NATIONAL TRANSPORTATION SAFETY BOARD
**Investigative Hearing**
Washington Metropolitan Area Transit Authority Metrorail train 302 that encountered heavy smoke in the tunnel between the L'Enfant Plaza Station and the Potomac River Bridge on January 12, 2015

| GROUP | H |
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| EXHIBIT | |
| 21 | |

Agency / Organization

Federal Transit Administration

Title

# Washington Metropolitan Area Transit Authority Safety Management Inspection Final Report

# FINAL REPORT

## Washington Metropolitan Area Transit Authority (WMATA)

## Safety Management Inspection

Examination Dates: March 16 to April 3, 2015

Federal Transit Administration
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

June 17, 2015

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**Acronyms**

| | |
|---|---|
| **AC** | **Alternating Current** |
| **AIM** | **Advanced Information Management** |
| **APTA** | **American Public Transportation Association** |
| **AREMA** | **American Railway Engineering and Maintenance-of-Way Association** |
| **ASE** | **Automotive Service Excellence** |
| **ATC** | **Automatic Train Control** |
| **ATO** | **Automatic Train Operation** |
| **ATP** | **Automatic Train Protection** |
| **ATS** | **Automatic Train Supervision** |
| **BMNT** | **Office of Bus Maintenance** |
| **BOCC** | **Bus Operations Control Center** |
| **BSEH** | **Department of Bus Service Employees' Handbook** |
| **BUS** | **Department of Bus Service** |
| **CAP** | **Corrective Action Plan** |
| **CBT** | **Computer Based Training** |
| **CCTV** | **Closed Circuit Television** |
| **CENI** | **Office of Chief Engineering, Infrastructure** |
| **CENV** | **Office of Chief Engineering, Vehicles** |
| **CFR** | **Code of Federal Regulations** |
| **CMNT** | **Office of Rail Car Maintenance** |
| **CNG** | **Compressed Natural Gas** |
| **COMM** | **Communications Branch within Office of Systems Maintenance** |
| **CPDO** | **Office of Capital Program Delivery** |
| **CSCM** | **Department of Customer Service, Communications and Marketing** |
| **CQAL** | **Corporate Quality Assurance** |
| **DC** | **Direct Current** |
| **DSC** | **Departmental/Area Safety Committee** |
| **ELES** | **Office of Elevator and Escalator Services** |
| **ELM** | **Enterprise Learning Management** |
| **EMI** | **Engineering Modification Instruction** |
| **ESC** | **Executive Safety Committee** |
| **FTA** | **Federal Transit Administration** |
| **HR** | **Department of Human Resources** |
| **IRPG** | **Office of Infrastructure Renewal Program** |
| **IT** | **Department of Information Technology** |
| **LOS** | **Loss of Shunt** |
| **MAP-21** | **Moving Ahead for Progress in the 21st Century** |
| **MCAP** | **Office of Major Capital Projects** |
| **MMIS** | **Maintenance Management Information System** |
| **MOC** | **Maintenance Operations Center** |
| **MPLN** | **Maintenance Planning and Scheduling** |
| **MSRPH** | **Metrorail Safety Rules and Procedures Handbook** |

| | |
|---|---|
| **MTPD** | **Metro Transit Police Department** |
| **NFPA** | **National Fire Protection Association** |
| **NTD** | **National Transit Database** |
| **NTSB** | **National Transportation Safety Board** |
| **OAP** | **Operations Administrative Procedures** |
| **OEM** | **Original Equipment Manufacturer** |
| **PLI** | **Platform Line Instructor** |
| **PLNT** | **Office of Plant Maintenance** |
| **POWR** | **Power Branch within Office of Systems Maintenance** |
| **PRMT** | **Office of Procurement and Materials** |
| **PROTECT** | **Program for the Response Options and Technology Enhancements for Chemical/Biological Terrorism** |
| **QAAW** | **Office of Quality Assurance and Warranty** |
| **REPA** | **Reliability and Performance Analysis Branch** |
| **ROCC** | **Rail Operations Control Center** |
| **ROQT** | **Office of Rail Operations Quality Training** |
| **ROW** | **Right-of-Way** |
| **RTC** | **Rail Traffic Controller** |
| **RTRA** | **Office of Rail Transportation** |
| **RTTO** | **Office of Train Operations** |
| **RWIC** | **Roadway Worker in Charge** |
| **RWP** | **Roadway Worker Protection** |
| **S&I** | **Service and Inspection** |
| **SAFE** | **Department of Safety and Environmental Management** |
| **SIGAR** | **System Implementation Gap Analysis Report** |
| **SMI** | **Safety Management Inspection** |
| **SMNT** | **Office of System Maintenance** |
| **SMS** | **Safety Management Systems** |
| **SOM** | **Street Operations Managers** |
| **SOP** | **Standard Operating Procedure** |
| **SRPG** | **System Renewal Program** |
| **SSO** | **State Safety Oversight** |
| **SSPP** | **System Safety Program Plan** |
| **TIES** | **Department of Transit Infrastructure and Engineering Services** |
| **TOC** | **Tri-State Oversight Committee** |
| **TRST** | **Office of Transit and Structures** |
| **UPS** | **Uninterruptible Power Supply** |
| **VERSE** | **Vertical Rail Stiffness Equipment** |
| **WMATA** | **Washington Metropolitan Area Transit Authority** |

# 1.0 Executive Summary

Over the last decade, the Washington Metropolitan Area Transit Authority (WMATA) has experienced several serious rail accidents. Among these is the June 22, 2009, collision of two Metrorail trains near Fort Totten station, resulting in the death of eight passengers and a train operator and injuring 52 others, and the January 12, 2015, electrical arcing incident near the L'Enfant Plaza underground station that produced toxic smoke conditions resulting in one passenger fatality and 90 injuries. Over the last decade, seven collisions occurred with WMATA workers on the rail transit right-of-way (ROW), resulting in nine fatalities and several serious injuries.

In response to concerns regarding this safety performance, the U.S. Department of Transportation's Federal Transit Administration (FTA) conducted an organization-wide Safety Management Inspection (SMI) of the WMATA rail and bus transit systems. Utilizing new safety authority established by the Moving Ahead for Progress in the 21st Century Act (MAP-21) in 2012, the FTA SMI evaluated WMATA's operations and maintenance programs, safety management capabilities, and organizational structures to identify areas where the agency must further enhance its conformance with its own rules and procedures, FTA's existing regulations, and FTA's Safety Advisories to reduce risks and make improvements for the safety and well-being of its passengers and employees.

FTA finds that over the last five years, WMATA has implemented new management initiatives and programs to address safety concerns, made advancements in many areas, and improved its safety culture. However, the SMI identified organizational deficiencies and operational concerns that continue to limit the agency's effectiveness in recognizing and resolving safety issues and hazards. In key areas, WMATA's organization is not effectively balancing safety-critical operations and maintenance activities with the demand for passenger service.

For Metrorail, the FTA SMI determined that WMATA work crews do not have sufficient access to the rail ROW to perform critical inspection, testing and maintenance activities. Also, for some of Metrorail's more complicated technical systems, shared responsibilities for maintenance inspections and repairs, training, and operational testing are not always well managed, leaving one department's top safety priorities unaddressed by another department with different focus areas and considerations. In addition, the SMI identified clear deficiencies in the availability, quality and performance of technical training, refresher training, and rules compliance and operational testing activities. Poorly functioning and poorly utilized information management systems and technology also limit the effectiveness of WMATA's training, rules checks and operational testing, and maintenance programs and activities.

Perhaps most significantly, the FTA SMI found serious safety lapses in the Rail Operations Control Center (ROCC) related to the training and certification of rail traffic controllers; the ROCC structure, organization and staffing; the availability of checklists, procedures, manuals and tools; the quality of the radio system and radio communications; and the performance of the Advanced Information Management system to visually display and monitor the status of the rail transit system. Collectively, these issues significantly impact the ability of the Metrorail system

to schedule and conduct maintenance work, to manage abnormal and emergency events, and to ensure the safety of trains and personnel on the ROW.

While not rising to the level of seriousness found in rail operations, the SMI identified a few concerns in the Bus Operations Control Center regarding the lack of manuals, documented checklists and procedures for bus dispatchers, and a general level of informality in bus radio use and communications. The SMI also determined that WMATA's bus operating and maintenance departments have unmet training needs, and do not generally conform with all requirements specified in rules compliance and operations testing programs, including annual refresher requirements. Areas were identified where automated systems could greatly improve safety processes, and where specific types of maintenance inspections and reviews would benefit fleet safety performance. FTA also found that Metrobus employees at all levels of the organization identified their most significant safety concern as WMATA's ability to protect bus operations personnel from violent, disgruntled, or disruptive passengers and members of the public.

