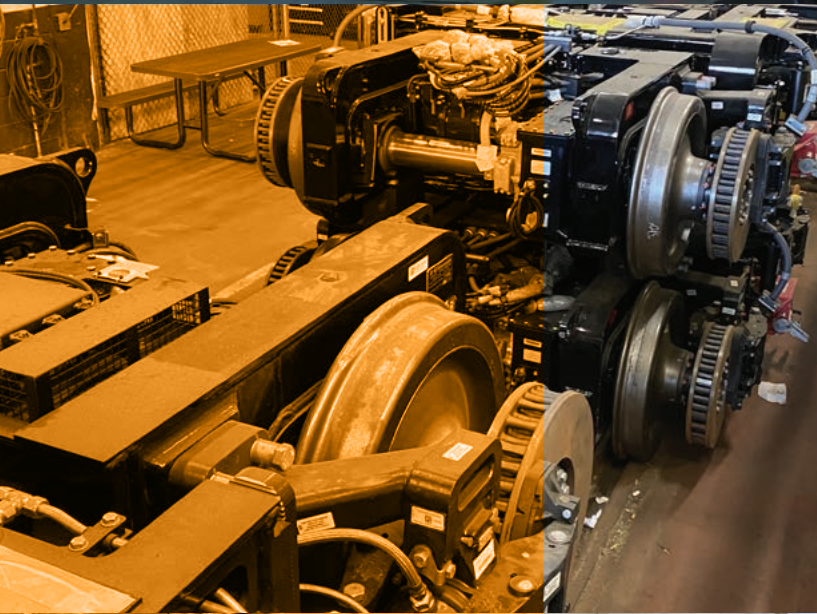


The Washington Metrorail Safety Commission



Safety Audit

of the Washington Metropolitan Area Transit Authority
Audit of Revenue Vehicles (Railcar) Program



Final Report:
May 21, 2024

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Prepared under the authority of the Washington Metrorail Safety Commission

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Executive Summary

The Washington Metrorail Safety Commission (WMSC) performed this audit of Washington Metropolitan Area Transit Authority (WMATA) Metrorail's revenue vehicles (railcar) program through in-depth interviews, site visits, and document and data reviews conducted in August and September 2023, with additional follow up and document review in October, November, and December 2023.

The scope of this audit includes Metrorail's maintenance and engineering practices related to railcars, those vehicles designed to carry customers. The audit also includes associated shop equipment such as railcar movers.

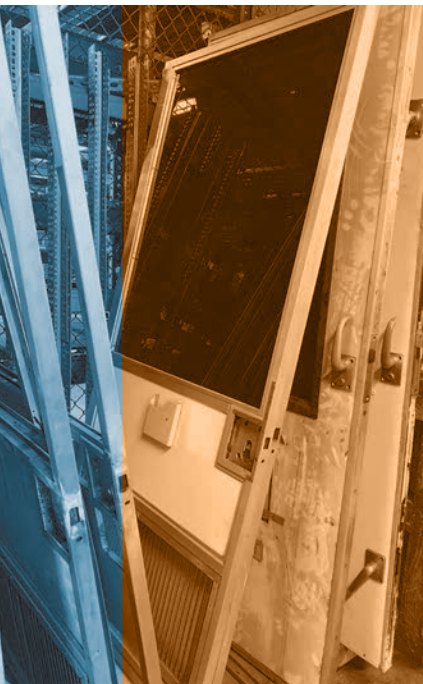
The audit objectives include the assessment of inspection, maintenance, and engineering practices and procedures (personnel interviewed listed in Appendix A, site visits listed in Appendix B, documents reviewed listed in Appendix C), and associated training for purposes of compliance with applicable plans, policies, regulations, and industry best practices. This audit also focuses on closed corrective action plans that were issued as part of the WMSC's Audit of Metrorail's Revenue Vehicles (Railcar) Program that was issued on September 14, 2021, and other closed corrective action plans related to findings and recommendations from the WMSC, the Federal Transit Administration (FTA), and the National Transportation Safety Board (NTSB).

The scope of this audit includes Metrorail's maintenance and engineering practices related to railcars, those vehicles designed to carry customers.

As this report was being drafted, the NTSB released its final report on the investigation into the October 12, 2021 derailment of a 7000 Series train on the Blue Line. The WMSC adopted this report on January 23, 2024

(**W-0256**). During the investigation, the WMSC issued orders to Metrorail to ensure the safe return to service of each 7000 Series railcar, and the WMSC oversaw Metrorail's development and implementation of associated return to service plans.

Among the positive practices identified in this audit, Metrorail developed under the WMSC's oversight a digital indicator gauge along with associated procedures for performing accurate back-to-back measurements. Digital indicator gauges and calibration blocks have been manufactured and are being used, and have successfully detected railcars with wheelsets beyond Metrorail's safety requirements, allowing those wheelsets to be removed from service. Also under this oversight, Metrorail has made upgrades to its Vehicle-Track Interaction systems in place on some 7000 Series railcars to resume system functionality. As part of Metrorail's return to service plan, due to the WMSC's oversight, Metrorail is now analyzing Vehicle Track Interaction (VTI) data on a regular basis, leading to actions to improve safety in the system.



Metrorail is not carrying out railcar maintenance and inspection tasks as specified by its procedures.

During this audit, the WMSC observed the positive practice of safety communications within Car Maintenance via safety alerts (“CMNT Special Alert”). However, Metrorail did not have a process for developing, reviewing, and distributing these documents. Metrorail resolved this issue during the audit by developing such a process.

This audit includes seven findings and three recommendations.

The findings include that Metrorail is not carrying out railcar maintenance and inspection tasks as specified by its procedures, is training personnel on outdated procedures, and is not identifying and mitigating hazards related to railcars and railcar personnel.

The audit found that Metrorail is not meeting life-safety and occupational safety and health requirements in railcar maintenance facilities. These include requirements of Metrorail’s hot works program, fall protection requirements, and safe crane lifting practices.

Other findings of the audit are:

- Metrorail is not following its operational certification requirements for Car Maintenance Road Mechanics.
- Metrorail is not following industry standard electrostatic discharge protection practices for railcar components.
- Metrorail is using equipment that is not calibrated in accordance with its policies and procedures, including for inspection and maintenance of components with a direct impact on safety.

The three recommendations in this audit are:

- Metrorail is not tracking the shelf life of railcar parts that decay over time and therefore have a limited shelf life.
- Metrorail could improve the effectiveness of its maintenance tasks by proactively providing training records to supervisors of employees newly assigned to their shift or location.
- Metrorail should update its railcar maintenance staffing assessment to account for current facilities, railcars, maintenance requirements, and other operational changes.

WMATA is required to propose Corrective Action Plans (CAPs) to address each finding and respond to each recommendation no later than 30 days after the issuance of this report.



Background and Scope

Background and Scope



The scope of this audit includes Metrorail's maintenance and engineering practices related to railcars, those vehicles designed to carry customers (Metrorail also refers to these as Class 1 vehicles). The audit also includes associated shop equipment such as railcar movers.

The audit objectives include the assessment of inspection, maintenance, and engineering practices and procedures, and associated training (personnel interviewed listed in Appendix A, site visits listed in Appendix B, documents reviewed listed in Appendix C) for purposes of compliance with applicable plans, policies, regulations, and industry best practices. This audit also focuses on closed corrective action plans that were issued as part of the WMSC's Audit of Metrorail's Revenue Vehicles (Railcar) Program that was issued on September 14, 2021, and other closed corrective action plans related to findings and recommendations from the WMSC, the Federal Transit Administration, and the National Transportation Safety Board.

The audit is based on the WMATA Public Transportation Agency Safety Plan (PTASP) effective December 31, 2022 (Rev. 3.0), Metrorail's procedures and documentation, and other associated requirements. The specific elements of the Public Transportation Agency Safety Plan covered in this audit are listed in Appendix D. This includes the element of hazardous materials and environmental management, which was added during the audit process due to concerns identified during site visits for this audit that are described below.

The WMSC completed a separate audit of WMATA's Roadway Maintenance Machines (RMM) Program **issued in October 2023** that addressed similar areas in relation to RMMs, which Metrorail also refers to as Class 2 vehicles.

Metrorail's Current Railcar Fleet

Metrorail's active railcar fleet at the time of this audit included 2000, 3000, 6000, and 7000 Series railcars. These designations reflect the railcar model and associated dates of delivery. Each railcar series has different features and designs. Metrorail's original railcars used when the system opened in 1976 were the 1000 Series. The newest railcars currently in service are the 7000 Series. At the time of this audit, Metrorail is in advanced design stages for its next series of railcars, the 8000 Series.

Fleet	Cars delivered	Current fleet size (in use or that may return to regular use)	In Service
1000 Series	300	0	1976-2017
2000 Series	76	74*	1982-2024
3000 Series	290	276	1987-present
4000 Series	100	0	1991-2017
5000 Series	192	0	2001-2018
6000 Series	184	180	2006-present
7000 Series	748	748	2015-present
8000 Series	(Planned) Min. 256, Max. 800	Not yet delivered	First pilot cars expected in 2026
Total: 1,278			

* Metrorail announced in May 2024, just before the issuance of this final report, that it would no longer utilize the 2000 Series railcars in passenger service. The fleet size listed in this table reflects the total at the time of on-site audit activities.

The audit is based on the WMATA Public Transportation Agency Safety Plan (PTASP) effective December 31, 2022 (Rev. 3.0), Metrorail's procedures and documentation, and other associated requirements.

The first of Metrorail's 2000 Series railcars, the oldest railcars in use at Metrorail at the time of this audit, entered service in 1982. The last of Metrorail's 7000 Series railcars, the newest railcars in use today at Metrorail, entered service in 2019.

Each railcar in a series is individually numbered based on its model and order of arrival. For example, the first 7000 Series car delivered is number 7000, the second is 7001, and the last, delivered to Metrorail in winter 2019, is 7747. The railcars operate in "married pairs" that are semi-permanently connected (for example, railcars 7000 and 7001).

Metrorail operates the 2000, 3000, and 6000 Series railcars, also referred to by Metrorail as "Legacy" railcars, in passenger service in six-car or eight-car configurations.

Metrorail operates the 7000 Series in sets of four cars that are arranged into eight-car trains in revenue service. The four-car sets are broken up into pairs for maintenance work because WMATA's shops are designed to accommodate married pairs of cars. After the on-site portion of this audit, Metrorail began testing related to operation of 7000 Series railcars in a six-car configuration, and later began operating some six-car 7000 Series trains. The 7000 Series railcar manufacturer, Kawasaki, continued to have personnel on site at Metrorail at the time of this audit working on items such as field modifications.



Metrorail ended its passenger use of the original 1000 Series cars in 2017, of the 4000 Series cars (entered service in 1991) in 2017, and of the 5000 Series cars (entered service in 2001) in 2018.

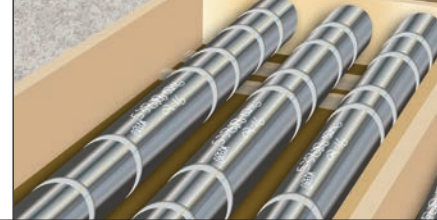
Metrorail plans to retire 3000 Series cars as 8000 Series cars enter passenger service. WMATA formally awarded the contract to Hitachi Rail Car for the 8000 Series final design and construction in early 2021. Design work on these railcars was continuing at the time of this audit, and an assembly plant in Hagerstown, Md. was in the late stages of construction. The 8000 Series requirements include meeting crashworthiness requirements that the 2000 and 3000 Series railcars were not required to meet, as well as other requirements incorporated into the initial request for proposals or subsequent revisions during the procurement process. Revisions included cybersecurity requirements, safety reference standards, software quality assurance and other requirements. Revisions made in May 2023 adjusted the car body material from stainless steel to aluminum and added an open gangway between cars in a married pair. The design review process was continuing as this report was drafted.



Safety Events

Wheel migration on axles

On October 12, 2021, a 7000 Series railcar derailed at least three times. The subsequent investigation identified that Metrorail had identified wheel migration on its railcar axles in 2014, and did not incorporate changes to interference fit and



The WMSC identified and communicated to Metrorail leadership that Metrorail had placed railcars into passenger service that had been determined in its special inspections to not meet Metrorail's safety requirements.

press tonnage appropriate for the size and weight of each railcar identified at that time into its 7000 Series railcars, none of which had yet entered service. The investigation also determined that Metrorail identified wheel migration on its 7000 Series railcar wheelsets beginning in 2017, and detected this migration more frequently in the months prior to the October 12, 2021 derailments.

On January 4, 2024, the NTSB released its final report on the investigation, [Railroad Investigation Report RIR 23-15](#). The WMSC adopted this report on January 23, 2024 ([W-0256](#)).

The National Transportation Safety Board determined that the probable cause of the derailment of Washington Metropolitan Area Transit Authority train 407 south of Rosslyn Station was an out-of-specification wheelset that caused a wheel to depart the rail at a turnout; the wheelset was out of specification because the wheelset's design allowed the wheels to migrate outward and eventually exceed the maximum permitted back-to-back measurement.

The wheels had moved outward.

Following the October 12, 2021 derailments, Metrorail conducted special inspections of 7000 Series railcars that identified additional cars with wheelsets that did not meet Metrorail's safety requirements. Metrorail personnel also shared with Metrorail executives and the WMSC that prior exceedances had been identified on other 7000 Series railcars.

The WMSC identified and communicated to Metrorail leadership that Metrorail had placed railcars into passenger service that had been determined in its special inspections to not meet Metrorail's safety requirements.

On October 17, 2021, the WMSC ordered Metrorail to remove all 7000 Series railcars from passenger service by 5 a.m. the following day, and to develop and implement a plan under the WMSC's oversight to provide for the safe return to passenger service of each 7000 Series railcar.

Metrorail developed a return to service plan in December 2021. However, the WMSC identified in December 2021 that Metrorail placed 7000 Series railcars into passenger service that did not meet the inspection criteria specified by Metrorail's plan, and Metrorail then stated it would temporarily remove 7000 Series railcars from passenger service.

The WMSC followed up on that Metrorail commitment with an order issued later on December 29, 2021 requiring Metrorail to keep all 7000 Series railcars out of passenger service until Metrorail provided a revised return to service plan describing the specific additional protections and internal oversight Metrorail would carry out to ensure that any asset that fails a safety-critical inspection is removed from and kept out of passenger service; the specific additional protections and internal oversight Metrorail would carry out to ensure that no alternative procedures or practices are introduced outside of the official return to service plan; revised inspection frequency and any other criteria based on all available data; the WMSC notified WMATA that the WMSC had no technical objection to the revised plan; and Metrorail implemented such plan.





Metrorail developed under the WMSC's oversight and began to implement revised return to service plans beginning in spring 2022. Metrorail's revised plans included significantly improved measurement tools, training for railcar maintenance personnel on the use of these tools, and oversight for the personnel carrying out these inspections. When process failures occurred as Metrorail implemented these plans, the WMSC ensured Metrorail investigated and mitigated the issues.

Metrorail continued to develop plan revisions through 2023, leading to the version of the return to service plan in effect at the time of this audit. This plan in effect at the time of the audit included Metrorail measuring 7000 Series railcar wheelsets (distance between wheel flanges) and journal bearing gap (distance between bearing and wheel) every 30 days to detect wheel migration. Metrorail had begun assembling new wheelsets with a higher interference fit and press tonnage that better aligns with industry norms for cars of the weight of the 7000 Series railcars. The newest of those wheelsets were subject to an engineering test plan, were being measured more frequently, and were planned to undergo more detailed inspections after the cars have travelled at least 20,000 miles. If the engineering test is successful, Metrorail will place all cars with wheelsets with the increased interference fit and press tonnage on a 60-day cycle for back-to-back and journal bearing measurements. This matches Metrorail's revised 7000 Series periodic inspection cycle of 60 days to align with the inspection cycle for other railcars. Metrorail had previously inspected 7000 Series railcars every 90 days.

The improved measurement process, tools, training, and internal oversight implemented due to the WMSC's actions has mitigated risk over the last two years, including by ensuring inspection intervals were only adjusted as supported by the data. Metrorail continues to identify evidence of wheel migration on 7000 Series railcars, but now removes those wheelsets from service.

Prior data not acted upon

The investigation demonstrated that Metrorail was aware of wheel migration on its railcars since at least 2014¹. Beginning in March 2014, prior to 7000 Series railcars entering service, Metrorail identified wheel migration on "legacy" (non-7000 Series) railcars. These inspections were initially triggered by alerts from a then-active Truck Performance Detector Metrorail had installed. The special inspections of railcars then in service identified more than 30 legacy cars with back-to-back measurement exceedances. Metrorail did not incorporate this data on the likelihood of this hazard in the WMATA Rail System into the 7000 Series railcar design and acceptance process.

Beginning in 2017, Metrorail identified wheel migration on 7000 Series railcars. Later, Metrorail changed the wheelset assembly specification for 7000 Series railcars that were delivered later in the acceptance process. Metrorail did not make any changes for the railcars built and accepted prior to the change taking effect. As demonstrated by evidence including Metrorail not seeking any failure analysis related to identified 7000 Series wheel migration and not sharing information regarding wheel migration on older railcars with the 7000 Series railcar manufacturer, Metrorail did not consider that the hazard could lead to derailment. Metrorail had

The improved measurement process, tools, training, and internal oversight implemented due to the WMSC's actions has mitigated risk over the last two years.



