



Rail Transit Safety Program:

Safety and Maintenance Audit of the Washington Metropolitan Area Transit Authority (WMATA)

FINAL REPORT

November 28, 2012

Federal Transit Administration,
Office of Safety and Security



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1.0 Executive Summary

The Federal Transit Administration (FTA) issues this final report to document the results of its safety and maintenance audit of the Washington Metropolitan Area Transit Authority (WMATA). FTA conducted this audit on-site at WMATA's Metrorail system at the direction of Transportation Secretary Ray LaHood in response to a request from U.S. Senator Barbara Mikulski.

FTA's objectives in conducting this audit were to assess:

- The effectiveness of actions taken by WMATA to close findings from FTA's March 4, 2010 Final Safety Audit Report;
- The quality of WMATA's implementation of its safety programs, including safety communication and hazard management, accident investigation, roadway worker protection, and system-wide coordination and outreach regarding the resolution of safety issues; and
- The quality of the oversight partnership between WMATA and the Tri-State Oversight Committee (TOC).

In addition, based on a series of high-profile incidents involving maintenance failures in safety-critical systems and equipment, FTA's audit includes an examination of how WMATA manages the maintenance of safety-critical infrastructure, equipment and systems, including the appropriateness of procedures and the frequency of inspections.

Overall, FTA finds that WMATA has made considerable progress in strengthening its safety organization, safety analysis capabilities, and information sharing and communication processes regarding safety issues. FTA concludes that WMATA has effectively addressed the audit findings from FTA's March 4, 2010 Final Audit Report and improved its safety oversight relationship with the Tri-State Oversight Committee and the local jurisdictions. FTA also confirms that the WMATA Board of Directors has taken a more active role in monitoring WMATA's safety performance.

While WMATA has clearly strengthened its safety organization and management, FTA agrees with WMATA's General Manager and Chief Executive Officer that WMATA's progress over the last two-and-a-half years is a critical but fragile foundation for the future. WMATA's continued progress will rely considerably on the team of executives, managers, supervisors, and front-line employees who have worked to bring about improvements to date. Any major changes in personnel, relaxation in attention to safety, reduction of resources devoted to safety, or reemergence of complacency in the reporting and investigation of unusual occurrences and conditions could easily reverse WMATA's recent gains.

In reviewing WMATA's maintenance and inspection programs, FTA finds that WMATA adopts voluntary consensus standards and practices, such as those developed by the



American Public Transportation Association (APTA) and the American Railway Engineering and Maintenance-of-Way Association (AREMA). Interviews, field observations and records reviews confirmed that WMATA maintenance and engineering departments generally implement and follow these voluntary standards. This finding, however, should not be construed as support for, or an endorsement of, these standards and practices. Rather, FTA's audit finds that in the absence of regulated safety standards, WMATA has adopted and generally follows available industry standards.

To support WMATA's continuing commitment to create a safer organization FTA issues six (6) recommendations to address remaining gaps. Most of these recommendations relate to the way in which WMATA managed safety concerns resulting from the extreme weather of the spring and summer months. Based on an extensive review of the nine (9) accidents identified by Senator Mikulski in her July 24, 2012 letter, FTA determined that WMATA's engineering and maintenance departments were not sufficiently prepared in planning for and reacting to the extreme heat and weather conditions of the spring and summer months.

FTA finds that extended weeks of above-average heat, lightning strikes and electrical storms, power outages, rolling brownouts, and flash flooding created vulnerabilities to malfunctions in system components that should have been identified and addressed more aggressively by WMATA personnel before they resulted in accidents and incidents affecting passengers and employees. To further review and enhance the agency's capabilities to address similar situations in the future, FTA recommends the following:

- First, that WMATA complete final investigation reports for all nine (9) accidents and incidents reviewed as part of this audit, and submit them to FTA for final review by Thursday, January 31, 2013. To date, WMATA has submitted six (6) investigation reports and all supporting attachments and analyses to FTA and the TOC. As of November 19, 2012, TOC has formally approved two (2) of the six (6) reports for closure. FTA continues to coordinate with TOC and WMATA regarding final dispositions and approvals for the remaining four (4) reports. If necessary, based on FTA's assessment, FTA will schedule a meeting with WMATA and TOC to further review conclusions and corrective actions developed to prevent recurrence of these accidents.
- Second, FTA recommends that, through WMATA's hazard management program, WMATA's Safety Department conduct an assessment regarding the July 6, 2012 "heat kink" derailment. This assessment should determine if an independent review is required regarding WMATA's current rail de-stressing process. WMATA should submit the completed analysis to FTA for final review by Friday, February 15, 2013.
- Third, FTA also recommends that a formal hazard assessment be conducted to determine if additional measures are needed to protect workers in WMATA's vehicle maintenance facilities and rail yards. WMATA should submit the completed analysis to FTA for final review by Friday, February 15, 2013.



- Fourth, FTA recommends additional safety analysis regarding the ways in which railcar doors can open off-platform to ensure that further risks of unintentional door openings have been eliminated. WMATA should submit the completed analysis to FTA for final review. WMATA should provide FTA with a due date for receipt of this analysis.
- Fifth, within 90 days from the issuance of this audit report, WMATA should schedule with FTA a demonstration of WMATA's new Safety Management System (SMS), including the analysis performed by WMATA's Safety Department regarding the agency's most significant safety challenges and the steps being taken to address them. FTA anticipates key issues discussed during this meeting will include:
 - Employee and supervisor recruitment, training, and evaluation;
 - Safety challenges of vacancies and resource limitations in certain maintenance departments, including the Storerooms and Material Logistics Shop (SAMS);
 - Enhancing the roadway worker protection program to address rail yards and maintenance facilities;
 - Managing fatigue and sleep apnea; and
 - Ensuring sufficient engineering support for track and structures.
- Sixth, FTA recommends that WMATA and TOC work together to ensure that each corrective action plan (CAP) on the joint WMATA-TOC tracking matrix reflects an action plan with assigned responsibilities and milestones to track and close outstanding CAPs. The action plan at a minimum should clarify the status of each CAP remaining on the matrix, reduce redundancy across CAPs, identify the actions required to close each CAP and the milestone schedule, and propose a performance measure for WMATA's GM/CEO, Board and Executive Leadership Team to track CAP closure activity. WMATA should submit the revised tracking matrix to FTA for final review by Friday, February 15, 2013.



2.0 Introduction

2.1 Background

On March 4, 2010, Administrator Peter Rogoff delivered the results of the Federal Transit Administration (FTA) audit of the Tri-State Oversight Committee (TOC) and the Washington Metropolitan Area Transit Authority (WMATA). That report, which was requested by Senator Barbara Mikulski on behalf of the National Capital Delegation, highlighted key deficiencies in the safety and oversight programs at WMATA and TOC.

The 11 findings and 10 recommendations from FTA's 2010 audit were adopted by the National Transportation Safety Board (NTSB) in its Final Accident Investigation Report for the June 22, 2009 Fort Totten Collision, and a Congressional inquiry was held on the audit report to explore WMATA's safety and the need for enhanced oversight authority for FTA and TOC.

FTA's 2010 audit identified clear shortcomings in WMATA's internal communications, the agency's recognition of hazards and assessment of risk from those hazards, and WMATA's implementation of corrective actions to effectively resolve hazards. The audit also found that WMATA's Safety Department lacked the necessary resources and authority within the organizational structure of WMATA to adequately identify and address system safety issues and ensure the distribution of safety-critical information throughout the organization.

FTA's March 4, 2010 Final Audit Report recommended that WMATA fundamentally change its organization and culture. This report also created a blueprint for key activities that FTA believed WMATA should complete to strengthen its safety capabilities and performance.

Since the 2010 report was released, WMATA has taken many positive steps to make improvements and address FTA's findings. Based on this activity, FTA was able to close the last open items from the 2010 audit on January 11, 2012. On July 19, 2012, the NTSB also closed Safety Recommendation R-10-15 related to WMATA's implementation of FTA's audit findings.

2.2 Request from Senator Mikulski

On July 24, 2012, in response to a series of accidents and incidents that occurred at WMATA between the end of May and July 15, 2012, U.S. Senator Barbara Mikulski requested that FTA update its 2010 safety audit at WMATA "to determine the progress made fulfilling the initial recommendations and identify what gaps remain."

Senator Mikulski also directed FTA to review:

- Information on WMATA's system and equipment maintenance.



- WMATA's procedures for inspecting equipment and software.
- WMATA's frequency of inspections and maintenance.
- The process used by WMATA to report this information to the public.

Transportation Secretary LaHood directed FTA to conduct this audit as soon as feasible. FTA notified WMATA on August 2, 2012 and the audit was conducted on-site at WMATA's Metrorail system between August 20 and 24, 2012.

FTA continued to review and evaluate WMATA's document submissions and interview and field review results, and to request additional information from WMATA, through the months of September, October and November.

FTA's Audit Methodology is provided in Appendix A.



3.0 Major Findings

The following presents FTA's findings regarding progress made by WMATA in addressing FTA's March 4, 2010 Final Audit Report, as well as remaining gaps and the results of FTA's review of WMATA's maintenance and inspection procedures and frequencies.

Overall, FTA finds that WMATA has made considerable progress in strengthening its safety organization, safety analysis capabilities, and information sharing and communication processes regarding safety issues. FTA concludes that WMATA has effectively addressed FTA's audit findings from its March 4, 2010 Final Audit Report and improved its safety oversight relationship with the Tri-State Oversight Committee and the local jurisdictions. FTA also confirms that the WMATA Board of Directors has taken a more active role in monitoring WMATA's safety performance.