As a result of this SMI, FTA issues 44 safety findings in eight categories regarding WMATA's Metrorail system and 10 safety findings in five categories regarding WMATA's Metrobus system. To ensure that FTA's SMI findings are resolved, FTA is issuing Safety Directive 15-1 to WMATA that identifies 78 distinct corrective actions to be completed by Metrorail and 13 distinct corrective actions to be completed by Metrobus.

| WMATA Metrorail System | |
|---|---|
| ***Categories of Metrorail System Finding*** | ***Number of Findings and Required Actions*** |
| • Category R-1: Inadequate Rail Operations Control Center Staffing and Procedures | 14 Findings and 21 Required Actions |
| • Category R-2:Ineffective Training, Operational Testing and Rules Compliance Programs | 8 Findings and 22 Required Actions |
| • Category R-3: Insufficient Track Time for Maintenance | 4 Findings and 4 Required Actions |
| • Category R-4: System-wide Maintenance Issues | 7 Findings and 7 Required Actions |
| • Category R-5: Fire/Life Safety and Emergency Preparedness | 2 Findings and 7 Required Actions |
| • Category R-6: Condition and Performance of Tunnel Ventilation System | 3 Findings and 4 Required Actions |
| • Category R-7: Performance of Information Management Technology | 4 Findings and 8 Required Actions |
| • Category R-8: Outstanding Items from Previous FTA Audits and Reviews | 2 Findings and 5 Required Actions |
| ***Total*** | ***44 Findings and 78 Required Actions*** |

| WMATA Metrobus System | |
|---|---|
| ***Categories of Metrobus System Finding*** | ***Number of Findings and Required Actions*** |
| • Category B-1: Concern over Protection of Metrobus Operations Personnel | 1 Finding and 2 Required Actions |
| • Category B-2: Limited Availability of Training for Operations and Maintenance Personnel | 2 Findings and 2 Required Actions |
| • Category B-3: Inconsistent Operational Testing and Rules Compliance Checks | 3 Findings and 4 Required Actions |
| • Category B-4: System-wide Maintenance Issues | 2 Findings and 2 Required Actions |
| • Category B-5: Lack of Information Management System Technology | 2 Findings and 3 Required Actions |
| ***Total*** | ***10 Findings and 13 Required Actions*** |

WMATA will have 30 days to respond to FTA's Safety Directive, to provide additional information for consideration, and to propose any equivalent alternate actions. Sixty days thereafter, WMATA must submit a tracking matrix to FTA that identifies the specific actions that will be performed to address each required element specified in this Safety Directive; the milestone schedule for completing corrective action; the responsible parties for action and their contact information; and the verification strategy for ensuring the completion of required work.

FTA will review and approve WMATA's work plans, and will monitor the agency's progress in resolving each finding and required action. FTA will conduct monthly meetings with WMATA to review progress until such time as FTA determines that these meetings are no longer needed or may be conducted with less frequency.

FTA also will consult with the Tri-State Oversight Committee (TOC), the entity responsible for managing the federally required State Safety Oversight Program for the Metrorail system, on the final review and approval for WMATA work plans addressing Metrorail activities. In addition, FTA is asking the WMATA Board of Directors to closely monitor the time and resources made available for the operations and maintenance departments to conduct safety critical inspection, testing, training, and repair activities on the Metrorail rail system. WMATA participated fully in the SMI and FTA anticipates that cooperation to continue through the completion of all corrective actions in response to this report.

In addition, in support of the SMI, FTA performed a Safety Management System (SMS) Gap Analysis to evaluate WMATA's approach to safety management practices as they relate to a fully mature SMS. The SMS Gap Analysis was not an exercise in safety compliance. SMS is a management approach adopted by FTA that ensures each public transportation agency has the necessary organizational structures, accountabilities, policies, and procedures in place to direct and control resources for safety management. SMS is not a requirement in the public transportation industry. Thus, this cooperative effort with WMATA serves as a tool for continuous improvement in WMATA SMS development and implementation activities.

SMS has four levels of maturity: Initiating, Planning, Implementing, and Managing and Monitoring. The SMS Gap Analysis identified an overall WMATA SMS maturity level between Planning and Implementing with some areas at the Managing and Monitoring level. SMS is new to the public transportation industry and may take a transit agency two to four years to reach the full maturity level depending on its size and complexity. To further advance its SMS efforts, WMATA has accepted an FTA invitation to participate in a SMS pilot program.

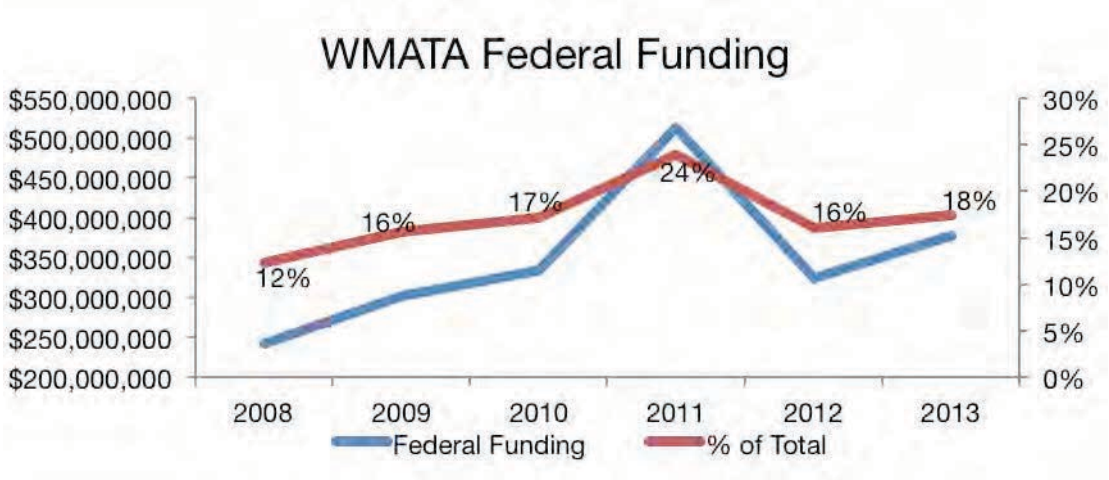
# 2.0 Introduction

This final report documents the results of the Safety Management Inspection (SMI) performed by the Federal Transit Administration (FTA) for the Washington Metropolitan Area Transit Authority (WMATA) Metrorail and Metrobus systems. Conducted with the full participation of WMATA's state safety oversight agency, the Tri-State Oversight Committee (TOC), FTA's SMI evaluated WMATA's operations and maintenance programs, safety management capabilities, and organizational structures to assess WMATA's compliance with its own requirements, procedures, rules and programs to ensure the safety of the public, WMATA's employees, and WMATA's system infrastructure.

## 2.1 Background

WMATA manages the second largest heavy rail transit system (Metrorail) and the sixth largest bus network (Metrobus) in the United States. WMATA provides 85 percent of all public transportation in the national capital region, serving a geographic area of 1,500 square miles and 5 million residents. WMATA's Metrorail system averages approximately 730,000 weekday passengers and Metrobus carries approximately 465,000 weekday passengers.

FTA is a major funding partner in the WMATA system, providing between $250 million and $500 million per year through a range of grant programs, such as Section 5307 Formula funding for capital assistance, the Section 5309 Fixed Guideway Modernization program, and the recent American Recovery and Reinvestment Act provisions devoted to transit capital projects and preventive maintenance. In addition, beginning in 2010, the U.S. Department of Transportation provided the first of 10, $150 million grants authorized through the Passenger Rail Investment and Improvement Act to address critical safety needs at WMATA, such as replacing WMATA's aging 1000 series rail cars with more crashworthy and energy efficient vehicles. In all, the Federal government provides approximately 20 percent of WMATA's total budget. This level of funding does not count FTA's $900 million commitment to the Dulles Corridor Silver Line project, being constructed by the Metropolitan Washington Airports Authority (MWAA).



Over the last decade, WMATA has experienced several serious accidents, including the collision of two Metrorail trains on June 22, 2009, near Fort Totten station, which resulted in the deaths of eight passengers and a train operator, and injured 52 others. Between 2005 and 2010, WMATA also lost eight workers in six collisions with trains and equipment on the rail transit right-of-way (ROW). Since 2010, in partnership with FTA, the TOC, and in response to recommendations from the National Transportation Safety Board (NTSB) and increased scrutiny from the Virginia, Maryland and District of Columbia Congressional delegations, WMATA enhanced its safety focus and improved safety performance.