¹ The WMSC's state safety oversight program was certified in March 2019.



not conducted an engineering failure analysis of wheel migration on 7000 Series axles, had no documentation of any requests for failure analysis on back-to-back issues, and did not share the older report on wheel migration on its other railcars with the railcar manufacturer prior to the derailment investigation. For the railcars Metrorail accepted with the initial wheelset assembly specifications, Metrorail did not implement any mitigations to systematically address this safety issue (such as changes to measurement tools and frequency, or engineering changes for railcars already delivered or near delivery).

Metrorail had identified 4 instances of wheel migration on 7000 Series railcars in 2017, 1 in 2018, 4 in 2019, 4 in 2020, and 18 in 2021 prior to the October 12, 2021 derailments. Metrorail had not identified or acted upon this safety data. Metrorail subsequently identified additional instances of wheel migration after the derailments.

Metrorail's siloed approach to safety and its inconsistent consideration of available safety data to make safety improvements prevented WMATA leadership outside of the railcar departments (and prevented Metrorail's state safety oversight agency) from learning of and acting upon the wheel spread safety issue prior to the derailment despite an abundance of data indicating that this safety issue was occurring and was being identified more and more frequently, and despite other Metrorail data and reports demonstrating this wheel migration has occurred on other WMATA railcar fleets.

The investigation also demonstrated deficiencies in Metrorail's safety certification of the 7000 Series railcars during their design and acceptance process (which occurred prior to the existence of the WMSC).

Since the certification of the WMSC's oversight program in 2019, the WMSC has issued several findings identifying that Metrorail was not following its safety certification program, which required Metrorail to address these safety issues. The broadest of these was the finding issued on August 13, 2021 that Metrorail does not consistently follow its safety certification process, which leads to project activation and use without proper hazard identification and mitigation, putting Metrorail customers, personnel and first responders at risk. Metrorail is addressing this finding through CAP C-0118. The final actionable item related to this CAP is scheduled to be completed in spring 2024. Regarding railcars specifically, the WMSC regularly observes the activities of Metrorail's 8000 Series railcar safety certification working group, and has selected the 8000 Series railcar project for in-depth review. "In-depth review" is a process established by the WMSC Program Standard for conducting more detailed oversight of Metrorail's safety certification process for certain projects. For each project, it is Metrorail's responsibility to carry out its safety certification in accordance with its programs and procedures.

Train pull-aparts

In fall 2020, two similar 6000 Series railcar pull-aparts occurred on the Red Line (on **October 9, 2020 near Union Station** and on **November 24, 2020 near Glenmont Station**). The WMSC adopted final investigation reports on May 18, 2021. These investigations identified a series of necessary corrective actions related to railcar maintenance, inspection and training, tools availability, engineering processes, emergency management and response, and rail operations. Additional details and required corrective actions were identified through the

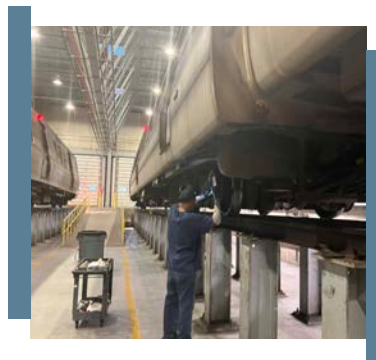
WMSC's first Railcar Audit issued later in 2021. The evaluation of Metrorail's implementation of the associated corrective action plans addressing the findings from that audit, including those findings related to Metrorail's "scheduled maintenance program" on the 6000 and 7000 series railcars, associated coupler work for 6000 Series railcars, and gaps related to safety certification of that work, is provided later in this report.

Brake disc assembly failure leads to derailment

During this audit, a derailment occurred on September 29, 2023 south of Ronald Reagan National Airport Station. The WMSC responded to the scene of the derailment and coordinated with Metrorail personnel.

The preliminary investigation, including forward-facing video from the train that derailed, showed that the train struck a brake disc that was leaning against the running rail, causing the train to derail. The investigation determined that the brake disc had fallen from the preceding train, made up of 2000 and 3000 Series railcars. Bolts designed to hold the brake disc in place were on the roadway still connected by safety wire.

Metrorail subsequently conducted special checks of the bolts holding these friction brake discs on 2000 and 3000 Series railcars and identified dozens of bolts that were not properly secured (loose and/or broken). Metrorail replaced all bolts on discs found to have defects. Metrorail also added requirements to its preventive maintenance processes to check the torque of these disc bolts to its preventive maintenance processes.



In response to WMSC follow up on these new torque checks during periodic inspections, Metrorail provided data showing that among the additional brake discs that failed these checks in periodic inspections, at least two wheels were identified as having brake disc bolts fail torque checks a second time. Metrorail then stated it would incorporate a standardized cross-torquing process into its procedures. Overall, Metrorail had identified during the revised periodic inspection process at least 68 additional brake discs that were not properly secured as of March 2024.

The investigation remained ongoing at the time this report was drafted.

Prior WMSC Audit, Findings, and Other Oversight

WMSC Railcar Audit issued in 2021

The WMSC issued its first audit of Metrorail's Revenue Vehicles (Railcar) program in September 2021. The **report** included 12 findings requiring Metrorail to develop corrective action plans (CAPs), and three recommendations. Metrorail developed corrective action plans for each of the three recommendations.

As noted above, the findings included that Metrorail did not follow its safety certification processes for the 6000-Series rehabilitation and overhaul project. In addition, Metrorail did not follow the other steps, improperly created outside of its safety certification process, that it said were being used for this railcar rehabilitation work. Later, in fall 2020, two 6000 Series

The WMSC issued its first audit of Metrorail's Revenue Vehicles (Railcar) program in September 2021.



train pull-aparts occurred involving Red Line trains in revenue service. Safety certification is designed to ensure that hazards are addressed or mitigated prior to a safety event. Metrorail was also developing a similar rehabilitation project for the 7000 Series cars, but was doing so without full coordination with its Safety Department.

Among other findings in this 2021 audit, Metrorail was not requiring or receiving all necessary documentation, parts, and tools from original equipment manufacturers (OEMs). Metrorail did not have adequate document control practices for car maintenance job plans, did not clearly define the use of certain engineering documents, and did not have a systematic process to ensure that mechanics and engineers are trained for the specific tasks they are assigned to perform. Metrorail also did not consistently follow a standard process to address wheels out-of-round, a situation that can be felt by operators and customers as significant vibrations or bouncing during their ride and that can contribute to infrastructure damage.



The three recommendations in this 2021 report included that Metrorail address the lack of inward- and outward-facing audio and image recorders in operating compartments that the National Transportation Safety Board (NTSB) has recommended transit agencies use to improve safety event investigations and to conduct regular hazard identification activities.

The complete list of findings and the audit's evaluation of Metrorail's implementation of corrective action plans to address the 2021 findings is provided later in this report.

Safety Certification

The WMSC issued a finding on August 13, 2021 regarding Metrorail not consistently following its safety certification process, which leads to project activation and use without proper hazard identification and mitigation, putting Metrorail customers, personnel and first responders at risk.

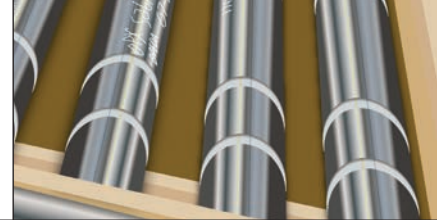
This finding was based on the WMSC's safety audits, other regular oversight activities, and work conducted in coordination with WMATA's Office of Inspector General.

The corrective action plan Metrorail developed as required by the August 13, 2021 finding is CAP C-0118.

Metrorail was in the process of implementing remaining parts of this CAP at the time of this audit.

Federal Transit Administration and Tri-State Oversight Committee Oversight

The Tri-State Oversight Committee (TOC) conducted several audits with findings and observations related to revenue vehicles, and the Federal Transit Administration (FTA) also directed Metrorail to address items related to revenue vehicles during its direct safety oversight of Metrorail prior to the establishment of the WMSC.



For example, in 2016, the TOC published an audit of Metrorail's Railcar Maintenance programs based on work conducted both independently and in conjunction with the FTA's Safety Management Inspection (SMI) of Metrorail. Among other areas, the TOC's report identified that Car Maintenance (CMNT) supervisors could not review or access training records and requirements of employees they supervised, and there were no notifications of training or retraining requirements. The WMSC identified similar concerns during this audit (see Recommendation 2). The 2016 TOC Audit also identified concerns related to railcar CCTV systems, availability of qualified training instructors, lack of railcar maintenance plans, and incomplete preventive maintenance inspection checklists and supervisor sign-off sheets.

Additional information related to previous FTA and TOC reports is included in the WMSC's [2021 Railcar Audit](#).

Internal WMATA Reviews

Since the last WMSC audit of Metrorail's revenue vehicles program, Metrorail conducted several related internal reviews and internal safety reviews. These included the September 2022 QICO Internal Review of Engineering Modifications Instruction Process – CMOR, August 2022 QICO Internal Review of Car Maintenance Road Mechanics, August 2022 Internal Safety Review of Office of Car Maintenance, June 2021 Internal Review Restraining Rail Installation and Maintenance (relates to wheel-rail interaction), and an Internal Safety Review Vehicle Program Services conducted in 2021 and published in 2022.

The December 2021 review identified hazards in the Greenbelt Rail Yard Building H such as tripping hazards and missing labels on chemicals that were generally addressed during the review. The review also identified the positive practices of the use of Documentum as a centralized document repository, and communication of those approved documents.

Identified items requiring improvement included:

- the need to perform regular workplace inspections
- the need to maintain calibration of test, measurement and diagnostic equipment
- the need to maintain current policies and procedures
- the need to use standardized templates
- the need for formal training courses for routine employee tasks, and updated training logs
- the need for continuously updated hazard log and risk register
- the need to participate in all mandatory safety committee meetings
- the need to ensure reliable vehicle monitoring system and event recorder data



Several of these items from the 2022 review directly relate to findings and recommendations noted later in this report.

The August 2022 final report of the Internal Safety Review of Rail Car Maintenance (CMNT) identified positive practices of the communication of CMNT Special Alerts for safety items to be communicated to CMNT personnel. The report also identified areas requiring improvement including:

- A lack of hazard identification and resolution related to the safe and proper conduct of work in service and inspection facilities (including use of procedures, proper personal protective equipment, inconsistent use of tags on out-of-service equipment, tripping hazards, improperly stored shop power high voltage cables, improperly stored and labeled chemical containers, and eye wash station cartridges without installation dates)
- The need to review and update governing documents such as procedures on the specified timelines (80% were overdue based on Metrorail's requirement to review every 2 years)
- The need for a maintenance control plan to provide for consistency and traceability of maintenance activities as specified in Metrorail's Agency Safety Plan
- The need to perform regular workplace inspections effectively, capturing discrepancies such as non-compliance with personal protective equipment, electrical safety, chemical storage and labeling, high voltage safety gloves, lock out tag out processes, tool calibration, and overall conditions
- The need to maintain a comprehensive training matrix and effectively manage records to assure employees are properly trained and qualified for their duties
- The need for effective supervisory oversight and rule compliance, including conducting supervisory oversight required by existing procedure
- The need to complete Maximo work orders with specific data to ensure accuracy and safety performance reporting (a repeat finding). Work orders included incorrect component codes, with a smaller portion of issues related to failure codes and supervisor remarks

Several of these items from the 2022 review directly relate to findings and recommendations noted later in this report.

WMATA's Office of Inspector General also evaluated Metrorail cannibalizing 7000 Series railcar parts, which concluded in a report **issued in September 2023**. This report identified concerns related to Metrorail's lack of definition of safety critical parts, and CMOR retracting statements about safety sensitive or critical parts. This retraction to the Office of Inspector General occurred during Metrorail's development of return to service plans for the 7000 Series railcars. The report also identified concerns that parts CMOR had initially identified as safety sensitive had been cannibalized from railcars 7038 and 7039, but were not tracked to recipient rail cars, despite Metrorail personnel telling the Office of Inspector General that one of the parts was railcar specific. Metrorail had relied on railcars 7038 and 7039 for parts for more than four years beginning in mid-2019, contrary to Metrorail's Standard Operating Procedure (SOP) 1.18,



Cannibalization of Parts to Repair Class 1 Rail Vehicle(s). Metrorail subsequently replaced the cannibalized parts and placed the cars into service in August 2023.

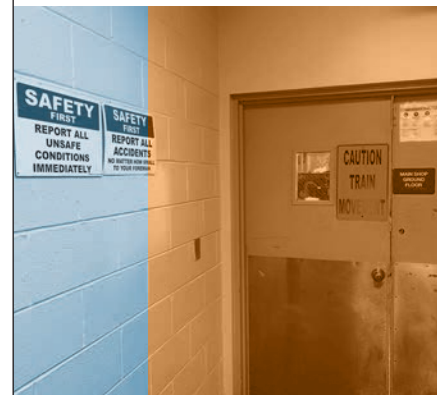
Previously, WMATA's Office of Inspector General evaluated deficiencies in Metrorail's 7000 Series railcar contract related to a lack of cybersecurity requirements. The Office of Inspector General stated in 2019 that this could make WMATA vulnerable to "manipulation of rail software which could adversely impact the safe operation of Metro's rail system." Metrorail subsequently conducted penetration testing later in 2019 on the 7000 Series railcars, and added cybersecurity requirements to its 8000 Series railcar contract.

iCAPA Status

As of October 2023, Metrorail had several internal corrective action plans (iCAPAs) that were open related to railcars. Metrorail had closed other iCAPAs.

Open iCAPAs included:

- QICO-CENV-21-01 designed to address the need to meet standards for workplace safety inspection, safety committee participation, and hazard management processes defined in Metrorail's Agency Safety Plan. Remaining steps included the vehicles groups implementing Metrorail's safety risk management system.
- QICO-CENV-21-02 designed to align training, inspection, process control, measuring & testing equipment, and document control management with organization-wide quality management system plan standards. Remaining steps included demonstrating calibration of equipment (See Finding 7 below).
- QICO-CMNT-22-04 designed to review and update procedures and operational governing documents per specified period with relevant safety and quality information. The initial step was to develop a master document log.
- QICO-CMNT-22-05 designed to incorporate the requirements of Metrorail's Agency Safety Plan and Metrorail's fleet maintenance management into a comprehensive maintenance control plan.
- QICO-CMNT-22-07 designed to develop and implement policies and procedures to effectively manage the CMNT employees' training system.
- QICO-CMNT-22-09 designed to develop and implement a process to improve work order data capture in Maximo for accuracy and consistency, including improvements to work order coding.
- QICO-CMNT-22-03 related to the need for a comprehensive quality record system identified in a review related to Car Maintenance Road Mechanics.



Metrorail has assigned the Office of the Chief Mechanical Officer, Rail (CMOR) as responsible for railcar maintenance and engineering.

- QICO-CENV-22-01 designed to assess the need for changes in work strategies or working positions for overseeing internal engineering modification instructions (EMIs) and manufacturing service instructions.
- QICO-CENV-22-02 designed to update the procedure for identifying completion criteria for engineering modification instructions and documentation of corrective maintenance work orders.
- QICO-CENV-22-03 designed to monitor internal modification instruction creation.

Metrorail had also recently closed iCAPA QICO-CENV-21-03 related to the need to improve reliability of 2000 and 3000 series railcar event recorder systems to comply with requirements of National Transportation Safety Board recommendation NTSB R-10-21. Metrorail closed this iCAPA based on an action plan developed following an engineering analysis.

Organizational Structure

Metrorail has assigned the Office of the Chief Mechanical Officer, Rail (CMOR) as responsible for railcar maintenance and engineering. The Chief Mechanical Officer, Rail reports to the Senior Vice President of Rail, who reports to the Chief Operations Officer.

Car Maintenance (CMNT) and Vehicle Program Services, also referred to as Vehicle Engineering or Chief Engineer for Vehicles (CENV), are the two departments that are part of CMOR that carry out day-to-day engineering and maintenance work.

Metrorail described the Office of Car Maintenance mission as initiating and achieving a comprehensive maintenance program for railcars and steel wheel non-revenue vehicles.

Metrorail described the Office of Vehicle Program Services mission as exceeding performance goals and encouraging teamwork, proactive problem solving, and continuous improvement by providing increased railcar reliability and high standards of engineering that builds partnerships at all levels of the organization and fosters input from, and respect for all stakeholders.

Other parts of CMOR include Railcar Quality Assurance and Warranty Compliance (RQAW) and a project management group (PMO).

Metrorail described the mission of the Project Management Office as ensuring the success of railcar maintenance initiatives – by providing project management, materials management, financial management and reporting, qualification of parts and suppliers, facilities development, and coordination of work across CMOR departments.



Metrorail described the Railcar Quality Assurance and Warranty Compliance mission as improving activities for ensuring quality in the rail car processes by which products are developed and maintained. This includes many quality methods, all with the purpose of preventing defects in the final product or maintenance activity.

Audit Work

The WMSC received initial documents related to this audit from WMATA in July 2023, made subsequent document requests, and reviewed the documents provided by Metrorail throughout the course of this audit. The WMSC conducted an entrance conference in September 2023, and conducted site visits and extensive interviews with Metrorail personnel in September and October 2023. The WMSC held an exit conference with Metrorail in November 2023, and reviewed additional documents provided by Metrorail into December 2023.

Lists of documents reviewed, site visit locations, and personnel interviewed for this audit are provided in the appendices.

The WMSC later provided a draft of this report to WMATA for technical review and incorporated any comments or technical corrections as appropriate.

The WMSC held an exit conference with Metrorail in November 2023, and reviewed additional documents provided by Metrorail into December 2023.



