



**STAFF REPORT  
ACTION REQUIRED**  
with Confidential Attachment

**Internal Audit Activities – Quarterly Update: Q1 2017**

<b>Date:</b>	May 29, 2017
<b>To:</b>	TTC Audit and Risk Management Committee
<b>From:</b>	Head of Internal Audit
<b>Reason for Confidential Information:</b>	This report involves the security of the property of the municipality or local board

**Summary**

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During the quarter, TTC's Internal Audit Department focused our efforts on completing the following key projects to facilitate the timely communication of our findings to the Audit and Risk Management Committee (ARMC).

- The initial phase of understanding TTC's complex Workforce Planning processes will be presented as an education session to inform the Committee in advance of upcoming CBA negotiations.
- The Asset Management: Subway Rolling Stock (T1 – HVAC – “Hot Cars”) audit provides assurance that management has taken appropriate action to address the T1 Hot Cars issues and the summer 2017 target of 300 ‘cold cars’ will be met.
- At the request of TTC's Investigative Services Unit, Internal Audit completed targeted assurance work and root cause analysis in areas where fraud was suspected, perpetrated or is being investigated. Our work identified control gaps and process improvements that will help mitigate the risk of fraud going forward and serve as a visible deterrent to employees. The results of our fraud deterrent work have been summarized as a Confidential Attachment.

## **Recommendations**

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It is recommended that the TTC Audit and Risk Management Committee:

1. Receive Internal Audit Activities – Quarterly Update: Q1 2017 with Rolling Stock (T1 – HVAC – “Hot Cars”) attachment, and
2. Receive the confidential information as set out in the confidential attachment on Fraud Deterrence Internal Audit Activities: Q1 2017, noting that it is to remain confidential in its entirety as it involves the security of the property of the municipality or local board.

## **Financial Summary**

This report has no financial impact as the purpose is to report on TTC Internal Audit activities during Q1 2017.

## **Accessibility/Equity Matters**

There are no accessibility or equity issues associated with this report.

## **Comments**

TTC Internal Audit Department completed several key initiatives during the first quarter, made progress on other projects and actively participated in several advisory projects. Key highlights for the quarter include the following:

### ***Completed Projects***

- Preparation of materials for an ARMC education session in advance of upcoming CBA negotiations that aims to explain the complexities of Workforce Planning for Bus Operators, and highlights key drivers of unproductive time and crewing inefficiencies, including restrictive CBA provisions.
- Rolling stock audit work focused on providing independent assurance that T1 HVAC “Hot Car” issues have been addressed and the likelihood of a customer experiencing a T1 hot car in summer 2017 significantly reduced. While risks cannot be completely eliminated, management has demonstrated resilience moving along the maintenance maturity spectrum away from ‘firefighting’ T1 HVAC repairs by improving preventive maintenance procedures, and towards performing T1 HVAC predictive and condition based maintenance. However, Internal Audit is not able to comment on the reasonableness of expenditures incurred to reach this stage, nor the costs required to maintain and further progress towards a total productive maintenance maturity level. See Attachment 1 for Internal Audit’s Report - ROLLING STOCK (T1 - HVAC - “HOT CARS”).

- Internal Audit concluded reviews in two areas where fraud was suspected or perpetrated as a result of weak controls and ineffective processes. Internal Audit's support of TTC's Investigative Services sends a clear message that employee fraud will not be tolerated and corrective action must be taken to mitigate the risk of future occurrence.

### ***In-Progress Projects***

- PRESTO devices continue to experience reliability issues, impacting TTC ridership revenue and escalating implementation costs. Our current audit is focused on TTC's internal processes that monitor and support PRESTO device reliability and availability.
- Internal Audit's work on the use of consultants/contract staff involves two key users of staff augmentation contracts at the TTC (EC&C and ITS) and is focused on the transparency and fairness of the entire process from contract award, requisition and selection of consultant/contract staff, adequacy of rates being charged and the duration of time the consultants/contract staff have been working at the TTC.

### ***On-Going Advisory Projects***

- Internal Audit monitors the activities of TTC's internal governance committees and other groups, with particular attention on the Risk & Governance Committee (RGX), Project Advisory Group (PAG) and SAP; and attends meetings as required or when issues discussed are of relevance to our 2017 Work Plan. Internal Audit representatives regularly attend meetings of the PRESTO Joint Executive Committee (JEC), comprised of senior TTC and Metrolinx representatives, and PRESTO Audit Assurance Committee (PAAC).