As a result of these initiatives and activities, many of which were reviewed and approved by FTA and the TOC, WMATA's Metrorail system experienced no passenger, employee or contractor fatalities for 44 straight months (February 2010 through October 2013). For both Metrorail and Metrobus, employee injuries fell from 5.19 per 200,000 hours worked in calendar year 2011 to 4.2 per 200,000 hours worked for calendar year 2014. Passenger injuries fluctuated from a low of 1.68 injuries per million passengers in calendar year 2012 to 1.96 injuries per million passengers in calendar year 2014, allowing WMATA to maintain its goal of less than 2 injuries per one million passengers for four straight years. However, on October 6, 2013, two WMATA employees were injured and a contractor was killed when they were struck by a 40-foot section of rail during an emergency evacuation of work zone in a tunnel near Union Station. During calendar year 2014, the number of fires and smoke events requiring suppression on the WMATA Metrorail system almost doubled from 15 in 2013 to 29 by the end of December 2014. On January 12, 2015, an electrical arcing incident resulted in toxic smoke conditions that caused one passenger fatality and injured 90 others.

## 2.2 Purpose

In response to concerns regarding this recent safety performance, the FTA conducted an SMI of the WMATA Metrorail and Metrobus transit systems, utilizing new safety authority established by the Moving Ahead for Progress in the 21st Century Act (MAP-21). FTA's SMI evaluated WMATA's operations and maintenance programs, safety management capabilities, and organizational structures to identify areas where the agency must further enhance its conformance with its own rules and procedures, FTA's existing regulations, and FTA's Safety Advisories, to reduce risks and make improvements for the safety and well-being of its passengers and employees.

## 2.3 Schedule and Major Activities

After formally notifying WMATA on February 4, 2015, FTA worked closely with WMATA to complete an extensive document request and to schedule interviews, field observations, inspections, and demonstrations regarding the performance of key equipment, information management systems and technology. FTA conducted the SMI for both WMATA's Metrorail and Metrobus systems between March 16 and April 3, 2015.

To conduct the SMI, FTA assembled 10 teams comprised of over 35 technical, safety and transit operations experts to complete a comprehensive assessment. FTA's SMI team reviewed and assessed:

- WMATA's track, traction power, signal and train control, ventilation, physical plant, and rail and bus vehicle inspection, testing, and maintenance programs;
- WMATA's rail and bus operations control centers;
- Radio and visual display systems used to support and monitor rail and bus operations;
- WMATA's roadway worker protection program and employee safety programs;
- Formal and informal communication regarding maintenance and safety issues at all levels of the organization;
- Initial and refresher training programs for operations and maintenance employees;
- Fatigue management and work scheduling practices;
- Rules compliance and operational testing programs, and the quality of supervision;
- WMATA's information management and data analysis capabilities; and
- Plans, procedures, and training programs for managing emergencies in service, and ensuring the readiness of front-line personnel and local emergency responders.

Throughout the course of the SMI, FTA's experts reviewed relevant records, documents, plans, policies, and procedures; conducted field inspections and made observations at various locations on the WMATA system by riding trains, other on-track equipment and buses, by walking along tracks and in facilities and observing work, by conducting independent inspections of completed work orders at a range of rail and bus facilities and installations, and by interviewing over 300 WMATA employees at all levels of the agency, including executive management, technical management, superintendents, assistant superintendents, managers, supervisors, front-line employees and union representatives.

FTA's SMI team members also attended WMATA safety committee meetings at every level, completed Level 1 Roadway Worker Protection (RWP) training and certification, and reviewed several on-going training classes and training materials. FTA's experts spent one week focused on WMATA's Rail Operations Control Center (ROCC) and several days in WMATA's Bus Operations Control Center (BOCC) observing communications, the performance of radio and visual display systems, the documentation and transmission of information and calls coming into the ROCC and BOCC, and the overall quality of radio communications to manage the transit system.

Finally, FTA's experts carefully assessed the tools and systems used by WMATA employees to manage, schedule and plan work; to monitor the performance and quality of work; and to establish indicators and targets to direct specific maintenance and operations activities, considerations and coordinated actions.

During the SMI, FTA teams met regularly with WMATA leadership and staff, to brief them on FTA's findings. FTA also conducted a factual review of the contents of this report with WMATA's technical leadership. Over the course of the SMI, WMATA's executive team also updated FTA on the status of 14 initiatives newly underway to improve the safety of WMATA's operations and procedures since the January 2015 incident. **Appendix A** lists these activities.

## 2.4 NTSB Urgent Safety Recommendations

On February 11, 2015, the NTSB issued a series of Urgent Safety Recommendations to WMATA, the American Public Transportation Association (APTA), and FTA to address concerns stemming form their investigation into the January 12, 2015 electrical arcing incident at L'Enfant Plaza station. These urgent recommendations, R-15-7 through R-15-12, related to the need for improvements in the performance of tunnel ventilation systems, the availability and quality of written procedures to address smoke and fire events in tunnels, compliance with industry best standards, including those issued by the National Fire Protection Association (NFPA), and training and emergency preparedness programs.

On June 8, 2015, the NTSB also issued safety recommendation R-15-25 to WMATA, urging the Metrorail system to promptly develop and implement a program to ensure that all power cable connector assemblies are properly constructed and installed in accordance with the agency's engineering design specifications, including the weather tight seals that prevent intrusion by contaminants and moisture. The NTSB also noted that there are other components in the third rail power distribution system that can be susceptible to electrical arc tracking and short circuits, and that WMATA's programs and maintenance procedures to address these issues are being examined as part of the ongoing L'Enfant Plaza accident investigation

While FTA's SMI is separate from the NTSB investigation, FTA incorporated elements of NTSB's Urgent Safety Recommendation R-15-7 to FTA into field activities, interviews, and document reviews. During the week of March 30, FTA's experts spent several days focused on the state of repair of WMATA's tunnel ventilation system; the procedures regarding the inspection, maintenance and repair of those systems; the level of oversight and monitoring regarding the performance of this work; the interfaces required across departments to ensure the effective repair and functioning of all tunnel ventilation system components; and necessary coordination with the ROCC.

While the NTSB's Safety Recommendation R-15-25 was issued after the conclusion of the on-site portion of FTA's inspection, FTA did review maintenance practices and procedures for WMATA's third rail power distribution system as part of the SMI.

**Appendix B** addresses the status of NTSB recommendations made to WMATA.

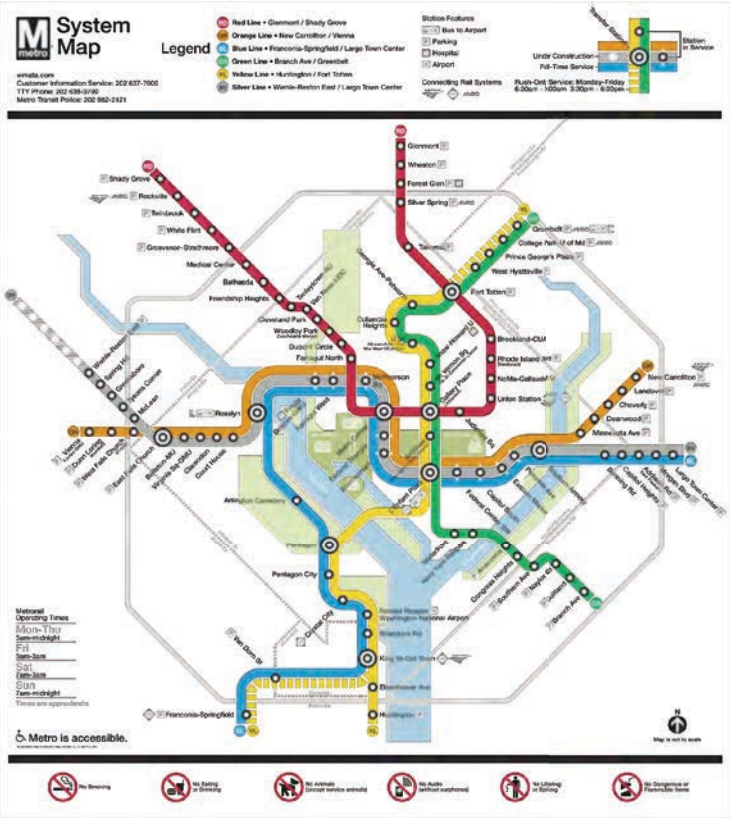
# 3.0 The WMATA System

WMATA operates the second largest heavy rail transit system (Metrorail) and the sixth largest bus network (Metrobus) in the United States. WMATA provides 85 percent of all public transportation in the national capital region, serving a geographic area of 1,500 square miles and five million residents, across the jurisdictions of the District of Columbia, Maryland (Montgomery and Prince George's Counties), and Northern Virginia (Alexandria City, Arlington County, and Fairfax County).