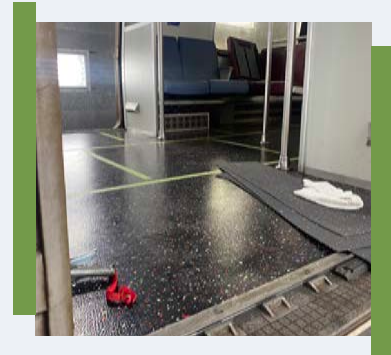
What the **WMSC** Found

What the **WMSC** Found

Metrorail has made improvements through corrective action plans to address WMSC findings or recommendations, such as the implementation of railcar-specific familiarization training for engineers.

Positive Practices

- Under the WMSC's orders related to the safe return to service of each 7000 Series railcar, Metrorail developed a digital indicator gauge along with associated procedures for performing accurate back-to-back measurements. Digital indicator gauges and calibration blocks have been manufactured and are being used, and have successfully detected railcars with wheelsets beyond Metrorail's safety requirements, allowing those wheelsets to be removed from service.
- Under the WMSC's oversight, Metrorail has made upgrades to its Vehicle-Track Interaction systems in place on some 7000 Series railcars to resume system functionality by upgrading 3G cellular communication systems to 4G systems. As part of Metrorail's return to service plan, Metrorail is now analyzing Vehicle Track Interaction (VTI) data on a regular basis, leading to actions to improve safety in the system.
- Metrorail provided "6H" training and certification for painters as required for the use of Metrorail's railcar paint booth. The training was conducted in 2022. This training relates to Environmental Protection Agency requirements in 40 CFR 63 Subpart HHHHHH (hence, "6H") governing paint stripping and surface coating as sources of hazardous air pollutants. The rule was last revised in November 2022.
- Metrorail develops and distributes railcar reliability reports covering some available data.
- Metrorail has made improvements through corrective action plans to address WMSC findings or recommendations, such as the implementation of railcar-specific familiarization training for engineers.
- Under WMSC oversight of Metrorail's safety certification of Automatic Door Operation and Automatic Train Operation, Metrorail identified that 7000 Series railcar marker coil antennas required "normalization," which had not previously been implemented. Metrorail began to conduct this work.



Item resolved during audit

- The WMSC observed the positive practice of safety communications within Car Maintenance via safety alerts ("CMNT Special Alert"). However, Metrorail did not have a documented process for developing, reviewing, and distributing these documents. After the WMSC communicated this identified issue, Metrorail provided information during the audit related to the development of a process to continue these safety promotion activities covering the proper way to work safely in Car Maintenance facilities. This led to a memorandum to Car Maintenance personnel providing a process to initiate, draft, review, and disseminate CMNT Incident/Accident Review Lessons Learned bulletins. The memorandum described these bulletins as an "evolution of the Special Alerts notices issued by the former Incident/Accident Review Committee."



Assessment of Previous Corrective Action Plans

► C-0134 (Open)

Metrorail's 6000-Series rehabilitation program, including coupler overhaul work, was implemented by CMOR, CENV and CMNT without safety certification and approvals required by WMATA's SSCPP.

At the time of this audit, this CAP remains open. Metrorail has made progress and updated the Verified Items List (VIL) to a Certified Items List (CIL) for its 6000 Series Scheduled Maintenance Program (SMP). Training on the Safety Certification process was ongoing. Metrorail has completed coupler overhaul and other work in accordance with its CIL for all but two pairs of 6000 Series railcars. These two pairs of railcars remained out of service at the time of this audit but may return to service, which led to this CAP remaining open at the time of the audit.

► C-0135 (Closed)

SAFE approved SMP documentation that was incomplete and that did not match approved forms, and Metrorail did not comply with safety certification requirements defined in the SSCPP.

Metrorail developed a process to administrate a review and voting process for their Safety Certification Review Committee. The process included the creation of a tracking mechanism to verify the accuracy and approval of the Certified Items List.

► C-0136 (Open)

6000 Series cars that underwent rehabilitation were put into service without SAFE approval.

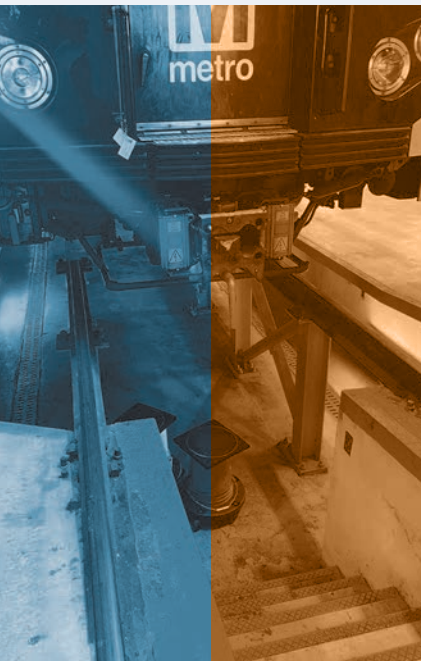
► C-0137(Open)

Metrorail removed the coupler overhaul from the 6000 Series SMP process without documenting that change or completing a review of that change by the SCRC.

► C-0139 (Open)

The 7000 Series rehabilitation and subsystems overhaul program is being developed without full SAFE coordination, involvement or approval.

Metrorail is transitioning from mid-life overhauls of railcars to what it calls a "scheduled maintenance program," or SMP. This involves conducting work on each railcar every six years, with separate programs and scopes of work for each fleet of railcars, and an increasing scope each six-year cycle (6, 12, and 18 years before repeating the 12-year program). Metrorail had recently completed the 6-year work on most of the 6000 Series railcars just before this audit began, and was preparing to start work on the 3000 Series and 7000 Series. Metrorail completed the 6000 Series SMP for active railcars after making





At the time of this audit, Metrorail was preparing to begin its 7000 Series Scheduled Maintenance Program (SMP).

corrections required under CAPs C-0134, C-0135, C-0136, and C-0137 to ensure it followed its change management and interdepartmental coordination and verification requirements. Under CAP C-0139, Metrorail began coordination between railcar and safety personnel on the 7000 Series scheduled maintenance program. Following the above findings of the WMSC's previous audit, and associated safety event investigations, Metrorail incorporated Safety Department review and approval, including developing these programs under Metrorail's safety certification process, as required by Metrorail's PTASP and Safety and Security Certification Program Plan (SSCPP).

At the time of this audit, Metrorail was preparing to begin its 7000 Series Scheduled Maintenance Program (SMP).

Interviews conducted for this audit demonstrated a disconnect between the project team and Metrorail's safety certification requirements to ensure that all required items are addressed prior to placing a railcar back into service. The WMSC communicated with Metrorail's safety certification team, who understood the requirements, and informed that team of the gap in understanding to provide Metrorail with the opportunity to proactively correct this misunderstanding and ensure that Metrorail follows its requirements to complete safety certification steps prior to placing a rehabilitated railcar into service.

The next 6000 Series SMP work cycle was tentatively set to begin in July 2025. Due to the size of the 7000 Series fleet and the expected time to complete each car, Metrorail expects the 7000 Series SMP to be a continuous process moving forward (roughly six years after the first car is completed, the last car will be completed, and the 12-year cycle would then begin). Metrorail expected not to conduct an SMP for the 2000 Series railcars unless there are delays in the 8000 Series railcar delivery. The WMSC noted potential risks of changes from Metrorail's previous practice of scheduled changeouts of specific parts along with a mid-life overhaul for each car to a six-year cycle. This includes risks related to items with shorter lifespans of 4 to 5 years, which Metrorail will need to ensure are captured in its periodic inspection cycles. Metrorail will also need to ensure that other component preventive maintenance requirements continue to be met.



► **C-0138 (Closed)**

Metrorail does not require or receive all necessary OEM documentation, parts, or tools.

Metrorail has completed an inventory of all necessary original equipment manufacturer (OEM) documents, parts, and tools. Metrorail acquired missing documentation and tools found during that inventory. Metrorail established a documented process to identify procedures, documentation, and special tools required to perform maintenance activities.

► **C-0140 (Closed)**

The responsibilities of CMOR's Incident Investigation Team and CMOR's separate unusual occurrence response personnel conflict and are not clearly defined.

Metrorail has created procedures for incident and occurrence response of railcar engineers. This procedure includes responsibilities for coordination with other parts of CMOR and with Metrorail's Office of Safety.

Metrorail requested an extension of this corrective action plan (C-0143) at the time key deliverables were due.

► **C-0141 (Closed)**

Metrorail does not have adequate document control practices for car maintenance job plans.

Metrorail has developed a documented process to standardize the method to vet, enter and review Railcar Maintenance job plans in Maximo. An Approved Job Plans List has been published and is the responsibility of Reliability Centered Maintenance Planning (RCMP).

► **C-0142 (Closed)**

Metrorail does not have a systematic process to ensure that mechanics and engineers are trained for the specific tasks they are assigned to perform.

Metrorail performed a training assessment to determine the minimum training needs for all applicable engineering personnel and technicians for each railcar series. From this, Metrorail compiled a training matrix for engineers and technicians that included the minimum recurring training, certifications, and refresher training requirements for each railcar series. Metrorail also established supervisory checks.

This helps increase understanding. However, as described in Finding 1 below, Metrorail is not carrying out railcar maintenance and inspection tasks as specified by its procedures. Further, as described in Recommendation 2, Metrorail has the opportunity to proactively provide training records for personnel to their supervisors to ensure the personnel are assigned to tasks commensurate with their training.

► **C-0143 (Open)**

Metrorail does not consistently follow a standard process to address wheels out-of-round, to prevent cars with wheels out-of-round from operating, and to identify and address the root causes of wheels out-of-round.

Metrorail has not completed this corrective action plan on schedule. Metrorail requested an extension of this corrective action plan at the time key deliverables were due, and subsequently split its study into a third phase. The first phases of Metrorail's study identified areas of concern related to vibrations on 7000 Series railcars. Undesired vibrations or harmonics can have undesirable safety impacts on multiple elements of the railcar, as well as on Metrorail's track, structures, and other infrastructure. Metrorail's historical data demonstrates that 7000 Series railcars with new wheels (that have not yet begun to be cut down to smaller sizes) are more likely to experience wheels out of round. Metrorail is investigating factors including the stiffness of chevrons that are intended to reduce vibrations through the truck and axle. Metrorail's installation of new wheels on 7000 Series railcars beginning in November and December 2023 increases the risk that Metrorail may exacerbate issues related to the railcars and wheels out of round if these underlying causes are not addressed. Metrorail reported that it had instructed road mechanics to report railcars that are exhibiting out-of-round wheels (this can be reliably identified by trained personnel based on the sound made by these train wheels or, when





riding the train, based on the vibration pattern of the railcar). If Metrorail identifies potential wheels out of round, the car is taken to a railcar shop where wheels are measured and trued as needed. The WMSC continues to closely monitor Metrorail's implementation of this corrective action plan.

At the time this report was drafted, Metrorail had delayed the final Phase 3 report further.

► **C-0144 (Closed)**

Metrorail does not clearly define the proper use of engineering modification instructions (EMIs), service bulletins (SBs), and other railcar engineering change documents.

Metrorail has defined these documents, and is generally following its new procedures for development of the documents.

► **C-0145 (Closed)**

Metrorail utilizes multiple versions of the same inspection form that do not all include the same pass/fail criteria.

Metrorail has reviewed and identified Periodic Inspection (PI) checklists that required revision to ensure consistency across all Class 1 rail vehicle fleets, shops, and mechanics. Metrorail updated and distributed revised PI checklists.

► **C-0146 (Open)**

Metrorail railcars do not include inward- and outward-facing audio and image recorders in all operating compartments.

Metrorail submitted an extension and revision request, which the WMSC approved, for the scheduled timeframes for this CAP based on the design and performance of the work on the 6000 Series railcars. The timeline changes relate to the project plan for the equipment procurement, installation, and testing for 6000 and 7000 series railcars.

► **C-0147 (Closed)**

Part numbers are not being consistently entered in Maximo Work Orders for 7000 Series railcars.

Metrorail conducted a component code analysis for the part numbers being entered into Maximo Work Orders. Metrorail identified missing component codes for field-replaceable parts, and made revisions to the system to improve consistent usage. Metrorail revised its 'CMNT Work Order Audit Form' to include the validation of component codes being input into Maximo as a verification step.

Maximo records and personnel interviewed for this audit demonstrated disagreement among different entities within WMATA regarding the use of component codes and the ability to optimize Maximo's use for data analysis and trending. The system limits work orders to one main component, even when there may be multiple items addressed.

Metrorail updated and distributed revised PI checklists.



Component code tracking has improved under CAP C-0147. However, personnel interviewed for this audit reported disconnects among mechanics, supervisors, superintendents and data analytics and maintenance planning personnel in regard to closing work orders. As noted above, Metrorail has identified similar concerns in an internal review. Metrorail personnel reported that they have begun presentations focused on component code accuracy and the importance of these entries to providing management with a full story of what is happening in the field. Metrorail's Office of Inspector General identified related concerns regarding component tracking and serialization in 2023. Some personnel interviewed for this audit expressed related concerns about circuit boards and other items requiring individual software updates that they believe are not being appropriately tracked to that part-specific level. Metrorail can continue to make improvements to maximize the use of its maintenance management system to ensure timely and accurate identification and trending of data and completion of maintenance tasks. Metrorail is required to address safety data trending and analysis as part of its corrective action plans required by the WMSC's January 17, 2024 order related to National Transportation Safety Board safety recommendation R-23-28.

► **C-0148 (Closed)**

Some WMATA job descriptions have not been reviewed in more than 20 years.

Metrorail created a procedure requiring managers with direct reports review and update job descriptions periodically to ensure they reflect current practices and requirements. Metrorail provided the WMSC with examples of updated job descriptions under the procedure.

► **C-0017, C-0149 (Closed)**

WMATA has not fully implemented sufficient protections against the unauthorized movement of trains with zero speed commands.

Metrorail implemented a mode awareness software, also referred to as "stop and proceed," that requires train operators to acknowledge that they are entering a condition of movement without speed commands. Metrorail initially implemented this on its newest railcars, leading to the resolution of CAP C-0017 (which superseded FTA-RED-16-003-B). Metrorail then developed and implemented this system update on 2000 and 3000 Series railcars, leading to the closure of CAP C-0149.



Findings and Minimum Corrective Actions

Findings and Minimum Corrective Actions

Metrorail is not consistently following railcar-related procedures and is not ensuring safety rules are followed while carrying out maintenance and inspection tasks.



Findings

► **Finding 1: Metrorail is not carrying out railcar maintenance and inspection tasks as specified by its procedures.**

The WMSC's on-site observations and interviews conducted for this audit demonstrated that Metrorail is not consistently following railcar-related procedures and is not ensuring safety rules are followed while carrying out maintenance and inspection tasks.

| **Back-to-back measurements and safety**

During on-site audit activities, the WMSC observed mechanics working alone while measuring back-to-back distance between wheels on legacy railcars, which is contrary to Metrorail periodic inspection procedure task 20. Task 20 Section 20.2.2, as confirmed in Metrorail's comments in response to this draft report, requires each inspection team for legacy railcar back-to-back inspections to consist of two mechanics (technicians) to perform the back-to-back measurement on each wheelset assembly. Metrorail's Maintenance and Service Instruction (MSI) Procedure 140026 includes additional quality procedures and personnel for these measurements on 7000 Series railcars which have experienced wheel migration more recently than Metrorail's older railcars that experienced wheel migration on axles approximately a decade ago. The WMSC communicated this issue on site to the personnel performing the task, and shop supervisory personnel. In one of these cases, personnel stated they returned to complete the measurement properly.

In addition, the WMSC observed personnel remove wheel chocks from a railcar elevated on a lift in the Alexandria Rail Yard to conduct other back-to-back measurements without placing those or other chocks on other wheels to ensure the safety mitigation against the train rolling off the lift remained in place. Metrorail Operating Rulebook section 9.9.1 requires safety chocks to be placed under wheels whenever there is a possibility that the vehicle could move during maintenance.

| **Daily Inspections, Blue Signal/Flag Protection**

The WMSC also observed Metrorail personnel not completing Daily Inspections as required by Metrorail procedure CENV WI DI0001 – Daily Inspection. These inspections are designed to ensure that railcars are safe and functional for use in passenger service.

Personnel indicated that despite the procedure stating that steps must be conducted in order, they acted in the order that they chose, and that they do not consistently complete all tasks required by the procedure. Documents provided for this audit supported this, as checklists were not completed.

The WMSC audit team observed personnel doing tasks out of order, and missing completion of other required tasks.

Even for steps that were indicated as completed, the WMSC observed that personnel in the field did not carry out all of those checks in detail as specified in the procedure. This includes, for example, the required check of all breaker boxes.

Metrorail management involved in the oversight of the completion of these daily inspections indicated in interviews that they were aware that up to 1 out of 5 daily

Seals provide a level of assurance for switches of particular significance that personnel only manipulate intended switches, such as those controlling automatic train protection cutout, vehicle monitoring system functionality, operating mode selection, and door mode selection.



inspections were not being 100% completed as specified in Metrorail procedures.

The WMSC also observed that Metrorail personnel conducting Daily Inspections were not following all aspects of Metrorail's Blue Signal (Blue Flag) safety procedure. Some inspection of the trains was done prior to placing lights and other protections, despite the procedure requiring the safety protections be in place prior to conducting work. The WMSC also observed the blue cards (a card with the appropriate technician's photo, name and employee number printed onto it) designed to ensure trains are not moved or otherwise adjusted by one individual while being inspected by another individual were not consistently placed in the required location outside of the railcar to provide notice to other personnel that the train may not be moved.