### ***Departmental Initiatives***

- Internal Audit has organized a number of focused training sessions to the benefit of all departmental staff. Other TTC staff and City internal audit groups have attended these sessions, when feasible, to foster positive working relationships and mutual understanding on a variety of topics.
- A communication protocol between the City of Toronto Auditor General and TTC Internal Audit has been finalized to ensure the independence of each group and minimize duplication of efforts. An internal protocol that outlines Internal Audit activities designed to support management with respect to Auditor General audits and their use of TTC's enterprise risk management system First Priority to track progress and completion of all agreed upon recommendations has also been completed.

- A protocol was designed to facilitate an improved understanding of the role of Internal Audit to support TTC management subject to City of Toronto Auditor General audits, and expectations for management to monitor and report the status of all agreed upon management action plans put forth in response to internal and external audits. Internal Audit intends to present relevant materials at a future Executive Management Leadership forum.

## **Contact**

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## **Attachments**

- 1) Attachment - Rolling Stock (T1 - HVAC - “Hot Cars”)
- 2) Confidential Attachment - Fraud Deterrence Internal Audit Activities: Q1 2017

## Rolling Stock (T1 – HVAC – “Hot Cars”)

### EXECUTIVE SUMMARY

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#### Background:

In mid-2014, after four years of relatively stable T1 HVAC performance, a slight increase of 4% in ‘hot car’ failure events occurred during service. This small number of events grew exponentially throughout 2015, spiked in the summer of 2016 and continued into the fall as temperatures remained high, with an overall noted 30% increase in failure events. While hot car conditions are uncomfortable, HVAC systems are not considered safety critical. However, the discomfort of hot cars and concentration of the problem to the Bloor - Danforth Line aggravated the situation and triggered customer outcry and political attention.

Prior to the “Hot Car incident” in the summer of 2016, the Rail Vehicle Engineering (RVE) Group within Rail Cars & Shops (RCS) had been investigating the T1 HVAC failure event data since mid-2015. A number of initiatives (“Phase 1”) aimed at analyzing T1 HVAC failure trends, improving HVAC preventive maintenance processes, and addressing HVAC mechanic skill set issues were implemented.

However, output was slow due to lack of parts and available labour, attributed in part to recruitment and CBA challenges. T1 HVAC repairs are also labour intensive and complicated because components are located on top of the train and beneath. So notwithstanding these efforts, the extreme hot weather experienced in 2016 pushed marginally performing cars into failure; and the prior analytical/procedural changes could not effectively keep up with the growing failure rate of T1 HVAC systems throughout the fleet. And ultimately, T1 cars purchased in 1992-1998 are not designed with HVAC redundancy systems; so when the HVAC system failed on a car, there is no back-up cooling system. This is in contrast to the TR fleet, which effectively has two HVAC units per car.

Following the 2016 Hot Car incident, RCS was directed by Senior Leadership to adopt an aggressive, comprehensive approach (“Phase 2”) to further mitigate the risk of hot cars being experienced by customers in summer 2017. Extensive, collaborative work amongst RCS staff was immediately initiated to accurately assess the functioning of the entire T1 HVAC fleet. RVE developed an HVAC overhaul work plan and an 8-step overhaul work process by the end of 2016, as HVAC overhaul work had not been included in the 10 year or 15 year T1 overhaul programs.

Parts supply chain issues were tackled by securing, with Board approval, an accelerated material delivery schedule with the original equipment manufacturer, on a sole source basis, valued at approximately CDN \$6.4M in November 2016. T1 HVAC overhaul work was prioritized based on HVAC health check and triage repair results so as to focus on the poorest performing cars; and scheduled to achieve a goal of having 300 cars with functioning air conditioners (AC) by June 18, 2017—252 cars to cover anticipated summer service and 48 car contingency.

## Rolling Stock (T1 – HVAC – “Hot Cars”)

### EXECUTIVE SUMMARY

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#### **Audit Objective and Approach:**

Internal Audit's objective is to provide independent assurance to executive management and the Audit and Risk Management Committee (ARMC) that efficient and effective action to mitigate HVAC issues, and to reduce the likelihood of a customer experiencing a T1 hot car after June 18, 2017, has been executed by RCS.