## 3.1 Metrorail

### 3.1.1 Overview

WMATA's Metrorail system operates six lines (Blue, Green, Orange, Red, Silver and Yellow) through 118 miles of track and 91 stations using a fleet of approximately 1,100 vehicles in seven different series (1000 through 7000). Each weekday Metrorail provides approximately 730,000 passenger trips. Typical service hours are 5:00 a.m. through midnight on Monday through Thursday; 5:00 a.m. on Friday morning through 3:00 a.m. on Saturday morning; 7:00 a.m. Saturday morning through 3:00 a.m. on Sunday; and 7:00 a.m. on Sunday morning through midnight.




Metrorail stations are subsurface, at grade and elevated construction with multiple entry/exit points to street level. Additional exits, escalators, stairs and elevators provide vertical circulation

between street, fare collection and platform levels. In total, WMATA maintains 613 escalators in the operating system and 275 elevators in stations and parking facilities. Some stations have adjacent parking facilities, pick-up/drop-off areas and/or bus pull-in areas to accommodate patrons arriving by automobile or by bus.

Depending on special events and other considerations, WMATA puts between 125 and 144 trains in service each day, using a combination of 6-car and 8-car trains. Beginning on April 14, 2015, WMATA placed its first 8-car train comprised entirely of its new 7000-series vehicles, manufactured by Kawasaki Rail Car, Inc., into service. At the time of FTA's SMI, WMATA had ordered 528 of these new rail cars, enough to replace all 1000- and 4000-series cars and expand the size of the Metro fleet by 128 cars. The composition of WMATA's rail fleet at the time of the SMI appears below:

| Years Introduced | Number of Rail Cars Owned | Rail Cars Available for Service | Series |
|---|---|---|---|
| 1975-1980 | 300 | 278 | 1000 |
| 1983-1988 | 366 | 358 | 2000 and 3000 |
| 1992-1994 | 100 | 100 | 4000 |
| 2001-2004 | 192 | 184 | 5000 |
| 2006-2008 | 184 | 184 | 6000 |
| 2015 | 8 | 8 | 7000 |
| Total | 1,142 | 1,112 | n.a. |

### 3.1.2 Rail Vehicles and Maintenance

WMATA uses seven Service and Inspection (S&I) Shops located throughout the system to provide routine maintenance for WMATA's rail vehicles. WMATA also has tracks for overnight storage of vehicles at two other locations. The major repair facilities for rail car and equipment overhaul, extensive modifications, wheel cutting, and spare parts storage to support the Metrorail system are located at the Brentwood and Greenbelt Yards.

All shops with the exception of Branch Avenue have the capacity for providing wheel truing. With the construction of Dulles Corridor Rail Extension, a new storage yard with heavy repair and overhaul shop will be constructed and located in the Dulles Corridor. New rail car acceptance and preparation are accomplished at the Greenbelt Yard, where WMATA will complete a new test track and commissioning facility for the 7000-series vehicles later this year.

WMATA's Office of Rail Car Maintenance (CMNT) Preventive Maintenance Program is comprised of progressive inspection, servicing and cleaning activities needed to meet the inspection requirements defined by the vehicle manufacturer and WMATA's vehicle engineers. An average of 76 rail cars are needed to conduct the scheduled maintenance program on a daily basis.

Because not all preventive maintenance can be done during off peak and non-revenue hours, vehicles must be withdrawn from revenue service for some portions of the Preventative Maintenance Program. Inspection and preventative maintenance occurs seven-days-a-week in three shifts. In addition to these standard preventative maintenance staff hours, WMATA

employs mechanics to respond to unscheduled maintenance issues and failures in the field and during off-peak hours.

WMATA inspects all vehicles on a daily basis before they enter service, with more in-depth inspections every 30 (Intermediate Inspection), 90 (A Inspection), 180 (B Inspection), or 360 days (C Inspection). The inspection procedures identify a list of parts that must be checked to perform within specifications, or the vehicle is not released for service. The total time needed to perform an inspection varies from half an hour for daily inspections, to 36 total hours for Type C inspections. Additional time may be required for part replacement or repair activities. WMATA's new 7000 series vehicles will be inspected and maintained on a mileage basis.

WMATA's Office of Chief Engineer Vehicles (CENV) supports CMNT. CENV provides technical support for vehicle procurement and contractor selection for rail car vehicles. CENV is also responsible for the development and maintenance of configuration control specifications and historical databases for rail car vehicles and configuration controlled documents for rail car maintenance personnel.

Within CENV is the Reliability and Performance Analysis Branch (REPA) that monitors and reports on reliability and performance of the rail car fleet. A second branch with CENV is the Maintenance Planning and Scheduling (MPLN) branch that provides technical support to CMNT and other departments for the purpose of implementing WMATA's overall preventive and corrective maintenance programs. MPLN ensures that every asset, fixed or rolling stock is properly and effectively maintained through preventive and corrective maintenance and that all records and data pertaining to the assets are accurate, reliable and controlled.

WMATA's Quality Assurance and Warranty (QAAW) is another support component of the CMNT team. QAAW has the responsibility to perform quality control inspection, testing, as well as identifying and resolving problems relating to personnel performance, equipment and procedures. QAAW inspectors observe, inspect and document non-compliance of equipment procedures and employees' actions against approved and established standards.

### 3.1.3 Rail Operations Control Center

Train control supervision for the entire rail transit system is performed through the Rail Operations Control Center (ROCC) located at the Carmen E. Turner Maintenance and Training Facility in Maryland. WMATA's ROCC is staffed 24 hours per day, seven days per week. Train operating rules and standard operating procedures (SOPs) for all WMATA Metrorail mainline routes are set forth in the Metrorail Safety Rules and Procedures Handbook (MSRPH).

The ROCC directs Metrorail traffic using an Advanced Information Management (AIM) system to provide a visual display and alarm status monitoring for train positions, switch positions, signal status and malfunctions, and status of support systems such as ventilation, drainage, fire and intrusion alarms, traction power system status, and drainage pumping station alarms. Rail Traffic Controller or RTCs must respond to alarms and notifications from the AIM system to manage service and ensure the proper functioning of equipment and systems.

The ROCC has direct communication via radio, telephone and/or public address with the following:

- Train operators and passengers,
- Station managers and passengers in stations,
- Office of Track and Structures and the Office of System Maintenance (including Automatic Train Control, Communications, Power and Automatic Fare Collection),
- Office of Rail Car Maintenance and Office of Plant Maintenance,
- Road, terminal, and yard tower supervisors,
- Local fire/rescue communications centers,
- Metro Transit Police Department and local police,
- Bus Operations Control Center,
- Control towers of common corridor railroads, and
- WMATA's Department of Safety and Environmental Management (SAFE).

WMATA's communication systems include:

- Comprehensive Radio Communications System,
- Conventional Mobile Radio Systems,
- Metro Transit Police Mobile Data Terminals,
- Public Safety Radio System Interfaces,
- Public Safety System Distributed Antenna System,
- Metrorail Station Closed Circuit Television (CCTV) System,
- Metrorail Station Digital Video Recorder System and Parking Garage CCTV,
- Fire and Intrusion Alarm Systems and Yard Security System,
- Public Address Systems, Integrated Intercommunications System, Passenger Emergency Response System, and Passenger Information Display Systems,
- Environmental Monitoring Systems (Veeder Root/Gas Tank Leak Detection Systems) and Methane Gas Detection Systems, and
- Program for the Response Options and Technology Enhancements for Chemical/Biological Terrorism (PROTECT) system.

A back-up computer provides redundancy, and automatically activates if the primary control computer malfunctions. Two diesel generators provide standby power if commercial power is lost. In addition, an Uninterruptible Power Supply (UPS) that will provide thirty minutes of emergency power supply for critical ROCC communication equipment and computer functions.

The Maintenance Operations Center (MOC), also part of the ROCC, is responsible for coordinating and monitoring all personnel and equipment responding to emergencies, revenue train delays, unusual occurrences, equipment, and facility malfunctions having the potential to disrupt or affect revenue service on the rail and bus systems.

WMATA's Jackson Graham Headquarters contains a back-up ROCC, which served as the Metrorail's original control center before the new Carmen E. Turner facility was constructed. WMATA's Metrorail system can be operated from either location.

### 3.1.5 Signal and Train Control

WMATA's train operations are governed by an automatic train control (ATC) system for train movements in both directions on two main tracks. The train control system was designed during Metrorail's original construction in the early 1970's. In many locations throughout the system, original train control equipment continues to be utilized, though rehabilitation and upgrade programs are underway to replace ATC components. The system employs "go/no-go" signals located at interlockings and speed read-outs to direct train operation. Interlockings are places where tracks join together and include track switches, associated signals and the control machinery that connects them to enable their operation and ensure safe operation.

Metrorail mainline routes are divided into blocks between the terminal stations at the ends of each route. Each block is checked for train occupancy utilizing audio frequency track circuits. Tuned impedance bond devices are installed at block boundaries. The impedance bonds transmit onto the rails the coded signals generated in the train control room that are used to detect the presence of a train in a block and to signal speed commands to trains.