Outdated Procedures

During WMSC field observations, Metrorail personnel had Daily Inspection procedure, version 6.0, however that procedure had been superseded by version 7.0 several months earlier, in May 2023. As described above, the personnel were not following the requirements of either version of the procedure to complete specific steps and to complete specific steps in order.

Release of cars with improperly sealed switches

WMSC inspections and safety certification oversight conducted during the timeframe of this audit identified that Metrorail was placing railcars into service with sealed switches that were not properly secured in accordance with Metrorail requirements. Seals provide a level of assurance for switches of particular significance that personnel only manipulate intended switches, such as those controlling automatic train protection cutout, vehicle monitoring system functionality, operating mode selection, and door mode selection. Seals also provide a level of assurance that personnel do not intentionally manipulate a switch without permission. Metrorail seals railcar switches by placing a small metal bar, through the switch guard and placing a wire through that bar that has a lead seal. The lead seal is then crimped. Manipulating the wire to access the switch breaks the seal. Metrorail rules require permission from a Rail Traffic Controller to break a seal when the train is operating on the mainline (outside of rail yards).

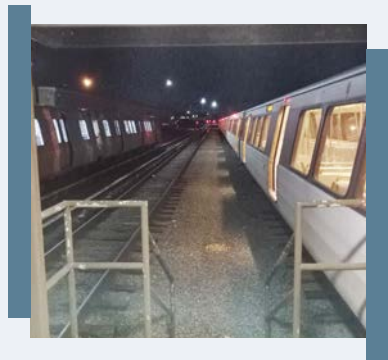
The WMSC's observation of such seal adjustments by Metrorail as part of Metrorail's work to certify train operators on automatic door operation on the Red Line, and subsequently during other WMSC field observations, demonstrated that Metrorail was releasing trains into service that did not have the seals properly in place. This included railcars where only wires were placed (without a bar), which means there is no way to determine whether the switch may have been manipulated. It also included railcars where a single wire was placed through multiple switches. Because this use of a single wire through multiple switches means removing the wire will unseal multiple switches, not just the switch that personnel have permission to manipulate to address an issue, this creates a risk that the wrong switch will be manipulated, leading to a safety event.



After the WMSC raised this safety issue to Metrorail management, Metrorail initially dismissed its noncompliance with this safety mitigation. The WMSC explained to Metrorail that Metrorail had established the seal requirements to provide a safety mitigation. Metrorail managers later acknowledged that the requirements would be carried out.

After the WMSC raised this issue to Metrorail, Metrorail confirmed that this type of “seal” of solely a wire without a bar in place is not acceptable under Metrorail practices, developed a memorandum and notice to personnel that stated that Metrorail did not have the required metal seal bars for 7000 Series trains, and retroactively stated in that memorandum that the seals with wires only that do not meet Metrorail’s requirements would be acceptable until these bars are in stock. Wires alone do not provide the same safety assurance.

Metrorail had not identified and addressed these improper seals in its railcar inspection and release process, including in railcar shops, during daily inspections by railcar maintenance personnel, or during required daily pre-revenue inspections by train operators. Similar to the items described above, this demonstrates that Metrorail is not following its procedures. By not identifying and acting upon these issues the first times they arose, Metrorail allowed these safety issues to become a broader hazard across its railcar fleet.

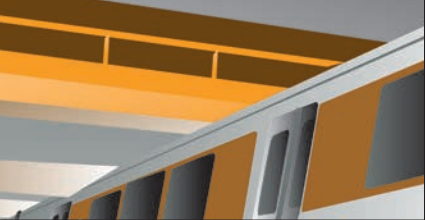


The WMSC also observed that Metrorail personnel are not properly crimping the seals in accordance with Metrorail requirements. Metrorail requires use of a special crimping tool for VMS/VMDS switches as an additional layer of assurance that these critical safety monitoring systems have not been unsealed without proper communication. Most railcar shops the WMSC asked to show these tools did not immediately know where they were, and spot checks showed railcars without this special stamp on the VMS seal. As the audit process was concluding, Metrorail provided a planned procedural revision that explicitly notes this as a required special tool in the 2000/3000 Series and 6000 Series C Periodic Inspection. Separate crimping tools are intended to be used to crimp other seals in place, however personnel stated they frequently use pliers or other tools rather than the intended crimping tools. These other tools do not assure that the fragile seals properly remain in place between inspections. Metrorail had been working to implement CAP C-0138 to address the identification of and availability of necessary special tools.

| Pre-revenue checks

Based on the above observations, the WMSC requested and reviewed Metrorail Car Maintenance Supervisor Pre-Revenue Inspection Forms for railcars for February 2022, July 2022, and October 2023. Some or all inspection fields were left blank on multiple forms, and some other forms had fields filled in but did not have a required signature supporting the form’s completion. The forms that showed incomplete inspections being represented as complete included inspection forms with no documentation of the inspection areas, forms with no information about the status of emergency equipment on the cars, and forms with no information on several areas such as doors and communication. Other forms were submitted as complete but did not list car numbers or other documentation that would be

Metrorail had not identified and addressed these improper seals in its railcar inspection and release process.



necessary to determine whether any inspection had been conducted or what had been inspected (these forms included only the supervisor name and date).

| Release of cars with other failed tests

During this audit, the WMSC observed that Metrorail had released railcars into service as a lead car on a train that had failed tests on one of their Automatic Train Protection (ATP) coils which are used to collect speed command information from Metrorail's wayside system. This test was designed to address numerous instances of intermittent speed commands on 2000 Series and 3000 Series railcars. After these railcars, 3156 and 3157, were identified as having operational issues during automatic door operation certification activities being observed by the WMSC, Metrorail subsequently opened a work order related to manual door operation only. The work order records show the underlying issues were not addressed, but the work order was closed.

The test that these cars had failed, conducted under MSI 180320 to check ATP coils, specified that its purpose was "to provide instruction to CMNT personnel for testing the frequency response of Alstom ATP receiver coils (WMATA P/N C18-59-6002). This test uses a CMNT PTU and test equipment specially programmed to perform automated testing. ATP coils tested and found within specification will remain on the vehicle. Any coil that tests outside of passing criteria will be removed from the railcar and replaced with a coil that is within specification (Rev E or previously passing coil)."

The coils that tested outside of the passing criteria on these railcars according to the portable test unit were not removed and replaced as specified.

Metrorail later determined that it would use different criteria for testing. The WMSC assessed Metrorail's compliance with this procedure as part of this audit and did not assess the testing criteria for this procedure.

During field observations for this audit, the WMSC audit team further observed a traction motor test checklist at the Greenbelt Service and Inspection facility (the specific location where this testing task is conducted) that showed a motor marked as passing the test even though the numbers recorded on the form did not reflect the required resistance. The form and the values recorded did not include the units of measurement. The personnel conducting the test could not say what the numbers indicated. This test is conducted by connecting a computer to the motor that runs pre-programmed resistance testing. The form is then completed by hand.

| Supervision

During on-site observations for this audit, the WMSC observed a train-to-wayside communication marker antenna frame in the Brentwood Rail Yard shop nearly toppling off a small plastic cart that it was balanced on as an individual attempted to move the large frame to a tool location on their own. Supervisors in other shops stated that they had lone individuals attempting to lift items on their own that were too heavy or difficult to lift safely alone. Car Maintenance management expressed concerns that there are not enough supervisors or frontline personnel to carry out required tasks (see Recommendation 3).



Metrorail is not consistently following its processes to implement operational restrictions for railcars that have deferred work orders.

Frontline personnel also noted that each shop carries out the same procedure differently, including by grouping Periodic Inspection subtasks differently to assign them to different personnel even though the subtasks may fall under specific tasks in the written procedure that Metrorail requires managers and supervisors to ensure is carried out and that Metrorail requires frontline personnel to carry out. Frontline personnel also stated that they only follow a procedure step by step if they have never done that procedure before, and otherwise act based on their own understanding.

Managers also stated in interviews that it was their discretion as to what periodic inspection should be conducted on a car returning to service after long-term storage, even though CENV WI 236 CSI Rev. 2.0 (Feb. 4, 2022) specifies the minimum inspection requirements.

According to the documents Metrorail provided for this audit, Metrorail has not updated its QA training for maintenance supervisors since November 2017. The then-current version of OAP 100-20 (Rev. 2, last reviewed Nov. 3, 2017) attached to the QA training for maintenance supervisors course requires Car Maintenance (and Automatic Train Control Maintenance, Track and Structures Maintenance and Traction Power Maintenance) supervisors to perform a minimum of one inspection per week of completed work to observe maintenance, look at quality of work, and formally intervene to evaluate, re-train and enhance the professional development of employees, and required Car Maintenance to define in its SOPs maintenance supervisor responsibilities and requirements for quality control of maintenance activities, as well as training requirements, formalized reporting process, and mechanisms for reviewing the proficiency of maintenance staff. Training records provided indicate a quality management course, but not this maintenance supervisors course that Metrorail provided as part of its training courses during this audit, has been completed.

Further, the WMSC observed a Metrorail manager on the floor of railcar shops with a Bluetooth electronic device in their ear, contrary to Metrorail safety policies and associated signage designating only specific areas where personal electronic devices may be used in each shop. As with other observations during this audit, the WMSC communicated this issue to Car Maintenance leadership.

| Deferrals, service restrictions

The WMSC's analysis of Metrorail data demonstrated that Metrorail is not consistently following its processes to implement operational restrictions for railcars that have deferred work orders.

Metrorail can designate railcar pairs to operate only in the middle (“belly”) of a train if the car or cars have a defect that would only be a hazard if the railcars were used as a lead car. For example, if a defect relates to the radio in an operating cab, but all other systems are functional, Metrorail may determine that the railcar pair is safe to utilize in the middle of the train where the operating cab is not needed. Metrorail's process includes recording maintenance information in Maximo, Metrorail's maintenance management system, and reflecting operational restrictions and maintenance status in the Rail Performance Monitoring (RPM) system. The RPM system is used by operations and maintenance personnel to view the status and location of railcars within rail yards.





The WMSC's analysis of Metrorail data indicated many railcars with work orders deferred due to lack of parts, and missing car wash pushbuttons on 2000 and 3000 series railcars that are utilized for safe movement of trains in specific situations, primarily in rail yards. Metrorail's comments on the draft of this audit report stated that Supply Chain reviews daily reports for out-of-stock items that prevent cars from being returned to service (rather than deferred), and that pushbutton shortages were not addressed in weekly Supply Chain Management - Railcar parts update meetings or Sales and Operations Planning meetings.

By not monitoring operational restrictions to ensure they are accurate, Metrorail introduces the risk that railcars that need to be restricted are inadvertently placed into service outside of Metrorail's requirements. For example, cars 6030 and 6031 were listed as having inoperative emergency intercom speakers, but had not had operational restrictions implemented by Metrorail until the issue was resolved.

The WMSC also identified the deferral for several months of work on car 2020 for a radio that was not transmitting, but no associated restriction to ensure car 2020 was not used as a lead car. In some other instances, the implementation of a restriction was not carried out in accordance with Metrorail procedure. For example, a work order on car 3261 stated that the yard horn, one of the two horn types on the vehicle, was inoperable and the car should be "bellied" (operated only in the middle of a train, never as a lead car) until the part is available. However, the work order was then closed, rather than deferred, which prevented the work order from being noted for personnel as the railcar entered a rail yard each day as would be required to ensure this restriction was consistently applied. In other cases, cars with inoperable yard horns and buzzers did not have any restriction applied.

Some items deferred included radio communication problems, instances where personnel did not know the part number of items such as radio antennas, and deferrals of 7000 Series railcar intercar barriers that were worn beyond the required limit and permitted to operate until the next periodic inspection.

WMSC review of Maximo data also showed that some deferred work orders dated back as long as 2016. The data also indicated conflicting records for other railcars regarding operational restrictions due to deferred work, and the possible completion of that work. This included instances where a work order was open and deferred and required mitigations such as "bellying" the railcar by operating it only in the middle rather than at the lead end of a consist, yet a separate work order had been opened and later closed for the same task, suggesting work may have been completed.

The WMSC did verify that, at the specific point in time the WMSC sampled, railcars that had restrictions recorded and properly entered into Metrorail's Rail Performance Monitoring system that were in a rail yard at that time (where the system provides the relevant information) displayed on Metrorail's Rail Performance Monitoring system the intended restriction noted in Maximo.

◆ **Minimum Corrective Action:**

Metrorail must ensure railcar maintenance is done in accordance with its procedures and that cars are only released and only put into service if they meet safety requirements for dispatch. Metrorail must also ensure personnel in Railcar Maintenance facilities are following Metrorail personal safety rules and procedures including blue signal/flag protection, use of wheel chocks, electronic device policies, and ergonomic safety requirements.

► **Finding 2: Metrorail is training railcar personnel on outdated procedures.**

Metrorail training documents provided for this audit included outdated procedures.

For example, training documents included multiple versions of daily inspection procedures that were each out of date and each superseded. Some of the associated training material had not been reviewed or updated since April 2018, five years before this audit, despite multiple iterations of procedural changes in that time period and despite Metrorail's requirements to review documents on a regular basis.

Providing conflicting and outdated information in training prevents personnel from understanding and acting upon current procedures and requirements. The updated procedures include, for example, additional safety warnings. As described above, Metrorail personnel were not following either version of the procedure in the field.



Other training documents also showed outdated running maintenance and service manuals, periodic inspection, and other procedures dating back more than a decade, which creates the risk that personnel will not carry out current maintenance requirements in the field as required.

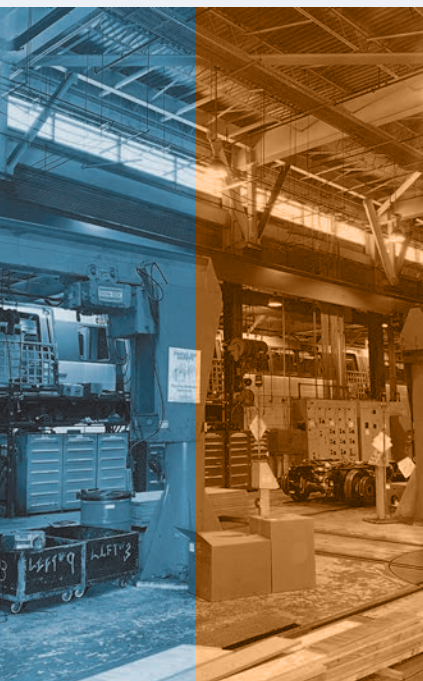
In initial document requests for this audit, Metrorail provided procedures regarding maintenance of procedures that were also not up to date.

Further, although Metrorail provided a tracking document of required procedure review dates, that document control tracker had not been consistently updated with subsequent review date requirements past the first required revision date.

Meeting Metrorail's configuration management requirements requires incorporating procedural revisions and improvements into training and other materials.

◆ **Minimum Corrective Action:**

Metrorail must establish and implement an effective process to review and update training materials on a regular basis as required, including ensuring that there is communication when relevant procedures are updated, and that those updates are incorporated into all relevant training material.



Shop cranes were used to move equipment overhead with no warning, and without personnel donning the personal protective equipment (hard hats) that supervisors acknowledged is required.

► **Finding 3: Metrorail is not meeting life-safety and occupational safety and health requirements in railcar maintenance facilities.**

Metrorail is not complying with its hot works program related to metal grinding, has improper NFPA signage, and does not have or keep required fall protection in place around repair pits. In addition, despite the rules in the Metrorail Operating Rulebook, personnel have differing understandings of the personal protective equipment and safety practices required during lifting operations, such as whether a hard hat is required if materials are being lifted overhead by a crane.



Observations of hazards described below during on site visits, such as those related to grease control and compressed gas, led to the WMSC adding the PTASP element of hazardous materials and environmental management to this audit.

The WMSC observed some eyewash stations that were past due for cartridge replacement. Those issues with eyewash cartridges were resolved by Metrorail personnel with the WMSC during the site visit.

| **Safety of Lifting**

Metrorail personnel have differing understandings of the personal protective equipment required during lifting operations, such as whether a hard hat is required if materials are being lifted overhead by a crane, and whether such lifting is authorized.

During the WMSC's field observations, shop cranes were used to move equipment overhead with no warning, and without personnel donning the personal protective equipment (hard hats) that supervisors acknowledged is required when under an active crane to provide protection against falling objects. Other work in a Metrorail railcar shop requires a bump cap when working under vehicles. The WMSC also observed personnel utilizing a crane to load traction motors into a pickup truck for delivery to another shop without any head protection.

Protection against being struck by a falling object by limiting movement of loads overhead, confirming appropriate rigging, communication with equipment operators, and wearing personal protective equipment is a requirement under Occupational Safety and Health Administration and other industry guidance and requirements. OSHA regulations codified at 29 CFR 1910.135 (general industry) and 29 CFR 1926.100 (construction industry), require employers to ensure that each affected employee wears a protective helmet when working in areas with a potential for injury to the head from falling objects.

Metrorail incorporates this requirement in rule 18.5.2 of the Metrorail Operating rulebook: "Hard hats shall be worn in areas where the possibility of head injury from impact, falling objects, or electrical shock or burn exists."

The WMSC provided Metrorail with opportunities to provide documented procedures governing these protections for personnel that were explained by personnel in Car

Maintenance shops as requiring hard hats under moving cranes. Metrorail provided its Metrorail Operating Rule Book, which additionally, in section 11.22, requires that “employees shall not stand or work under a load supported by a crane,” and that “loads supported by cranes shall not be swung over employees or customers.”