While substantial progress has been made, FTA identifies some remaining gaps in the implementation of WMATA's safety programs and procedures. FTA also identifies some needed improvements in the matrix used by WMATA and TOC to track corrective action plans (CAPs) developed to address findings from investigations, audits and reviews.

To address these gaps, FTA issues six (6) recommendations to WMATA. These recommendations are listed in "Section 5.0 Recommendations" of this report.

3.1 Safety Organization and Management

3.1.1 Progress since 2010

Appendix B identifies a comprehensive list of the changes made at WMATA since FTA's March 4, 2010 Final Audit Report to enhance safety organization and management. Key improvements at WMATA since 2010 include:

- The strengthening of the Safety Department in terms of authority, personnel resources, technical qualifications, and direct reporting relationship to the General Manager and Chief Executive Officer (GM/CEO),
- Conclusion of the long-overdue revision of WMATA's rulebook and the creation of a new program to protect workers on the right-of-way that draws heavily on the Federal Railroad Administration's 49 CFR Part 214, Railroad Workplace Safety and lessons learned from industry peers,
- The re-establishment and strengthening of WMATA's safety committee structure, including the Local Safety Committees at each WMATA facility, the Metrorail Departmental Safety Committee, and the Executive Safety Committee,
- The development of enhanced capabilities for accident investigation,
- The integration of the agency's operating and maintenance data into an enterprise information management system accessible by all WMATA departments and oversight agencies,



- The initiation of several major capital projects designed to address critical safety recommendations from the NTSB relating to WMATA's train control and signal system and the quality of the agency's wheel-rail interface, and
- The closing of 464 safety-related corrective action plans designed to address the findings from accident and hazard investigations, audits and reviews, some of which dated back to 2004.

FTA's audit team finds that safety is much better integrated into WMATA's critical decision-making processes, and substantial resources have been committed to improve safety and engineering performance throughout the agency. Over the last two years, WMATA has successfully completed multiple submissions to FTA, TOC and the NTSB to close dozens of critical findings related to safety organization and management.

3.1.2 Remaining Gaps

During interviews, the GM/CEO and Chief Safety Officer stated that, because of the challenging situation at WMATA when they took the helm in 2010, the agency was now focused on safety issues and concerns as never before. The GM/CEO stated that for his first six months as an interim General Manager, he worked almost exclusively on safety issues. WMATA's Board of Directors and local jurisdictions, the NTSB and FTA also worked to support enhanced safety at WMATA in unprecedented ways, providing technical resources, training, and financial support.

FTA agrees with the GM/CEO's assessment that WMATA's progress over the last two-and-a-half years is a critical but fragile foundation for the future. WMATA's continued progress will rely considerably on the team of executives, managers, supervisors, and front-line employees who have worked to bring about WMATA's progress to date. Any major changes in personnel, relaxation in attention to safety, reduction of resources devoted to safety, or reemergence of complacency in the reporting and investigation unusual occurrences and conditions, could easily reverse WMATA's recent gains.

WMATA's Board of Directors is working with WMATA's Executive Leadership Team to establish a strategic vision and business plan for the future. Moving forward, FTA expects that WMATA's Board will formalize its commitment safety and work to develop clear processes that ensure:

- Accountability for safety at all levels throughout the organization,
- Routine reporting on meaningful safety performance targets and indicators,
- Budgeting process for safety activities and safety priorities,
- On-going investment in employee training and evaluation, for both technical and safety topics areas, and
- Development and maintenance of qualified, in-house capabilities to perform on-going system safety and engineering analyses to evaluate and resolve identified problems and potential hazards.



FTA is not making recommendations to WMATA related to their Safety Organization and Management, but will continue to monitor progress to ensure a strong safety emphasis throughout all levels of the agency.

3.2 WMATA's Safety Performance

3.2.1 Progress since 2010

The graph below shows WMATA's safety performance in terms of fatalities and injuries reported to FTA's National Transit Database (NTD) between January 1, 2008 and August 31, 2012.

WMATA Fatalities, 2008 - current

Person Type	2008	2009	2010	2011	2012	Total
Passengers	0	8	0	0	0	8
Patrons	2	12	6	6	3	29
Public	0	0	2	1	2	5
Workers	0	3	2	0	0	5
Total	2	23	10	7	5	47

WMATA Injuries, 2008 - current

Person Type	2008	2009	2010	2011	2012	Total
Passengers	2	70	4	7	13	96
Patrons	3	2	19	48	33	105
Public	0	0	0	0	0	0
Workers	1	5	3	5	4	18
Total	6	77	26	60	50	219

WMATA Fatalities and Injuries, January 1, 2008 through August 31, 2012

The NTD tracks four (4) categories of people affected by accidents:

- **Passengers:** Individuals on-board a rail transit vehicle or boarding or alighting a rail transit vehicle.
- **Patrons:** Individuals waiting for or leaving rail transit at stations, in mezzanines, on stairs, escalators, or elevators, in parking lots and other transit-controlled property.
- **Workers:** Rail transit agency employees or contractors.
- **Public:** All others who come into contact with the rail transit system, including pedestrians, automobile drivers, and trespassers.



Since FTA's March 4, 2010 Final Audit Report was issued, there has been a 32-month period with no passenger or employee fatalities at WMATA.

Patron and public fatalities identified in the graph are largely the result of suicide attempts from WMATA platforms and trespassing on the WMATA right-of-way. Patron injuries are mainly the result of patrons jumping or falling into the trackbed, unsuccessful suicide attempts, assaults in stations, station evacuations due to bomb threats, and slips and falls on escalators.

In addition to the serious worker injury that occurred as a result of a collision with a train in WMATA's Shady Grove car wash on May 29, 2012, other worker injuries reported to NTD by WMATA typically resulted from evacuations in smoke and/or fire conditions, industrial accidents at worksites involving tools or electricity, and minor collisions in the rail yard.

FTA's audit team finds that WMATA's GM/CEO and Board of Directors are actively monitoring the types of events occurring on WMATA's Metrorail system. Monthly and quarterly reports are provided to WMATA's Executive Leadership Team and reviewed during Executive Safety Committee meetings, Board meetings, and other sessions.

Further, records from FTA's NTD reporting system matched the data maintained by both TOC and WMATA. FTA's NTD reporting system captures the most serious incidents to occur at rail transit agencies. Many of the incidents identified in Senator Mikulski's letter, and reviewed as part of this FTA audit, did not result in injuries or cause property damage sufficient to trigger NTD reporting thresholds.

3.2.2 Remaining Gaps

As indicated in the graph below, through August 31, 2012, WMATA has experienced 3 mainline derailments, a significant increase over earlier years.

WMATA Incident counts, 2008 - current

Incident Category	2008	2009	2010	2011	2012	Total
Collision	5	6	3	3	0	17
Rail Collision	5	6	2	3	0	16
Non-Transit Rail Collision	0	0	1	0	0	1
Derailment	1	1	1	1	3	7
Fire	3	0	4	1	0	8
Other	1	1	13	3	0	18
Flood	0	0	2	0	0	2
Other	1	1	11	3	0	16
Total	10	8	21	8	3	50

WMATA Incidents by Type, January 1, 2008 through August 31, 2012



FTA's review of one of these derailments, the July 6, 2012 event on Green Line, caused by buckling in the track from a heat kink, results in recommendations to WMATA regarding the need for additional engineering analysis on the condition of track in several key locations. FTA also will be continuing its involvement in the development of corrective action plans to mitigate the conditions that led to this derailment.

3.3 Accident and Incident Investigation

3.3.1 Progress since 2010

During FTA's 2010 audit, FTA found that due to lack of staff and on-going organizational changes, WMATA's Safety Department had not completed accident investigations as required by WMATA's System Safety Program Plan (SSPP), TOC's Program Standard and Procedures, and FTA's 49 CFR Part 659. FTA's audit found that WMATA had sixty-three open accident/incident investigations, dating from April 10, 2006 through October 6, 2009. Of these, probable causes had only been identified for six accidents, and the majority of the remaining fifty-seven accidents had yet to be investigated.

As requested by FTA, in 2010 and through 2011, WMATA worked with TOC to complete these sixty-three open accident investigations. WMATA also continued to investigate accidents and incidents that occurred on the Metrorail system, under extensions granted by TOC. The quality of WMATA's accident investigations has improved substantially, and, through August 2012, WMATA had closed and TOC had reviewed and approved over 120 accident investigation reports dating back to 2006.

By the end of calendar year 2012, WMATA expects to be fully caught up and require no further extensions or waivers from TOC. At that point, WMATA will have closed and TOC reviewed and approved over 140 accident investigation reports dating back to 2006.

FTA finds that WMATA's activity to complete outstanding accident investigation reports did not result in many corrective action plans beyond those implemented at the time of these accidents, or those required by the NTSB or TOC, however, WMATA's efforts did serve to train the WMATA operating and maintenance departments on the Safety Department's new accident investigation procedure, *Incident and Accident Investigation Policy P/I No. 10.4/0*, and the TOC and FTA requirements.

FTA also concludes that this process has established stronger working level relationships across the departments involved in accident investigation, including WMATA's Safety Department, the Offices of the Chief of Vehicle Engineering (CENV) and the Chief of Infrastructure Engineering (CENI), Rail Transportation (RTRA), and Metro Transit Police. Also, WMATA's Safety Department staff gained proficiency in the agency's operating and maintenance information management systems, including MAXIMO, OpTram, and Documentum.



