The Washington Metrorail Safety Commission

Safety Audit

of the Washington Metropolitan Area Transit Authority

Audit of Metrorail Power Systems

WASHINGTON METRORAIL SAFETY COMMISSION

Final Report:
February 7, 2024

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Prepared under the authority of the Washington Metrorail Safety Commission

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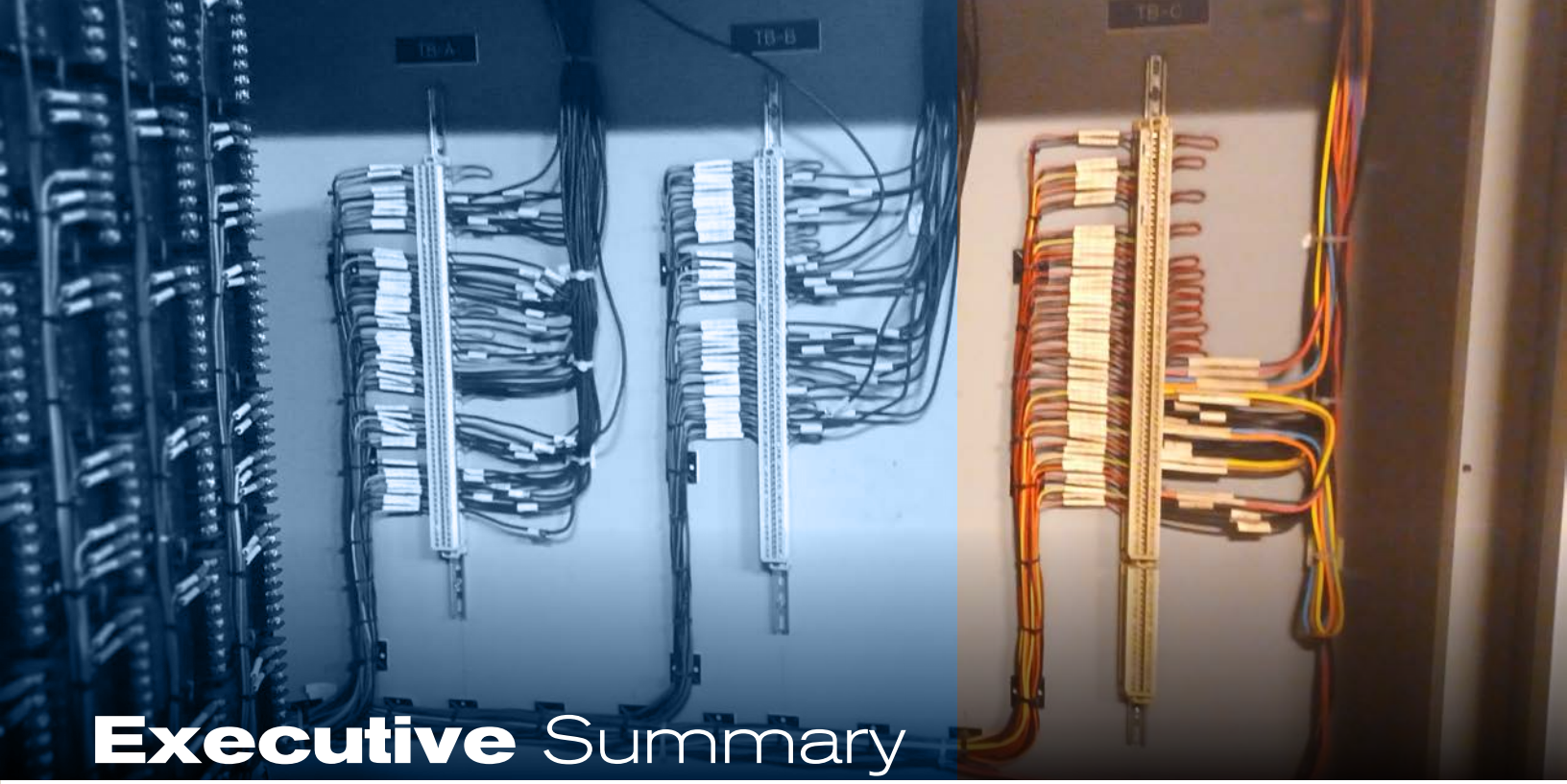


Executive Summary

The Washington Metrorail Safety Commission (WMSC) performed this audit of the Washington Metropolitan Area Transit Authority (WMATA) Metrorail's Power Systems inspection, maintenance, and engineering practices and procedures, and associated training through in-depth interviews, site visits, and document and data reviews in 2023. The scope of this audit includes high-voltage power and low-voltage power. High-voltage power includes all aspects from the utility connection through and including the wayside cables that connect to the third rail, as well as the negative return system. Low-voltage power systems (defined by Metrorail as 480-volt and lower voltage electrical systems) provide power to rail stations, rail yards, chiller plants, tunnels and fan shafts.

Metrorail is not consistently identifying, addressing, and preventing water intrusion in power rooms.

The audit objectives include the assessment of inspection, maintenance, and engineering practices and procedures, 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 (CAPs) from the WMSC's Audit of High Voltage and Traction Power that was issued in October 2021, and relevant the Federal Transit Administration (FTA) oversight actions and National Transportation Safety Board (NTSB) safety recommendations. The WMSC appreciates the cooperation of Metrorail personnel during this audit.

This audit identified positive practices such as Metrorail's consolidation of Preventive Maintenance Instructions (PMIs) which has made it easier for personnel to understand and utilize the correct procedure, and effective supervisory oversight and safety promotion related to personal safety demonstrated during observation of onsite work.

The 2023 WMSC audit identified three findings and identified three existing CAPs addressing findings from the WMSC's 2021 Audit of High Voltage and Traction Power that required modifications. Metrorail addressed one of the findings prior to issuance of this report.

Findings:

- **1. Metrorail is not consistently identifying, addressing, and preventing water intrusion in power rooms.**
- **2. Metrorail is not ensuring that adequate egress paths are maintained for Power facilities.**
- **3. Metrorail Office of Power personnel are performing maintenance work using torque wrenches that are out of calibration (Closed prior to issuance of report).**

The WMSC communicated these issues to Metrorail during the audit process.

Regarding Finding 3, Metrorail management specifically determined the underlying cause – that these torque wrenches had not been included in calibration tracking practices – and addressed this issue by incorporating these torque wrenches into the long-term process and calibrating them for current use prior to the issuance of the draft report. The WMSC appreciates the action by the leadership of the Office of Power to address this safety issue in a timely manner.

Metrorail also addressed or began work to address other specific observations from the WMSC's on-site activities during the audit work.

Existing corrective action plans identified during this audit that required modifications (such as additional action items to ensure completion or revised scope) were:

1. C-0154

2021 finding: Traction Power Maintenance employees do not get all required information and training to maintain equipment that they are directed to work on, and there is no process in place to ensure that personnel are trained on specific equipment prior to working on that equipment.

2. C-0155

2021 finding: Metrorail is not effectively identifying, tracking and mitigating hazards related to high voltage and traction power.

3. C-0157

2021 finding: The latest as-built schematics are not available in each traction power facility, as required by the TRPM-1000 and Metrorail preventive maintenance instructions.

The WMSC and Metrorail began the CAP modification process after Metrorail's opportunity to provide any additional information based on the exit conference for this audit. Each CAP modification has now been approved by the WMSC for implementation.

WMATA is required to propose a CAP for Finding 1 and Finding 2 in this audit not later than 30 days after the issuance of this report.

Background and Scope

Background and Scope

As of October 2023, Metrorail has implemented six of its 12 corrective action plans related to the 2021 audit.

The scope of this audit includes Metrorail power systems, both those that Metrorail designates as high-voltage and those that Metrorail designates as low-voltage. This includes all aspects from the utility connection through and including the wayside cables that connect to the third rail, as well as the negative return system.

The audit objectives include the assessment of inspection, maintenance, and engineering practices and procedures, and associated training, for purposes of compliance with applicable plans, policies, regulations, and industry best practices. This audit also focuses on closed Metrorail corrective action plans to address findings and recommendations from the WMSC, the Federal Transit Administration (FTA), and the National Transportation Safety Board (NTSB).

This audit was based on the WMATA Public Transportation Agency Safety Plan (PTASP) effective December 31, 2022 (Rev. 3.0), Metrorail's procedures and documentation, industry standards, and other associated requirements. The specific elements of the Public Transportation Agency Safety Plan covered in this audit are listed in Appendix D.

Prior Reviews and Audits

2021 Audit of High Voltage and Traction Power

The WMSC conducted an **audit of Metrorail's high voltage and traction power systems in 2021** as part of the WMSC's first triennial audit cycle.

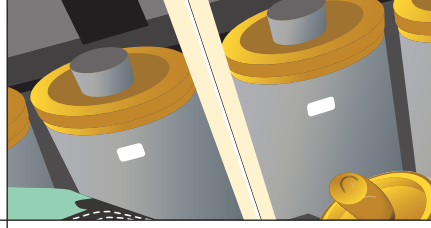
The WMSC identified several positive practices and a number of areas that required improvement. As a result, the WMSC issued eight findings and four recommendations, each of which Metrorail developed a corrective action plan to address. An evaluation of WMATA's corrective action plans from this audit is included in the Evaluation of Corrective Action Plans from Previous WMSC Findings and Recommendations section of this report.