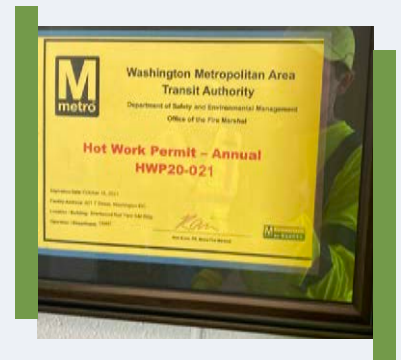
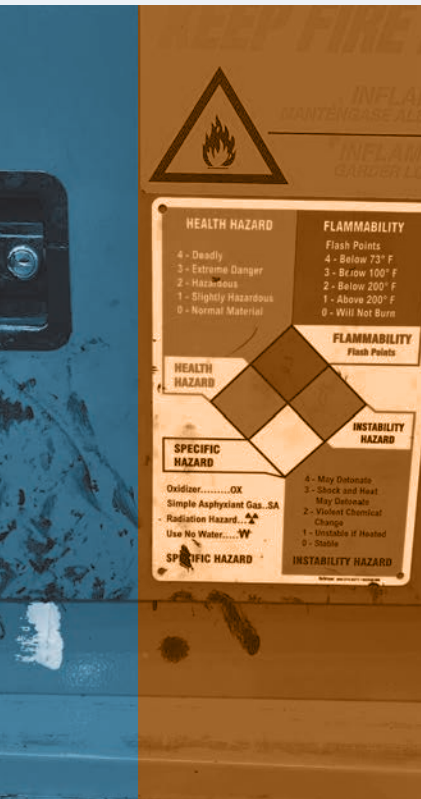
The WMSC observed personnel not following Metrorail’s safety requirements for shop cranes.

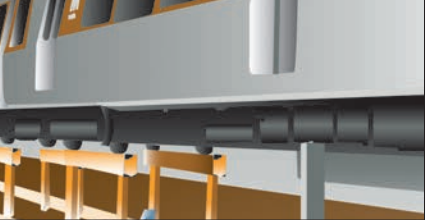
Hot Works

Metrorail’s current Hot Work Program, last updated in 2021, covers items - such as metal grinding, welding and associated processes, torch cutting and abrasive saw cutting, soldering, and similar work processes that produce sparks, hot slag, or conductive, convective, or radiant heat transfer.

WMSC site visits during this audit identified multiple grinders in shops without protections required by Metrorail’s Hot Work Program, and in areas where personnel stated they do not have or follow hot work protections if they were to use the grinders and do not conduct hot work shop self-inspections described in the Hot Work Program Manual. Metrorail’s Hot Work Program Manual specifies that these grinders do not require individual hot work permits if compliant with OSHA 29 CFR 1910.215, and that such work may be performed “in any non-hazardous location...but are still subject to compliance with all other requirements established in this document.” Metrorail’s Hot Work Program requires appropriate personal protective equipment as determined by a job hazard analysis (JHA), consideration of respiratory protection for all hot work (with associated respiratory protection training, medical monitoring, and respirator fit testing), ventilation fans where possible, clean protective clothing that meets ANSI Z49.1 and AWS standards, safety footwear conforming to ASTM standard F2413-11 that is high top and provides protection against sparks and spatter, long pants and long sleeve shirts made of a non-synthetic or flame-retardant/proof material, the shirt top button closed and secured at all times, and other protective equipment.

The Hot Work Program (2021) requires a Hot Work Fire Safety Supervisor or designee to inspect and ensure an area is fire safe, and requires a Hot Work Permit to be signed and executed prior to any hot work, with an exception for permit exempt work processes. A job briefing and Pre-Hot Work Checklist is required prior to the start of all work. The Hot Work Program also states that, when hot work is occurring above pits and trenches such as those found in the shops, the open areas around the hot work must be covered with flameproof covers, tarps, or pads. These covered pits and trenches must be barricaded from accidental access by personnel. Where practical, all combustible materials are located at least 35 ft. in all directions from the hot work. A continuous fire watch is required during hot work activities and for a minimum of 30 minutes after the hot work is completed. After the work is completed, the Hot Work Fire Watch Person will document fire watch activities accordingly on the WMATA Fire Watch Log form.





As specified in the manual, when multiple hot work zones/areas are required, hot work zone boundaries are established. The manual also requires hot work operators to survey the area prior to beginning work to verify the area is fire safe, including in annual permit required locations, such as rail repair shops, which the manual specifies includes portable and non-portable equipment. “Shops and similar type designated areas for conducting hot work on a continuous basis are typically maintained to eliminate or control hazards found in other environments, which are not specifically designated for this purpose. The Hot Work Operator is responsible for compliance with all applicable requirements contained in this document,” the manual states.

The manual defines requirements for shop locations including separation from surrounding areas, lighting levels, ventilation, fire extinguisher, and hazard warning signs. Specific to the items identified in this audit, the manual requires that “floors are kept clean and free of any combustible materials at all times.” The manual further requires that “no combustibles can be stored within the room or in the immediate area.”

The WMSC observed materials such as cardboard and other items in the immediate area of these grinders, within the rooms where these grinders are placed in areas including the Greenbelt and Brentwood facilities.

The manual defines hot work as including any work that produces, among other things, hot sparks, which includes grinding.

Grinders in railcar facilities were placed within 35 feet of combustible materials such as boxes and other equipment, and those materials were not protected by flameproof covers, pads, or screens.

Further, there was conflicting signage in the area of additional grinders in the Greenbelt Rail Yard’s back shops regarding whether or not it was acceptable to grind aluminum.

In addition, the manual requires annual hot works permits to be current. During on-site visits, an expired hot work permit was posted at the Brentwood Rail Yard Service and Inspection Shop. In its comments on the draft of this audit report, Metrorail stated that there was a current permit, but it was not posted. Metrorail’s response stated that permit HWP 23-021 expires on October 31, 2024. Separate WMSC review of records from WMATA’s Fire Marshal’s office indicated that permit exists and expires on December 31, 2024. Despite the differing information, Metrorail’s Hot Works Program Manual, Section 5.5, requires a current hot work permit be displayed at the work site.

The manual also references Metrorail respiratory protection training requirements, fit testing requirements, and medical monitoring requirements that must be followed as part of the hot work program. However, during work separate from this audit, Metrorail told the WMSC in January 2024 that it did not have such a respiratory protection program. In February 2024, Metrorail provided the WMSC with Metrorail’s first respiratory protection program.

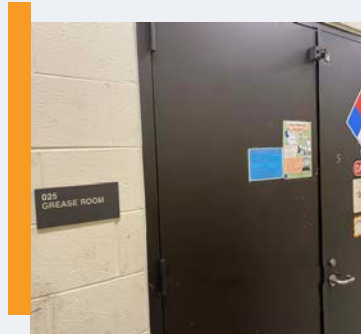
Metrorail’s Hot Work Program Manual requires any individual functioning as a hot work operator to complete hot works training (familiarization module, fire extinguisher module, any required certifications, and hot work operator module), and requires any individual



The WMSC observed materials such as cardboard and other items in the immediate area of these grinders, within the rooms where these grinders are placed in areas including the Greenbelt and Brentwood facilities.

The WMSC also observed areas where existing railings were left open and were therefore not providing the designed fall protection.

functioning as a hot work fire watch person to complete hot works training (familiarization module, fire extinguisher module, and hot work fire watch person module). Metrorail provided records of 33 Car Maintenance personnel with hot works training. Based on employee records, interviews, and shop observations, other Car Maintenance employees beyond those who have had this training routinely participate in hot works in roles requiring such training. As described in the Hot Work Program Manual, these safety requirements are in place for all hot works, including work in permit-exempt areas.



The WMSC also identified some fire extinguishers in railcar shops that had not been checked for several months.

Improper NFPA Signage

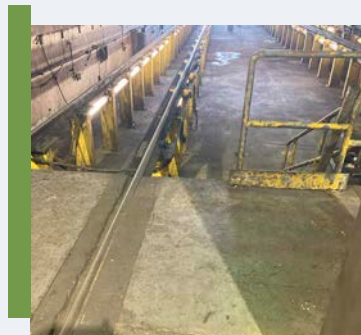
The WMSC audit team observed National Fire Protection Association (NFPA) 704 signs with handwritten, non-bolded, faded markings intended to indicate the hazard posed by chemicals in specific cabinets or locations at several railcar facilities. This

includes multiple locations across the railcar facilities in the Greenbelt Rail Yard.

NFPA standards permit handwritten information on this signage, but require that the numbers that provide the relevant information be bold in order to be legible from distance or in degraded visibility. This is designed to provide for the safest response by providing clear information regarding the hazard posed by chemicals in a given cabinet, area, or room.

Metrorail's internal safety review of Vehicle Program Services (CENV) completed in December 2021 identified related hazards of unlabeled chemicals in the Greenbelt Rail Yard's Building H.

Fall Protection



Metrorail railcar maintenance facilities include open pits to permit for undercar maintenance and cleaning without the use of lifts and elevated work platforms for railcar roof work. For some of these pits and platforms, Metrorail has railings along the sides of the pit or visible safety markings. However, Metrorail does not have fall protection that encompasses areas such as its wheel lathes, has floor markings in other areas placed directly at the edge of the pit rather than several feet away as specified in OSHA requirements within 29 CFR

1910.28, and does not have signage or visible floor markings warning of the open pit at all locations ensuring personnel remain at least six feet away unless they have fall protection training, for example, when approaching in line with the running rails. The WMSC also observed areas where existing railings were left open and were therefore not providing the designed fall protection at, for example, the Alexandria Rail Yard Service and Inspection Shop.





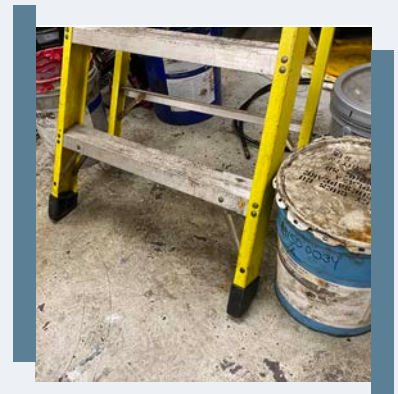
Shop personnel and managers said the personnel who typically work in these areas are aware of the fall hazard, however, not all Metrorail personnel and contractors who enter a shop work in that particular shop on a regular basis.

Further, Metrorail's training records provided for this audit do not show that fall protection training has been provided to or successfully completed by CMOR personnel.

| Environmental controls, grease storage

During on-site visits for this audit, the WMSC observed grease spread and lumped on the floor in facilities such as Room 025 in the Greenbelt S&I Shop and rusting drums at the Brentwood S&I Shop building.

Uncontrolled contaminants such as grease pose a risk of environmental or personal harm. This is among the items the WMSC highlighted to personnel responsible for the facility during the on-site visit.



In addition, the WMSC observed that Metrorail has challenges related to control of hazards related to car wash chemicals at locations such as the Shady Grove and West Falls Church railyards. Backups or overflow of systems within the building pose a hazard to personnel of fumes that cause irritation to the eyes, nose, and mouth that can impact their safety and the safety of conducting work. The WMSC noted this hazard to Metrorail as part of inspections in 2022 and 2023. 2023 West Falls Church local safety committee meeting records provided for this audit did not include this hazard or mitigations for it. Metrorail personnel working in and around these facilities reported ongoing concerns to the WMSC.

| Refrigerant recovery

Metrorail's Compressed Gas Cylinder Storage, Use & Handling Program Manual (2021) for cylinders primarily used in rail and vehicle maintenance shops and in various rail maintenance/repair processes covers gases such as refrigerant 407C, 134A and R-122.

The WMSC observed many such containers in a shop on the ground floor of Building H at the Greenbelt Rail Yard. The tanks were each placed on pallets. Personnel expressed concerns about the handling of these gases, and about visible deterioration of the wall in the area where the cylinders are kept. This led the WMSC to include consideration of the Public Transportation Agency Safety Plan (PTASP) element related to hazardous materials during this audit.

Metrorail does not have an SOP or other process for handling recovered R-407C refrigerant. Following the WMSC's observations and requests, Metrorail provided what was labeled as a draft SOP dated Sept. 21, 2023. This SOP was not in a Metrorail SOP format, was not tied to a department, and had not been signed or reviewed. The draft SOP did not include checks of the certification date of the storage tanks or a check of the valve for leakage. In response to the draft of this audit report, Metrorail stated it is developing MSI 000008 to document procedures for a refrigerant recovery process.

Metrorail does not have an SOP or other process for handling recovered R-407C refrigerant.



The Compressed Gas Cylinder Storage, Use & Handling Program Manual requires that

“All WMATA employees assigned to perform any duties involving the storage, use, or handling (including transportation) of compressed gas cylinders must be properly trained in the skills required for each of their assigned duties and be knowledgeable in all aspects of safety related to each job function/ job task. All WMATA employees assigned to perform any duties involving the storage, use, or handling (including transportation) of compressed gas cylinders are required to complete the compressed gas storage, use & handling program training module(s) developed in cooperation with SAFE. These are: Compressed Gas Program Familiarization Module; and Emergency Procedures for Compressed Gas Emergencies.”

These courses are not included in the Car Maintenance Training Matrix provided for this audit, and these courses are not reflected in the learning management system records provided for this audit.

Metrorail’s Compressed Gas Cylinder program requires empty or unused cylinders with expired test dates, contents that have expired, or that show visible signs of significant corrosion or other hazards are removed immediately from WMATA property by the supplier, or as otherwise directed by SAFE. The program specifies that indoor storage of compressed gas cylinders will be maintained in designated Control/Cutoff Rooms or Control Areas designed and constructed in accordance with the applicable building and fire codes. Indoor storage of compressed gas cylinders will be stored in designated areas only. Permissible quantities of compressed gas cylinders will be determined based upon operational needs and the maximum code allowable quantity limits. The type and number of cylinders permitted in each storage location will be posted with code/standard compliant signs. Indoor storage of compressed gas cylinders will not be comingled with the storage of other goods. A “Compressed Gas Storage, Use & Handling Permit” will be issued by the WMATA FM [Fire Marshal] for those facilities storing, using or handling compressed gas cylinders in quantities that exceed “exempt” amounts. The permit will limit the amount of compressed gas cylinders that can be stored in each building. Permits may also be issued, at the discretion of the WMATA FM [Fire Marshal], for those facilities storing, using or handling quantities in less than “exempt” amounts.

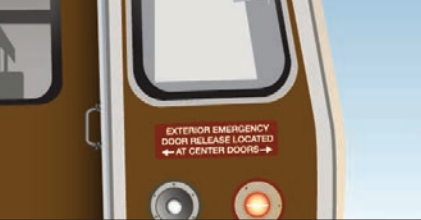
◆ **Minimum Corrective Action:**

Metrorail must meet its life-safety and occupational safety and health requirements in railcar maintenance facilities. Metrorail must address each of the issues identified in this finding, and develop and implement a proactive program to mitigate the risk of deviations from life-safety and occupational safety and health requirements in railcar maintenance facilities in the future.

▶ **Finding 4: Metrorail is not identifying and mitigating hazards related to railcars and railcar personnel.**

Metrorail stated it does not maintain a hazard log related to railcars. Such a log has long been required by Metrorail’s safety plans.

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The mitigation was not implemented even in shops where the special alert remained posted on bulletin boards.

In addition, local safety committee meetings for rail yards did not have consistent documentation that they occur each month or that meetings at different locations cover the same types of information. Some shops have agendas only, others have minutes, and several have missing months where there is no record of a required meeting being held. Metrorail was beginning work at the time of this audit to implement its safety risk management system for railcar departments.

Metrorail's current Public Transportation Agency Safety Plan requires the identification and mitigation of hazards and evaluation of the effectiveness of those mitigations as part of Metrorail's safety management system.

| Electrical-Related Hazards

High voltage power cables

In multiple shops visited for this audit, including the Greenbelt Service and Inspection Shop, Metrorail personnel had placed high voltage power cables used to provide power to railcars while in a shop in a way that posed a trip hazard to personnel, and that risked the power cord being unintentionally dislodged, creating additional hazards.



Metrorail had identified this hazard and an associated mitigation, and communicated it to personnel in late 2022 through a Car Maintenance Special Alert (SA 22-12-L), that stated covers had been provided and were to be used as a safety mitigation when the cables were attached to a railcar or otherwise unspooled in order to protect personnel from injury and to prevent damage to or damage caused by electrical systems. The safety alert was a positive attempt, but Metrorail had not conducted supervisory oversight or otherwise followed through to ensure that the mitigation was implemented, let alone to evaluate under its safety assurance and safety risk management process whether the planned mitigation was effective as required by Metrorail's Public Transportation Agency Safety Plan. The mitigation was not implemented even in shops where the special alert remained posted on bulletin boards on the shop floor.

Warning lights for active high voltage power not visible

When the shop power boxes are activated to provide power to the high voltage cables described in the previous subsection, a red warning light on the box is intended to serve as a reminder and warning to personnel. However, these warning lights are not visible from most angles, including those angles where personnel working or moving around the energized equipment are most likely to be positioned. The small red light cannot be distinguished from a distance inside the shops.

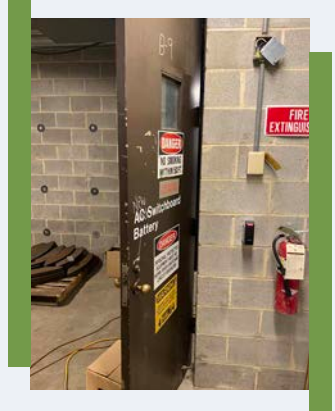
Metrorail has no hazard log related to railcars and railcar personnel, and therefore cannot systematically identify and appropriately mitigate these types of hazards.