3.3.2 Remaining Gaps

FTA reviewed the information, reports, and assessments conducted to date regarding nine (9) accidents/incidents identified by Senator Mikulski in her letter of July 24, 2012. These accidents and incidents, which remain under investigation, include:

- July 14-15, 2012 Rail Operations Control Center (ROCC) computer network outage.
- The July 6, 2012 Green Line train derailment attributed to “heat kink.”
- The July 3, 2012 self-evacuation of passengers from a stalled train near College Park Station.
- Four (4) instances of the loss of friction rings (brake discs) from Metro trains from December 2011 through June 2012.
- The May 29th striking of a WMATA employee by a train in the car wash at Shady Grove Yard.
- Doors opening off-platform (both confirmed and unconfirmed instances from May 2012).

FTA conducted this review with the Chief Safety Officer and safety department staff, along with WMATA’s engineering, operations and maintenance personnel, in accordance with the WMATA’s *Incident and Accident Investigation Policy P/I No. 10.4/0*.

FTA’s review of the nine accidents identified by Senator Mikulski shows that WMATA’s engineering and maintenance departments were not sufficiently prepared in planning for and reacting to the extreme heat and weather conditions of the spring and summer months.

FTA finds that extended weeks of above-average heat, lightning strikes and electrical storms, power outages, and flash flooding created vulnerabilities to malfunctions in system components that should have been identified and addressed more aggressively by WMATA personnel before they resulted in accidents and incidents affecting passengers and employees. Examples of WMATA actions that could have supported better management of adverse weather conditions include:

- Enhanced temperature and condition monitoring and speed restrictions as required in WMATA’s continuous welded rail (CWR) maintenance plan to attempt to detect and/or prevent the buckling or “heat kink” in the track that led to the July 6, 2012 derailment on the Green Line;
- Initial detection of the loss of feeders from utilities providers to the traction power system and failed remote terminal units (RTUs) damaged by lightning that caused the July 3, 2012 train evacuation incident near College Park Station,
- Initial detection of the failed network modules resulting from extended power outages and rolling brown-outs that froze the display screens at WMATA’s Rail Operations Control Center on July 14 and 15, and



- Identification of damaged vehicle coupler pins resulting from heavy-duty coupling cycles that contributed to Red Line door openings on a moving train.

In “Section 5.0 Recommendations” FTA issues recommendations to WMATA to enhance the identification and management of potential maintenance issues and hazards arising from changing operating conditions. Infrastructure condition assessment plans, track speed restrictions, temperature monitoring, and additional inspections and network testing are examples of the types of measures that WMATA could have taken to prevent these accidents, and did take, after the accidents occurred, to prevent recurrence.

Additional information on FTA’s assessment regarding these accident investigations is located in Appendix C.

FTA also finds that WMATA, for the first time in its 30-plus year history, has employees with a range of experience in operating and maintaining its system and equipment. Over the last 18 months, hundreds of veteran employees have retired and been replaced with new engineers, maintenance personnel and supervisors, as well as train operators and supervisors. WMATA is also staffing up for the Silver Line to Tysons Corner and Dulles Airport. Throughout the audit, WMATA acknowledged that, with so many new employees on the system, unusual occurrences and unexpected failures in system components were not always handled as well as they should have been, particularly when communicating with passengers and the public.

Interviews revealed that it can take a new employee 2 to 5 years to fully master all elements of WMATA’s complex operating and maintenance environment. After 3 months or more of initial training, new employees are given assignments commensurate with their skill levels, evaluated in an on-going manner by their supervisors, and partnered with more senior employees when possible. Additional on-the-job training and formal training is also provided to enhance skills and promote workforce development.

Over the last two years, TOC, WMATA’s Office of the Inspector General, the NTSB, and WMATA’s internal safety audit process have all issued findings to WMATA’s operating and maintenance departments regarding the need for more training, supervision, formal training programs, and written policies and procedures to support the professional development of the new employees and supervisors on the system. Collectively, these findings have resulted in over 30 corrective action plans being implemented by WMATA’s operating and maintenance departments to enhance the documentation of work practices and procedures, the quality of training, the level of evaluation of employees and supervisors, and the method of communicating updates, revisions and special orders to employees.

FTA’s audit carefully reviewed WMATA’s approach to addressing these workforce development challenges. FTA finds that WMATA is taking satisfactory action to implement the corrective action plans and that most items are scheduled to be completed by mid-2013. Based on the activity being undertaken to implement these corrective action plans, FTA issues no recommendations in this area at this time, but will continue



to monitor WMATA's activity, and reserves the right to issue recommendations in this area at a future time.

3.4 Hazard Management Program

3.4.1 Progress since 2010

In late 2009/early 2010, FTA found that WMATA was not implementing the hazard management program required by TOC's Program Standard and Procedures, and by WMATA's own System Safety Program Plan. At that time, WMATA did not have a process, including a single point of responsibility, which ensured the timely identification and evaluation of safety hazards. FTA could find little evidence that safety analyses were being performed to prioritize hazards for elimination and mitigation. FTA was also concerned that the Safety Department did not have adequate technical capability and capacity to conduct thorough hazard analyses on an on-going basis.

During the audit in late 2009/early 2010, FTA found clear evidence that WMATA's Safety Department was not "plugged-in" to critical conversations, decision-making meetings, and reporting systems that provide information on hazards and potential safety concerns throughout the agency. Key documents, reports and decisions were not consistently shared with the Safety Department.

In August 2012, FTA finds that considerable progress has been made in WMATA's sharing of critical operating and maintenance information. WMATA's Safety Department is now leading the implementation of the WMATA Hazard Management Program through *WMATA Safety Procedure No. 2.5/0, Hazard Management Program*. The program includes:

- Developing, updating and auditing implementation of the agency's hazard management program.
- Training all designated WMATA employees and its contractors on the hazard management process.
- Documenting and tracking all identified hazards to resolution.
- Reporting on results to the Executive Leadership Team, TOC, and other external oversight agencies as appropriate.

WMATA's Safety Department now routinely accesses WMATA's enterprise information technology systems used for maintenance and work planning. WMATA's Safety Department also accesses systems used by Rail Transportation and Rail Service Delivery Quality to monitor rules compliance checks, special rule enforcement blitzes and the results of unannounced observations and inspections. WMATA's Safety Department staff uses these information technology systems to support accident investigations; to run available algorithms and reports to review performance of particular components and the performance of maintenance inspections; to monitor evaluation of the implementation of safety-critical rules by operations and maintenance personnel; and to track specific issues, hazards and concerns.



Over the last few years, in part to address NTSB, TOC and FTA recommendations, WMATA has made the commitment to use IBM's strategic asset management information system MAXIMO to manage the inspection, maintenance, replacement and repair of all of its critical systems, including track, structures, vehicles, elevators and escalators, and now signal and train control, as well as bus stops and vehicles. WMATA also uses Bentley's OpTram, which plugs into MAXIMO, to integrate rail system data sources with a linear model of the track network to continuously generate a prioritized work plan. The prioritized work plan is linked to MAXIMO where staff, materials, and equipment are managed.

WMATA's Safety Department staff and contractors have received extensive training on using MAXIMO and are learning how to use OpTram. TOC members and contractors, too, have received training on MAXIMO. WMATA's Safety Department also has on-line access to all reports generated by Rail Transportation and Rail Service Delivery Quality. FTA's audit team also determines that WMATA's Safety Department has renewed its involvement in the engineering modification process used at WMATA as well, so WMATA's Safety Department staff routinely accesses WMATA's Documentum system, and formally reviews and signs off on all engineering modification instructions (EMIs).

To further refine the utility of WMATA's enterprise information management systems for the identification and management of safety issues, hazards and concerns, WMATA's Safety Department has established a safety measurement system (SMS) to automate access to critical WMATA information management systems and the Rail Operations Control Center (ROCC). The SMS web-based tool has been developed in modules that are tested on WMATA's internal platforms and with the agency's information technology systems prior to release. The SMS functions as an umbrella system that pulls together and consolidates information from various data systems within WMATA. For most of the last year, the hazard management module of the SMS has been under development. WMATA's Safety Department and WMATA's Information Technology Department provided FTA with a demonstration of this module that should be active by the end of September.

3.4.2 Remaining Gaps

An aggressive hazard management program, such as FTA recommends for WMATA, actively reviews maintenance information and identifies and mitigates potential failures before they result in accidents.

In past audits, FTA has raised concerns regarding WMATA's ability to respond to unusual occurrences and to identify how these occurrences can impact the safe operation of the Metrorail system. For example, during FTA's 2007 and 2010 audits, FTA discussed how changing conditions resulting from increasing train traffic and maintenance work performed during revenue service hours also changed conditions for track workers and signal technicians on the rail transit right-of-way, lowering the



effectiveness of WMATA's on-track safety procedures. WMATA did not fully address these hazards until 2010.

To support WMATA's continued progress in strengthening its safety program, FTA now makes recommendations to WMATA designed to guarantee that hazards experienced as result of the accidents that occurred over the spring and summer months are appropriately identified, assessed, monitored and mitigation. Further, FTA requests additional demonstration and validation regarding the effectiveness of the SMS developed by WMATA's Safety Department to support the evaluation of operating and maintenance data for the identification of hazards.

3.5 WMATA's Internal Safety Audit Program

3.5.1 Progress since 2010

During FTA's late 2009/early 2010 audit, FTA found that, while WMATA had begun its new internal safety audit cycle by submitting an audit schedule and audit checklists to TOC, the agency was not meeting the approved schedule and failed to perform the audits in an on-going manner as required by TOC Program Standards and Procedures and 49 CFR Part 659.

Over the five years prior to FTA's late 2009/early 2010 audit, TOC and FTA made repeated findings regarding the inability of WMATA's Safety Department to work with other WMATA departments to develop and manage an effective internal audit program. In interviews, WMATA personnel explained that they did not have the resources or training to conduct internal safety audits.