As of October 2023, Metrorail had implemented six of its 12 corrective action plans related to the 2021 audit. As a result of this current audit, the WMSC required corrective action plan modifications for CAPs C-0154, C-0155, C-0157 (see Required Modifications to Existing Corrective Actions Identified During this Audit section). Metrorail is still implementing three other CAPs. Two remaining open corrective action plans related to conducting all preventive maintenance and complying with Metrorail's safety certification requirements have expected completion dates in 2024. The other remaining open corrective action plan, related to floating slab testing for deterioration due to stray current (a longer testing cycle), has a scheduled completion date in 2026.

WMSC Oversight

WMSC inspections, other oversight work, and multiple safety event investigations have also identified areas that require improvement.

For example, Investigation **W-0195** of an evacuation for life safety reasons near Dupont Circle Station on July 30, 2022, demonstrated the ineffectiveness of Metrorail's inspection and maintenance practices related to power assets. Electrical arcing from wall-mounted cables that began due to a prolonged overloaded circuit continued for more than six hours. Three hours into the event, Power



personnel identified the source of the fire as an electrical junction box. Metrorail personnel on scene did not address and were not able to disconnect the power source through the breaker that is designed to be used for this purpose, and did not de-energize all breakers in order to stop the arcing, smoke and damage.

In another example, Investigation **W-0189** of an event where toxic sulfide gas from overheated Metrorail batteries filled parts of Ballston-MU Station on August 11, 2022, demonstrated that Metrorail's maintenance and monitoring of equipment integral to safety such as battery chargers and exhaust fans was insufficient. The battery charger was not working properly, which led to excess energy being fed into the batteries. Metrorail had kept the uninterruptible power supply in service beyond the end of its useful life, allowing it to run to failure. Metrorail's Traction Power Maintenance Department determined that the output voltage was 181 volts direct current (DC) rather than the intended 131 volts DC. The batteries were overcharged at 3 volts per cell rather than 2 volts per cell. The batteries overheated. The Traction Power Maintenance Department determined based on system data that the toxic gas release began approximately 15 hours after the improper charging began, when the acid inside each battery began to boil.

On May 17, 2022, the WMSC issued an **order** regarding Metrorail's improper power restoration. The WMSC found that Metrorail was continuing to put personnel at risk of serious injury or death by repeatedly bypassing safety redundancies in power restoration procedures that Metrorail has deliberately designed for the safety of its employees, contractors and first responders. Among the events that led to the order was a May 6, 2022, event in which third rail power was re-energized in an active work zone on the Red Line. During this event, Power personnel did not follow required safety steps, racked out the wrong breaker, and then replaced it. When the circuit breaker was replaced, the power crew manually closed a breaker without permission, which re-energized power in the active work zone. That circuit breaker had been remotely opened by a Power Desk Controller prior to being racked out to de-energize power for that work zone under a supervisory power outage, which the power crew in the field was not aware of.

The order required WMATA to reduce the number of work locations requiring power de-energization and energization until several requirements were met related to training and technology improvements, and to restart and properly conduct its safety certification process of the Power Desk, including a renewed review by the Safety Certification Review Committee, and to develop a new Safety Certification Verification Report that demonstrates that the Power Desk process is properly completed and safely implemented.

Metrorail's maintenance and monitoring of equipment integral to safety such as battery chargers and exhaust fans was insufficient.

Internal WMATA Reviews

In 2020, WMATA's Quality Assurance, Internal Compliance & Oversight completed an internal safety review of WMATA's Department of Low Voltage Electrical Maintenance. This review identified seven areas for improvement:

- Complying with required Personal Protective Equipment (PPE) reduces risks associated with occupational tasks.
- Conducting required Job Safety Briefings enhances compliance with safety requirements, improves controls for risks, and incorporates utilization of hazard identification and mitigation.

WMATA's Office of Power was created in December 2022 to oversee the existing traction power and low-voltage power departments.

- Utilization of documented Preventive Maintenance Instructions (PMI) before and during the performance of the PMIs promotes preparedness and ensures the use of approved and pertinent equipment and tools.
- Reviewing and updating documented PMIs in accordance with the required periodicity promotes efficiency and safety.
- Establishing a documented process for the entire Maximo Work Order lifecycle promotes traceability and accountability.
- Adherence to WMATA and OSHA training requirements promotes compliance and minimizes risks associated with workplace hazards.
- Complying with the SMNT MCP Quality Control program promotes a culture of safety and the effective implementation of rules and procedures.

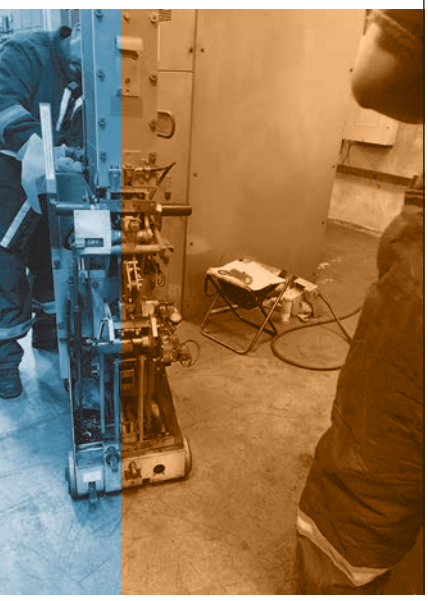
In 2017, an internal safety review of Metrorail's Traction Power Inspection and Maintenance included ten findings. These findings included that electrical facilities room inspections records were incomplete and inconsistent. Other findings in the 2017 report included those related to document control, compliance and supervisory oversight.

All Internal Corrective Action Plans (iCAPAs) created by WMATA to address findings from both internal safety reviews were closed at the time of this audit.

Organizational Structure

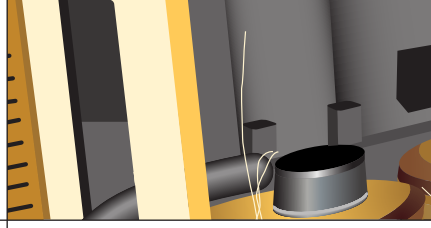
Metrorail's Office of Power is responsible for the inspection and maintenance of high-voltage and low-voltage power assets. The Office of Power was created in December 2022 to oversee the existing traction power and low-voltage power departments. Metrorail's realignment was not yet reflected in Metrorail's Public Transportation Agency Safety Plan that is the basis for this audit. Metrorail updated its Agency Safety Plan in late 2023 to reflect this and other high level organizational changes.

The Senior Vice President of Power oversees power maintenance and engineering, and reports to the Executive Vice President & Chief Infrastructure Officer. The Office of Power Maintenance is led by a Senior Director.



The Traction Power group within the Office of Power is responsible for work on systems that Metrorail designates as high voltage (above 480 volts). This group is divided into several units:

- Cable Maintenance and Inspection (Cable) – Conducts preventive and corrective maintenance and inspection of track feeder cable throughout the system to ensure a state of good repair and provides escort support to all power assets on the roadway.
- Preventive Maintenance Inspection (PMI) – Conducts preventive and corrective asset and equipment maintenance at all AC substations, traction power substations and tie breaker stations. Personnel in this group have advanced levels of experience and expertise in specific systems.



- Regional Maintenance (Regions) – Conducts preventive and corrective asset and equipment maintenance in rail stations and rail yards throughout the system, generally in assigned geographical areas.

Each of these subgroups is led by an assistant general superintendent and has superintendents, assistant superintendents, and shift supervisors managing frontline personnel.

The Low Voltage Maintenance (LV) group is responsible for the maintenance and inspection of WMATA's 480-volt (or lower) electrical systems and distribution equipment.

The remaining subgroups under the Office of Power are:

- Compliance, Safety & Inspection (CSI) – Provides compliance oversight, including corrective action plan compliance, through inspection, auditing and other activities. This group is also responsible for safety management, training, departmental website administration and management of operations programs. This group is led by a manager and has an assistant superintendent, compliance supervisor, safety supervisor and inspection supervisor.
- Material Control (MATCON) – Provides support for procurement and distribution of equipment, repair parts, and consumable items. This group manages the Traction Power Maintenance RPM Calibrated equipment program and Maximo personnel data and is led by a supervisor.
- Administration (ADMIN) – Provides administrative support to all groups.

Traction Power Operations Engineering (previously referred to as Maintenance of Way Engineering, Traction Power Operations Engineering) is responsible for Traction Power Infrastructure Engineering throughout the Metrorail system, Power Supervisory Control and Data Acquisition (SCADA) system operation, Stray Current and Corrosion Control programs, and Power Systems Reliability Engineering. The engineers provide technical guidance and maintenance of Metrorail's SCADA system, develop, revise, and implement engineering guidelines for preventative and corrective traction power maintenance programs in rail services. The Traction Power Operations Engineering group also coordinates with counterparts in Engineering and Architecture, Traction Power Maintenance, and Capital Delivery.

The Low Voltage Maintenance (LV) group is responsible for the maintenance and inspection of WMATA's 480-volt (or lower) electrical systems and distribution equipment.

Audit Work

The WMSC received initial documents related to this audit from WMATA in May 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 June 2023, and conducted site visits and extensive interviews with Metrorail personnel in June and July 2023. The WMSC held an exit conference with Metrorail in August 2023 and provided additional follow up to Metrorail through November 2023 regarding the required modifications to existing open corrective action plans described later in this report.