Internal Audit reviewed key documents, including chronological engineering problem reports relating to the T1 HVAC system, a sample of Subway Maintenance System (SMS) car maintenance history records for a period of time before and after the summer 2016 Hot Car Incident, and project management charts used to schedule and monitor progress against the summer 2017 cold car target.

#### **Overall Conclusion:**

While risks cannot be completely eliminated, RCS staff is of the opinion that Hot Car issues have been effectively addressed and the summer 2017 target of 300 'cold cars' will be met. Based on the assurance work performed, Internal Audit is in agreement that the summer 2017 'cold car' target is likely to be met.

RCS management has demonstrated resilience moving along the maintenance maturity spectrum away from 'firefighting' T1 HVAC repairs by improving preventive maintenance procedures, and towards performing T1 HVAC predictive and condition based maintenance. However, Internal Audit is not able to comment on the reasonableness of expenditures incurred to reach this stage, nor the costs required to maintain and further progress towards a total productive maintenance maturity level.

The use of scheduling tools and fleet status sheets, and the ability to restrict certain cars from being dispatched into service is expected to further mitigate in-service hot car incidents in summer 2017. Also, cold car spares will be more readily available to facilitate faster car exchange for in-service failures as a percentage of the cold car fleet will be stored and dispatched from remote entry locations (Kennedy, Kipling and Keele), and monitored by end terminal workers.

Lessons learned from the Hot Car Incident have been discussed with key RCS staff; but a 'post-incident' review of incremental costs incurred and the benefits realized from its evolutionary mitigation approach has not been prepared. A presentation of these lessons learned and summary of key mitigating costs will be made to the ARMC to enhance their understanding of rolling stock predictive asset management, proactive maintenance regimes, life extension and reliability enhancement program possibilities, and transit industry benchmarks.

## Rolling Stock (T1 – HVAC – “Hot Cars”)

### EXECUTIVE SUMMARY

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Management Action Plans that bring closure to the T1 Hot Cars issue, and leverage the experience gained through improved failure mode analysis, health-check condition based assessments and maintenance methodology evaluations, have been put forth. In particular, the need to define management’s expectation for regularly performing events review and trend analysis across all the fleets, and for developing appropriate KPI’s to measure adherence and transparently report meaningful results thereof.

RCS management asserts maintenance programs of safety critical components are robust and remain the focus and priority of the department. The Head of RCS meets regularly with other Subway Operation Heads to discuss relevant issues. T1 fleet performance as measured in ‘Mean Distance Between Failures’ and reported in the CEO’s report remains relatively stable. This suggests completion of crucial maintenance activities has not been compromised as a result of the intense focus on T1 HVAC overhauls following the summer 2016 incident. However, a review of failure mode event data and adherence to essential maintenance and overhaul programs for safety critical components will be the focus of future internal audits.

The level of scrutiny and media attention the 2016 Hot Cars Incident sparked was unexpected by RCS management. Corporate communications staff should coordinate and lead all public responses. In anticipation of summer 2017, weather trends and heat alerts should be monitored, and the corporate message if a hot car incident should occur prepared in advance. Consideration should be given to proactively communicating to customers TTC’s extensive efforts this past year to ensure their comfort this summer.

A detailed discussion of Internal Audit’s review and of management’s action plans to bring closure to the T1 HVAC Hot Car Incident has been provided in Table 1.

**Rolling Stock (T1 – HVAC – “Hot Cars”)**  
**TABLE 1: DETAILED DISCUSSION**  
**Internal Audit Observations and Management Action Plans (MAP)**

The following table summarizes Internal Audit’s observations and Management Actions Plans designed to transparently bring closure to the T1 HVAC Hot Car Incidents, communicate results and costs of Rail Car and Shops (RCS) management’s mitigating efforts, and to ensure lessons learned are proactively leveraged to improve risk management of safety critical components and achievement of maintenance maturity across all fleets.