As part of this audit, FTA finds that this situation has improved. Initially relying on its technical engineering and services contractor, and now transitioning to WMATA's Safety Department's Corporate Quality Assurance Group, the WMATA's Safety Department overhauled its internal safety audit program. WMATA has conducted a thorough and on-going program since October 2010:

- To conduct internal audits, WMATA now follows the process specified in *Safety Rules and Procedures No. 2.3/2; Internal Safety and Security Audit Procedure*.
- Instead of auditing by SSPP element, WMATA's Safety Department and its contractors audit by department – reviewing all 21 SSPP elements, as applicable, for each WMATA department. This process, combined with the new checklists and enhanced verification processes, has greatly increased the effectiveness of the audit approach and reduced audit burden for key WMATA operating and maintenance departments.
- Since October 2010, 11 WMATA departments out of 15 have been audited, and the process is on track to be completed as scheduled in September 2013.



- To date, findings from WMATA's internal audits have given rise to 30 percent of all new corrective action plans generated for the agency. For example, 71 corrective action plans were required from internal audits conducted in 2012.
- This level of findings requiring action is in keeping with FTA recommendations. FTA's review of WMATA's internal safety audit reports and corrective action plans demonstrates an active internal oversight function

Many of WMATA's Safety Department's findings focus on the need to require additional procedures and formal training, evaluate programs for supervisors, and ensure better tracking for training certifications and re-certifications. WMATA's Safety Department is also working to ensure that on-the-job training is documented and evaluated for consistency and quality, and that follow-on training is being provided as required. Configuration management and the development, storage, revisioning and updating of critical documents, plans, drawings, and manuals are being conducted. Implementation of the Documentum software is enabling this effort.

3.5.2 Remaining Gaps

Based on interviews and record reviews, it appears that WMATA's GM/CEO, the WMATA Board, TOC, and TOC's Executive Committee have shown strong support for WMATA's Safety Department in moving the agency in this direction. WMATA's Safety Department also has established an outreach process with audited departments to provide technical assistance in working with them to track and address internal audit findings.

While FTA issues no recommendations in this area, FTA will continue to monitor how WMATA's operating and maintenance departments comply with corrective actions developed to address these internal audit findings.

3.6 Corrective Action Tracking Program

3.6.1 Progress since 2010

FTA reviewed WMATA's progress to implement corrective action plans (CAPs) developed to address findings from accidents, incidents, hazards, audits, TOC, FTA, NTSB and other agencies.

- Since 2010, WMATA has closed 464 CAPs, dating back to 2004.
- At this time, WMATA had 86 open CAPs (mostly from TOC and NTSB) with another 71 to be added as a result of findings from internal safety audits conducted in 2012.

Appendix B provides greater detail on WMATA's activities to address and resolve CAPs since FTA's 2010 audit.



3.6.1 Remaining Gaps

FTA finds that the WMATA CAP Matrix is difficult to use and maintain. WMATA has made progress in closing CAPs, and improving responsiveness to external oversight agencies and WMATA's Safety Department. However, some of the remaining items require multi-year capital, training and development projects. For these long-term projects, the current CAP Matrix does not specify the exact status of each individual activity required to complete the overall CAP, nor does it provide the sequence of deliverables and milestones required for the CAP to be closed.

Also, aside from identifying whether a CAP is open or closed, and its hazard rating, it is difficult to obtain any other at-a-glance information regarding the CAP. FTA also identified a few errors in CAP tracking, as well as evidence of non-decision and confusion regarding CAP acceptance and CAP closure.

FTA issues one recommendation to WMATA to improve the utility of this tracking tool with enhanced status reporting to the GM/CEO, TOC, and FTA.



4.0 Additional Findings and Observations

FTA's audit team also made the following findings and observations:

- WMATA's Department of Transit Infrastructure and Engineering Services (TIES) is responsible for maintenance of WMATA's 106 miles of track, 86 stations, 1,118 rail cars, 588 station escalators and 239 station elevators. TIES also manages WMATA's Capital Improvement Program (CIP).
 - TIES develops and oversees the maintenance staffing and programs implemented by Track and Structures (TRST); Systems Maintenance (SMNT), including the Automatic Train Control (ATC) branch, the Power (POWR) branch and the Storerooms and Material Logistics Shop (SAMS); Car Maintenance (CMNT); Elevator and Escalator Maintenance (ELES); as well as supporting information and procedures from Chief Engineer Infrastructure (CENI) and Chief Engineer Vehicles (CENV). FTA's audit team had the opportunity to review the staffing and implementation of maintenance procedures and programs with WMATA maintenance employees in the field.
- In reviewing WMATA's maintenance and inspection programs, FTA finds that WMATA adopts voluntary industry standards and practices, such as those developed by the American Public Transportation Association (APTA) and the American Railway Engineering and Maintenance-of-Way Association (AREMA). Interviews, field observations and records reviews confirmed that WMATA maintenance and engineering departments generally implement and follow these voluntary, consensus standards. This finding, however, should not be construed as support for, or an endorsement of, these standards and practices. Rather, FTA's audit finds that in the absence of regulated safety standards, WMATA has adopted and generally follows available industry standards.
- In Fiscal Year 2013, TIES was authorized for 4,731 employees; however, vacancies vary by TIES departments, with most departments averaging 10 percent to 12 percent vacancy rates.
- In response to NTSB, TOC, FTA and WMATA Office of Inspector General findings and concerns, TIES and its supporting branches have made many changes in WMATA's maintenance program, including reorganizing engineering and maintenance groups to enhance coordination with operational teams; revising maintenance and inspection procedures; developing new/enhanced training; purchasing new inspection and maintenance equipment; upgrading tool calibration programs; and automating the collection and analysis of maintenance information into WMATA's MAXIMO system.



- Spot checks of records and WMATA's maintenance information system (MAXIMO and OpTram) and independent inspections of track, signal, vehicle, and escalator system components conducted by FTA's audit demonstrated that scheduled maintenance inspections appear to be occurring, with defects identified, prioritized for repair, and work orders completed generally as required.
- WMATA is in the process of closing out the last three (3) open recommendations from a report issued by the WMATA Office of Inspector General regarding the need to enhance controls used to track work orders in the MAXIMO system.

4.1 Track and Structures (TRST) Maintenance

- TRST develops issues, maintains and complies with the Track Standards Manual to ensure safe and reliable track for passenger service through consistent and effective track maintenance practices. Maintenance of Structures adheres to OAP 208-02, *Structures Maintenance Management, and Maintenance of Way*. TRST has recently revised the track maintenance and inspection manual (dated 8/4/2012). Through review of the manuals and procedures, FTA's audit team noted that:
 - The walking track inspections are carried out two times each week with an interval of at least one calendar day by qualified track personnel.
 - All major elements of the track are to be visually inspected, and exceptions recorded on the Track Inspection Form.
 - The rail flaw inspection program provides a continuous ultrasonic rail flaw detection of all mainline track at a minimum of once per year.
 - All broken rails are reported using the Report of Rail Failure form. Replacement of defective rail is completed within 48 hours.
 - Rail wear is measured and recorded on all mainline track and turnouts with a profilometer annually or by geometry inspection vehicles.
 - Mainline track switches are inspected monthly.
 - A detailed walking inspection of super elevation and gauge on all curves and spirals is made at least every 4 months.
- The track inspections are categorized as "limit states" by four distinct conditions, including:
 - **Green** – Minimum wear of the track segment or component, but needs to be addressed to prevent additional wear.
 - **Yellow** – Damage or wear of track segment or component within allowed tolerances. Trains may continue to operate normally, however the issue is prioritized.
 - **Red** – Restricted operations as a result of track segment or component exceeding allowed tolerances. Immediate actions are required and train speed restrictions are often implemented.
 - **Black** – Safety hazard condition that must be addressed immediately. Often, the track segment or component is removed from service until repaired.



- In addition to recently reviewing and revising track and structure inspection procedures, the TRST provided its employees with track inspection training and issued track inspection pocket guides. FTA also supported TRST in additional track inspection training.
- TRST maintenance uses the MAXIMO database to log and report Preventive Maintenance Inspections (PMIs), corrective work orders, incidents and defects using the limit conditions (black, red, yellow and green criteria). The audit team randomly reviewed TRST MAXIMO records to confirm:
 - Track walker twice-weekly maintenance reports for K-Line were routinely conducted and records were reviewed for a two-month period.
 - Track walker weekly maintenance reports for E-Line were routinely conducted and records were reviewed for a two-month period.
 - Major track defects (red condition) were reported and measures were implemented for safe operations.
 - TRST managers receive and discuss daily incident reports.
- The audit team accompanied the TRST staff to conduct an on-site inspection of approximately one-half mile of the E-line. As part of the inspection, the audit team reviewed the July 6, 2012 heat kink incident location, tunnel track conditions, recent continuous welded rails (CWR) installation and a recently installed guarded number 8 turnout. The audit team also toured the Greenbelt yard and observed the recently purchased track geometry car, which is capable of ultrasonic testing and is equipped with infrared cameras used to detect hot spots to proactively prevent hot third rail components.
- The audit team also inspected other recently purchased maintenance-of-way equipment including a 360°-material handler, rail lifter, and 4x4 tamper. The audit team noted that hi-rail vehicles have been upgraded to exceed FRA 49 CFR Part 214 standards for high-intensity lighting and cameras for restricted views.