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.

What the **WMSC** Found

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Metrorail has consolidated Preventive Maintenance Instructions, improving document control and making it easier for frontline workers.

Positive Practices

- Metrorail has consolidated Preventive Maintenance Instructions (PMIs) to manufacturer specific PMIs, improving document control and making it easier for frontline workers to use and follow. Previously, there were over 40 PMIs, some of which contributed to confusion about the required procedures for different types of similar equipment.
- Comprehensive job safety briefings, personal protective equipment compliance checks and Roadway Worker Protection certification checks were conducted prior to all onsite work observed by the WMSC. All personnel were in compliance, demonstrating effective supervisory oversight and safety promotion related to personal safety.

Metrorail has completed implementation of six of its 12 corrective action plans related to the WMSC's 2021 audit. Three others had scheduled completion dates in 2024 and 2026.

Evaluation of Corrective Action Plans from Previous WMSC Findings and Recommendations

C-0150 (Scheduled for completion April 2024)

Metrorail is not complying with its safety certification and approval requirements that are specified in its SSCPP before installing and placing traction power systems into service.

Metrorail is still in the process of implementing this CAP.

C-0151 (Scheduled for completion July 2024)

Metrorail is not documenting, tracking and conducting all preventive maintenance inspections that are required by WMATA policy, manuals and instruction.

Metrorail is still in the process of implementing this CAP.

C-0152 (closed)

Metrorail is relying on vital traction power equipment that is beyond its useful life, and has not fully followed through on implementation of prioritized renewal plans to ensure a state of good repair.

Metrorail has provided all the required deliverables to close the CAP, including temporary mitigations for worst-case equipment. The WMSC will continue to monitor the completion of equipment renewal as part of the 10-year capital replacement program.

C-0153 (closed)

There is inadequate awareness, documentation, interdepartmental coordination, training and supervisory oversight to ensure knowledge of and compliance with documented procedures.

Metrorail has provided all the required deliverables to close this CAP and demonstrated improved supervisory engagement during the 2023 triennial audit.

C-0154

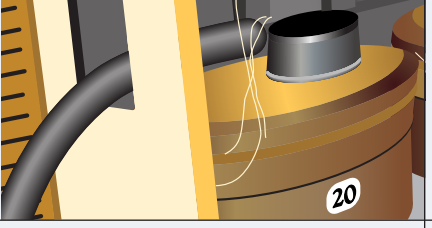
Traction Power Maintenance employees do not get all required information and training to maintain equipment that they are directed to work on, and there is no process in place to ensure that personnel are trained on specific equipment prior to working on that equipment.

See below for required modifications that were identified as part of this audit.

C-0155

Metrorail is not effectively identifying, tracking and mitigating hazards related to high voltage and traction power.

See below for required modifications that were identified as part of this audit.



As a result this audit, the WMSC required corrective action plan modifications for the three other CAPs. Metrorail is now implementing these additional steps.

C-0156 (Scheduled for completion April 2026)

Metrorail is behind schedule on its floating slab testing to monitor for deterioration due to stray current.

Metrorail is still in the process of implementing this CAP. Metrorail has committed to providing evidence of the initial round of slab testing in March 2024. WMSC will monitor the progress of this CAP through completion.

C-0157

The latest as-built schematics are not available in each traction power facility, as required by the TRPM-1000 and Metrorail preventive maintenance instructions.

See below for required modifications that were identified as part of this audit.

C-0158 (closed)

Metrorail does not have a policy, process or procedure to ensure effective prioritization of corrective maintenance work orders.

Metrorail submitted evidence of the application of the prioritization of corrective maintenance work orders as part of this audit, demonstrating adherence to the process implemented under this CAP.

C-0159 (closed)

Metrorail risks equipment quality and availability issues that impact operational safety due to gaps in materials tracking, storage, and procurement practices.

This CAP was closed right after the completion of audit activities. The WMSC will continue to monitor Metrorail's progress in this area.

C-0160 (closed)

Metrorail databases include many electrical tools that are beyond their required calibration dates.

As described in Finding 3 of this audit, the WMSC found torque wrenches in use by Power personnel that were out of calibration. As also described below, Metrorail addressed Finding 3 prior to the issuance of this report. CAP C-0160 remains closed.

C-0161 (closed)

Some WMATA job descriptions have not been reviewed in more than 30 years.

Metrorail has provided the required deliverables to close this CAP. The updated job descriptions were consistent with WMSC observations during documentation review, employee interviews, and witnessing of field activities during this audit.

The WMSC identified deficiencies closely related to three open corrective action plans that had been created to address issues identified during the earlier audit.

Required Modifications to Existing Corrective Action Plans Identified During This Audit

The WMSC appreciates the progress Metrorail has made towards correcting findings and recommendations made by the WMSC during the 2021 Audit of High Voltage and Traction Power. Through activities for this current audit, the WMSC identified deficiencies closely related to three open corrective action plans that had been created to address issues identified during the earlier audit. Because these items could be addressed through the CAP modification process as provided for in the WMSC Program Standard, Section 9.C.4, CAP Modifications, the WMSC proposed these modifications to Metrorail, Metrorail subsequently developed revised corrective action plans, and the WMSC approved the implementation of those corrective action plans.

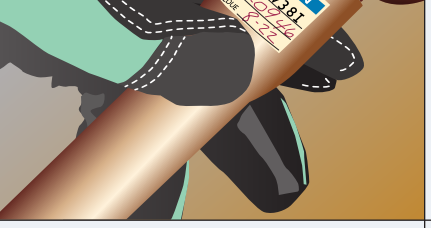
The WMSC had provided details at the exit conference for this audit, and provided Metrorail with an opportunity to provide any additional relevant information or documentation, prior to communicating proposed modifications to Metrorail.

Metrorail submitted revised corrective action plan proposals in accordance with the WMSC Program Standard. Following the review, feedback, revision, and approval process, the WMSC approved each revised corrective action plan for implementation by December 2023.

▶ C-0154

In both audit interviews and observations, the WMSC identified that Metrorail is not adequately training personnel on new power equipment that personnel are being assigned to work on. For example, the process for racking breakers in and out is different on different equipment. The training matrices submitted by Metrorail during this audit, and provided separately under this CAP, do not capture specific new equipment. The training matrix has not been updated to account for new equipment such as Secheron breakers installed in the Metrorail system. During the Exit Conference, Metrorail noted that a new class for Secheron equipment is planned, but has not been implemented.

The previous CAP deliverables addressed “training” but did not account for updates to those trainings that would capture new equipment. The WMSC communicated to Metrorail to add an actionable item(s) that establishes and implements a process to ensure that training requirements for Power personnel are updated on an ongoing basis to include new equipment as that equipment is brought into the system (currently listed as a paragraph in Actionable Item 1, but not established as a procedure). In addition, Metrorail’s modification was to establish a process to set and document training requirements for each new type of equipment, and to develop and implement a process to ensure that personnel are only assigned to work on equipment that they have been fully and properly trained to work on. All processes must capture both existing personnel and personnel who are new to the role.



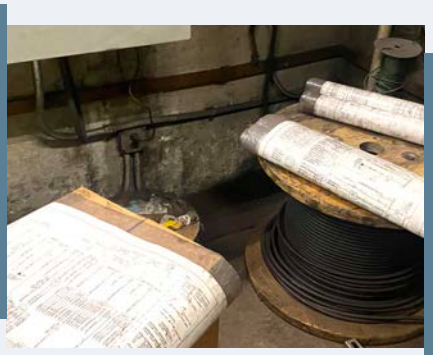
The hazard log provided for this audit did not include electrical hazards, water intrusion, or egress deficiencies.

C-0155

The corrective action plan Metrorail was implementing at the time of this audit applied only to high voltage and traction power. Metrorail was due to submit a hazard log by mid-December 2023. Metrorail had stated that it had conducted safety management system awareness training for high voltage personnel. Audit interviews and on-site activities demonstrated that this did not result in Power personnel becoming familiar with hazard identification and hazard management. For example, during an interview for this audit, a member of management stated that they were unaware of what items were being tracked in the hazard log. Further, the hazard log provided for this audit did not include electrical hazards, water intrusion, or egress deficiencies.

The WMSC's modification proposal required revision of the corrective action plan to expressly include all elements of what is now under the realigned Office of Power (not just high voltage and traction power). The training must also ensure all Power personnel are familiar with hazard identification and hazard management, which would require another training that covers hazard identification and management at Metrorail and/or determining and instituting recurring refresher training requirements in this area. The WMSC also communicated the need for an additional actionable item(s) that demonstrates that the training was effective and an actionable item(s) that demonstrates that the Safety Management System (SMS) was in fact implemented as specified in WMATA's Agency Safety Plan and Power department manuals.

C-0157

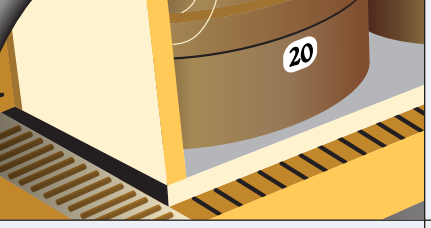


The WMSC's review of submittals related to this CAP through August 2023 showed that Metrorail is identifying locations with as-built schematics that are either missing or not-current, which is positive. However, of the rooms where this issue was identified by Metrorail, only some inspections listed corresponding work orders to address that deficiency. Documents received and field observations conducted by the WMSC as part of this audit also showed this issue of not-current/missing as-built schematics (as required by TRPM 1000 Section 7) is ongoing. These schematics are necessary to safely and effectively troubleshoot and to reliably maintain power systems.