The cord ran down stairs, through a specially created hole in a door, and into the basement where it was plugged in.

Power room for railcar shop propped open

One method of providing a layer of safety related to power equipment is to secure power rooms. During site observations at the Alexandria Service and Inspection building, the WMSC observed an AC Switchboard room with the door propped open and fans in the room. Metrorail personnel, including railcar and power personnel, provided conflicting explanations for the door being open contrary to Metrorail safety requirements. One explanation related to an effort to prevent fire alarms from triggering due to heat in the room. Another explanation related to water intrusion that Metrorail personnel were attempting to dry out. Railcar personnel stated they placed fans in the power room. Whatever the true underlying hazard, Metrorail had not identified and effectively and safely mitigated it, and in the meantime introduced a hazard of allowing access to such a power room in a railcar facility by unauthorized personnel, exposing those personnel to electrical hazards and creating related risks to Metrorail assets.



Improper Extension Cord Use

The WMSC audit team observed an extension cord that appeared to be a permanent installation in the Alexandria Service and Inspection building, contrary to electrical safety requirements. The International Fire Code and NFPA 70 National Electrical Code both state that "Extension cords and flexible cords shall not be a substitute for permanent wiring." The cord ran down stairs, through a specially created hole in a door, and into the basement where it was plugged in. The cord appeared to be in use at the time of the WMSC's site visit to power or charge mobile lifting equipment. As a semi-permanent installation, this is an improper use of an extension cord that poses an electrical hazard that had not been identified nor addressed by Metrorail.

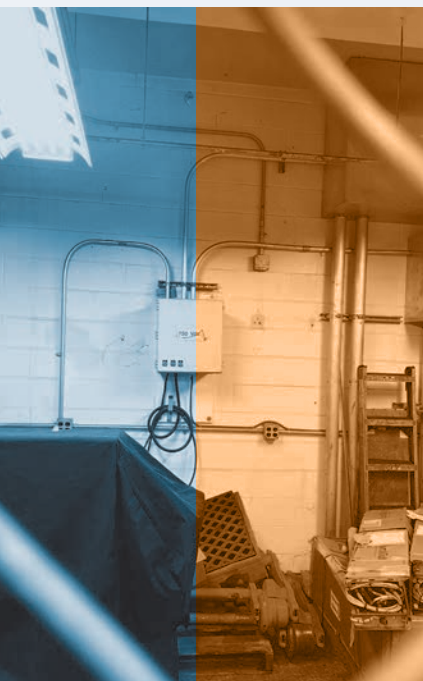
Unsecured equipment

Metrorail is not securing equipment such as re-rail equipment in its rubber-tired vehicles and trailers, creating a risk of collision, injury, and damage.

Metrorail owns several sets of equipment that can be used to return a derailed railcar or other vehicle to the tracks. Metrorail typically transports this equipment in a dedicated rubber-tired trailer that is towed by a rubber-tired vehicle to the derailment location. The equipment can then be brought to the derailment site at that location, or can be transferred to a flatcar at a rail yard if rail-based access is best for the response scenario.

The WMSC observed the trailer containing this equipment at the Brentwood Rail Yard. The equipment in this trailer was not secured, creating the risk that it will move while in transport and cause a collision on the road or damage to the equipment.

In response to a follow-up request for any procedure or process related to transportation of re-rail equipment, Metrorail provided SOP 301.07, Rev. 4 that requires that the equipment is exercised at least annually and that it is inspected monthly. The procedure





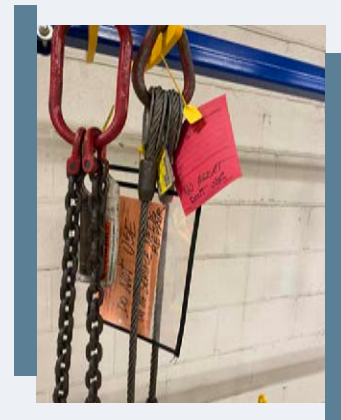
Equipment in the basement of the Brentwood Service and Inspection building was stored without any tags indicating it was nonfunctional.

does not provide for the securement of the equipment in the trailer for transport. If the equipment is not secured, there is an increased risk of damage or causing damage or injury during transport.

| Non-functional equipment available in storage areas

The WMSC audit team observed non-functional equipment in storage areas of railcar facilities that was not tagged out to ensure it remained out of service.

For example, re-rail equipment in the basement of the Brentwood Service and Inspection building was stored without any tags indicating it was nonfunctional, but personnel stated it was nonfunctional equipment that was previously relied on when Metrorail had more re-rail teams active. Metrorail was relying solely on the memory and presence of key personnel to identify which equipment in the area was functional and could be used if needed, and which equipment was out of service.



Metrorail processes require out of service equipment to be tagged to mitigate the hazard of personnel using inoperable or otherwise unsafe equipment.

| Shop inspections not capturing all hazards

The WMSC reviewed Metrorail shop safety inspection reports, WMSC inspection reports, and Maximo work orders. The review showed that not all elements of inspection forms, such as a Brentwood Truck Shop Monthly Safety Inspection, were complete, and that known issues were not being recorded on these forms to ensure they are addressed and that Metrorail has an accurate picture of current safety conditions.

The records also demonstrated gaps related to interdepartmental processes, such as no record on the railcar departments' forms of ongoing problems with car wash chemicals entering other parts of the facility at locations such as Shady Grove and West Falls Church shops.

As noted earlier in this report, Metrorail's Quality personnel have also separately identified in recent internal reviews of the Chief Mechanical Officer, Rail (CMOR) departments that Metrorail's railcar shop inspections are not capturing hazards and non-compliance.

| Work orders not prioritized in accordance with Metrorail policy

Metrorail defines prioritization of items in railcar facilities as:

Low	Low to no impact to shop or personnel
Med	Has some impact but you can work around the issue
High	Safety of personnel or equipment is compromised

However, the records provided showed work orders are not prioritized in this fashion. Instead, all items at given locations were rated the same, and the same types of items were rated differently at different locations. This prevents Metrorail from effectively prioritizing and mitigating hazards as required under its safety management system.



For example, the Greenbelt Service and Inspection Shop had all items rated as moderate, while all items in the truck machine shop were rated as high, despite these ratings not conforming to Metrorail's prioritization requirements. At the Alexandria Service and Inspection Shop, multiple ratings also did not align with Metrorail policy, such as a broken water fountain rated as high priority.

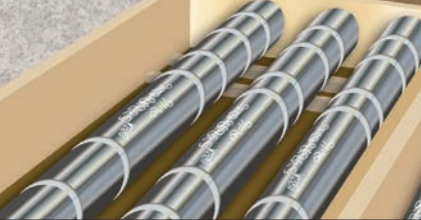
In other cases, items marked as high priority were not addressed for an extended period, such as a fire extinguisher in a parking garage marked as high priority that had not been addressed for more than two years.

| Train with operational hazard could be returned to service

The WMSC's on-site audit observations included observing Car Maintenance Controllers in the Rail Operations Control Center (now Metro Integrated Command and Control Center). During this observation, a train experienced a propulsion problem. Metrorail offloaded riders from the train. However, the Rail Traffic Controller did not document the incident in a timely fashion, which led to the train reaching the end of the line before it had a work order or other action taken to ensure that the train was kept out of service. Under Metrorail's processes, without the Rail Traffic Controller providing the necessary information, the vehicle continues to display to a Terminal Supervisor or Interlocking Operator as released for service. Therefore, this delay in opening the work order due to the delay in the Rail Traffic Controller providing the necessary information creates the hazard of a train being placed into service that does not meet safety requirements. Under Metrorail's process, Rail Traffic Controllers must document the train identification number, time, and other details of the event first before Car Maintenance Controllers can enter additional information necessary to ensure the relevant vehicles remain in the rail yard until they are repaired. In this case, it took more than an hour for the writeup of this motor overload event. This hazard, and mitigations for this hazard, related to the use of railcars that are known to be unsafe for passenger operation is not reflected in Metrorail's hazard tracking systems.

◆ Minimum Corrective Action:

Metrorail must ensure that it is identifying, prioritizing, and effectively mitigating hazards related to railcars and railcar personnel by implementing its safety management system for these areas as specified in its Agency Safety Plan. Metrorail must also ensure that it identifies and mitigates electrical hazards including those noted in this finding, that it prioritizes work orders in accordance with its requirements, that it reports trains that must be held out of service in a timely fashion, that it communicates and follows a uniform process for trains out of service for an extended period, that there is effective collaboration among organizational units, and that it establishes and implements requirements to secure equipment during transport, specifically re-rail equipment. This CAP may incorporate planned deliverables from Roadway Maintenance Machine Audit CAP C-0241.



► **Finding 5: Metrorail is not following its operational certification requirements for Car Maintenance Road Mechanics.**

Metrorail certification records and audit interviews demonstrate that Metrorail is certifying Car Maintenance Road Mechanics (personnel assigned to identify and troubleshoot problems in the field on both in service and out of service trains on mainline tracks who may be assigned to operate a train and who must understand train operations) in train operation without these Road Mechanics attempting or completing all tasks required by Metrorail's Performance Standardization Manual on Train Operations. In addition to the records showing road mechanics designated as certified in train operations despite not being directed to attempt all tasks required by Metrorail's manual, Metrorail could not provide any such certification records for one active road mechanic.

These records showing that the personnel had not completed all required steps, but that Metrorail was relying on to demonstrate certification was current in fall 2023, were from certification activities conducted between February 2023 and October 2023 (the dates provided on forms did not match dates provided on a summary sheet tracking certifications of Road Mechanics).

The WMSC issued **an order** on February 28, 2024 related to Metrorail's noncompliance with its train operator certification requirements. The order referenced these records reviewed during this audit. In addition to the requirements of that order regarding the proper conduct and oversight of train operator certification exams, this finding requires Metrorail to ensure that it only assigns personnel as Car Maintenance Road Mechanics who meet the requirements of that position.

► **Not all safety tasks attempted or completed**

Mechanics Metrorail designated as certified to operate trains despite not being directed to attempt and complete required tasks specified in its Performance Standardization Manual were not directed to complete baseline requirements set in the manual such as the ability to operate on mainline tracks, the ability to properly select routes, or the ability to conduct an environmental system shutdown in a timely manner required in the event of smoke or fire to protect personnel and passengers on a train. The records show these personnel did not attempt the coupling, uncoupling, or manual switch operation required by Metrorail's manual for certification. Other personnel did not complete required interior inspections. For multiple personnel with records indicating that they performed a turn back move, the time recorded is precisely 2 minutes, exactly the listed time allotted.

Metrorail records show personnel marked as achieving the highest score, QL-1, on certification despite these required tasks not being attempted.

Metrorail confirmed during this audit that these personnel are required to meet the same requirements of the Performance Standardization Manual, and that they are required to be certified using the same process as any other personnel who are authorized to operate trains on mainline (outside of rail yards).



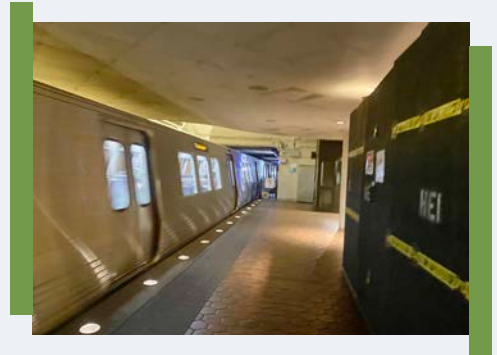
The WMSC issued an order on February 28, 2024 related to Metrorail's noncompliance with its train operator certification requirements.

The road mechanic certification records reviewed for this audit also show that Metrorail certified personnel who were not required to attempt the necessary written testing.

For a road mechanic who was not required to demonstrate shutting off the environmental system, for example, Metrorail also did not require them to demonstrate mainline communications, door operation and station stopping, use of horn, speed adherence/manual operation and manual route selection. The only item recorded as demonstrated in the mainline operation category is a turn back move, which is improperly marked as a QL-1 despite the recorded time exceeding the requirement for this score. Even if those tasks had been attempted and successfully demonstrated, the certification record is missing required documentation of the time taken to complete troubleshooting tasks, which makes it impossible (for the WMSC or for Metrorail) to determine whether this individual met the requirements of Metrorail's Performance Standardization Manual for those tasks.

Another road mechanic recorded as not completing any mainline operation tasks except a turn back move is recorded as performing that turn back in 3 minutes, which is precisely the maximum time for a QL-2 score. Any longer and the road mechanic would have failed the certification exam (QL-3). The records incorrectly note this as a QL-1 (highest) score.

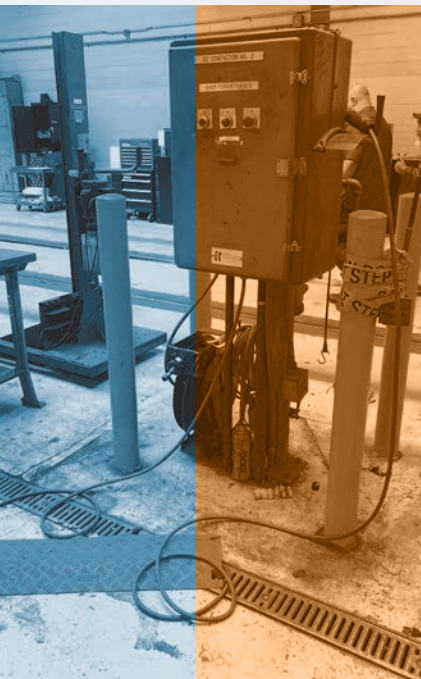
The individual was also recorded at precisely the maximum permitted time for a QL-1 score for isolation (self-recovery) and the testing documentation does not include the time to complete troubleshooting tasks. Each of these inconsistencies makes it impossible (for the WMSC or for Metrorail) to determine whether this individual met the requirements of Metrorail's Performance Standardization Manual for those tasks that Metrorail did have the individual attempt.



The road mechanic certification records reviewed for this audit also show that Metrorail certified personnel who were not required to attempt the necessary written testing on Metrorail operational rules and procedures, and who did not have in their possession required documents such as the rule book with them at the time of certification. Records of written tests show that written testing was not consistently administered, with the records showing different road mechanics that did take written tests took different types of written exams. Metrorail's Performance Standardization Program Manual requires all personnel attempting to certify as train operators to take two written exams, in addition to the practical certification exam. Road mechanic records show that many did not take the required exams, and others did not achieve the required scores on exams they did take. Frontline employees are required to score 75%, and supervisors are required to score 85% on each test. Road mechanics were designated as certified who scored below 75% on one test and who did not take the other test.

◆ Minimum Corrective Action:

Metrorail must develop and implement a process to ensure that CMOR verifies that it only assigns personnel to work as Road Mechanics who have all required current training and certifications.



The boards were together in a container without protection, and each board was placed and removed by personnel not using electrostatic protection.

► **Finding 6: Metrorail is not following industry standard electrostatic discharge protection practices for railcar components.**

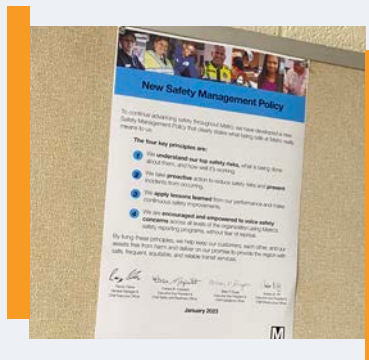
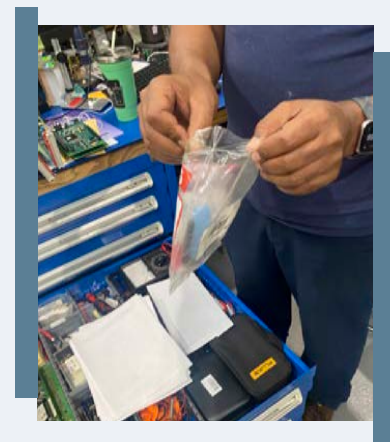
During field observations for this audit, the WMSC identified that Metrorail is not following industry standard anti-static practices to prevent electrostatic discharge. The release of this discharge can cause electronic systems such as printed circuit boards to deteriorate more quickly. This deterioration leads to components on railcars with degraded reliability or reduced useful life due to this mishandling. Metrorail managers acknowledged these protection practices should be carried out.

Electrostatic discharge protection may include steps such as protective mats, wrist straps, blowers, antistatic bags, and other procedural protections during repair, maintenance, installation or testing of these boards.

Some Metrorail procedures such as Maintenance and Service Instruction (MSI) Procedure 180351 include requirements to “Use a WMATA approved Electrostatic Discharge (ESD) “Foot Strap” or “Wrist Strap” while handling electronic boards or static sensitive devices.”

The WMSC observed Metrorail Car Maintenance personnel handling multiple electronic boards on the floor of the Greenbelt Service and Inspection Shop without any electrostatic protection. These personnel were testing these boards by putting them in and pulling them out of a railcar in the shop. The boards were together in a container without protection, and each board was placed and removed by personnel not using electrostatic protection.

The WMSC also observed that in the electronics shop in the building next door, there were additional electronic boards and other materials for railcars and railcar maintenance that were also not kept in electrostatic protection bags. Further, when the WMSC asked whether personnel used standard protections such as wrist straps, personnel said they did, but when asked to show these to WMSC personnel, the straps were not immediately available. An individual asked to show their strap dug around in drawers for an extended period at their work area, and eventually found a wrist strap that was still in its original packaging. The individual then opened the package.