4.2 Systems Maintenance (SMNT)

- Each branch within SMNT, including Automatic Train Control (ATC), Power (POWR), Communication (COMM) and the Shops and Material Support Branch (SAMS), is responsible for maintaining its inspection and maintenance procedures and manuals. As part of the pre-audit material submission, WMATA provided over 100 SMNT documents. Notable documents and procedures reviewed by the audit team include:
 - Procedures for ATC, POWR COMM and SAMS;



- Preventative maintenance inspection checklists;
 - Sample inspection and corrective action workorders;
 - Sample inspection data sheets and calibration summaries;
 - Weekly activity reports summarizing inspection and corrective activities;
 - Corrective maintenance process summaries; and
 - Various train control policies, memos and white papers.
- SMNT Preventive Maintenance Inspections (PMIs) are performed in accordance with manufacturer requirements and/or pre-determined standards. In general, checklists are used when performing the PMIs. Quality Assurance conducts periodic maintenance audits of facilities and equipment, utilizing checklists, in accordance with the WMATA Quality Assurance and Procedures Manual. PMI schedules and the resultant data are maintained and tracked in the MAXIMO database for all facilities and equipment.
- During on-site reviews, the audit team was informed that the ATC procedures have been significantly revised to allow for consolidation and integration into MAXIMO. The SMNT department has completed its revision and approval for ATC 1000-series procedures, which include procedures supporting PMIs, corrective maintenance, testing and manufacture manuals. SMNT is undergoing revision of the ATC 2000 and 3000-series procedures which support system modifications and non-safety critical processes such as labeling.
- Each SMNT branch, including the Automatic Train Control (ATC) branch, the Power (POWR) branch, and the Storerooms and Material Logistics Shop (SAMS) is responsible for recording relative maintenance data within the MAXIMO database. The MAXIMO database stores SMNT related PMIs, incidents, corrective maintenance activities and work orders. FTA's audit team randomly reviewed ATC maintenance records stored within MAXIMO to confirm:
 - ATC PMI monthly maintenance activities were routinely conducted and records were reviewed for a one-year period.
 - ATC corrective work orders were addressed and closed for 98 percent of assigned work orders for the month of July 2012.
 - On average, over 1,000 ATC corrective maintenance work orders and 5,000 preventative maintenance work orders were generated each month during CY2012.
 - Track circuit testing was routinely monitored twice each day to determine loss of shunt.
 - Incidents involving loss of shunt that were not immediately resolved were reported to WMATA's Safety Department and documented within the daily incident report for various August 2012 occurrences.



- The daily incident reports were emailed to SMNT managers and the audit team was informed that WMATA personnel routinely discuss the SMNT incidents during morning meetings.
- In addition to performing routine inspections and maintenance during revenue operations, SMNT also coordinates with TRST to schedule and conduct alignment shutdowns and single tracking operations to support involved maintenance activities such as interlock replacement and CWR installation. The shutdowns allow for the safe and effective resolution of numerous maintenance activities.
- SMNT provided the audit team with a sample shutdown activity list scheduled for August 25-26, 2012 that documented hundreds of ATC and POWR maintenance activities.
- The audit team also reviewed the implementation of the procedures during the on-site field reviews. During the ATC lab tour, SMNT personnel provided a demonstration of the ferrite choke cable component used to mitigate parasitic oscillation, a closed NTSB recommendation. SMNT provided a tour of the POWR training center supporting Traction Power Substation (TPSS) training. The SMNT provided a demonstration of common inspection methods of various TPSS. The audit team noted that utilizing spare, non-energized TPSS to support training is an effective practice.
- FTA's audit team also inspected the train control room for the Alexandria and Telegraph Road yards. SMNT explained the operation and inspection for vital relays and control room function. Finally, SMNT provided a tour of the SAMS department.
- During the inspection, the audit team reviewed SAMS work orders and noted that over 12,000 work orders were addressed during the last year. The audit team expressed concerns regarding the overcrowded work site conditions and limited resources, including technicians and supervisors, available to support SAMS. During on-site interviews, the audit team was informed that SAMS has not seen a significant resource increase in several years, even though the system demand and responsibilities have increased. FTA is asking WMATA's Safety Department to review this situation for inclusion in the hazard management program.

4.3 Car Maintenance (CMNT)

- The Metrorail Safety Rules and Procedures Handbook, the manufacturer's technical manuals and CMNT daily inspection procedures provide guidance for assuring that vehicles are safe for use in revenue service. CMNT Preventive



Maintenance Inspections (PMIs) are performed in accordance with manufacturer requirements and modified to accommodate WMATA's unique operating environment, which includes duty cycles beyond those normally expected for this type of equipment.

- CMNT is currently in the process of changing its current time-based maintenance interval program with a mileage-based system. As of an August 6, 2012 status update, WMATA was in process of developing a formal engineering test plan, completing procurement for on-board equipment, conducting critical and final design review, and beginning the necessary testing for the inspection intervals.
- Daily Safety Tests (DST) are performed by CMNT technicians on each rail car. Any identified deficiencies are corrected prior to the car being released for revenue service. Vehicle preventive maintenance inspections are made by CMNT in accordance with the following:
 - Periodic preventative maintenance inspections in accordance with manufacturers' recommendations and WMATA operating experience;
 - Periodic inspections specified by CENV and QAAW to ensure that all components/ services meet or exceed manufacturers' recommendations;
 - Walk-around inspection checklist; and
 - Visual inspection by operator.
- For CMNT, each maintenance facility is responsible for maintaining its maintenance and inspection procedures and manuals. As part of the pre-audit material submission, WMATA provided over 50 CMNT documents. Notable documents and procedures reviewed by FTA's audit team include:
 - Inspection Procedures for the 1K, 2-3K, 4K, 5K and 6K series railcars.
 - Daily Safety Test (DST) Manual and Sample Logs from each maintenance facility.
 - Engineering Request SOP and sample form used to request engineering services.
 - Draft Railcar Software Configuration SOP with a sample matrix for 2K-3K and 5K series railcars.
 - Periodic Inspection Task List for I, A, B, and C inspections for all series railcars.
 - Calibration, Inspection and Maintenance of Precision Measuring Devices and Tools for Rail Transit Vehicles and Rolling Stock.



- Railcar Maintenance Staffing Levels from 2009 to present include authorized staffing for 1,061 with a vacancy rate of 8 percent.
- In general, checklists are used when performing the Preventive Maintenance Inspections (PMIs). Quality Assurance conducts periodic maintenance audits of railcars, shops, and railcar equipment, utilizing checklists, in accordance with the WMATA Quality Assurance and Procedures Manual. PMI schedules and the resultant data are maintained and tracked in the MAXIMO database for all railcars, shops, and shop equipment.
- Through review of the procedures and safety plans, the audit team noted that:
 - CMNT uses a robust change management process for railcar modifications that were identified through accident investigation and normal periodic inspection intervals.
 - Railcar incoming parts, materials, chemicals, and components undergo an incoming inspection by WMATA's Quality and Warranty Assurance Department.
 - CMNT uses a comprehensive Daily Safety Inspection (DSI) process to ensure that safety critical elements of each train are inspected and tested prior to revenue service.
 - CMNT tracks preventive and corrective maintenance items in MAXIMO. MAXIMO is also used to track vehicle engineering modifications, to perform trend analysis, and to maintain maintenance procedures and service bulletins.
 - CMNT is supported by a vehicle engineering consultant and independent metallurgical/chemical laboratories to assist with failure analysis from incidents/accidents and to ensure vehicle modifications do not introduce additional safety concerns.
 - CMNT, with engineering support, is developing a more comprehensive component serialization process to better control preventive maintenance requirements, warranties, and trending issues.
- During on-site reviews, FTA's audit team discussed CMNT corrective actions related to the January 6, 2012 and June 28, 2012 incidents involving a friction rings falling off revenue trains. CMNT, in coordination with engineering, conducted an investigation that resulted in friction ring design changes and development of maintenance procedures to address investigation findings. The audit team also reviewed design changes surrounding the safety wire changes securing brake discs. WMATA's engineering change/modification procedure was being implemented as intended and investigations were conducted to determine



the incidents root cause. Based on these actions, WMATA engineering and CMNT staff believe that future issues with the friction rings are unlikely.

4.4 Elevator and Escalator Maintenance (ELES)

- The ELES branch performs preventative maintenance and periodic inspections and audits in accordance with established procedures based on ASTM A17.1.
- ELES faces many challenges in keeping WMATA's 588 station escalators and 239 station elevators in working condition. As part of the multi-billion dollar System Infrastructure Rehabilitation Program (SIRP), WMATA is replacing over 100 escalators entirely and is completing extensive rehabilitation work on over 200 other escalators.
- The audit team randomly reviewed ELES maintenance records stored within MAXIMO to confirm:
 - The inspection schedule was developed by the ELES supervisor and routinely submitted to ELES Staff;
 - When possible, the inspector was sent to conduct re-inspections of repaired equipment when applicable;
 - System wide escalator and elevator availability was approximately 89% for the previous six months;
 - Website is linked to MAXIMO and information for unit and station outages were updated real time;
 - PMI's were routinely conducted for previous two-years of randomly sampled stations (L'Enfant and Wheaton stations);
 - Corrective work orders were generated for PMI resulting in deficiencies;
- In the event of an incident, the ELES branch utilizes its internal accident investigation procedures that can require supervisors to coordinate with an accident investigation subcommittee in developing the investigation report. Upon review of the procedures, the audit team noted notification inconsistencies with the Tri-State Oversight Committee program standard and WMATA's SSPP.
- The ELES apprenticeship program is a four-year training period with classroom/lab training as well as on-the-job experience to prepare apprentices for journeyman level positions.
 - The audit team toured the training lab and was provided a demonstration of the training escalator, elevators and major components. The audit team was informed by ELES employees that the training lab and course is effective in preparing the mechanics for field repairs. However, the training program did not routinely provide refresher courses to train existing employees on updated procedures or equipment. Additionally, as the mechanics training process is four-years, the audit team was also



informed that ELES branch faces resources challenges and must contract certain unit services.