The WMSC's modification proposal required a new actionable item that demonstrates the missing or not-current as-built schematics that Metrorail is now identifying have been addressed and that each are now current.

WMATA has submitted a CAP modification to include full review of all rooms, recording of the necessary as-built schematics, printing the necessary materials, and posting at the rooms.

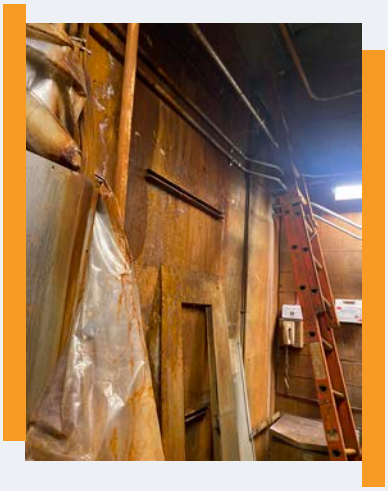
Findings and **Minimum** Corrective Actions

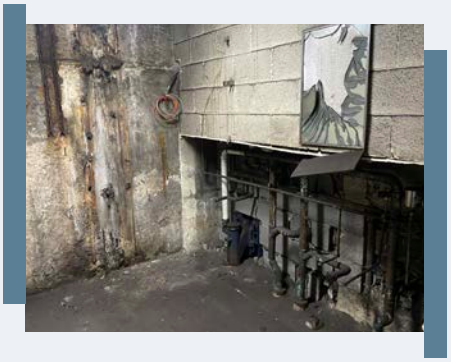


Findings and Minimum Corrective Actions

The WMSC Audit team visited power rooms that had evidence of recurring, significant water damage including evidence of corrosion, sediment buildup, and negative effects of this water intrusion on equipment, and egress doors and stairs (see Finding 2).

Findings





Finding 1: Metrorail is not consistently identifying, addressing, and preventing water intrusion in power rooms.

The WMSC Audit team visited power rooms that had evidence of recurring, significant water damage including evidence of corrosion, sediment buildup, and negative effects of this water intrusion on equipment, and egress doors and stairs (see Finding 2). Water intrusion is a hazard related to multiple elements of the Metrorail system that poses a particular risk to the safety of Office of Power personnel and the functionality of power-related systems. The WMSC communicated several safety concerns to WMATA personnel as they were identified onsite and sent follow-up correspondence to WMATA on July 21, 2023.

Locations where significant water intrusion was evident by extensive corrosion included the Traction Power Substation at Benning Road. Other power rooms had varying evidence of water leaks onto or around equipment, such as the Gallery Place (F01) battery room floor, and other rooms with evidence of leaks onto equipment. Significant signs of water intrusion were also found in the Alternating Current (AC) Room at Metro Center Station where much of the room was rust-colored. Power rooms, tie-breaker facilities, and traction power substations house vital electrical equipment responsible for supplying power to sections of third rail and surrounding facilities. Water intrusion could result in injury or death by electrocution or safety critical systems failure, including systems designed to ensure safe train movement.

At Metro Center AC Room 1, the WMSC Audit team observed a heavy leak from a pipe onto the roadway outside the room, and extensive corrosion, sediment and apparent water damage inside the room. The walls, floors and other parts of the room were coated in a rust color. Room logbooks showed the water intrusion issue noted repeatedly for many years, but onsite observations and logbooks showed that the water intrusion has not been effectively mitigated. This demonstrates deficiencies in Metrorail's corrective maintenance program. In response to a subsequent request, Metrorail provided records showing that repeated work orders were created and closed starting in January 2021 for Metro Center AC Room 1 and in March 2021 for AC Room 2 for water intrusion inspection. The observations demonstrate that this problem persists. After the WMSC raised this concern to Metrorail, WMATA personnel performed an inspection that determined water was leaking from the pipe outside the room at a rate of 1 gallon per minute. Repairs on that pipe, which were separate from the evidence of long-term water intrusion that remains in the room, were completed on July 23, 2023.

Deficiencies in the maintenance of hazard logs is an issue the WMSC has identified in several areas previously audited.

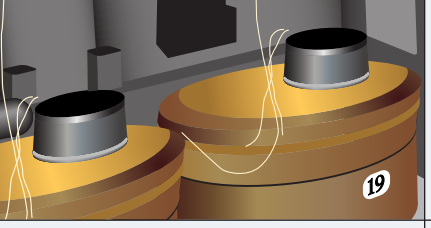
During an onsite observation at Benning Road TPSS 2, the WMSC found evidence of consistent water intrusion into the room. The emergency exit door was not functioning properly due to deterioration from repeated water intrusion. The door only opened when kicked with force by a WMATA employee. The door's auto close mechanism then did not function. Outside that emergency exit door, the emergency exit stairs were corroding due to pooling of water at the base of the shaft. This poses a hazard to workers who must exit in an emergency both by restricting their egress and by not providing protection behind them as they attempt to exit up the stairs and ladder (See Finding 2). In addition, the floor inside the power room showed evidence that water was regularly pooling in the room under the door, causing corrosion. Metrorail had not identified or mitigated the hazard posed by this repeated water intrusion to equipment or personnel.

Metrorail procedure TRPM-SOP04-00, TRPM Hazard Identification Process requires all personnel to identify and report hazards, which would include the visible evidence in the Benning Road TPSS of consistent water intrusion into the room and damage to the emergency exit door. TRPM-1000 Electrical and Traction Power Systems Maintenance and Inspection Manual contains several requirements related to water intrusion inspection. For example, Section 5.2, Facility Housekeeping, states that upon entering the facility, personnel must verify the flooring is dry, and look for any signs of past water intrusion. Section 5.4.13.1.6 requires the inspection of transformers for evidence of water entry, rust and deteriorated paint. Section 6.5 Trackside Disconnect Switches includes instructions to inspect for water intrusion resulting from rain, snow accumulation and sleet.

Inadequate water intrusion prevention and remediation is causing systems, equipment and infrastructure to not be maintained in a state of good repair as required by WMATA's Public Transportation Agency Safety Plan. WMATA is working to address water intrusion in some locations, but implementation of a more comprehensive approach is still needed.

The "POWER Hazard Tracker" submitted by WMATA, which covers the period January 1, 2022, through April 20, 2023, does not contain any items related to water intrusion, despite it being a regularly identified hazard throughout the system (see CAP Modification C-0155). Deficiencies in the maintenance of hazard logs is an issue the WMSC has identified in several areas previously audited including High Voltage Traction Power, Rail Operations and Communications Systems, which Metrorail has committed to addressing by beginning to implement the safety risk management process specified in its Public Transportation Agency Safety Plan.

Several WMATA employees interviewed during this audit listed water intrusion as a safety concern. Personnel interviewed during this audit indicated they raised an issue regarding water intrusion in rooms that they work in using WMATA's Safety Hotline and that they had received communication regarding related status updates. A member of the Office of Power's management described water intrusion under the floor in the Dupont Circle AC Room that has caused the ducts located there to deteriorate. They stated they were unaware if this issue had been captured in the department's hazard log and stated that the hazard log was the sole responsibility of departmental safety personnel. Metrorail's Public Transportation Agency Safety Plan and Power department procedures require all personnel to participate in the safety management system process (see CAP modification required for C-0155). In its comments on the draft of this report, Metrorail stated it has begun tracking



this hazard after the completion of this audit, and provided a supporting excerpt from its hazard management system.

In March 2022, the WMSC communicated urgent safety concerns regarding the condition of the Train Control Room (TCRs) at Friendship Heights Station, including water intrusion, to Metrorail and later identified additional TCRs with similar conditions. In response, WMATA committed to conduct special inspections of all Automatic Train Control and ancillary rooms, including those that house power systems. However, WMSC's monitoring established that this was not conducted as described by Metrorail. This in part led to the WMSC issuing an August 4, 2022, order to WMATA regarding Metrorail's ineffective and insufficient Automation Train Control (ATC) Room inspection, maintenance and cleaning program. The WMSC's audit activities demonstrate that, although there are elements of long-term capital plans related to these issues, Metrorail has not taken systematic action to identify and address water intrusion safety issues in power rooms today.

The WMSC also identified water intrusion issues in our 2022 audits of WMATA's Station Maintenance, Elevator and Escalators and Communications Systems. WMATA committed to developing a process to evaluate water intrusion in stations, elevators and escalators and managing issued identified through corrective maintenance and capital projects. Further identification of water intrusion and deficiencies in mitigation found during this audit demonstrates the need for similar actions as it relates to power facilities and systems.

The WMSC's audit activities demonstrate that, although there are elements of long-term capital plans related to these issues, Metrorail has not taken systematic action to identify and address water intrusion safety issues in power rooms today.

◆ **Minimum Corrective Action:**

WMATA must conduct special inspections of all power facilities for signs of water intrusion and provide detailed records, including all hazards and safety deficiencies identified as well as records of all planned mitigations. Based on the hazards identified during those inspections Metrorail must prioritize and address those safety deficiencies in a timely manner and provide records of the mitigations through completion.

▶ Finding 2: Metrorail is not ensuring that adequate egress paths are maintained for Power facilities.