Personnel in this area also provided conflicting explanations for not following electrostatic protection practices.

Other personnel reported that a lack of calibration of bench test equipment has contributed to a need to test individual circuit boards in railcars on the shop floor. While the lack of use of uncalibrated equipment is appropriate, moving electronic boards around the back shops and down to inspection shop floors without following electrostatic discharge protections further increases the risk that these systems will deteriorate prematurely.

The WMSC audit team observed a power supply in use in the small motor shop at the Greenbelt Rail Yard that was out of calibration but that was being used.

The only general railcar maintenance procedure that Metrorail could provide referencing electrostatic protection was a procedure completed after most of the on-site work for this audit had been completed. This procedure, dated after the WMSC's on-site communication and follow up, addresses this protection only for a specific 2000 and 3000 Series railcar part (Propulsion Common Case Relay Board Inspection and Repair). The procedure notes that there have been micro-cracks on the solder pins of the relay base, which led to Metrorail determining it would re-work all of these boards during the 3000 Series maintenance program. The inclusion of electrostatic protection is a step in the right direction that must be implemented and extended to match industry practice. The procedure highlights the need to ensure equipment is grounded and to use an electrostatic discharge (ESD) foot strap or wrist strap while handling electronic boards or static-sensitive devices.

Metrorail can further improve its tracking of these issues by ensuring that such parts are properly tagged and identified throughout the maintenance, inspection, repair, and installation process. The WMSC observed parts in the back shops, including the electronic shops, that did not have tags specifying their origin or destination.

◆ **Minimum Corrective Action:**

Metrorail must establish and implement electrostatic discharge protection procedures for railcar maintenance tasks, including for the handling of circuit boards on service and inspection or heavy repair and overhaul shop floors, in transport, and in electronic shops or other shops.



▶ **Finding 7: Metrorail is using equipment that is not calibrated in accordance with its policies and procedures, including for inspection and maintenance of components with a direct impact on safety.**

The WMSC audit team observed a power supply in use in the small motor shop at the Greenbelt Rail Yard that was out of calibration but that was being used to test contactors.

Metrorail provided a print-out of its Maintenance and Material Management System CMNT Calibrated Items

Database for this audit that showed some items past due for calibration, and many other items within calibration requirements. The past-due items included power supplies, multimeters, torque wrenches, calipers, load cells, gauges, and bench test equipment ranging in calibration due dates from 2018 to 2023.

It is positive that Metrorail has tracking systems in place in Maximo designed to provide for a log of equipment due for calibration, and that Metrorail personnel reported running weekly reports to identify items that will be due for calibration; however, Metrorail must ensure that these reports are acted upon to verify that equipment out of calibration is not in use, and must ensure that its frontline personnel, supervisors, and managers, regularly check operations in the field to ensure that only calibrated equipment is in use.



◆ **Minimum Corrective Action:**

Metrorail must ensure all calibrated equipment is included in its calibration database, that personnel are trained on requirements to ensure use of only properly calibrated equipment, and that supervisors conduct regular oversight of work areas to ensure that equipment that is out of calibration is removed from service and only properly calibrated equipment is in use.

Recommendations

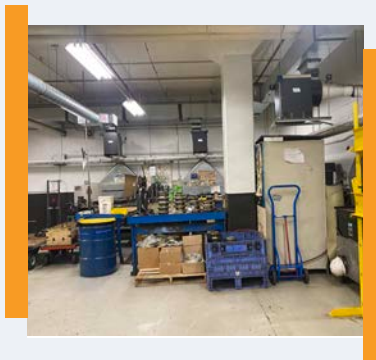
Recommendation 1: Metrorail is not tracking the shelf life of railcar parts that decay over time and therefore have a limited shelf life.

Some parts, such as rubber gaskets, have defined shelf lives to ensure that they function as designed when installed on a railcar. Metrorail does not track this shelf life to ensure that parts are clearly labeled and that expired parts are removed from stock to prevent their use.

The WMSC includes addressing this issue as a recommendation rather than a finding due to this audit work not directly documenting Metrorail use of expired parts.

Metrorail acknowledged that shelf life is not tracked for railcar-related parts, and expressed challenges in tracking such items via Maximo, despite the implications for the proper maintenance and safe functionality of railcar systems.

The WMSC notes that other Metrorail organizational units mitigate this risk through labelling and other protections to mark discard dates, and by providing for supervisory checks of available parts.



◆ **Recommended Corrective Action:**

Metrorail may develop and implement a process to ensure railcar-related items that decay over time are identified and that expired items are discarded.

Recommendation 2: Metrorail could improve the effectiveness of its maintenance tasks by proactively providing training records to supervisors of employees newly assigned to their shift or location.

Car Maintenance supervisors do not receive information about the training or specific experience of personnel newly assigned to their location or shift until and unless they request such access.

Interviews for this audit demonstrated that after personnel change locations during a job pick or are otherwise newly assigned, supervisors do not have complete information about their personnel for days or weeks.

Metrorail provided a memorandum confirming that supervisors must request access to each individual's training records. Although these are eventually provided, they are not typically available to supervisors when they are first assigning these personnel to tasks.

Interviews for this audit demonstrated that after personnel change locations during a job pick or are otherwise newly assigned, supervisors do not have complete information about their personnel for days or weeks.

Multiple personnel interviewed for this audit expressed concerns regarding railcar maintenance staffing and succession planning.

Metrorail has the opportunity to ensure personnel are immediately only assigned tasks commensurate with their training and experience from the first day at a new location or shift by proactively providing training and other records to the relevant supervisors or managers before or during that first shift.

◆ Recommended Corrective Action:

Metrorail may establish a process to proactively provide supervisors and other necessary management personnel with training information for personnel prior to the start of that individual's first shift under that supervisor and management.

Recommendation 3: Metrorail should update its railcar maintenance staffing assessment to account for current facilities, railcars, maintenance requirements, and other operational changes.

The WMSC observed instances described above of individuals performing tasks alone that are required to be performed with at least one other person, but it was unclear whether that was due to inadequate staffing or the separate acceptance of noncompliance with rules and procedures described in Finding 1. Interviews also identified instances where frontline employees felt rushed and attempted work alone that, for safety, supervisors said should have been done only with additional personnel, such as changing an air compressor.

Similarly, multiple personnel interviewed for this audit expressed concerns regarding railcar maintenance staffing and succession planning.

Metrorail conducted a manpower assessment for Car Track Equipment Maintenance (CTEM), which is responsible for non-revenue rail maintenance vehicles and associated equipment in 2019, but did not have any such assessment to determine the necessary staffing for railcar maintenance (CMNT). Car Maintenance managers stated there had not been such a staffing assessment in the last five years. It was not clear whether or when there may have been staffing assessments prior to that time. In the past 5-year period alone Metrorail has completed delivery of the 7000 Series railcar fleet, added a new rail yard and shop, and has updated safety procedures and railcar maintenance and inspection procedures.

Metrorail personnel also stated that frontline car maintenance staffing has decreased significantly over time, even as Metrorail has added additional railcars and railcar miles.

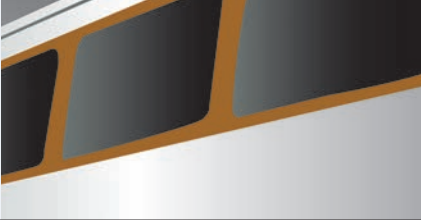
◆ Recommended Corrective Action:

Metrorail may conduct and act upon a staffing assessment for car maintenance personnel.

Other Observations

As this audit was being completed, Metrorail completed its response to the WMSC's direction related to Federal Transit Administration (FTA) Safety Advisory 22-1, which recommended safety practices for Periodic Maintenance Inspections (PMI) for Rail Car Passenger Door Inspection and Function Testing. In accordance with the safety advisory, the WMSC directed Metrorail to review its policies, procedures, and checklists for rail car passenger door PMIs to determine if they meet the recommended practices in the safety advisory, and to revise and





improve those procedures as necessary. Metrorail had previously experienced train movement with doors open due to failure of the safety systems designed to prevent movement if train doors are not closed and locked (W-0017, May 19, 2019). In that event, wires inside the master controller short-circuited. Metrorail issued a daily test procedure and began overhauling master controllers. In response to the WMSC's direction to address FTA Safety Advisory 22-1, Metrorail updated several procedures to incorporate and highlight requirements of American Public Transportation Association (APTA) Recommended Practice APTA RT-VIM-RP-005-02, Rev. 1 and the FTA Safety Advisory. This includes adding new steps to check that doors do not open when zero speed indications are lost to 7000 Series railcar periodic inspections. Metrorail provided the WMSC in December 2023 with a summary of the changes it had made to become compliant with the requirements.

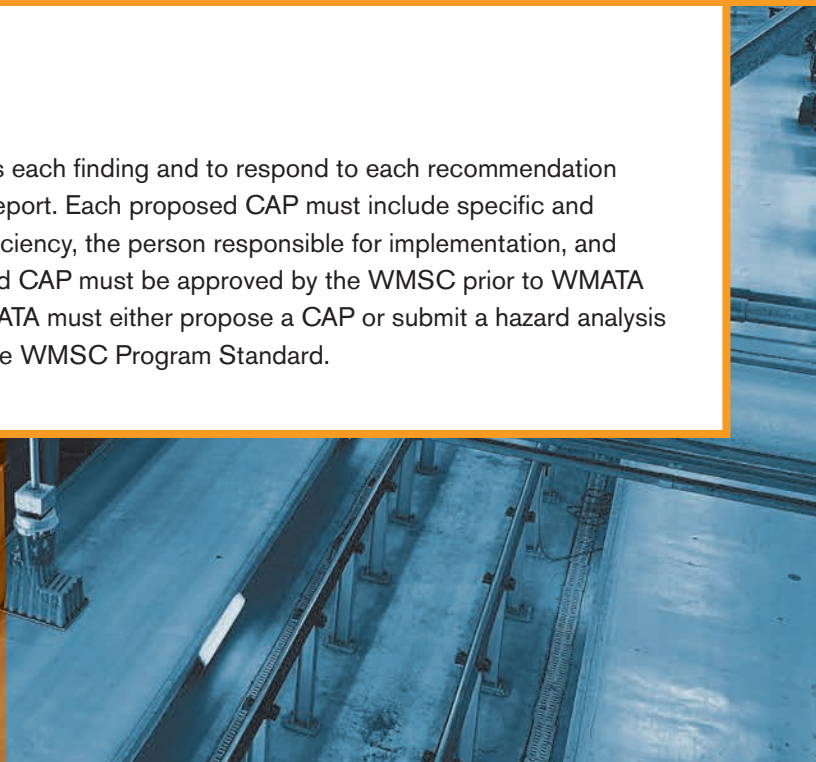

During the time this audit was underway, Metrorail provided conflicting statements and information on a variety of topics, including the functionality of the Daily Safety Test as it relates to Automatic Door Operation. The confusion within Metrorail about the functionality of its systems demonstrates the importance of coordinated, complete understanding of both existing and future railcar systems and subsystems, as well as how each of those relates to the overall features of the railcar.

Metrorail is continuing to work to address identified items related to each series of railcar, including speed sensor alert and holding brake issues on 7000 Series railcars. Related to the recurring stuck holding brake issues, for example, Metrorail had not yet identified a solution, and had begun focusing on a potential replacement of a switch. Metrorail was also in the process of testing a modification that would address the 7000 Series truck center pin liner sliding out of place.



Next Steps

WMATA is required to propose CAPs to address each finding and to respond to each recommendation no later than 30 days after the issuance of this report. Each proposed CAP must include specific and achievable planned actions to remediate the deficiency, the person responsible for implementation, and the estimated date of completion. Each proposed CAP must be approved by the WMSC prior to WMATA implementation. For each recommendation, WMATA must either propose a CAP or submit a hazard analysis and associated documentation as required by the WMSC Program Standard.





Appendices

Appendices **A, B, C** and **D**

Appendix A: Personnel Interviewed

- ◆ Office of the Chief Mechanical Officer (CMOR)
 - Vice President & Chief Mechanical Officer
- ◆ Office of Car Maintenance (CMNT)
 - General Superintendent, Railcar Maintenance
 - Assistant General Superintendent
 - Mechanic AA (3)
 - Mechanic B
 - Mechanic C
 - Mechanic Helper
 - Service Delivery Superintendent
 - Shift Supervisor (2)
 - Superintendent
- ◆ Railcar Quality Assurance and Warranty (RQAW)
 - Sr. Manager, Quality Assurance and Warranty Compliance
 - Senior Vehicle Engineer (2)
 - Project Quality Manager, 8K Fleet
 - Specification Writer
- ◆ Office of Vehicle Program Services (CENV)
 - Deputy Chief Engineer
 - Deputy CMO New Car Program
 - Senior Maintenance Planner
 - Senior Program Manager
 - Senior Project Manager
 - Senior Reliability Engineer
 - Vehicle Engineer (2)
- ◆ Project Management Office (PMO)
 - Project Manager
 - Project Manager, Materials Management
 - Project Manager, SMP
 - Project Manager, Supplier Qualification
 - Senior Program Manager
- ◆ Office of Safety (SAFE)
 - Senior Safety Certification Specialist (2)

Appendix B: Site Visits

- Observed Railcar Maintenance personnel at Shady Grove Rail Yard (09/18/2023)
- Observed Railcar Maintenance personnel at New Carrollton Rail Yard (09/18/2023)
- Observed Railcar Maintenance personnel at West Falls Church Rail Yard (09/19/2023)
- Observed Railcar Maintenance personnel at Brentwood Rail Yard (09/20/2023)
- Observed Railcar Maintenance personnel at Alexandria Rail Yard (09/20/2023)
- Observed Railcar Maintenance personnel at Greenbelt Rail Yard (09/21/2023)
- Observed Car Maintenance personnel in the Rail Operations Control Center at Carmen Turner Facility (09/22/2023)
- Observed Railcar Maintenance personnel beginning at Gallery Place Station and Metro Center Station (09/26/2023)

Appendix C: Documents Reviewed

ORGANIZATIONAL CHARTS AND DEPARTMENT RESPONSIBILITIES:

- CMNT QICO Worksheet (Jan. 2023 to Jul. 2023)
- Office of the Chief Mechanical Officer Organizational Chart (07/26/2023)
- WMATA Revenue Vehicles Budgeted Positions List (07/26/2023)

ROLES/RESPONSIBILITIES/JOB DESCRIPTIONS/STAFFING:

- Car Track Equipment Maintenance (CTEM) Manpower Assessment Report (04/29/2019)
- FTA-R-18-004, FTA Finding on Manpower Assessment (01/19/2018)
- Railcar Maintenance Department Timecards (07/2021 to 09/2023)

INTERNAL SAFETY REVIEWS:

- Office of Vehicle Program Services Internal Safety Review (12/15/2021)
- Overview of Internal Corrective Action Plan Schedule (07/21/2023)
- Railcar Maintenance Internal Safety Review (08/29/2022)

PROCEDURES/POLICIES/MANUALS/FORMS:

- CENV Form: 40.964, Vehicle Program Services Maintenance Services Instructions Signed Authorization Form, MSI 180351 (05/18/2022)
- CENV WI DI1001, 2-3000/6000/7000 Series Daily Inspection (05/01/2023)
- CENV-ODCM Document Control Tracker (07/26/2023)
- CMNT Form 51.001, CMNT Mechanics Tools Checklist (09/12/2018)
- Draft SOP for Recovered R-407C HVAC Refrigerant (09/21/2023)
- Performance Standardization Program Manual: Train Operations (06/2022)
- SAFE-FM-M-02, WMATA Compressed Gas Cylinder Storage, Use & Handling Program Manual (04/2021)



- SOP 202.01, Preparing, Processing, and Approvals of Engineering Modification Instructions (09/29/2023)
- SOP 301.04, Procedures for Recording Maintenance Work Order(s) for Class 1 Rail Vehicles (05/21/2023)
- SOP 301.07, Class 1 Rail Vehicle Re-rail Procedures (08/25/2020)

TRAINING:

- 2/3K & 6K periodic Inspection Electrical – Participant Workbook #1 (02/2018)
- 2/3K & 6K periodic Inspection Electrical – Participant Workbook #2 (02/2018)
- 2/3K & 6K periodic Inspection Electrical – Participant Workbook #3 (02/2018)
- 2/3K & 6K periodic Inspection Electrical – Participant Workbook #4 (02/2018)
- 2K/3K Friction Brake System Student Guide (01/2020)
- 2K/3K-6K Series Rapid Transit Railcars, Trucks & Suspension Familiarization Presentation (09/2019)
- 2K-3K Maintenance Training Trucks and Suspension Student Guide (no date)
- 2K3K Trucks and Suspension Checklist and Exam (01/26/2016)
- 2K3K6K7K Periodic Inspection Hands-on Course (no date)