- The ELES maintenance branch also oversees a rehabilitation / replacement program responsible for the modernization of 36 elevators and over 250 escalators in the next four-years. The rehabilitation / replacement program scheduled work for 48 escalators and 14 elevators in CY2012. The ELES branch does have an acceptance program for the rehabbed / replaced units under the capital program, however the audit team was informed during on-site interviews that mechanics involved in the maintenance of the units are not yet involved in the acceptance process. ELES should consider including acceptance inspections by internal mechanics to ensure units meet the criteria and are safe.
- The ELES supervisor is responsible for storing and ensuring all inspections are properly documented and entered into the MAXIMO database.
- ELES Preventive Maintenance Inspections (PMIs) are performed in accordance with authorities having jurisdiction and manufacturer.
- ELES utilizes procedures and checklists signed by the mechanic when conducting the PMIs. The supervisor is also responsible for reviewing and signing the PMI checklist. ELES coordinates with Quality Assurance to perform periodic maintenance audits of facilities, equipment and documentation. Through review of the procedures and safety plans, FTA's audit team noted that:
 - PMI schedules and the resultant data are maintained and tracked in the MAXIMO database for all facilities and equipment.
 - Jurisdictional (legally required) annual inspections are performed during the day and night.
 - Using MAXIMO, the inspectors review their scheduled units as well as unit outages to determine inspection locations.
 - All preventive maintenance is performed at night; thus, most journeymen are assigned to the night shift.
 - Every elevator and escalator unit is scheduled for a monthly and an annual PM service.
 - A detailed test and inspection for elevators is conducted in five-year increments.
 - Scheduled repairs generally result from PMIs and are not safety critical
 - Automatic shutdowns result from comb impacts, handrail issues, etc.
 - Safety critical work orders require shutdowns until repairs are made.
 - Falling under various jurisdictions, FTA's audit team also verified that ELES branch generally applies the more conservative inspection standards and routinely reviews performance measures to ensure procedures are consistently applied.



- ELES is working to ensure that all new escalators will be Transit Grade in accordance with APTA Standards and have no glass panels, making them easier maintain and more vandal proof.
- WMATA has made a commitment that all new escalators will be Transit Grade in accordance with APTA Standards and have no glass panels, making them easier to maintain and more vandal proof.

4.5 Customer Service and Communications

- FTA's audit team also reviewed the WMATA processes that support communicating safety and security information to the public and internal communications with their employees. The audit team conducted on-site reviews for WMATA's primary branches responsible for customer relations including the Office of Customer Service, Communications and Marketing (CSCM), the Rail Customer Service Units located at the New Carrollton Division, and the Rail Operations Control Center (ROCC).
 - FTA finds WMATA's CSMC team is working to provide more timely information to the public regarding the impacts of system maintenance:
 - An incident communications protocol has been developed to support the collection and dissemination of timely and accurate information.
 - Website and email with information is often provided within seconds-to-minutes of incidents, delays and service changes.
 - WMATA has enhanced its social media monitoring to be aware of events and their impact on riders.
 - WMATA is also providing customer service training for Train Operators and Station Managers and installing computer displays in the Station Manager kiosks to provide alerts and updated information.
 - FTA will continue to monitor the implementation of these activities to improve customer communication and outreach.



5.0 Recommendations

To address FTA's findings from this audit, FTA issues the following recommendations to WMATA explicit for our review:

- Recommendation #1: Complete final investigation reports for all nine (9) accidents and incidents reviewed as part of this audit, and submit them to FTA for final review by Thursday, January 31, 2013. To date, WMATA has submitted six (6) investigation reports and all supporting attachments and analyses to FTA and the TOC. As of November 19, 2012, TOC has formally approved two (2) of the six (6) reports for closure. FTA continues to coordinate with TOC and WMATA regarding final dispositions and approvals for the remaining four (4) reports. If necessary, based on FTA's assessment, FTA will schedule a meeting with WMATA and TOC to further review conclusions and corrective actions developed to prevent recurrence of these accidents.
- Recommendation #2: WMATA's Safety Department, through WMATA's hazard management program, should conduct an assessment regarding the July 6, 2012 "heat kink" derailment. This assessment should determine if an independent review is required regarding WMATA's current rail de-stressing process. Submit completed analysis to FTA for final review by Friday, February 15, 2013.
- Recommendation #3: WMATA should also conduct a formal hazard assessment to determine if additional measures are needed to protect workers in WMATA's vehicle maintenance facilities and rail yards. Submit completed analysis to FTA for final review by Friday, February 15, 2013.
- Recommendation #4: Additional safety analysis should be performed regarding the ways in which railcar doors can open off-platform to ensure that further risks of unintentional door openings have been eliminated. This assessment should be submitted to FTA when completed. WMATA should provide FTA with a due date for receipt of this analysis.
- Recommendation #5: Within 90 days from the issuance of this final report, WMATA should schedule with FTA a demonstration of WMATA's new Safety Management System (SMS), including the analysis performed by WMATA's Safety Department regarding the agency's most significant safety challenges and the steps being taken to address them. FTA anticipates key issues discussed would include:
 - Employee and supervisor recruitment, training, and evaluation;
 - Safety challenges of vacancies and resource limitations in certain maintenance departments, including SAMS;
 - Enhancing the roadway worker protection program to address rail yards and maintenance facilities;



- Managing fatigue and sleep apnea; and
 - Ensuring sufficient engineering support for track and structures.
- Recommendation #6: FTA recommends that WMATA and TOC work together to ensure that each corrective action plan (CAP) on the joint WMATA-TOC tracking matrix reflects an action plan with assigned responsibilities and milestones to track and close outstanding CAPs. The action plan at a minimum should clarify the status of each CAP remaining on the matrix, reduce redundancy across CAPs, identify the actions required to close each CAP and the milestone schedule, and propose a performance measure for WMATA's GM/CEO, Board and Executive Leadership Team to track CAP closure activity. WMATA should submit the revised tracking matrix to FTA for final review by Friday, February 15, 2013.



6.0 Appendix A: Scope and Methodology

FTA notified WMATA regarding this audit on August 2, 2012. FTA also invited TOC to participate in the audit as an observer.

Through August 17, FTA worked with WMATA to finalize the audit schedule and to collect audit materials for review. FTA conducted the on-site audit between August 20 and 24, 2012. FTA held an Exit Briefing with WMATA's Executive Leadership Team on August 24, 2012.

To conduct this audit, prior to arriving on-site at WMATA, FTA's audit team requested and reviewed documentation used by WMATA to direct, manage, implement and monitor its safety and maintenance programs.

While on-site, the audit team interviewed WMATA staff responsible for implementing safety program requirements as well as front-line staff, including train operators and supervisors, maintenance personnel, technicians and supervisors, and managers and WMATA's Executive Leadership Team. The audit team also coordinated with the Tri-State Oversight Committee to ensure their participation in this audit.

Prior to arriving on-site, the audit team coordinated with WMATA to assemble hundreds of pre-audit documents used to support the on-site activities and develop a structured audit guide for the audit team to discuss. During the five (5) day on-site review, the audit team interviewed, toured, inspected and performed record reviews focused on seven (7) areas of WMATA rail system including:

- **Safety Program Implementation:** Review of WMATA's safety organization and programs, including safety leadership, safety assurance, safety communication and hazard management, accident investigation, roadway worker protection, and system-wide coordination and outreach regarding the resolution of safety issues.
- **Track Maintenance:** Review of maintenance procedures and inspections performed by the Office of Track and Structures (TRST), including the WMATA Track Standards Manual and WMATA's Operations Administrative Procedure (OAP) 208-02, Structures Maintenance Management, Maintenance of Way.
- **Systems Maintenance:** Review of maintenance procedures and inspections performed by the Office of Systems Maintenance (SMNT), including the Power Branch (POWR), Automatic Train Control Branch (ATC), the Communications Branch (COMM), and the Shops and Material Support Branch (SAMS).
- **Engineering and Software:** Interview the Assistant General Manager, Transit Infrastructure and Engineering Services (TIES), the Chief Engineer for Infrastructure (CENI), the Chief Engineer for Vehicles (CENV), and designated



representatives from the Office of Information Technology (IT) responsible for AIM.

- **Vehicle Maintenance:** Review of maintenance procedures and inspections performed by the Office of Rail Car Maintenance (CMNT), including compliance with WMATA's OAP Series 202 for vehicle maintenance activities.
- **Elevator and Escalator Maintenance:** Review of maintenance procedures and inspections performed by the Office of Elevators and Escalators (ELES) following WMATA's Operations Administrative Procedures and the ELES Safety Maintenance Practices and Procedures Manual.
- **Rules Compliance Programs:** Review of procedures, policies and assessments performed to assess the compliance of WMATA employees with operations and maintenance rules by Rail Operations Delivery Quality Assurance and Rail Transportation (RTRA).

At the audit's conclusion, an exit briefing was conducted with WMATA on August 24, 2012 that explained the audit team's findings and concerns. The audit team then drafted a summary report and incorporated necessary comments from WMATA staff to ensure its accuracy.