Power facility exits are not being examined and maintained in a state of good repair, risking the inability of personnel to safely exit rooms during maintenance, repair, and inspection activities. The inadequate maintenance of exit stairs and lighting creates a risk that those who do utilize the exits in an emergency may be injured or unable to utilize the exits to reach a place of safety.

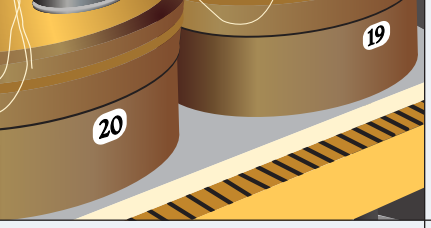
Properly maintained exit paths ensure a safe means of egress in the case of an emergency.

During onsite visits as part of this audit, WMSC personnel identified several immediate safety concerns that were noted to onsite WMATA personnel at the time and further communicated to WMATA in writing on July 21, 2023. Three of those immediate safety concerns were regarding exits. WMATA conducted inspections at the locations specified and provided their determinations to the WMSC on July 31, 2023.

There is evidence of consistent water intrusion into the room, including from under this door.

- At Benning Road Traction Power Substation 2, safety issues related to the emergency exit at the east end of the room that leads to a ladder to the street level were identified.
  - The emergency exit door did not open with a moderate amount of force, and only opened when kicked open by an employee (see Finding 1). The door's auto close mechanism then did not function. The bottom of the door appeared corroded from repeated water intrusion.
    - As an interim mitigation, WMATA installed aluminum and sprayed the hinges to ensure functionality. A work order to replace the door was created on July 22, 2023, and it was completed on September 11, 2023.

  - Lights in the stairwell were out, the protective covers for bulbs were sitting on the stairs, and one of the light sockets appeared to have been struck and damaged, posing a hazard
    - A Low Voltage Power crew repaired all lighting issues identified.
  - The bottom of the emergency exit stairs is corroding, apparently due to regular water pooling.
    - A work order to replace plumbing fixtures that Metrorail determined to be the cause of the water pooling was completed on July 24, 2023.
  - There is evidence of consistent water intrusion into the room, including from under this door.
    - WMATA determined that there was no drain at the bottom of the shaft, indicating a design issue. As a temporary mitigation, sandbags were placed at the entrance of the shaft to prevent water from coming in.
    - Structural engineering assessment of water intrusion mitigation is in progress.
- At Gallery Place Traction Power Substation, evidence of water intrusion was observed.
  - A work order, created to clear a drain that Metrorail determined to be the cause, was completed on July 24, 2023.
- At Metro Center Station Vent Shaft VE1 a light was out in the stairs to the battery room. This lack of light limits visibility, posing a fall hazard on the stairs.
  - A work order was created, and the lightbulb was replaced on July 26, 2023.



WMSC personnel observed the use of a torque wrench with a sticker showing the tool was past due for calibration.

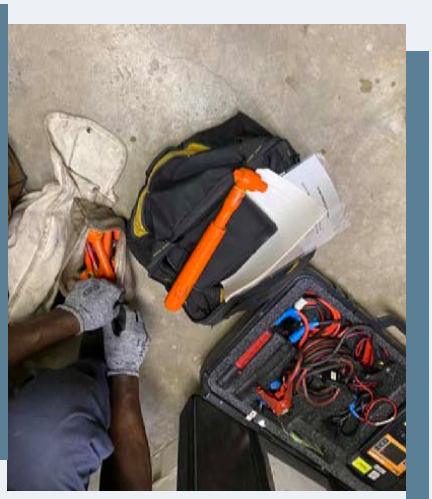
In its comments on the draft of this report, Metrorail stated that maintenance and repair of structural elements, stairways, and surface grating are jointly owned by the Structures Inspection and Plant Maintenance Departments. Under a safety management system approach, the consistent identification and mitigation of hazards by all personnel requires effective reporting and interdepartmental coordination.

- **Minimum Corrective Action:**

  Metrorail must conduct a risk assessment and evaluate whether emergency exit paths are adequately marked and meet the necessary requirements to evacuate safely in an emergency for rooms such as power facilities, and act upon the evaluation to ensure emergency exit paths are adequately marked and ensure safe emergency evacuation. Metrorail must ensure that emergency exit paths/ functionality are included in regular room checks by frontline personnel and evaluate procedures and training to determine whether personnel responsible for room inspections need additional information or guidance to ensure that all safety features such as emergency exits are regularly evaluated.

Finding Resolved Prior to Issuance of Final Report

▶ Finding 3: Metrorail Office of Power personnel are performing maintenance work using torque wrenches that are out of calibration.



WMSC personnel observed the use of a torque wrench with a sticker showing the tool was past due for calibration during a Battery Preventive Maintenance Inspection at Cheverly Station. A second torque wrench with the crew was also past due for calibration. Torque wrenches are used to tighten bolts, nuts and screws, in this case to ensure proper contact for battery terminals. Calibration ensures that the wrenches apply the intended force. The personnel that used the torque wrench as part of the PMI procedure stated that they had just received the tools back from Metrorail to use. In addition to the calibration responsibilities, TRPM-SOP06-00 – TRPM Equipment Calibration Process, Section 3 requires equipment users to submit equipment for calibration prior to the calibration expiration date and to verify the state of calibration of a tool prior to use. The use of the torque wrench past due for calibration demonstrates non-compliance with that requirement.

After the WMSC presented this safety concern, WMATA identified that the use of tools out of calibration by the battery maintenance crew is a systemic issue, and began to correct that issue. The Office of Power leadership stated that the battery personnel's torque

wrenches were not included in the calibrated tools process when Metrorail shifted responsibility for and organization of its calibration. These torque wrenches were not entered at that time in Maximo, Metrorail's maintenance management system, as requiring calibration.

Metrorail submitted documentation to the WMSC that detailed the corrective actions taken to address this finding.

- PMI group began removing torque wrenches from service. (completed 7/30/2023)
- PMI torque wrenches were transported to Material Control. (7/31/2023)
  - All PMI torque wrenches were inventoried and added to the Power Torque Wrench Calibration Tracking spreadsheet pending calibration.
- 17 torque wrenches were picked up by Electronic Laboratories Incorporated for calibration. (Week of 7/31/2023)
- Torque wrenches were returned to Power. (8/23/2023)
  - The 17 torque wrenches and associated ELI ID Numbers were documented in Power Torque Wrench Calibration tracking spreadsheet.
- Additional Preventive Measures.
  - All calibrated equipment will be handled in accordance with TRPM-SOP06-00, TRPM Equipment Calibration Process, dated 5/20/2022.
  - The Compliance, Safety and Inspection group within Power will randomly check equipment calibration during the following audits:
    - Crew Readiness and Safety Audit
    - Preventive Maintenance Inspection Audit
    - Roadway Worker Protection Safety Compliance Audit

The WMSC appreciates Metrorail management's action to identify a root cause of this safety issue and act to address it.

In response to the WMSC's 2021 High Voltage Traction Power Audit identifying that Metrorail databases include many electrical tools that are beyond their required calibration date, Metrorail developed and implemented CAP C-0160. This CAP addressed maintaining calibration of the tools in Metrorail's database and keeping that database current. Under this CAP Metrorail developed a documented procedure (TRPM-SOP06-00 – TRPM Equipment Calibration Process dated May 20, 2022). The new finding in this audit addresses Metrorail's tools in the field, and Metrorail ensuring that each of those tools are properly captured in the database as required by the above process to ensure calibration and accuracy. The WMSC appreciates Metrorail management's action to identify a root cause of this safety issue and act to address it.

Other Observations

As the WMSC communicated on July 21, 2023, during interviews and onsite activities, several Metrorail employees expressed concerns about their personal security while conducting or preparing to conduct work. WMSC personnel experienced one of those concerns realized while observing work at the Gallery Place Traction Power Substation.

During the Emergency Trip Station Preventive Maintenance Inspection near Deanwood Station, the audit team observed ETS boxes obstructed by vegetation, and ETS boxes with blue lights that were not functioning to indicate the locations of those boxes in an emergency. These concerns were communicated to Metrorail and addressed. Following completion of activities for this audit, WMATA submitted documentation regarding the implementation of a weed spraying program for WMSC review as part of existing CAP C-0232.

Next Steps

WMATA is required to propose CAPs to address Finding 1 and Finding 2 of this audit 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.