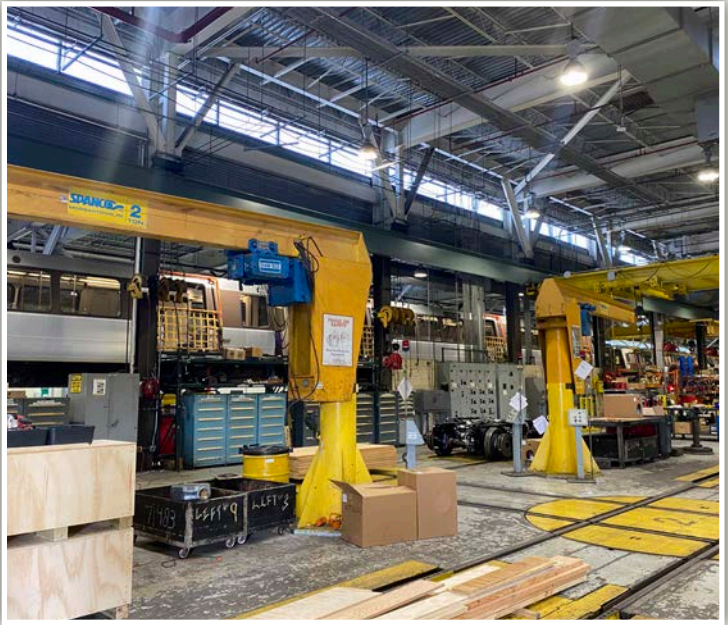
TRAINING: (CONTINUED)

- 7000 Series Periodic Inspection – Electrical C-Inspection Module (03/30/2021)
- Automatic Train Control – Preparation to Return to Automatic Operations Presentation (no date)
- Automatic Train Control – Preparation to Return to Automatic Operations Module (11/2014)
- Breda Marker Coil Nulling Procedure (no date)
- CENV Training Matrix (no date)
- C-Inspection Manual – Task 30 – Undercar Electrical – 2000/3000 Series (04/30/2021)
- C-Inspection Manual for 2000/300/6000/7000 Series Railcars Instructors Guide (04/30/2021)
- C-Inspection Manual for all 2000/3000/6000/7000 Series Railcars – Student Guide (04/30/2021)
- CMNT Required Training by Job Code (no date)
- CMNT Rigging Module Presentation (09/2017)
- CMNT Training Worksheet (Jan 2021 to Dec 2022)
- CMNT Training Worksheet (Jan 2023 to Jun 2023)
- C-Periodic Inspection Manual – Electrical Student Guide – 2000/3000 Series (07/31/2020)
- C-Periodic Inspection Manual for 2000/3000 series (04/30/2020)
- Daily Inspection Procedures Student Guide (03/30/2021)
- Door Control Familiarization Presentation (no date)
- Electrical C-Inspection Manual – 2000/3000 Series (11/30/2020)
- Friction Brake Familiarization Presentation (no date)
- Memorandum on CMNT Training Records (10/18/2023)
- Metrorail Refinish Division 6H Technical Training Course Certificates (10/25/2022)
- Preventative Maintenance Electrical Checklists (11/2017)
- Principles of Troubleshooting Instructors Guide (06/2020)
- Principles of Troubleshooting Student Guide (06/2020)
- Propulsion and Primary Power Refresher Training Presentation (no date)
- Propulsion Troubleshooting Presentation (no date)
- Rail Car Systems Familiarization Presentation (no date)
- Rail Car Systems Familiarization 2k/3k, 5k and 6k Bootcamp Presentation (no date)
- Railcar Propulsion Training Course Presentation (no date)
- Rigging Practical Check Sheet (no date)
- SA 22-05-A, CMNT Special Alert – Ladder Safety (05/13/2022)
- SA 22-07-A, CMNT Special Alert – Noise Hazard from Brake Pipe Pressure Release or “Dump” (07/20/2022)
- SA 22-09-A, CMNT Special Alert – New Carrollton 7K Unintentional Coupling (09/07/2022)
- SA 22-12-L, CMNT Special Alert – High Voltage Cable Covers (12/21/2022)
- SA 23-01-A, CMNT Special Alert – Employee Accident (01/05/2023)



TRAINING: (CONTINUED)

- SA 23-01-A, CMNT Special Alert – Employee Injury (01/06/2023)
- SOP 17 & 29 CBT Course Syllabus and Outline (05/01/2020)
- SOP 17 & 29 Presentation Module (04/2020)
- SOP 29, Blue Flag Protection – Storage Tracks, Shop, Shop Leads and Yards (04/03/2020)
- Technical Skills and Training – Periodic Inspection for HVAC Systems Presentation (no date)
- Train Operator and Road Supervisor Job Task Proficiency Evaluation Forms (05/2023 to 10/2023)
- UVR Inspection Document – 6000 Series (no date)
- Vehicle Monitoring System Familiarization Presentation (no date)
- WMATA 1K-6K Series Rapid Transit Railcars (no date)
- WMATA 2K-3K Series Rapid Transit Cars – Friction Brake Control Training Course Presentation (no date)
- WMATA 6000 Series Transit Car Friction Brake System Electrical Maintenance Training Circuit Diagrams (no date)
- WMATA 7000 Series ASU Exam (no date)
- WMATA 7000 Series Electrical Mechanical Maintenance Training for 7K ASU Compressor (06/18/2021)
- WMATA 7000 Series Maintenance Training for Trucks and Suspension Module (04/27/2016)
- WMATA 7000 Series Maintenance Training for Trucks and Suspension Presentation (04/27/2016)
- WMATA 7000 Series Railcar Propulsion Troubleshooting Training Instructors Guide (02/11/2021)
- WMATA 7000 Series Railcar Propulsion Troubleshooting Training Student Guide (02/11/2021)
- WMATA 7000 Series Railcar Troubleshooting Training Instructors Guide (06/12/2020)
- WMATA 7000 Series Railcar Troubleshooting Training Module - Propulsion (02/11/2021)
- WMATA 7000 Series Railcar Troubleshooting Training Student Guide (06/12/2020)



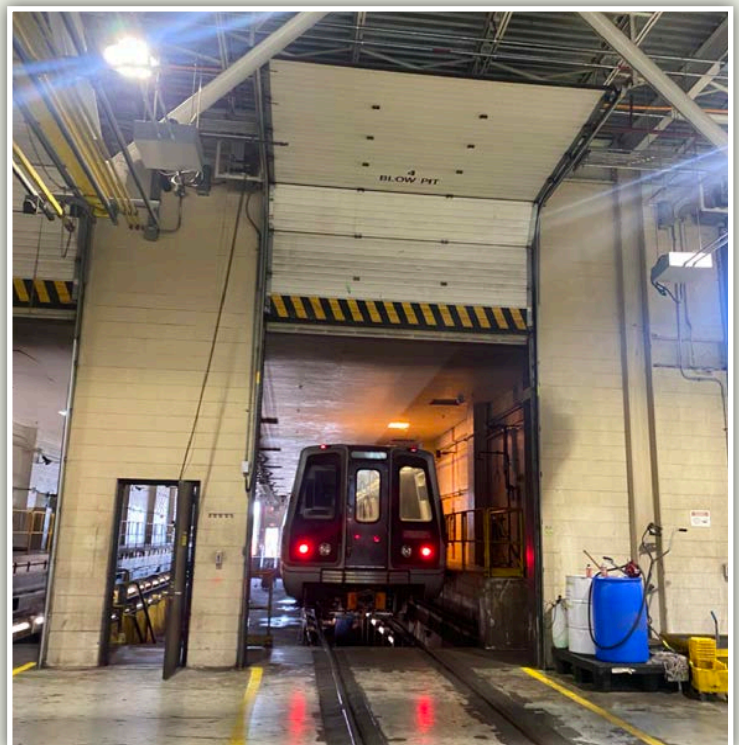
- WMATA Friction Brake Systems (MT) Module 2000, 3000, 6000 Series Student Workbook (no date)
- WMATA Monitoring and Diagnostics Presentation (no date)
- WMATA Principles of Troubleshooting Quiz (no date)
- WMATA Principles of Troubleshooting Student Handout (06/2020)

INSPECTION AND MAINTENANCE:

- 2000 Series Railcar Performance Reports (06/2022 to 06/2023)
- 3000 Series Railcar Performance Reports (06/2022 to 06/2023)
- 6000 Series Railcar Performance Reports (06/2022 to 06/2023)
- 7000 Series Railcar Performance Reports (06/2022 to 06/2023)
- 7000 series SMP 6-year scope (no date)
- CDRL No. 384.02 & 384.03, Kawasaki Door System Test – 7000 Series (03/25/2019)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Brentwood (05/03/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – West Falls Church (05/04/2023)

INSPECTION AND MAINTENANCE: (CONTINUED)

- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Greenbelt (04/18/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Shady Grove (05/09/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Greenbelt (05/03/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Alexandria (05/05/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Greenbelt Annex (04/12/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Branch Avenue (05/01/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Dulles (05/05/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Brentwood Machine Shop (05/01/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – Brentwood HVAC Shop (05/04/2023)
- CMNT Form 50.951, CMNT Shop Safety and Health Inspection Checklist – New Carrollton (05/12/2023)
- Corrective Maintenance Log (January 2022 to July 2023)
- Deferred Maintenance Log (January 2022 to June 2023)
- EMI Campaign Status List (July 2021 to June 2023)
- FAT-TJ-005-1, Visual Inspection and Function Testing of Completed Truck – 7000 Series Transit Cars (05/12/2017)
- List of EMIs, MSIs (July 2021 to June 2023)
- List of Supervisor PI and Pre-Revenue Audits (10/25/2023)
- Maintenance Supervisor Pre-Revenue Inspection Forms (02/2022, 07/2022 to 10/2023)
- Maximo Work Order Lists per Yard (July 2021 to June 2023)
- Memorandum outlining SMP statuses (07/17/2023)
- Metrorail Operating Rulebook (09/01/2023)
- ODCM Submittal List (no date)
- Open Engineering Request Tracking Report (no date)
- Overall Railcar Fleet Performance Reports (06/2022 to 06/2023)
- Preventative Maintenance Log (December 2021 to July 2023)
- Rail Car Maintenance Audit Forms (01/2022, 10/2022, 06/2023)
- Toshiba Discussion Presentation for Maintenance Plan 2 (10/08/2023)
- Train Operator and Road Supervisor Job Task Proficiency Evaluation Forms (06/2023 to 10/2023)
- US1032-CEPH2-902, ATC System Functional Description – 7000 series (12/2022)
- VTI Reports (Dec 2022 to May 2023)
- WM7-J-1136, System Functional Description, Vehicle Electrical Circuit – 7000 series (02/04/2011)
- WM7-J-3208d, Completed Underfloor Inspection (FAR-PG-013) (04/16/2012)



INSPECTION AND MAINTENANCE: (CONTINUED)

- WM7-J-3308, rev E, Door System Test, FAT-PG-007-05 (03/25/2019)

EQUIPMENT:

- 8k Specification Changes Based on 7K Lessons Learned (04/23/2021)
- CMNT Equipment List for Rail Vehicle Maintenance (no date)
- CMNT Item Balances (10/01/2023)
- CMNT List of Missing Tools (no date)
- Confirmed Technical Specifications, 8000 Series Railcars (10/29/2021)
- List of Railcar movers by Facility (no date)
- Maintenance and Material Management System – CMNT Calibrated Items List (10/26/2023)
- Master Tools Inventory List – Calibrated Tools (07/13/2023)
- Master Tools Inventory List – Shop Tools (07/14/2023)
- Railcar Status List (07/01/2023)

SAFETY CERTIFICATION:

- Memorandum outlining CIL, Hazard Analysis and Technical Specification Status – 8000 series railcars (07/26/2023)
- WM7-U-8036, WMATA RC7000 Series Transit Cars Hazard Tracking Log (02/19/2020)

MEETINGS MINUTES/AGENDAS:

- Alexandria Yard Local Safety Committee Meeting Agendas (01/2022 to 03/2023)
- Alexandria Yard Local Safety Committee Meeting Minutes (01/2022 to 03/2023)
- Branch Avenue Yard Local Safety Committee Meeting Agendas (01/2022 to 03/2023)
- Branch Avenue Yard Local Safety Committee Meeting Minutes (01/2022 to 03/2023)
- Brentwood Yard Local Safety Committee Meeting Agendas (01/2022 to 03/2023)
- Brentwood Yard Local Safety Committee Meeting Minutes (01/2022 to 03/2023)
- Car Maintenance Departmental Safety Committee Meeting Minutes (01/2022 to 03/2023)
- Car Maintenance Departmental Safety Committee Meeting Presentation (01/2022 to 03/2023)
- Dulles Yard Local Safety Committee Meeting Minutes (01/2023 to 03/2023)
- Greenbelt Yard Local Safety Committee Meeting Agendas (01/2022 to 03/2023)
- Greenbelt Yard Local Safety Committee Meeting Minutes (01/2022 to 03/2023)
- New Carrollton Yard Local Safety Committee Meeting Agendas (01/2022 to 03/2023)
- New Carrollton Yard Local Safety Committee Meeting Minutes (01/2022 to 03/2023)
- Shady Grove Yard Local Safety Committee Meeting Agendas (01/2022 to 03/2023)
- Shady Grove Yard Local Safety Committee Meeting Minutes (01/2022 to 03/2023)
- West Falls Church Yard Local Safety Committee Meeting Agendas (01/2022 to 03/2023)
- West Falls Church Yard Local Safety Committee Meeting Minutes (01/2022 to 03/2023)



Appendix D: Public Transportation Agency Safety Plan (PTASP) Elements Reviewed

1. Safety Management Policy

- a. Safety performance targets
- c. Organizational SMS Accountabilities and Responsibilities
- d. SMS documentation

2. Safety Risk Management

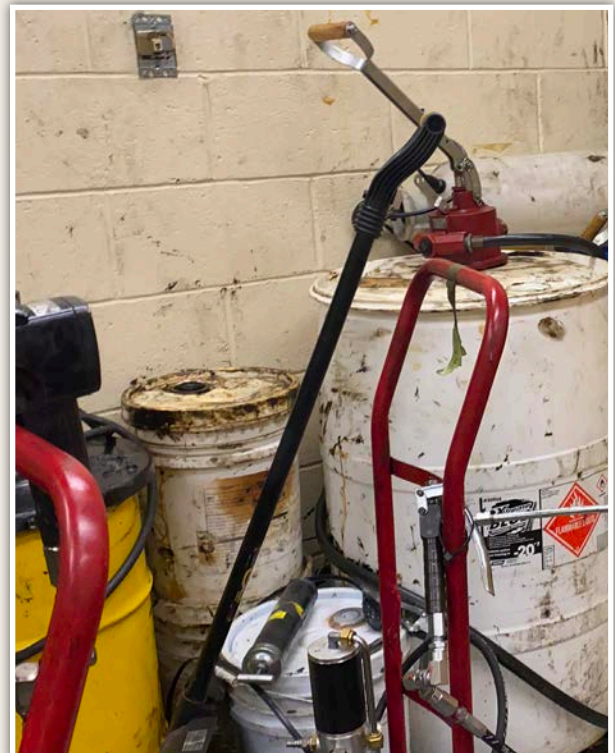
- a. Safety Risk Management (SRM) process
- b. Risk Assessment Process
- c. Risk assessment methodology
- d. Hazard identification
- e. Hazard investigation
- f. Hazard analysis and evaluation of safety risk
- g. Hazard resolution (mitigation, elimination)
- h. Hazard tracking

3. Safety Assurance

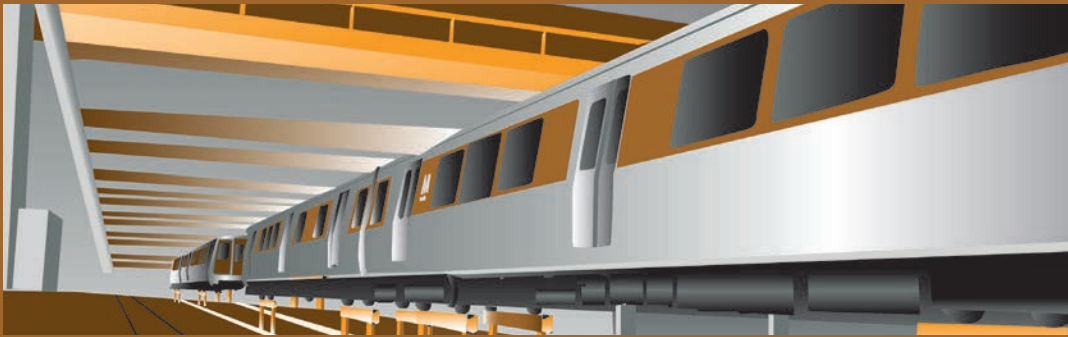
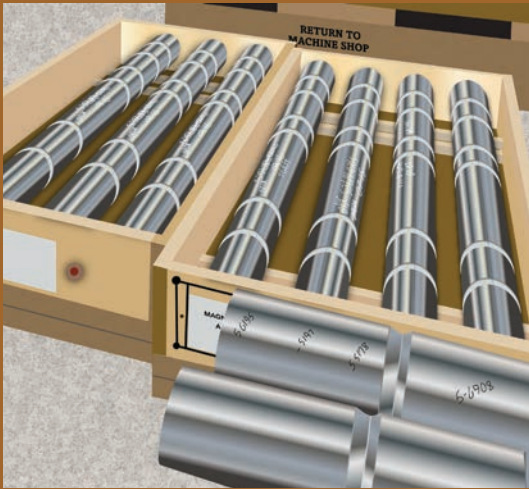
- a. Systematic, integrated data monitoring and recording of safety performance
- b. Real-time assessment with timely information
- d. Departmental controls
- e. Compliance and sufficiency monitoring (i.e. quality management system plan (QMSP))
- f. Document assurance activities
- g. Preventive, Predictive, and Corrective Maintenance
- h. Event reporting/investigations
- i. Change management
- j. Safety and Security Certification
- k. Corrective action plans

4. Safety Promotion

- a. Training
- c. Safety Communications
- d. Hazard and safety risk information
- e. Safety committees
- f. Hazardous materials and environmental management*



* Added based on on-site observations.



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