6.1 WMATA Activity to Support FTA Audit

In contrast to FTA's 2010 audit, FTA's audit team received WMATA's full cooperation at all levels throughout the audit process:

- In less than 3 weeks, WMATA assembled and uploaded over 800 documents requested by FTA, including manuals, procedures, policy instructions, rulebooks, training programs, and inspection records, many of which had been developed, revised or updated since early 2010 to address safety issues or concerns. Major document submissions were made to FTA on August 10, August 14, and August 23, 2012.
- At FTA's request, WMATA provided FTA's audit team with training to ensure safe track access and also to demonstrate its new Roadway Worker Protection (RWP) program. WMATA supervisors and managers escorted FTA's audit team on assessments and inspections of key infrastructure, including track, signals, vehicles, and escalators.
- FTA's audit team observed WMATA's monthly Executive Safety Committee meeting for August, and reviewed meeting minutes, reports, tracking matrices, and interviewed WMATA personnel regarding the functioning of the agency's full safety committee structure, including Local Safety Committees established at each major Metrorail facility and the Metrorail Departmental Safety Committee.



- WMATA opened its records and maintenance information system to FTA's audit team, and FTA independently reviewed inspection records and work orders, and assessed the quality of action taken to resolve identified defects. FTA also reviewed training programs and the results of efficiency and proficiency check programs developed to monitor WMATA employee compliance with operating and maintenance rules.
- FTA's audit team also conducted interviews with WMATA's front-line employees, supervisors, managers in operations and maintenance, as well as WMATA's Chief Safety Officer and Safety Department staff, WMATA's Executive Leadership Team, WMATA's Deputy General Manager Operations, and WMATA's General Manager and Chief Executive Officer.
- Finally, FTA's audit team reviewed the status and supporting materials for WMATA's investigations into the nine (9) accidents and incidents cited in Senator Mikulski's letter. None of these investigations is yet final. FTA assessed investigation status, the progress of technical and laboratory testing, the current understanding of probable and contributing causes, and the initial and long-term corrective actions being proposed. During these discussions, WMATA's Safety Department staff and engineering and maintenance managers were well-informed and readily shared information. FTA's follow-on requests for documents, site visits to accident locations, and further interviews with WMATA's technical specialists were all granted.

WMATA also provided FTA's audit team with full access to its information management systems, and WMATA personnel across all departments were knowledgeable in their use and took advantage of many automated tools and features to actively track the performance of the system.

WMATA staff also answered difficult questions posed by members of FTA's audit team with extensive MAXIMO experience, and also openly reviewed the results of assessments and reports that showed less than optimal compliance with specific operating rules or that indicated a major defect had been identified during a routine preventive maintenance inspection. WMATA also provided FTA with access to the MAXIMO inspection reports for track, vehicles, and equipment involved in recent accidents and incidents identified by Senator Mikulski.



7.0 Appendix B: WMATA Safety Actions since 2010

FTA finds that changes made by WMATA since early 2010 to its organization and governance designed to enhance safety are still in effect, and include:

- WMATA's Chief Safety Officer is a direct report to the General Manager and Chief Executive Officer (GM/CEO) and is an active and involved member of the Executive Leadership Team.
 - WMATA's Chief Safety Officer leads a department of 61 members that has doubled in size, and greatly increased in its authority, standing within the organization, and technical capacity since FTA's last audit.
 - WMATA's safety department has hired veteran safety officers from transit agencies nationwide representing 33 different degreed disciplines, with each averaging almost 15 years of transit safety experience. Several new safety officers also bring military and railroad safety experience.
 - Since 2010, WMATA's safety department hired the agency's first ever Fire Marshall, and also has added three (3) certified safety professionals (CSPs), three (3) professional engineers (PEs), and one (1) Certified Industrial Hygienist (CIH).
 - In response to FTA's 2010 audit report, WMATA developed and implemented a plan to improve the technical capacity and skill of its Safety Department members. To date, 45 percent of WMATA's safety department staff has earned Transit Safety and Security certification by the U.S. Department of Transportation's Transit Safety Institute (TSI), which instructs transit staff in key topics. WMATA now has more TSI-trained staff than any other transit property. FTA has been a partner in making this level of training available to WMATA staff.
 - WMATA's Safety Department also has a comprehensive technical engineering support services contract in place to address challenging accident investigations, conduct internal audits, develop an automated, web-based tool to support hazard management agency-wide, and to support analyses needed to advise operating and maintenance departments on safety issues and concerns.
 - WMATA's Safety Department's annual budget has more than tripled since late 2009/early 2010 to \$17.4 million (approximately 1% of WMATA's total operating budget).
- In 2010, WMATA administered a safety-focused employee survey for the entire agency. Reinforcing earlier FTA, TOC and NTSB findings, this survey showed



- that most employees observed at least one safety violation per year, that unsafe working conditions were the biggest concern, particularly on the rail transit right-of-way, that fear of retaliation was the main reason employees did not report safety concerns, and that while employees typically trusted their immediate supervisors and managers, they generally did not believe that top leadership was committed to their safety.
- Also in 2010, the WMATA Office of Inspector General (OIG) performed a Control Self-Assessment (CSA) of employee safety for the then-Office of Track and Structures Systems Maintenance (TSSM). The CSA results indicated that TSSM employees did not believe WMATA provided them a safe working environment. The issues brought to the attention of the OIG during the CSA fell into three categories: 1) the work environment having unmitigated hazards, 2) training not adequate to support the set-up and performance of work, and 3) ineffective internal and external communications.
 - To address both the findings from the employee survey and OIG CSA, late in 2010, WMATA's GM/CEO took several steps to change the tone at the top, to promote more open communications regarding safety, and to increase the agency's responsiveness to incidents and concerns that were reported by employees. The ten most significant activities completed by WMATA to address employee safety are identified below:
 1. WMATA completed its analysis and revision of critical safety rules, and updated its Metrorail Safety Rules and Procedures Handbook (MSRPH). At the same time, WMATA also developed a new Roadway Worker Protection (RWP) program. Both initiatives represent a positive change in the way WMATA conducts its operations and maintenance. Both initiatives target cardinal safety rules (always shown in red) and work to explain each rule and why it is needed drawing on past accidents and lessons learned. TOC, FTA, NTSB, the Federal Railroad Administration (FRA), as well as peer rail transit agencies from New York, Philadelphia, San Francisco, Baltimore, and Toronto participated in these revisions, working with WMATA to help the agency establish a new approach for enhancing the safety of its operations and protecting workers on the rail transit right-of-way. WMATA distributed these new rulebooks and supporting materials to every Metrorail employee, and provided new training programs. On-going refresher training and new or enhanced programs for job safety briefings, safety observations, and employee communication further institutionalize these changes. During interviews with members of FTA's audit team, front-line employees generally reported feeling and observing a greater sense of safety on the rail transit right-of-way and less animosity among train operators, workers on the right-of-way, and controllers than in late 2009/early 2010.
 2. WMATA re-established and strengthened its safety committee structure, including the Local Safety Committees at each WMATA facility and the



Departmental Safety Committee. FTA verified that monthly meetings are being conducted (with a few exceptions that have been noted and are being addressed). WMATA's Safety Department staff attends all meetings, to ensure that identified hazards and safety concerns are tracked, assessed, and resolved. With few exceptions, the safety committee structure is functioning as intended to ensure that safety concerns are identified at the field level (Local Safety Committees), evaluated and resolved at the managerial level (Departmental Safety Committee), and that conflicts and differences of opinions are decided at the executive level (Executive Safety Committee).

3. WMATA initiated a safety hotline that includes an anonymous, web-based reporting application that runs 24/7 and that also provides employees with the option of connecting immediately to a live, on-call safety officer. At the time of FTA's audit, 82 percent of issues raised were resolved within one month.
4. As part of the new RWP program, WMATA gave employees the right to challenge their safety on the job through a "Good Faith Challenge" process. Training and forms are provided to each employee regarding how to make a challenge. WMATA has also increased its training and rules compliance programs to ensure that new employees master WMATA's complex operating and maintenance environment. Special locations within the WMATA system and rail yards where train movements are particularly difficult have been flagged and additional training is being offered.
5. WMATA greatly increased the size and technical capacity of the Safety Department, and began deploying safety officers at locations where significant maintenance projects were being performed. In August 2012, no less than 2 safety officers were available 24/7 to respond to issues and concerns reported by employees at worksites. Also safety officers are now assigned to, and actively monitor conditions in, all major rail rehabilitation work, including weekend shutdowns and single-tracking operations.
6. WMATA strengthened its whistleblower policy, making it non-punitive. WMATA is also developing a formal non-punitive employee reporting program in partnership with Amalgamated Transit Union, Local 689. Upon its completion, WMATA hopes to have the most substantial non-punitive employee reporting program in the rail transit industry.
7. In partnership with TOC, WMATA is taking an agency-wide approach to improving the physical qualification and fitness of its employees, and reducing fatigue and sleep apnea. Working with TOC, WMATA is implementing the following: hours-of-service limitations by department, medical screening and treatment programs, quiet rooms in rail facilities, and further research conducted by medical experts and universities to determine optimum employee work schedules by department for a 24/7 operation such as WMATA.