Internal Audit Observations & Comments	Management Action Plans
<p><b><u>T1 “Hot Car Incident” – Root Causes, Aggravating Factors &amp; Mitigation Strategies</u></b></p> <p><b><i>T1 Design – Lack of Redundancy</i></b></p> <p>T1 cars purchased in 1992-1998 were not designed with HVAC redundancy systems; so when the HVAC system fails on a car, there is no back-up cooling system; nor can vehicle windows be opened for ventilation.</p> <p><b><i>Failure Event Analysis – Complex and Time Consuming</i></b></p> <p>Many sources of data are used by technical staff within the carhouses and shops to monitor vehicle performance. Noted trends in performance conditions may prompt investigations and involvement of the Rail Vehicle Engineering Group (RVE). Such was the case with Hot Car failure events, when after four years of relatively stable T1 HVAC performance, a slight increase of 4% in ‘hot car’ failure events occurred during service in summer 2015.</p> <p>T1 HVAC Temperature Control Units cause hot cars when they fail. RVE noted during its initial failure event analysis that when these devices were removed from the vehicle, event data was lost. The need to replace these obsolete units and procure more technically advanced products to improve fault diagnosis and aid in troubleshooting HVAC issues required them to reverse engineer to identify alternatives.</p>	<p>The impact of a lack of designed redundancy will be considered in conjunction with other risk factors when determining maintenance requirements.</p> <p>The overall review of event trends across all fleets will be formalized as part of RCS’s transition to predictive maintenance. The intention will be to: define an interval over which technical staff will compile event counts for key systems, and compare them to levels from the previous period; and to identify problematic trends worthy of additional detailed investigation and decreasing events that confirm the success of improvement initiatives. The challenge will be to define which events to monitor, and how to structure the reporting in a way that provides value for money for the time spent gathering the data and preparing the charts. Ideally, the metrics would be automatically generated and displayed. This concept will be thoroughly investigated as part of the SMS replacement project.</p>



**Rolling Stock (T1 – HVAC – “Hot Cars”)  
TABLE 1: DETAILED DISCUSSION  
Internal Audit Observations and Management Action Plans (MAP)**

Internal Audit Observations & Comments	Management Action Plans
<p>Reverse engineering involves analyzing a component and its function. This point of reference is then used to create a specification and engineered drawing. It is a process that can take several years to design, manufacture, and install; and should be followed up with comprehensive evaluation to verify the performance and reliability of the new parts in service before being approved for system wide implementation.</p> <p>By September 2016, RVE had developed a specification to procure a new TCU prototype. Working with Materials and Procurement, contracts were awarded to three vendors to develop and supply two prototype TCUs each for evaluation. The total upset limit for these contracts is \$354K; with approximately \$45K paid as at the end of April 2017 to two vendors.</p> <p>The first prototype was installed in one car for in-service testing. Prototype TCU evaluation is in progress, with fleet replacement anticipated in 2018. In the meantime, “repeater” problem TCU’s are being quarantined to reduce the risk of in-service failures.</p> <p><b><i>T1 HVAC Overhaul and Cleaning Procedures – Lack of Robust Condition Based Assessments: New Overhaul Program Implemented on an Accelerated Basis and Improved Preventive Maintenance Procedures</i></b></p> <p>HVAC overhaul work was not included in the 10 year or 15 year T1 overhaul programs because they are not considered safety critical components nor impact service vehicle reliability and availability. Instead, a regime of regular cleaning was adopted, but without a robust periodic condition assessment to measure the effectiveness and uniformity of this process across the carhouses.</p>	<p>RCS management will schedule and monitor the results of its TCU prototype program, including a comparison of each vendor’s product.</p>

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<p>As was determined by RVE during its initial investigation, annual seasonal preparation and cleaning procedures were damaging condenser coils, and a means for assessing the condition of the entire T1 HVAC fleet was required. So a T1 Air Conditioning “health check” diagnostic process was developed (Sept/15) to assess the condition of the entire fleet of T1 HVAC components and procedures were revised (Mar/16).</p> <p>The rigour of the T1 HVAC health check process evolved. In January 2017, RVE expanded the scope of HVAC inspection procedures and embedded them into the T1 Standard Inspection operating procedures. To standardize and improve the accuracy of year-round T1 HVAC health checks, RCS converted a carhouse track into a thermal test chamber to simulate actual extreme weather conditions, at an estimated capital cost of \$20K. The chamber was first used on April 4, 2017.</p> <p>Output from Phase 1 initiatives could not keep up with the spiking failure rate of T1 HVAC systems. The impact on TTC’s reputation and quality of customer experience was deemed high. To positively assure the performance of T1 HVAC systems in the summer of 2017, a drastic decision was made to overhaul the components for the entire fleet on an accelerated basis, i.e., over a two year period instead of the traditional five years.</p> <p>RVE established an 8-step HVAC overhaul process and associated bill of materials list; the Reliability, Availability, Maintainability &amp; Safety (RAMS) Group developed a checklist for each step for quality control and process documentation; and the Carhouse provided a listing of consumables and special tools required to perform the work.</p>	<p>Formal revisions to the Standard Inspection operating procedures will be finalized. Going forward, all T1 cars will go through the same inspection cycle regardless of performance level. The use of the thermal chamber for conducting T1 HVAC health checks will measure the effectiveness of the overhaul and/or repair work completed; and tracking of the health check results over time will facilitate the development of early-failure alarms. The cost of operating the chamber, including the opportunity cost of dedicating the converted carhouse track for this activity, will be considered going forward as measured against the benefit of its use; possibly to be used on a sample basis.</p> <p>Formalization of the new HVAC System Overhaul procedures will be finalized.</p>