A train operator can carry out train operations on Metrorail mainline routes in either automatic train control or manual control. ATC consists of three control subsystems; automatic train protection (ATP), automatic train supervision (ATS) and automatic train operation (ATO). Manual control can override ATS and ATO but does not override ATP. After the 2009 Fort Totten collision, WMATA suspended automatic train operations. After WMATA completed an extensive safety analysis and engineering evaluation of the performance of the ATC system, and replaced all of the older track circuits subject to the types of "parasitic oscillations" that caused the 2009 collision on the Red Line, automatic train control was recently restored to the Red Line during peak hour service. The rest of the system remains in manual operations.

Whether in manual or automatic operations, audio frequency track circuits provide track occupancy detection and speed commands. Audio frequency track circuits are electrical systems capable of detecting the presence of a train on the tracks and providing commands to such trains regarding their speed and behavior. Interlocking locations are primarily operated automatically; but the operation of the interlocking can be requested remotely by ROCC or from a local control panel in field train control rooms.

In automatic or manual, WMATA's ATP subsystem is designed to provide protection against collisions and over-speed conditions through the automatic block signaling system. Effective analysis and maintenance of the ATC system is critical to ensure the continued safe operation of the system. The ATP subsystem also provides control of interlockings, route security through interlockings and control of train door operation.

When in automatic modes, the ATO subsystem performs the functions of accelerating the train to running speed, regulating the train running speed, and stopping the train at proper positions at stations. The ATS subsystem controls and supervises the routing and scheduling of the trains. The ATS subsystem also supervises and controls the transit system mechanical support and electrical power facilities.

The ATC unit within the Office of Systems Maintenance (SMNT) maintains Metrorail's ATC system in conformance to WMATA's testing, inspection and maintenance procedures, including:

- ATC-1000 Instructions for Testing and Inspection of ATC Apparatus And Systems,
- ATC-2000 System Integrity Maintenance Practices, and
- ATC-3000 Preventative Maintenance and Technical Procedures Manual.

### 3.1.5 Traction Power and Auxiliary Power

The 750 volts, direct current (DC) traction power system provides the power source for vehicle propulsion. The traction power system includes contact and running rails, associated conductor system, with insulators supporting the contact rail, power substations and tiebreaker stations including transformers, rectifiers and switchgear for conversion and supply of power to the contact third rail system. Each segment of contact third rail can be supplied by adjacent power substations, and is supplied by separate power company substations, wherever practicable, for additional reliability. At many places in WMATA rail system, wide gaps in the third rails are provided to support track access and wayside equipment placement. Jumper cables bridge these gaps like extension cords, ensuring that 750 volts is available to the third rails, providing power to trains.

To enhance capacity, WMATA is currently making a series of improvements to the traction-power system to allow the deployment of eight-car trains. Eight-car trains increase the power requirements of each train and, therefore, the load put on the traction power system increases. Additional transformers, rectifiers, breakers, track feeder cables and negative return cables must be installed to support the power necessary to operate eight-car trains. These upgrades are required to ensure 8-car trains can operate without the risk of an overload to the power system, which could cause damage to the power equipment, cabling and/or trains.

A 480/277 volts alternating current (AC) auxiliary power system provides for lighting, heating, ventilation, air conditioning, escalators and elevators, communications, train control systems, fare collection equipment, emergency power systems, illuminated signs, clocks, alarms, station CCTV, public address (PA) systems, and pumping stations. Additionally, emergency power is provided from an uninterruptible power supply (UPS) battery system to prevent loss of critical lighting, Automatic Train Control, and communications in case of a complete loss of AC power. There are 74 permanent generators at key stations and facilities, 19 mobile (trailered) generators and 13 portable generators to provide power for safety critical equipment in the event of power loss.

The Power (POWR) branch within SMNT is responsible for the maintenance of all WMATA AC and DC power electrical facilities and equipment to ensure power is available for all passenger stations, trains, rail yards, chiller plants, tunnels, fan shafts, bus facilities and support for Start-up activities. Power personnel inspect, modify, overhaul, test and repair power distribution switchgear, lighting systems, associated electrical equipment and cables.

## 3.2 Metrorail Safety Performance

An analysis of WMATA's safety event, injury and fatality data from annual submissions collected by FTA through the state safety oversight (SSO) program for calendar years 2008 to 2013 shows generally improving safety performance for WMATA's Metrorail system. Total safety events, fatalities and injuries all fell at WMATA since 2010, while generally increasing for most of WMATA's peers and the entire heavy rail transit industry during the same period. Preliminary data reviewed from the FTA National Transit Database (NTD) for calendar year 2014 generally continues the downward trend in WMATA incidents.[1]

Data for calendar year 2015, including the January 12, 2015 smoke incident near L'Enfant Plaza Station, is not included in this analysis. For purposes of this review, WMATA's peers include the heavy rail transit systems operated by the Bay Area Rapid Transit (BART) district, the Chicago Transit Authority (CTA), the Massachusetts Bay Transportation Authority (MBTA), the Metropolitan Transportation Authority, New York City Transit (NYCT), and the Southeastern Pennsylvania Transportation Authority (SEPTA).

In reviewing this safety performance data, in Tables 3 through 5 below, it is important to recognize that reports made to FTA's SSO and NTD systems record information on only the most serious incidents to occur. This safety information includes the type of safety event (accident); the consequences, in terms of fatalities and injuries; and general causal information. This data is largely "lagging" because it captures what already happened, and does not reflect pre-cursor events, such a near-misses, employee safety reports, analysis of maintenance defects or formal observations of normal operations, that provide data-rich sources from which to examine and compare overall levels of safety among and between public transportation agencies and modes.

**Table 3. Rail Transit Safety Events, 2008 to 2013**

**Safety Events**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Avg. | Sum | Trend |
|---|---|---|---|---|---|---|---|---|---|
| **WMATA** | 23 | 31 | 78 | 63 | 32 | 21 | 41.33 | 248 | |
| *CTA* | 19 | 27 | 33 | 27 | 36 | 30 | 28.67 | 172 | |
| *SEPTA* | 9 | 19 | 12 | 27 | 15 | 22 | 17.33 | 104 | |
| *MBTA* | 10 | 9 | 10 | 6 | 11 | 19 | 10.83 | 65 | |
| *BART* | 12 | 9 | 8 | 8 | 11 | 8 | 9.33 | 56 | |
| *NYCT* | 52 | 12 | 81 | 91 | 101 | 108 | 74.17 | 445 | |
| **All Peers** | 102 | 76 | 144 | 159 | 174 | 187 | 140.33 | 842 | |
| **HR Industry** | 142 | 121 | 248 | 248 | 233 | 231 | 203.83 | 1223 | |

[1] The data exclude suicide and trespassing-related events, as well as homicides. State safety oversight program submittals for calendar year 2014 are not yet available, however, for this assessment, FTA was able to incorporate preliminary fatality and injury data for calendar year 2014 from the National Transit Database (NTD). Preliminary NTD data excludes single-injury security events, homicides, and suicides.

WMATA reported a significant decline in safety events since 2010.

In comparison, WMATA's peer group has reported an overall increase in events during that same period.

**Table 4. Rail Transit Fatalities, 2008 to 2014**

Fatalities

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014* | Avg. | Sum | Trend |
|---|---|---|---|---|---|---|---|---|---|---|
| **WMATA** | 0 | 12 | 8 | 3 | 4 | 2 | 0 | 4.14 | 29 | |
| *CTA* | 4 | 1 | 3 | 1 | 7 | 6 | 2 | 3.43 | 24 | |
| *SEPTA* | 1 | 1 | 3 | 0 | 1 | 6 | 1 | 1.86 | 13 | |
| *MBTA* | 0 | 1 | 0 | 1 | 0 | 1 | 2 | 0.71 | 5 | |
| *BART* | 1 | 0 | 3 | 3 | 2 | 4 | 1 | 2.00 | 14 | |
| *NYCT* | 7 | 5 | 10 | 5 | 18 | 10 | 30 | 12.14 | 85 | |
| **All Peers** | 13 | 8 | 19 | 10 | 28 | 27 | 36 | 20.14 | 141 | |
| **HR Industry** | 14 | 20 | 29 | 18 | 37 | 31 | 36 | 26.43 | 185 | |

Only NYCT has reported more heavy rail safety-related fatalities since 2008 than WMATA.

WMATA accounts for 16% of heavy rail safety-related fatalities since 2008.

WMATA heavy rail safety-related fatalities have been on the decline since 2009, when the agency reported 12 fatalities.