8. WMATA created the "Champions of Safety" program to recognize employees who maintain safe work practices. NTSB Chair Deborah Hersman provided the keynote address at last year's event. The program is now entering its third year.
 9. All WMATA executive management communication with employees, from bulletins to websites, including the agency's intranet, newsletters, and direct mailings, have been reviewed to ensure that safety is included and prioritized. WMATA Executive Leadership Team meetings begin with a safety contact to raise awareness about a safety issue, and safety has been established as the first agenda item for most executive meetings and briefings.
 10. WMATA plans to update the employee safety-focused survey in late 2012/early 2013 to gain additional feedback from employees to assess both progress made and areas in need of further improvement.
- WMATA also revised its System Safety Program Plan (SSPP) and Policy Instructions to clarify safety roles and responsibilities for all departments and members of WMATA's Executive Leadership Team and to provide additional authorities for the Chief Safety Officer and Safety Department. WMATA's Board of Directors also issued a safety policy that is included in the SSPP. FTA's in-depth review of the SSPP finds it to be a strong document in full compliance with 49 CFR Part 659 requirements and the TOC Program Standard and Procedures.
 - WMATA's Board of Directors established a Safety and Security Committee that meets monthly and provides public information on WMATA's safety program activities and initiatives, safety performance, as well as the results of investigations into accidents and incidents that occur. Presentations, audio recordings, and agendas are all available at:
http://www.wmata.com/about_metro/board_of_directors/meetings.cfm.
 - WMATA worked with TOC to develop and implement a detailed Memorandum of Understanding (MOU) to clarify the oversight relationship and guarantee TOC authorities and access to WMATA systems, personnel, and records. WMATA now provides TOC with detailed monthly reports on safety performance and actions taken to address TOC findings and concerns. TOC now has a daily presence at WMATA, with formal meetings monthly to review corrective action plan implementation and coordinate oversight activities.
 - Quarterly, TOC's Executive Committee, comprised of the Secretaries of Transportation for Virginia and Maryland and the Director of the District of Columbia Department of Transportation, reviews WMATA's safety performance and supports TOC in the resolution of outstanding items.



- To reduce communication silos and promote proactive ownership of safety issues, WMATA's GM/CEO conducts one-on-one monthly meetings with members of the Executive Leadership Team that are supported by the Chief Safety Officer.
 - During these meetings, safety and performance issues and concerns are reviewed and discussed, with formal presentations and assessments provided as needed. The GM/CEO uses the meetings to ensure that information is shared, and to resolve conflict relating to safety issues and the implementation of corrective action plans.
- WMATA's Executive Safety Committee has been re-established, and is chaired by the Chief Safety Officer with active involvement from the GM/CEO. This Committee includes the heads of relevant WMATA departments and meets monthly to review WMATA's safety performance and to discuss the results of investigations into accidents, incidents and unusual occurrences.
- The Governors of Maryland and Virginia and the Mayor of the District of Columbia created a Governance Work Group (GWG) comprised of the Secretaries of Transportation for Virginia and Maryland and the Director of the District of Columbia Department of Transportation. This same group comprises the TOC Executive Committee, and has ensured that safety and responsiveness to TOC remain top priorities in the development of Board by-laws, the revision of Board procedures and the Code of Ethics, and the creation of WMATA's strategic plan.
 - WMATA's GM/CEO and Board Chair now meet annually with the GWG to address governance reform at WMATA, including safety oversight.
 - Among other items, the GWG has tasked WMATA's Board of Directors with establishing a clear budget and development process that includes safety and the prioritization of safety-related activities in the budgeting process.
 - The GWG has also recommended that the WMATA Compact be amended to include a section that defines, clarifies and further bolsters TOC's legal oversight and enforcement authority.

Since 2010, WMATA's Safety Department has reported monthly to the WMATA Board, TOC and the TOC Executive Committee, FTA and the NTSB regarding the status of WMATA's activity to address open corrective action plans.



8.0 Appendix C: Additional Information on Accident Investigation

WMATA appears to be committed to the thorough investigation and resolution of each of these accidents and incidents identified by Senator Mikulski. In addition to coordinating with the Original Equipment Manufacturers (OEMs), the agency is using independent laboratories and contracted specialists to review each of the equipment failures and determine potential impacts on the system and to identify needed follow-on activities. WMATA's Safety Department is actively involved in this process and unresolved hazards are being identified and entered into WMATA's hazard management program for final mitigation.

Given the potential ramifications of these incidents, however, particularly the July 6, 2012 "heat kink" derailment, the May 29, 2012 employee injury in the car wash, and the doors opening off-platform on the Red Line, FTA is requesting that WMATA keep us involved in these investigations to monitor their progress and conclusions. FTA also is requesting additional analysis in a few key areas:

- FTA's audit team interviewed Track and Structures (TRST) staff regarding the investigation surrounding the July 6, 2012 heat kink incident on the E-line. The audit team was informed that TRST has implemented a continuous welded rail (CWR) de-stressing program to minimize/eliminate the potential for CWR heat kinks that lead to train derailments. TRST has again begun utilizing "VERSES" measuring equipment to help identify locations that may be in a high degree of tension and prone to heat kinks under extreme temperature conditions as experienced in July 6, 2012 incident. TRST also informed FTA that heat kink incident was largely a result of track design, including curvature, grade, fastening method, and operating speed. TRST provided the audit team with an analysis documenting other locations with similar attributes that may promote the heat kinking. TRST also implemented a heat monitoring procedure with several track temperature sensors and instituted an operational slow order if the track temperature reaches certain thresholds.
 - FTA's audit team is concerned that various other factors may have contributed to the July 6, 2012 heat kink incident, including recent tie replacement and CWR installation process. The audit team recommends that an independent de-stressing expert evaluate and validate WMATA's de-stressing program and the current condition of CWR. The audit team also recommends that TRST review its incident investigation procedures to ensure that the root cause is determined to prevent the incident's reoccurrence. FTA will continue to monitor investigation and corrective action implementation surrounding the July 6, 2012 heat kink incident.
- As part of the review of the May 29, 2012 employee injury at the Shady Grove car wash, FTA's audit team was provided a tour of the temporary safety improvements WMATA has put in place to prevent recurrence. The audit team



noted that doors with limited train visibility have been locked and exit only hardware installed on the doors. Signage and platform wash chains were also installed in an attempt to prevent personnel from unnecessarily fouling the carwash track. The audit team expressed concern regarding the open walking path across car wash tracks and recommended additional chains or pull-open swing gates as mitigations. The audit team was informed that the investigation is ongoing and more mitigation is expected. The audit team also observed open doors on rail cars raised on lifts, open pits without fall protection and exposed third rail shoes which appeared to be energized.

- FTA's audit team will continue monitoring the investigation of this incident and recommends that WMATA conduct a hazard analysis study for all shops to assess employee safety, and a formal review to determine any changes that need to be made to WMATA's RWP program to address employee safety in the shops and rail yards.
- The audit team also reviewed the WMATA's Safety Department and Car Maintenance (CMNT) investigation of the May 15, 2012 incident involving train line doors open while a train was in service on the Red Line. Preliminary investigation of this incident indicates that the coupler electrical head was damaged resulting in the electrical connections being misaligned which caused the door to open between stations during revenue service. The coupler may have been damaged as a result of an improper coupling of the two train cars. CMNT, in coordination with Vehicle Engineering, investigated the incident, including inspecting the coupling connectors of all vehicles and incorporating coupling connector design changes to strengthen the mounting bracket. Additionally, an inspection tool was developed to verify contact alignment on the coupler head during routine inspection intervals.
 - FTA's audit team recommends that WMATA continue to investigate the incident to ensure that unintentional door openings between stations will not occur. FTA also recommends that WMATA's Safety Department coordinate with CMNT regarding root cause analysis for this incident and include greater detail within the corrective action plans developed to prevent the incident's reoccurrence. FTA's audit team will also continue to monitor the investigation of these incidents to ensure corrective actions are implemented.
 - Given the extensive coupling and uncoupling required to belly the 1000 series railcars in the middle of WMATA's 8-car train-sets, the potential for damage from "hard" coupling or improper coupling must not be overlooked. During the audit, WMATA demonstrated to FTA's team how train movements in the yard are recorded, but there was one instance in which the operator's identification was not recorded. As part of this investigation, FTA urges WMATA ensure that steps are being taken to review the level of potential damage from improper coupling.



- Finally, FTA reviewed WMATA's investigation into the July 14 and 15, 2012 incidents involving the computer network problem that affected the Automated Information Management System (AIMS) that allows controllers in WMATA's Rail Operations Control Center (ROCC) to see where trains are on a dynamic map and to remotely control switches. The first occurrence affected service for approximately 40 minutes on Saturday afternoon, July 14. During this time, 44 Metrorail trains were instructed by controllers to hold their position at the next station. A second occurrence early in the morning on Sunday, July 15, 2012, resulted in a brief hold, after which trains were permitted to move with radio permission from controllers.
 - At all times during this outage, train movement was governed by wayside signals, as well as speed commands transmitted to each train's control cab. Radio communication between the control center and trains was maintained at all times.
 - As the investigation continued, WMATA's Rail and Information Technology (IT) departments took precautionary steps to minimize the chance for additional problems.
 - WMATA posted additional supervisory staff at key locations during the Monday, July 16, 2012, morning commute to respond quickly in the event of any technical issues.
 - IT continued to investigate failures and provided 24/7 coverage of the Rail Operation Control Center through Tuesday, July 17, 2012.
 - On Wednesday, July 18, 2012, the probable cause was determined to be a failed module in an information management network device.
 - Power surges had caused a partial failure of module, which led to periodic network disconnects that froze the AIMS display screens.
 - Once the computer module was replaced in the early morning hours before the start of train service, the errors that had occurred in the system stopped.
 - Throughout this investigation, WMATA worked closely with CISCO and ARINC, vendors for the network system and AIMS system, respectively, to confirm packet loss in the network and its impact on AIMS.
 - WMATA's IT department is also working on software upgrades to better monitor the condition of the computer network to identify and resolve periodic network disconnects as quickly as possible.



- WMATA's IT department is also working with an independent contractor to conduct an in-depth assessment of the AIMS system and to recommend possible upgrades to the system to optimize network redundancy.

WMATA is also coordinating even more closely with its electrical utilities providers Pepco and BGE to ensure greater preparedness and coordination for managing the electric outages and surges resulting from summer storms like the ones that occurred in late June.