THIS CIRCUIT IS PROVIDED WITH GROUND FAULT PROTECTION
B01-EUB-05
PANEL NEP
B01-EUB-07
PANEL SEPB
SGL600/400AS/250RP
B01-EUB-09
PANEL EMPA
15 KVA RFMR
RM 206
B01-EUB-11
SPARE
SGL600/400AS/400RP
Feed back
panel
B01-EUB-13
SPARE
B01-EUB-15
PANEL SM-B01
TUNNEL ADS
SGL600/150AS/150RP
LOCATED IN RM
E104 MECH EQUIP

Appendices

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

Appendix A: Personnel Interviewed

- Office of Power (POWR)
  - Vice President
  - General Superintendent
  - 2 Assistant General Superintendents
  - Assistant Superintendent
  - 3 Superintendents
  - 7 Supervisors
  - 13 Mechanics
  - Manager, CAP Compliance
  - Special Project Manager
- Power Engineering
  - Director
  - Assistant Chief Engineer
  - Manager, Engineering
- Maintenance of Way Engineering
  - Director
  - Manager, Power Operations & Maintenance Engineering
  - Manager, SCADA Engineering
  - Manager, Corrosion Control Engineering

Appendix B: Site Visits

- July 11, 2023
  - Observation of Breaker PMI at Benning Road (G01)
- July 12, 2023
  - Observation of Emergency Trip Station (ETS) PMI at Deanwood Station (D10)
  - Observation of corrective maintenance work.
- July 13, 2023
  - Observation of Battery PMI at Cheverly (D11) AC Room
- July 14, 2023
  - Observation of various rooms at the following stations:
    - Judiciary Square Station
    - Gallery Place-Chinatown Station
    - Metro Center Station
    - Foggy Bottom-GWU Station
    - Rosslyn Station

Appendix C: Documents Reviewed

ORGANIZATIONAL CHARTS AND DEPARTMENT RESPONSIBILITIES:

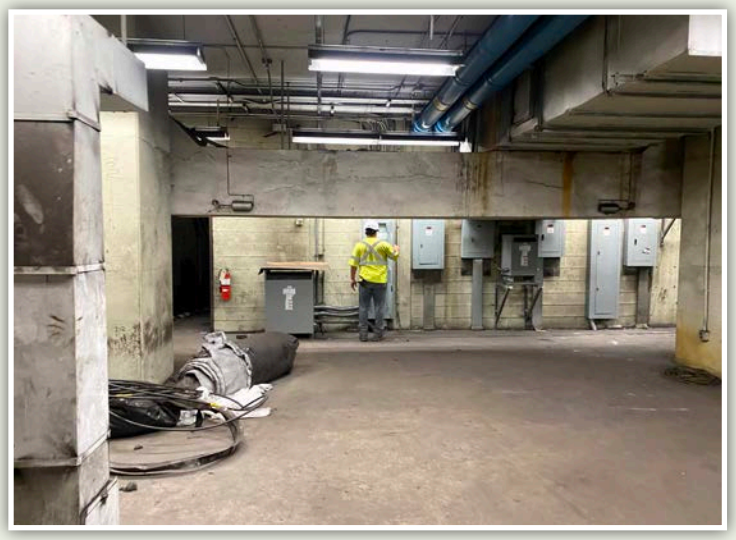
- INFR-TPOE-DOC-001.0, Traction Power Operations Engineering Roles and Responsibilities (04/20/2023)
- List of Departments and specific groups/divisions responsible for: High and Low Voltage Power Inspection and High and Low Voltage Power Maintenance (05/09/2023)
- List of Power Department Employees (no date)
- List of Power Department Employees-Power Staff (05/12/2023)
- List of Traction Power Group's Responsibilities (04/25/2023)
- MOWE Traction Power Operations Engineering Organizational Chart (04/19/2023)
- Office of Power (POWR) Master Employee Roster (no date)
- Power Engineering (PWRS) Organizational Charts (04/21/2023)
- Power Roles and Responsibilities for each group division (no date)
- System-wide DOR Matrix – TPSS (03/02/2023)
- WMATA Systems Training Instructor Position Description (04/17/2015)
- WMATA's Power Systems List of Departments for High and Low Voltage Power Engineering (no date)

INTERNAL REVIEWS:

- Internal Safety Review, Department of Low Voltage Electrical Maintenance (LVEM) (06/30/2020)
- Power iCAPA Status Report (05/05/2023)

PROCEDURES/POLICIES/MANUALS/FORMS:

- EMI-004-MOWE-POWER, G02 TPSS DC Feeder Cable Installation (08/10/2021)
- EMI-005-MOWE-POWER, Traction Power Temporary DTS Modification (E06 TPSS to E10 TPSS) (09/10/2021)



- EMI-006-MOWE-POWER, Removal of Wayside Disconnect Switches and Bridging Third Rail Gap at Union Station Portal (06/21/2022)
- EMI-007-MOWE-TPOE, DC Switchgear Energized Structure Mitigation (04/26/2022)
- MOWE-TPOE-MNL-121-01, Transit Asset Condition Assessment Methodology (6/15/2022)
- MOWE-TPOE-RI-121-01, Floating Slab Cable Repair Instruction (12/09/2021, Rev. 0)
- NFPA 70E, Standard for Electrical Safety in the Workplace (2018)
- Policy/Instruction 4.10/4, Configuration Control Management (01/11/2019)
- POWER Hazard Tracker (01/01/2022 to 04/20/2023)
- POWER-MAN-01-00, Department of Power-2000 Maintenance Control Procedures (04/12/2023)
- POWER-SOP-08-00, Department of Power Training Procedures (04/07/2023)
- POWER-SOP-10-00, Department of Power Internal Assessment Procedure (03/27/2023)
- POWER-SOP-11-00, Department of Power Document Control Process (03/27/2023)
- POWER-SOP-12-00, Non-Conformance and Corrective Action Procedure (03/31/2023)

PROCEDURES/POLICIES/MANUALS/FORMS: (CONTINUED)

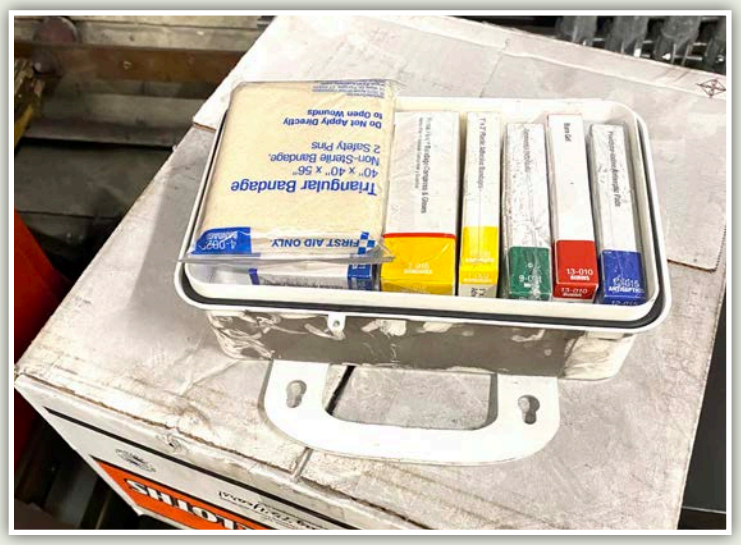
- SOP 121-02, Thermal Imagery Analysis and Tracking (04/28/2021)
- SOP 121-06, Stray Current Mitigation and Corrosion Control Test Analysis and Tracking (10/24/2018)
- SOP 121-07-01, Policy on Power Cable Meggering Testing, Planning and Analysis (04/12/2022)
- SOP 39, Lockout/Tagout Procedure for Traction Power Substations (01/30/2022)
- SOP 41, WMATA Crew Support Personnel Procedures for Non-Roadway (03/12/2020)
- Temporary Order, T-21-57, Rev. 1.0 Exception to Appendix A, SOP 2 (12/16/2022)
- Temporary Order, T-22-38, Exception to MSRPH 5.12.2 safety equipment and warning devices (08/24/2022)
- TPRM-FRM07-02, Supervisor's Conditional Inspection Form (08/2022)
- Traction Power Substation and Tie Breaker Station Ground Grid Resistance Testing Report (10/2021)
- TRPM-1000, Electrical and Traction Power Systems Maintenance and Inspection Manual (03/19/2021)
- TRPM-MADM-WI04-00, TRPM CM Work Order Prioritization Process (04/07/2022)
- TRPM-SOP01-02, Power Facility Logbook Documentation (05/20/2022)
- TRPM-SOP04-00, TRPM Hazard Identification Process (05/06/2022)
- TRPM-SOP05-01, TRPM Red Tag Power Switching Procedures (06/21/2022)
- TRPM-SOP06-00, TRPM Equipment Calibration Process (05/20/2022)
- TRPM-SOP14-03, Inoperable Emergency Trip Station Procedure (12/07/2022)
- TRPM-WI-05-00, Material Ordering, Inventory, New Testing Equipment, and Salvaged Equipment Management (02/15/2023)

TRAINING:

- AC Rooms & AC Switchgear, Introduction to the Substation Maintenance Profession Presentation (04/15/2017)
- AC Rooms and AC Switchgear Course Instructor Guide (02/13/2023)
- AC Rooms and AC Switchgear Course Module, slides (02/13/2023)
- AC Rooms and AC Switchgear Course Participant Manual (04/15/2017)
- AC Rooms and AC Switchgear Course Plan, Manual, Review Questions, Pre-Test and Answer Sheet (04/15/2017)
- Basic Electrical Theory Course Plan, Participant Manual, Lesson Plans, Test Questions and Answer Sheets (02/10/2023)
- Basic Operation of a MCP Traction Power Substation (TPSS) RPM 10-Day Refresher Course (04/19/2021)

TRAINING: (CONTINUED)