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<p><b><i>Parts and Labour – Significant Constraints</i></b></p> <p>T1 HVAC overhaul parts supply chain issues were tackled by securing, with Board approval, an accelerated material delivery schedule with the original equipment manufacturer on a sole source basis, valued at approximately CDN \$6.4M in November 2016.</p> <p>T1 HVAC repairs are difficult to perform. To address HVAC mechanic skills and resource requirements, new training programs were developed in 2015 and recruitment efforts continue.</p> <p><b><i>Media Attention – Lack of Corporate Communications Strategy</i></b></p> <p>Hot Car incidents are not a new issue; similar problems were experienced with H5/H6 series vehicles, but train windows could be opened for air ventilation. However, the ability for customers to now transmit direct and immediate communication with the media and government officials can quickly escalate any problem. Such was the case with the summer 2016 Hot Car Incident.</p> <p><b><i>Maintenance Culture – Moving Along the Maintenance Maturity Continuum</i></b></p> <p>In December 2016, RCS highlighted in its presentation to executive management a number of planned maintenance program improvements and initiatives designed to transform its maintenance culture, including:</p> <ul style="list-style-type: none"> <li>• Quality Assurance/Quality Control program development, guided by ISO 9000 International Standards outlining requirements of a Quality Management System;</li> </ul>	<p>RCS will work with TTC Corporate Communications to proactively message to customers the reduced risk of experiencing a ‘hot car’ in summer 2017, as a result of significant work being completed to overhaul and repair T1 HVAC systems. The corporate message to be issued if a hot car incident occurs will be prepared in advance and protocols to ensure Corporate Communications staff coordinate and lead all public responses established.</p> <p>RCS management will consider developing performance measures to monitor the progress of these strategic activities and achievement of stated goals. An update regarding the status of HVAC maintenance improvements and culture transformation initiatives, with particular attention on quality management systems and enhanced reliability measures, will be included in the close-out Hot Car Incident Summary and Lessons Learned documents.</p>

**Rolling Stock (T1 – HVAC – “Hot Cars”)  
TABLE 1: DETAILED DISCUSSION  
Internal Audit Observations and Management Action Plans (MAP)**

Internal Audit Observations & Comments	Management Action Plans
<ul style="list-style-type: none"> <li>• Revisiting RCS Asset Maintenance Policies to align vehicle maintenance processes with industry best practices;</li> <li>• Reliability Centered Maintenance to embed reliability culture at all levels within the department;</li> <li>• Maintenance Optimization that capitalizes on the success of academic models with respect to asset management and condition-based maintenance; and</li> <li>• Further Training Program Developments and Licensing Requirements.</li> </ul>	
<p><b><u>T1 Summer 2017 “Cold Car” Target – Project Management</u></b></p> <p><b><i>Target Set – Prioritized Work Approach Adopted</i></b></p> <p>RCS established a target to have 300 T1 cars with functioning AC (cold cars) by June 18, 2017. Using health check results and failure event data, the worst performing T1 HVAC vehicles were targeted for overhaul. RCS reported to executive management at the end of 2016 that 100 cars had been assessed as low risk for hard HVAC failure as they had functioning AC. Therefore, to achieve the summer 2017 target of 300 cold cars, 176 HVAC overhauls were scheduled for completion, and another 24 for triage repairs.</p> <p><b><i>Project Management – Variety of Tools Used to Schedule and Track Progress</i></b></p> <p>RCS has used various project management tools, including a decision matrix document, tally sheet, and Gantt chart to document the results of its initial prioritization activities, schedule overhauls/triage repairs,</p>	<p><b><u>Lessons Learned &amp; Summary of Hot Car Mitigation Costs</u></b></p> <p>RCS management will bring closure to the “T1 HVAC Hot Car Incident” by presenting to Executive Management and the ARMC, for educational purposes, a comprehensive Lessons Learned document that highlights what activities and experiences may be leveraged and translated into proactive measures.</p> <p>Key incremental costs and realized benefits attributable to Phase 1 &amp; 2 initiatives, and any onward actions, will be summarized as part of this post-incident assessment.</p> <p>Therefore, consideration will be given to:</p> <ul style="list-style-type: none"> <li>• Soliciting senior management’s expectations (frequency, methodologies, KPI’s) for event review and trend analysis, use of data driven strategies to support failure root cause analysis and formalizing them across all fleets;</li> </ul>