**Table 5. Rail Transit Injuries, 2008 to 2014**

Injuries

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014* | Avg. | Sum | Trend |
|---|---|---|---|---|---|---|---|---|---|---|
| **WMATA** | 4 | 57 | 39 | 27 | 25 | 12 | 2 | 23.71 | 166 | |
| *CTA* | 48 | 34 | 35 | 11 | 33 | 58 | 40 | 37.00 | 259 | |
| *SEPTA* | 8 | 18 | 7 | 40 | 11 | 12 | 3 | 14.14 | 99 | |
| *MBTA* | 1 | 3 | 22 | 3 | 7 | 5 | 2 | 6.14 | 43 | |
| *BART* | 2 | 10 | 0 | 8 | 5 | 13 | 0 | 5.43 | 38 | |
| *NYCT* | 75 | 6 | 60 | 67 | 83 | 73 | 52 | 59.43 | 416 | |
| **All Peers** | 134 | 71 | 124 | 129 | 139 | 161 | 97 | 122.14 | 855 | |
| **HR Industry** | 156 | 130 | 204 | 166 | 186 | 176 | 100 | 159.71 | 1118 | |

WMATA has reported a general decline in safety-related injuries since a peak of 57 in 2009.

Since 2008, WMATA reported the third most safety-related injuries amongst the identified peer group.

WMATA accounts for 15% of heavy rail safety-related injuries since 2008.

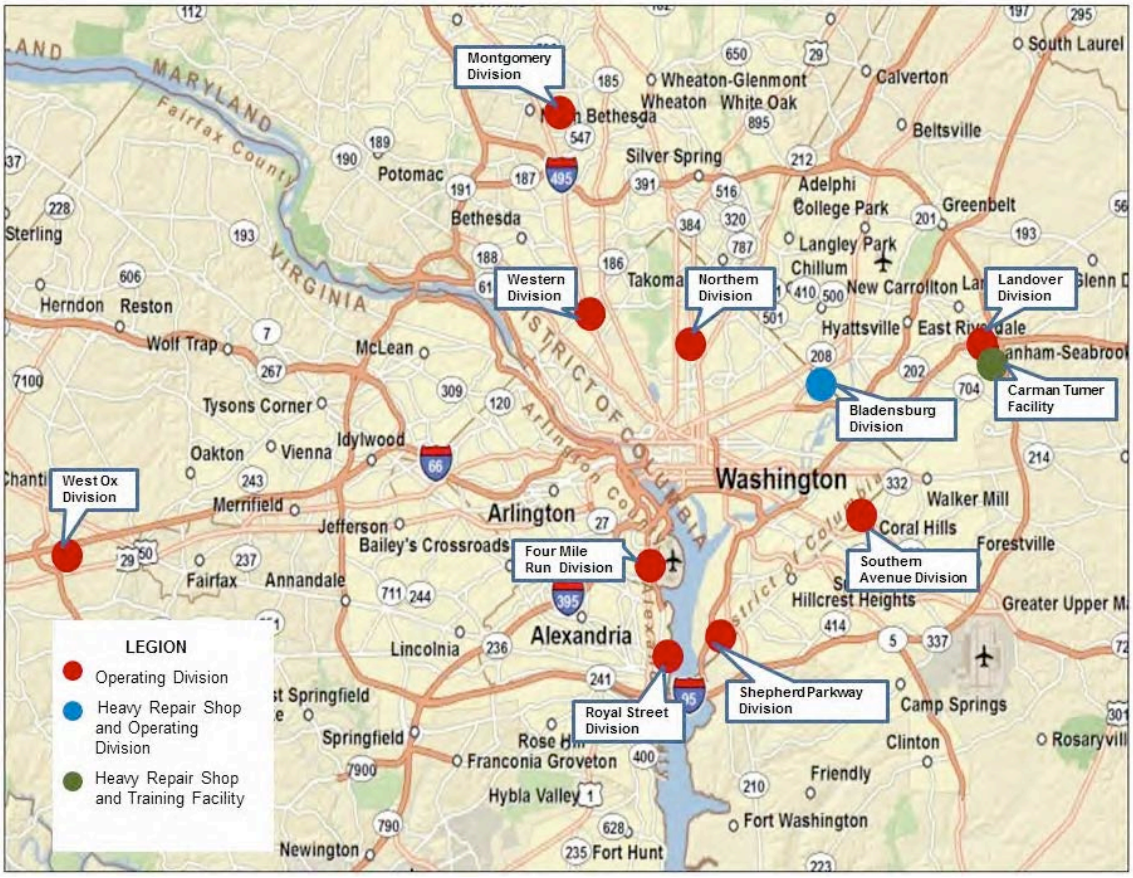
## 3.3 Metrobus

WMATA's Metrobus system was created in 1973, when WMATA consolidated service provided by four different private bus companies. Metrobus serves the District of Columbia, the suburban Maryland counties of Montgomery and Prince George's and the Northern Virginia counties of Arlington and Fairfax and the cities of Alexandria, Fairfax and Falls Church.

WMATA's Metrobus system operates a fleet of approximately 1,500 buses over 328 routes on 187 lines, servicing over 11,000 bus stops and 2,500 bus shelters, and carries roughly 465,000 weekday passengers. The nation's sixth largest bus fleet, WMATA's Metrobus operates 24 hours per day, seven days per week.

All Metrobuses are air-conditioned, equipped with two-way radios for emergency communication, video cameras, fire suppression systems, kneeling features and wheelchair capabilities. Metrobuses are 100% accessible for the elderly and disabled. The buses have silent alarms, emergency engine shutdown switches, and flashing lights located around the roof area that can be activated to alert police agencies for operator/passenger protection.

To service its bus fleet, Metrobus manages ten full-service operating divisions, as shown below:



Currently the operating facilities located in the District of Columbia accommodate 45% of the total fleet, with those in Maryland and Virginia at 29% and 26% respectively. In addition, WMATA has two heavy repair shops, at the Carmen E. Turner facility and the Bladensburg Division, both located in Maryland. The Carmen E. Turner facility performs major corrective maintenance and the heavy repair shop at the Bladensburg Division serves as the home of the WMATA Heavy Maintenance Overhaul Program. Through this program, WMATA's Board of Directors recently raised the expected service life of a standard Metrobus from 12 years to 15 years and set the target average age of the Metrobus fleet at seven-and-a-half years.

WMATA's buses are also 100% equipped with the DriveCam system, which is a comprehensive fleet safety and risk management program. This system assists with improving Metrobus safety by documenting incidents and assisting operators to develop safer, more efficient driving habits. As part of a five-year contract, the contractor will review and analyze video footage; and provide feedback on operator driving habits. The system detects when an operator makes a defensive move to avoid an accident, brakes or accelerates suddenly, turns sharply or is involved in an accident. The analysis is provided to management, supervisors, trainers and operators to encourage good driving habits, correct poor habits, and assist in investigations.

The exact number of buses in WMATA's Metrobus fleet is determined by the projected annual bus schedule requirements with additional spares, to account for buses in maintenance and inspection or awaiting repair. The Metrobus fleet is comprised of the following power trains: Diesel, 15%; compressed natural gas (CNG), 30%; Hybrid, 45%; and Clean Diesel, 10%. The sub-fleets include buses manufactured by: New Flyer, Neoplan, Orion, NABI and Chevrolet, with model years ranging from 1997 to 2014. There are five buses in the special and historical fleet. As of early 2014, there were approximately 1,530 active buses with a peak service level of approximately 1,290 buses.

## 3.4 Metrobus Safety Performance

FTA also conducted an analysis of major safety events and resulting injury and fatality data for Metrobus, several peer transit agencies, and the full bus industry, based on the NTD Safety and Security module for calendar years 2008 to 2014. The data exclude single-injury security events, suicide and trespassing-related events, as well as homicides. Data from calendar year 2014 is preliminary. WMATA's peers include bus systems operated by CTA, MBTA, NYCT, and SEPTA.

This analysis shows that between 2008 and 2014, WMATA's Metrobus service experienced a relatively steady trend in total safety events (averaging 188 per year), experienced fewer fatalities than its peer agencies during this period, and reported a modest downward trend in safety injuries after a peak in 2010 and 2011. As with Metrorail's safety performance, Metrobus experienced positive safety gains in recent years when most of its peers and the industry as a whole experienced a declining safety performance. As with the data presented above on Metrorail's safety performance, analysis focused exclusively on lagging indicators has limitations in terms of its predictive and comparative value.