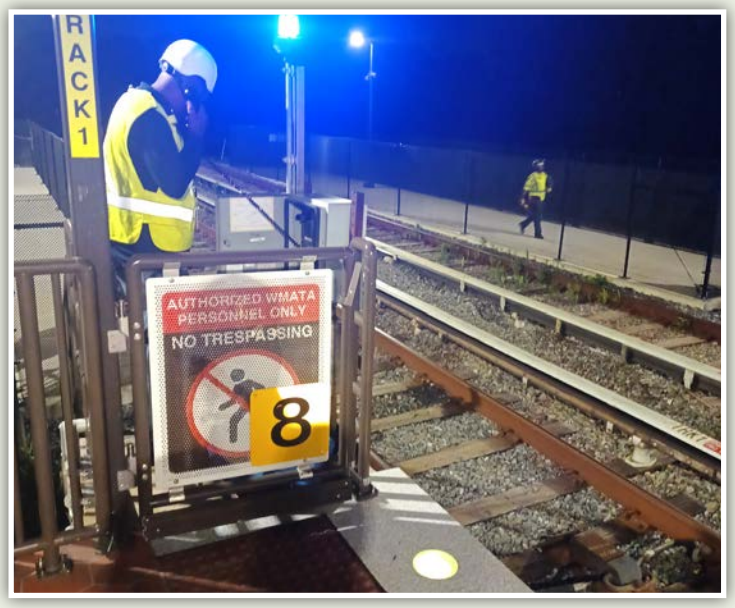
- Basic Operation of a Myers Controlled Power (MCP) Tie Breaker Station (TBS) TRPM 10-Day Refresher Course (04/19/2021)
- Battery PMI Course Syllabus (04/19/2021)
- Battery PMI Training Guide Module (02/14/2023)
- Battery PMI Training Guide Module (04/19/2021)
- Contractor Provided Power and SCADA Engineering Trainings (no date)
- Course Plan, Low Voltage (LV) Circuit Breaker Overcurrent Protection (02/13/2017
- Drawing/Schematic of Extension to Wiehle Ave Plainfield Street Equipment Arrangement (09/7/2009)
- Drawing/Schematic of WMATA Power Systems Network Configuration Diagram-TPSS, TBS, and AC Switchgear Room (11/16/2015)
- Electrical Safety for Traction Power Course Participant Manual (03/13/2017)
- Electrical Safety for Traction Power- Introduction to Electrical Safety Presentation (3/13/2017)
- Electrical Safety for Traction Power Training Module, Syllabus, Pre-Assessment, Participant Manual (02/13/2023)
- Emergency Trip Station (ETS) Training Presentation (02/13/2017)
- High Voltage AC & DC Circuit Breaker Training Program-Introduction to the Substation Maintenance Profession Module (02/14/2023)
- High Voltage AC and DC Circuit Breakers Appendices, Test Questions and Answer Sheets (04/19/2021)
- High Voltage AC and DC Circuit Breakers Course Instructor Guide (03/22/2017)
- High Voltage AC and DC Circuit Breakers Course Plan-Version (03/22/2017)
- High Voltage AC and DC Circuit Breakers Participant Manual (03/22/2017)
- Introduction to Substation Maintenance Course Instructor Guide (02/13/2023)



- Introduction to Substation Maintenance Course Module Presentation (02/13/2023)
- Introduction to Substation Maintenance Course Participant Manual (03/13/2017)
- Introduction to Substation Maintenance Course Plan (03/13/2017)
- Introduction to the Substation Maintenance Profession Presentation (02/13/2017)
- Liquid Filled Transformer Maintenance Course (02/13/2023)
- Liquid Filled Transformer Maintenance Course Module Presentation (02/13/2023)
- Liquid Filled Transformer Maintenance Course Participant Manual (03/17/2017)
- Liquid Filled Transformer Maintenance Course Plan (03/13/2017)
- List of Dates and Attendees at Contractor Provided Power and SCADA Engineering Trainings (no date)
- List of Power Engineering Employee Mandatory Training Requirements (04/19/2023)
- List of Power High Voltage Employee's Course Attendance, Course Grades, and Course Enrollment Dates-TRPM (no date)
- List of TRPM Instructors and TRPM Trainees' Course Attendance, Course Grades, and Course Enrollment Dates-TSMT (no date)

TRAINING: (CONTINUED)

- Low Voltage Circuit Breaker Overcurrent Protection Appendices (04/19/2021)
- Low Voltage Circuit Breaker Overcurrent Protection Course (04/13/2023)
- Low Voltage Circuit Breaker Overcurrent Protection Final Test Blank Answer Sheet (04/19/2021)
- Low Voltage Circuit Breaker Overcurrent Protection Final Test Pt1 Answer Sheet (04/19/2021)
- Low Voltage Circuit Breaker Overcurrent Protection Final Test Pt1 Answer Sheet with Questions (04/19/2021)
- Low Voltage Circuit Breaker Overcurrent Protection Final Test Questions (04/19/2021)
- Low Voltage Circuit Breaker Overcurrent Protection Participant Manual (02/14/2023)
- Low Voltage Circuit Breaker Overcurrent Protection Pre-Test Questions (04/19/2021)
- Low Voltage Circuit Breaker Overcurrent Protection Training Program Modules 1-4 Presentation (02/14/2023)
- Low Voltage Circuit Breaker Overcurrent Protection Training Program Modules 5-7, Cabinet and Switchgear Service Presentation (02/14/2023)
- Nomenclature Traction Power Substation Module Nomenclature Overview for TRPM (02/13/2023)
- Nomenclature Traction Power Substation Student Guide (04/14/2021)
- Racking of a Circuit Breaker Course Module, Student Guide, Activity Manual, Syllabus, Assessment and Answer Key (02/13/2023)
- Racking of a Circuit Breaker Course Module, Student Guide, Activity Manual, Syllabus, Assessment and Answer Key (02/13/2023)
- Racking of a Circuit Breaker Course Student Guide (02/13/2023)
- Rectifiers and Rectifier Transformers Course Instructor Guide (02/13/2023)
- Rectifiers and Rectifier Transformers Course Participant Manual (03/29/2017)
- Rectifiers and Rectifier Transformers Course Plan, Manual, Review Questions, Answer Sheets and Final (03/29/2017)
- Rectifiers and Rectifier Transformers Training Program, Introduction to the Substation Maintenance Profession Presentation (02/07/2017)
- Rectifiers and Rectifier Transformers Training Program, slides (02/13/2023)
- Relay Protective Devices Appendices (04/19/2021)
- Relay Protective Devices Course Plan (04/23/2017)
- Relay Protective Devices Participant Manual (04/23/2017)
- Relay Protective Devices Training Guide Module (02/14/2023)
- Schneider Full Function Test Kit Manual (02/05/2015)
- Tools and Material Handling Module, Student Guide, Activity Guide, Assessment and Answer Key (09/25/2019)
- Traction Power Substations Course Participant Manual (04/7/2017)
- Traction Power Substations Course Plan (04/7/2017)
- Traction Power Substations Course Plan (04/7/2017)
- Traction Power Substations Nomenclature Course Syllabus, Pre-Assessment, Student Guide, Assessment, Answer Key (04/14/2021)
- Traction Power Substations Training Program Module Presentation (04/7/2017)



- Traction Power Substations Training Program, Introduction to the Substation Maintenance Profession Presentation (2/13/2017)
- TRPM Requalification and Training Tracking Database (no date)
- Uninterruptible Power Supplies Course Plan, Participant Manual, Test Questions, Answer Sheets and Final Test (04/23/2017)

INSPECTION AND MAINTENANCE:

- December 2022 Supervisor Room Inspections TRPM Team Traction Power Maintenance Supervisor's Conditional Inspection Forms (12/2022)
- List of TRPM and Low Voltage Work Orders (01/01/2020 to 12/31/2022)
- List of TRPM and Low Voltage Work Orders (01/01/2021 to 12/31/2022)
- List of TRPM Preventive Maintenance Inspections (PMI) for High & Lower Voltage Power (04/26/2023)
- Low Voltage RCMP Compliance Reports (05/2021 to 03/2023)
- LVEM Failure Analysis Reports (02/2022 to 03/2023)
- March 2023 Supervisor Room Inspections TRPM Team Traction Power Maintenance Supervisor's Conditional Inspection Forms (03/2023)
- Power Switching Suits Spreadsheet (08/08/2023)
- POWR-FRM22-01, Roadway Worker Protection Safety Compliance Audit (04/18/2023)
- POWR-FRM22-01, Roadway Worker Protection Safety Compliance Audit (04/12/2023)
- POWR-FRM22-01, Roadway Worker Protection Safety Compliance Audit (04/25/2023)
- POWR-FRM22-01, Roadway Worker Protection Safety Compliance Audit (06/07/2023)
- POWR-FRM22-01, Roadway Worker Protection Safety Compliance Audit (05/23/2023)
- POWR-FRM22-01, Roadway Worker Protection Safety Compliance Audit (05/16/2023)
- POWR-FRM25-00, Preventative Maintenance Inspection Audit (02/07/2023)

- POWR-FRM25-00, Preventative Maintenance Inspection Audit (02/08/2023)
- POWR-FRM25-00, Preventative Maintenance Inspection Audit (04/03/2023)
- POWR-FRM25-00, Preventative Maintenance Inspection Audit (04/04/2023)
- Preventative Maintenance Inspection (PMI), Fan Shaft & DPS Systems: ATS, Voltage Regulators & MCC, 364 Day Inspection (02/26/2018)
- Preventative Maintenance Inspection (PMI), Lighting Inspection and Relamping of WMATA Facilities (03/14/2023)
- Preventative Maintenance Inspection for Emergency Trip Station (ETS), 1092 Day Inspection (06/20/2013)
- RPM-Failure-Analysis-Report.pdf (02/2022 to 03/2023)
- Supervisor Room Inspections TRPM Team Traction Power Maintenance Supervisor's Conditional Inspection Forms (01/2023)
- Traction Power RCMP Compliance Reports (05/2021 to 03/2023)
- TRPM Maximo Work Order List (10/2022 to 12/2022)
- TRPM Supervisor's Field Maintenance Audit Forms (01/02/2023 to 02/28/2023)
- TRPM-FM25-00, Preventative Maintenance Inspection Audit (06/23/2023)
- TRPM-FRM22-01, Roadway Worker Protection Safety Compliance Audit (12/01/2022)