## Rolling Stock (T1 – HVAC – “Hot Cars”)

### TABLE 1: DETAILED DISCUSSION

#### Internal Audit Observations and Management Action Plans (MAP)

Internal Audit Observations & Comments	Management Action Plans		
<p>track progress against targets, and assess the likelihood of meeting its summer 2017 target.</p> <p>Pertinent details noted on the tally sheet and supporting Gantt chart data were reconciled to SMS car histories. Cumulative substantial completion of HVAC overhaul and triage repair results as of the end of April 2017 exceed established targets, with 244 cars having passed their most recent health check. Per RCS management, the primary reason for any outstanding overhaul work relates to parts availability. The risk associated with the backlog of this work is effectively being monitored via the ongoing health checks.</p> <p>RCS identified the need for \$638.3K in its 2017 operating budget to cover T1 HVAC summer and winter preparation programs. Targets have been scheduled and embedded into the Gantt chart; and results are being monitored. As at the end of April 2017, Internal Audit noted that adherence to the targets is at risk with a 35% backlog. However, RCS management is not concerned as overhaul and repair activities have effectively postponed the immediate need for these preventive maintenance programs.</p>	<ul style="list-style-type: none"> <li>• Systematic identification of emerging risks and development of strategies to address aggravating factors, especially for safety critical components. For example:               <table style="width: 100%; margin-left: 20px;"> <tr> <td style="width: 50%; vertical-align: top;"> <b>Aggravating Factors:</b> <ul style="list-style-type: none"> <li>- resourcing</li> <li>- capacity to work</li> <li>- quality of work</li> <li>- operational</li> <li>- supply chain schedules</li> <li>- facility constraints</li> <li>- obsolete parts</li> </ul> </td> <td style="width: 50%; vertical-align: top;"> <b>May be mitigated by:</b> <ul style="list-style-type: none"> <li>- increased workforce</li> <li>- improved training programs</li> <li>- revised maintenance procedures</li> <li>- adjusted overhaul timelines</li> <li>- accelerated material delivery</li> <li>- creative use of facility space</li> <li>- intense engineering problem analysis</li> </ul> </td> </tr> </table> </li> <li>• Key costs, including:               <ul style="list-style-type: none"> <li>- Additional HVAC mechanic and engineering resources - overtime;</li> <li>- Conversion of a carhouse track into a thermal test chamber to simulate actual and extreme weather conditions – short term and long term use;</li> <li>- Accelerated overhaul program and triage approach to repairs;</li> <li>- Reverse engineering techniques; and</li> <li>- Adoption of data driven analysis strategies.</li> </ul> </li> </ul>	<b>Aggravating Factors:</b> <ul style="list-style-type: none"> <li>- resourcing</li> <li>- capacity to work</li> <li>- quality of work</li> <li>- operational</li> <li>- supply chain schedules</li> <li>- facility constraints</li> <li>- obsolete parts</li> </ul>	<b>May be mitigated by:</b> <ul style="list-style-type: none"> <li>- increased workforce</li> <li>- improved training programs</li> <li>- revised maintenance procedures</li> <li>- adjusted overhaul timelines</li> <li>- accelerated material delivery</li> <li>- creative use of facility space</li> <li>- intense engineering problem analysis</li> </ul>
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<p><b>Accountability / Responsibility:</b> Mike Palmer, Chief Operations Officer Raffaele Trentadue, Head of Rail Cars and Shops</p> <p><b>Target Date:</b> Verbal Update to ARMC – September 27, 2017 Formal Presentation to ARMC – November 28, 2017</p>			