**Table 6. Bus Transit Safety Events, 2008 to 2014**

Major Safety Events

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014* | Avg. | Sum | Trend |
|---|---|---|---|---|---|---|---|---|---|---|
| **WMATA** | 181 | 176 | 209 | 221 | 167 | 192 | 173 | 188.43 | 1,319 | |
| *CTA* | 320 | 289 | 259 | 287 | 283 | 252 | 260 | 278.57 | 1,950 | |
| *SEPTA* | 91 | 94 | 100 | 112 | 28 | 206 | 250 | 125.86 | 881 | |
| *MBTA* | 61 | 35 | 14 | 28 | 59 | 88 | 118 | 57.57 | 403 | |
| *NYCT* | 297 | 310 | 301 | 244 | 227 | 257 | 307 | 277.57 | 1,943 | |
| **All Peers** | 769 | 728 | 674 | 671 | 597 | 803 | 935 | 739.57 | 5,177 | |
| **Nonrail Industry** | 4,055 | 3,913 | 3,951 | 4,012 | 3,959 | 4,334 | 4,720 | 4,134.86 | 28,944 | |

WMATA accounts for about 4.6% of the non-rail safety events since 2008.
WMATA ranks third out of the five agencies in the peer group in terms of number of safety events reported since 2008.
WMATA has reported a modest downward trend in non-rail safety events since a peak in 2010 and 2011. The industry, on the other hand, has reported a general increase in safety events over those years.

**Table 7. Bus Transit Fatalities, 2008 to 2014**

Fatalities

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014* | Avg. | Sum | Trend |
|---|---|---|---|---|---|---|---|---|---|---|
| **WMATA** | 2 | 2 | 0 | 1 | 1 | 2 | 0 | 1.14 | 8 | |
| *CTA* | 1 | 4 | 1 | 2 | 3 | 1 | 3 | 2.14 | 15 | |
| *SEPTA* | 2 | 1 | 1 | 3 | 3 | 4 | 1 | 2.14 | 15 | |
| *MBTA* | 0 | 1 | 2 | 0 | 4 | 2 | 2 | 1.57 | 11 | |
| *NYCT* | 1 | 1 | 3 | 2 | 6 | 9 | 7 | 4.14 | 29 | |
| **All Peers** | 4 | 7 | 7 | 7 | 16 | 16 | 13 | 10.00 | 70 | |
| **Nonrail Industry** | 78 | 79 | 88 | 85 | 102 | 103 | 86 | 88.71 | 621 | |

WMATA accounts for about 1.3% of all non-rail safety fatalities.
WMATA ranks fifth out of the five peer agencies in terms of non-rail safety fatalities since 2008, averaging 1.14 fatalities per year. Only one other peer (MBTA) averaged less than two per year.

**Table 8. Bus Transit Injuries, 2008 to 2014**

Injuries

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014* | Avg. | Sum | Trend |
|---|---|---|---|---|---|---|---|---|---|---|
| **WMATA** | 306 | 288 | 429 | 407 | 297 | 345 | 262 | 333.43 | 2,334 | |
| *CTA* | 591 | 523 | 562 | 533 | 595 | 420 | 402 | 518.00 | 3,626 | |
| *SEPTA* | 169 | 250 | 386 | 312 | 67 | 373 | 438 | 285.00 | 1,995 | |
| *MBTA* | 88 | 69 | 33 | 92 | 132 | 120 | 141 | 96.43 | 675 | |
| *NYCT* | 700 | 702 | 706 | 644 | 559 | 659 | 526 | 642.29 | 4,496 | |
| **All Peers** | 1,548 | 1,544 | 1,687 | 1,581 | 1,353 | 1,572 | 1,507 | 1,541.71 | 10,792 | |
| **Nonrail Industry** | 7,290 | 7,162 | 7,570 | 7,745 | 7,882 | 8,259 | 7,718 | 7,660.86 | 53,626 | |

WMATA accounts for about 4.4% of the non-rail safety injuries since 2008.

WMATA ranks third out of the five agencies in the peer group in terms of number of safety injuries reported since 2008.

WMATA reported a modest downward trend in non-rail safety injuries since a peak in 2010 and 2011. The industry, on the other hand, has reported a general increase in injuries over those years.

# 4.0 FTA's SMI Approach

## 4.1 Methodology

To conduct the SMI, FTA assembled 10 teams comprised of over 35 technical, safety and transit operations experts to conduct a comprehensive assessment. FTA's SMI teams reviewed over 1,000 documents submitted by WMATA departments and interviewed over 300 people at all levels of the Metrorail and Metrobus systems. FTA's SMI team members conducted field observations of all shifts, and performed independent inspections, tests and measurements at WMATA's rail and bus vehicle maintenance facilities and in the field at track, switch and signal, traction power, communications and ventilation system installations.

FTA also conducted an independent safety culture assessment for front-line personnel, and reviewed the results against WMATA's safety survey, which captured the opinions, attitudes, and safety experience of over 6,500 employees in 2014. Finally, to address Urgent Safety Recommendation R-15-7, FTA reviewed WMATA's full audit of its tunnel fan and ventilation system, and conducted spot audits of preventive maintenance inspections at five fan shafts and two vent shafts, including observations regarding the process required for testing remote operation in both directions from the ROCC.

Through all activities to assess WMATA's safety performance, FTA's SMI teams evaluated:

- WMATA's compliance with requirements specified in the agency's track, traction power, signal, and rail and bus vehicle inspection, testing, and repair programs, and needed enhancements in these programs;
- The performance and effectiveness of WMATA's rail operations control center (ROCC) and bus operations control center (BOCC), and the overall quality of the radio system and visual display systems used to support and monitor rail and bus operations;
- The effectiveness of WMATA's roadway worker protection (RWP) program;
- The quality and frequency of communication regarding maintenance and safety issues across WMATA departments and with WMATA's executive leadership and board;
- The quality of, and WMATA's conformance with, initial and refresher training programs for major classifications of operations and maintenance employees;
- Implementation of WMATA's fatigue management program;
- The quality and effectiveness of WMATA's rules compliance and operational testing programs for major classifications of operations and maintenance employees, including supervisors and yard operations;
- The quality and effectiveness of supervision provided for major classifications of operations and maintenance employees;
- The quality and availability of data in WMATA's information management systems to support enhanced safety risk assessment and hazard management activities; and
- The quality and effectiveness of WMATA's plans, procedures, and training programs for managing emergencies, and ensuring the readiness of WMATA's front-line personnel and emergency responders.

## 4.2 Findings and Required Actions

Based on this evaluation, FTA finds that, over the last five (5) years, WMATA has implemented new management initiatives and programs to address safety concerns and improve safety culture. WMATA has made advances in many areas, including:

- Standing up a significantly strengthened Safety Department, reporting directly to the General Manager/Chief Executive Officer, with 67 total positions, including a range of expertise, backgrounds, and professional engineering and safety certifications, supplemented by a technical services contract for engineering and auditing support;
- Re-building WMATA's safety committee structure, and establishing clear procedures and processes for the management of Local Safety Committees, Departmental Safety Committees and the Executive Safety Committee;
- Initiating a first-of-its-kind, scientifically based fatigue management program for public transit employees;
- Initiating and sustaining a biennial employee safety culture survey assessment and sharing the results back with supervisors and employees;
- Establishing new hiring and training plans to "right size" the agency to address staffing needs for the new Silver Line extension and service expansions;
- Establishing an enhanced Roadway Worker Protection program that incorporates lessons learned and effective practices from other transit agencies and the Federal Railroad Administration;
- Developing new internal auditing and quality programs to assess (more accurately) the agency's level of conformance with plans, procedures and requirements;
- Developing new training programs to enhance skills for technical employees;
- Developing and carrying out two long-term capital investment programs (MetroForward and Momentum) to bring rail vehicles and infrastructure and buses and facilities into a better state of repair;
- Working cooperatively with the TOC to close 201 corrective action plans, stemming from audits, accidents, and internal reviews, since 2012; and
- Completing work to close out 26 safety recommendations issued by the NTSB since 2005, including completion of major programs to restore the reliability of the ATC system, to replace 178 No. 8 standard turnouts with guarded turnouts on mainline track, and to develop an industry-leading program for confidential close call reporting with WMATA's Amalgamated Transit Union (ATU) Local 689.

While FTA acknowledges WMATA's clear and substantial progress over the last five years, FTA's SMI also identified organizational deficiencies and operational concerns that continue to limit the agency's effectiveness in recognizing and resolving safety issues and hazards. FTA's SMI found that, in key areas, WMATA's organization is not effectively balancing safety-critical operations and maintenance activities with the demand for passenger service.

Specifically for Metrorail, FTA's SMI team determined that WMATA work crews do not have sufficient access to the rail ROW to perform critical inspection, testing and maintenance activities. FTAs' SMI team also found that for some of Metrorail's more complicated technical

systems, shared responsibilities for maintenance inspections and repairs, training, and operational testing, are not always well managed, leaving one department's top safety priorities unaddressed by another department with different focus areas and considerations. In addition, FTA's SMI team identified clear deficiencies in the availability, quality and performance of technical training, refresher training, and rules compliance and operational testing activities. Poorly functioning and poorly utilized information management systems and technology also limit the effectiveness of WMATA's training, rules checks and operational testing, and maintenance programs and activities.