INSPECTION AND MAINTENANCE: (CONTINUED)

- TRPM-FRM25-00, Preventative Maintenance Inspection Audit (06/13/2023)
- TRPM-FRM25-00, Preventative Maintenance Inspection Audit (06/14/2023)
- TRPM-GTM07-02, Supervisors' Conditional Inspection Forms (05/01/2023 to 05/31/2023)
- TRPM-GTM07-02, Supervisors' Conditional Inspection Forms (06/01/2023 to 06/30/2023)
- TRPM-Power AC Unit Substation/AC Room Facility Inspection Data Sheets (11/21/22 to 04/07/2023)
- TRPM-SOP209-1, Supervisors' Field Maintenance Audit Forms (05/01/2023 to 05/31/2023)
- TRPM-SOP209-1, Supervisors' Field Maintenance Audit Forms (06/01/2023 to 06/30/2023)
- Water-related CM Work Orders (2021-2023)
- WMATA PMI for Stationary Emergency Stand-By Power Generator-Monthly, Bi-Annual, Annual Inspections (06/17/2013)

EQUIPMENT:

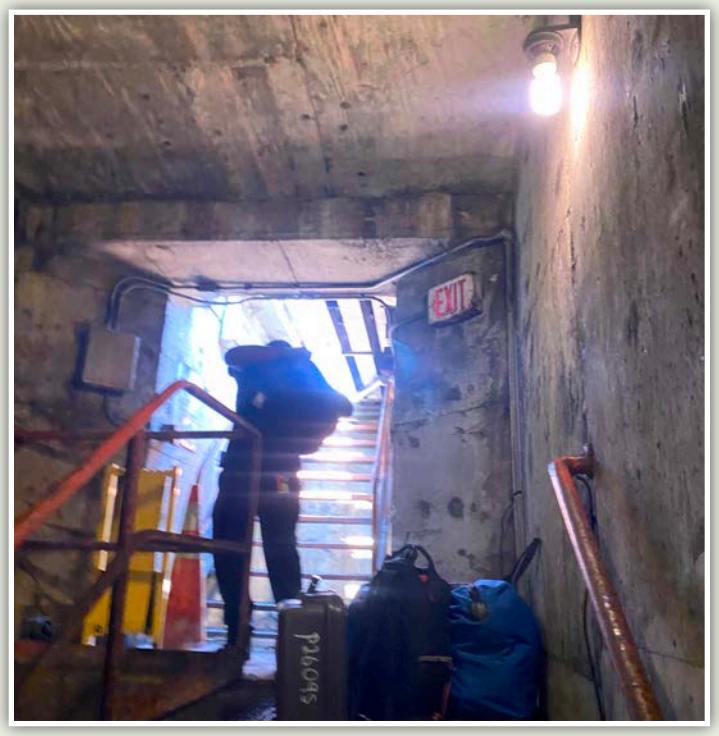
- Control Schematic Drawing of Breaker 52BT (07/07/2009)
- Control Schematic Drawing of Breaker 52L1 (07/07/2009)
- Control Schematic Drawing of Breaker 52L2 (07/07/2009)
- Control Schematic Drawing of Breaker 52R1 (07/07/2009)
- Control Schematic Drawing of Cathode Breaker 72-01 (07/07/2009)
- Control Schematic Drawing of Feeder Breaker 1 (07/08/2009)
- Cummins Aftertreatment System ISF/QSF 2.8 & 3.8 Training Slides (01/2016)
- Cummins OTPCSE 40-1000 Installation Manual (04/2009)
- Doosan-G185-G240-G290-G450 Operation and Maintenance Manual (07/2012)
- Emergency Generator Procedures (no date)
- Matcon Calibration List (05/08/2023)
- Onan OTEC series 40 to 1000 Amp Transfer Switch Operator's Manual (06/2004)
- TRPM-FRM12-01, Semi-Annual Tool Inventory & Inspection Form (11/2022)
- WhisperWatt Generators DCA Series Operation and Parts Manual (08/05/2009)

MEETING MINUTES/AGENDAS:

- LVEM Local Safety Committee Agendas, Presentations and Minutes (01/2022 to 03/2023)
- MOWE-TRPM Manager Meeting Agenda Actions (06/01/2022 to 04/30/2023)
- TRPM Local Safety Committee Agendas, Presentations and Minutes (01/2022 to 03/2023)

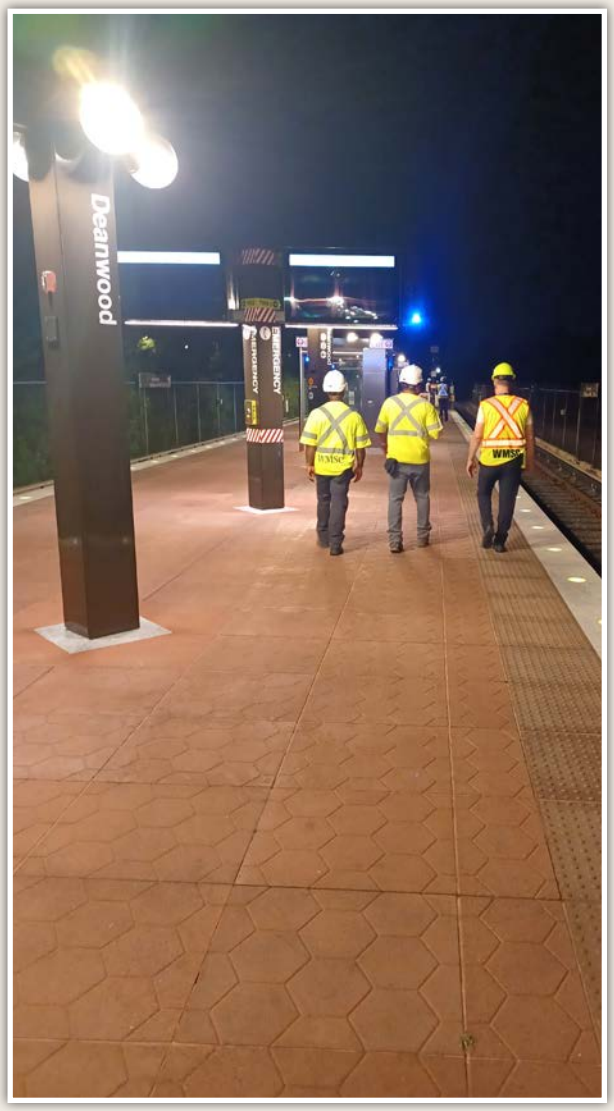
CAPITAL PLANNING:

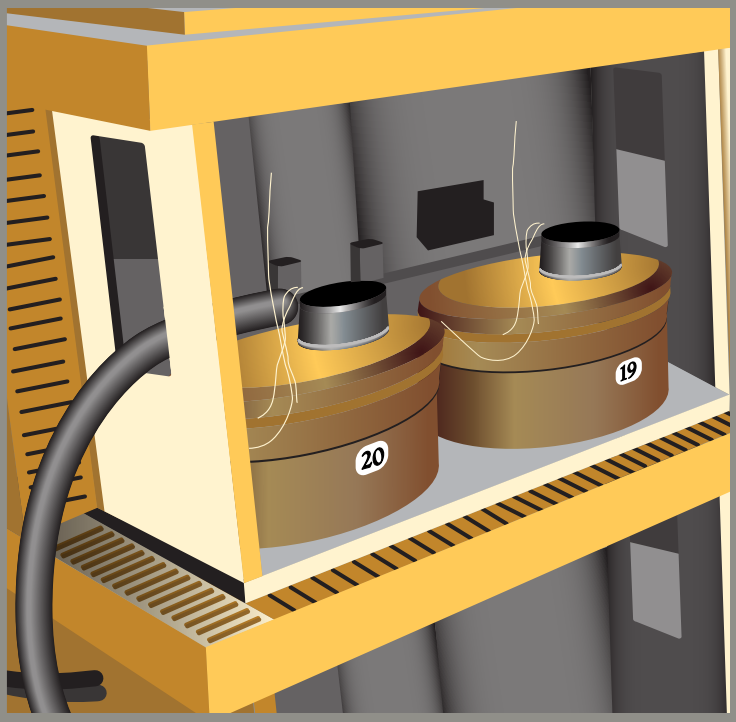
- Draft WMATA FY24 Proposed Budget CIP and 10 Year Plan (02/08/2023)
- Traction Power Lab & Classroom Project Business Case Summary (06/27/2021)
- Traction Power Lab & Classroom Project briefing, slides (06/06/2021)



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
   - b. Contractor Safety
   - c. Safety Communications
   - d. Hazard and safety risk information
   - e. Safety committees
   - f. Hazardous materials and environmental management





WASHINGTON METRORAIL SAFETY COMMISSION

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