure points for the chosen time period.
<ul style="list-style-type: none"> On IMIRS, although there are many reports related to Work Orders, none of them are focused on the payment mechanism, forcing any validation of failure points and deduction amounts to be done manually, using external resources such as spreadsheets. 	This access by the City for "ad-hoc" reporting supports compliance with the "Monthly Activity Report" and "Daily Report" requirements, as detailed in Schedule 15-3, Article 1.8.
<ul style="list-style-type: none"> There are no reports in TPMS nor IMIRS to show the detailed data that is daily transferred between them. The only way for an IMIRS user to validate what data is imported daily into the system is to check the .csv files generated by TPMS manually. 	
<ul style="list-style-type: none"> There is no sophisticated log report to track changes in critical data such as dollar amounts, services plans or scheduled hours and kilometers, in neither systems. 	
Key Examples	
<ul style="list-style-type: none"> There is no report in IMIRS to show how the UASP (Unadjusted Service Payment) calculation is done even though all its variables are entered manually into the system 	RTM will develop a revised Payment Adjustment Report, with improved clarity and details on variables used in the calculation of the Monthly Service Payment.
<ul style="list-style-type: none"> TPMS currently contains no reports to show the data transformations done from the ATS events to the "Arrival Time" and "Departure Time", nor to provide a detailed reconciliation between Scheduled Kilometers and Actual Kilometers 	
<ul style="list-style-type: none"> There is not a report on IMIRS to trace, for Service and Quality failures, all the rectification and response failure events, and their consequential dollar deductions, back to the work orders that generated them 	
Gap #10 - Inefficient Systems Support	Not a PA requirement.
<ul style="list-style-type: none"> Vital Systems to the operation, such as TPMS and IMIRS, demand a support structure to be able to operate uninterruptedly for a long period. The support structure currently established by RTG is not sufficient to ensure the success of the operation. 	RTM has in place an annual maintenance and technical support contract for IMIRS. Further, RTM has trained a backup for the Performance Analyst role, who is responsible for generation of the Daily Operating Reports, including analysis of Lost KM. A position responsible for KPM management and coordination with the City to align with PA interpretation has also been established.
<ul style="list-style-type: none"> RTG does not have a complete understanding of the systems architecture, database schema or functionalities, recurring to the system developers when situations that extrapolate the most basic operational routine arise. 	See Gap #7 response.
<ul style="list-style-type: none"> The technical conversations between RTG and the systems developers are managed inefficiently, without the usage of a proper configuration management tool, which is also a requirement established by the Project Agreement. 	Configuration Management is applicable to System Infrastructure; IMIRS is not part of the System Infrastructure.
<ul style="list-style-type: none"> RTG does not have a Disaster Recovery plan nor the sufficient knowledge about the systems to act quickly, leaving the operation open to severe disruptions whenever a technical issue within any of the systems happen. 	RTM has been working on implementing elements of a Disaster Recovery Plan, such as back-up server systems, with geographic separation.
<ul style="list-style-type: none"> RTG does not currently employ any Issue & Defect management plan, being unable to anticipate problems and becoming reactive to any issues that can undermine the daily routines of the systems and potentially affect the payment mechanism. 	
Key Examples:	
<ul style="list-style-type: none"> There were multiple occasions in which TPMS data was incomplete, or even entirely missing, given technical problems that RTG was unable to determine or solve 	It is noted that the "key examples" provided all pre-date Revenue Service, when RTM was still developing the full capabilities of the TPMS.
<ul style="list-style-type: none"> RTG was unable to confirm where the databases of both systems are stored and who 	

Deloitte Presentation - Summary of Findings Item	RTM Response
<p>has access to them, had no clarity about the details of the calculations on TPMS and could not conduct the manual data transfer process properly in different occasions</p> <ul style="list-style-type: none"> The relationship between RTG and Transit Insights (TPMS developer) is conducted by phone and emails, with no formal way to capture and log the discussions and solutions 	
Gap #11 - Unstructured System Lifecycle Management	Not a PA requirement.
<ul style="list-style-type: none"> Both TPMS and IMIRS were developed without proper consideration to Capacity planning, and there is no plan currently in place to design solutions for the capacity-related issues that are already starting to arise. There is no formal Testing and Quality Management plan in place. RTG does not employ a structured testing schedule and mostly rely on a reactive stance to identify issues that can materially undermine the quality of the results provided by TPMS and IMIRS. There is no Change and Configuration management plan in place by RTG, with no data being captured to subsidize future updates, no schedule to request or receive customizations and no track or control of the versions and configurations changes. RTG does not have a professional Build and Release management plan. Updates on systems, or in the systems critical data, are not properly scheduled, documented, or tested. There is no Access Control policy or management plan, with decisions about new users and new access privileges being taken in a case-by-case basis, with no objectivity, and without a proper authorization process. 	
Key Examples:	
<ul style="list-style-type: none"> The update of the Schedule 20 financial variables on IMIRS, which have been defined in May, will only occur in September and, even though it is not a technically complex operation, will result in a temporary shutdown of the system. 	<p>The cited examples all pre-date Revenue Service, except for the Schedule 20 Revisions. The Schedule 20 revisions were released from escrow after revenue service start; the changes were implemented shortly thereafter, with minimal system downtime (less than 1 hour). Downtime was also confined to engineering hours.</p>
<ul style="list-style-type: none"> The size of the data transfer file from ATS to TPMS, which will constantly increase over time, has exceed the system capacity in the first month of Revenue Service 	<p>This example refers to an event that occurred prior to Revenue Service and issue was resolved overnight. Folder and file management controls were implemented to prevent recurrence.</p>
<ul style="list-style-type: none"> RTG made multiple internal consultations, during the course of several weeks, to evaluate the possibility, and the technical procedures involved, to grant access to the systems databases 	<p>This example needs further context to clarify the issue being raised.</p>