Perhaps most significantly, FTA's SMI team found serious safety lapses in the ROCC, related to the training and certification of rail traffic controllers; the ROCC structure, organization and staffing; the availability of checklists, procedures, manuals and tools; the quality of the radio system and radio communications; and the performance of the AIM system to visually display and monitor the status of the rail transit system. Collectively, these issues significantly impact the ability of the Metrorail system to schedule and conduct maintenance work, to manage abnormal and emergency events, and to ensure the safety of trains and personnel on the ROW.

For the Metrobus system, FTA's SMI team found many effective practices relating to WMATA's industry-leading fatigue management program and WMATA's use of cameras and DriveCam technology on bus vehicles to monitor the safety of service. FTA's SMI team also generally observed a streamlined and effective process for the selection of bus operators, a comprehensive new-hire bus operator training program, as well as an extensive training program for new bus mechanics. FTA's SMI team determined that WMATA conducts a general knowledge assessment survey for mechanics, and supports a Mechanic Apprentice Program to guide mechanics through increasing levels of qualification and certification. Metrobus requires Automotive Service Excellence (ASE) certification of all mechanics, and provides a cash incentive program for mechanic performance. Metrobus also works to incorporate information technology, and to thoroughly document maintenance activities in its maintenance management work order system.

While FTA's SMI team found many effective practices at Metrobus, FTA's SMI team also identified concerns in WMATA's Bus Operations Control Center (BOCC) regarding the lack of manuals, documented checklists and procedures for bus dispatchers, and a general level of informality in bus radio use and communications. FTA's SMI team also determined that WMATA's bus operating and maintenance departments have unmet training needs, and do not generally conform with all requirements specified in rules compliance and operations testing programs, including annual refresher requirements.

FTA's SMI team identified areas where automated systems could greatly improve safety processes, and where specific types of maintenance inspections and reviews would benefit fleet safety performance. FTA also found that Metrobus employees at all levels of the organization identified their most significant safety concern as WMATA's ability to protect bus operations personnel from violent, disgruntled, or disruptive passengers and members of the public.

## 4.3 Findings, Required Actions and Close-out Process

As a result of this SMI, FTA issues 44 safety findings in eight categories regarding WMATA's Metrorail system and 10 safety findings in five categories regarding WMATA's Metrobus system. To address these findings, FTA is issuing Safety Directive 15-1, which uses FTA's new MAP-21 authority to direct WMATA to take specific actions to create and comply with an FTA-approved action plan that addresses gaps in operations and maintenance potentially affecting public safety.

In Safety Directive 15-1, FTA identifies 78 distinct actions to be completed by WMATA's Metrorail system and 13 distinct actions to be completed by WMATA's Metrobus system to enhance public safety. **Appendix C** provides a tracking matrix with the findings and required actions issued in FTA's Safety Directive 15-1.

WMATA will have 30 days to respond to Safety Directive 15-1, to provide additional information for consideration, and to propose any equivalent alternate actions for consideration by FTA's Acting Administrator. Sixty days thereafter, WMATA must submit a tracking matrix to FTA that identifies the specific actions that will be performed to address each required element specified in this Safety Directive; the milestone schedule for completing corrective action; the responsible parties for action and their contact information; and the verification strategy for ensuring the completion of required work. In preparing this response, WMATA will have the opportunity to propose its prioritization of action and available resources to address FTA's required actions.

| WMATA Metrorail System | |
|---|---|
| ***Categories of Metrorail System Finding*** | ***Number of Findings and Required Actions*** |
| • Category R-1: Inadequate Rail Operations Control Center Staffing and Procedures | 14 Findings and 21 Required Actions |
| • Category R-2:Ineffective Training, Operational Testing and Rules Compliance Programs | 8 Findings and 22 Required Actions |
| • Category R-3: Insufficient Track Time for Maintenance | 4 Findings and 4 Required Actions |
| • Category R-4: System-wide Maintenance Issues | 7 Findings and 7 Required Actions |
| • Category R-5: Fire/Life Safety and Emergency Preparedness | 2 Findings and 7 Required Actions |
| • Category R-6: Condition and Performance of Tunnel Ventilation System | 3 Findings and 4 Required Actions |
| • Category R-7: Performance of Information Management Technology | 4 Findings and 8 Required Actions |
| • Category R-8: Outstanding Items from Previous FTA Audits and Reviews | 2 Findings and 5 Required Actions |
| ***Total*** | ***44 Findings and 78 Required Actions*** |

| WMATA Metrobus System | |
|---|---|
| ***Categories of Metrobus System Finding*** | ***Number of Findings and Required Actions*** |
| • Category B-1: Concern over Protection of Metrobus Operations Personnel | 1 Finding and 2 Required Actions |
| • Category B-2: Limited Availability of Training for Operations and Maintenance Personnel | 2 Findings and 2 Required Actions |
| • Category B-3: Inconsistent Operational Testing and Rules Compliance Checks | 3 Findings and 4 Required Actions |
| • Category B-4: System-wide Maintenance Issues | 2 Findings and 2 Required Actions |
| • Category B-5: Lack of Information Management System Technology | 2 Findings and 3 Required Actions |
| ***Total*** | ***10 Findings and 13 Required Actions*** |

FTA will review and approve WMATA's work plans, and will monitor the agency's progress in resolving each finding and required action. FTA will conduct monthly meetings with WMATA to review progress until such time as FTA determines that these meetings are no longer needed or may be conducted with less frequency. FTA will also coordinate with the TOC regarding the review and final approvals of corrective action plans for the Metrorail system.

FTA is also asking WMATA's Board of Directors to closely monitor the time and resources made available to WMATA's operations and maintenance departments to conduct critical inspection, testing, training, and repair activities. **Appendix D** provides a copy of WMATA's organization chart in effect at the time of the SMI.

WMATA participated fully in the SMI and FTA anticipates that cooperation to continue through the completion of all corrective actions in response to this report.

In addition, in support of the SMI, FTA performed a Safety Management System (SMS) Gap Analysis to evaluate WMATA's approach to safety management practices as they relate to a fully mature SMS. The SMS Gap Analysis was not an exercise in safety compliance. SMS is a management approach adopted by FTA that ensures each public transportation agency has the necessary organizational structures, accountabilities, policies, and procedures in place to direct and control resources for safety management. SMS is not a requirement in the public transportation industry. Thus, this cooperative effort with WMATA serves as a tool for continuous improvement in WMATA SMS development and implementation activities.

SMS has four levels of maturity: Initiating, Planning, Implementing, and Managing and Monitoring. The SMS Gap Analysis identified an overall WMATA SMS maturity level between Planning and Implementing with some areas at the Managing and Monitoring level. SMS is new to the public transportation industry and may take a transit agency two to four years to reach the full maturity level depending on its size and complexity. To further advance its SMS efforts, WMATA has accepted an FTA invitation to participate in a SMS pilot program.

# 5.0 Metrorail Findings and Required Action

FTA organizes its discussion regarding the findings and required actions from its SMI at WMATA Metrorail into eight over-arching categories of safety critical concerns:

- Category R-1: Inadequate Rail Operations Control Center Staffing and Procedures
- Category R-2: Ineffective Training, Operational Testing, and Rules Compliance Programs
- Category R-3: Insufficient Track Time for Maintenance
- Category R-4: System-wide Maintenance Issues
- Category R-5: Fire/Life Safety and Emergency Preparedness
- Category R-6: Condition and Performance of Tunnel Ventilation System
- Category R-7: Performance of Information Management Technology
- Category R-8: Outstanding Items from Previous FTA Audits and Reviews

Within these categories, FTA makes specific findings based on the results of interviews, document and records reviews, field observations, and independent inspections, testing and measurements. In Safety Directive 15-1, FTA issues required actions that WMATA must take to address the findings described in each category of this SMI report. Safety Directory 15-1 also establishes required response times, a process for FTA approval of work plans, and the FTA's approach to the monitoring of the implementation WMATA's work plans.

## 5.1 Category R-1: Inadequate Rail Operations Control Center Staffing and Procedures

FTA's SMI team found that the staffing, organization, and tools used to manage the ROCC could be significantly improved to enhance effectiveness and reduce opportunities for distraction and miscommunication. FTA's SMI team identified 14 findings regarding ROCC staffing, ROCC procedures and training programs, the quality of WMATA's radio communications and radio discipline, and the performance technology systems.

### Situation

WMATA's Office of Rail Transportation (RTRA) is responsible for managing the ROCC. WMATA's ROCC is staffed 24 hours per day, seven days per week, and serves as a command and control facility from which all aspects of the Metrorail system are directed and from which decisions are made regarding normal, abnormal and emergency operations. The ROCC also serves as the primary point of coordination for all operational decisions affecting rail service. This coordination usually includes both internal WMATA departments as well as external emergency response agencies.

The ROCC provides positive control over all train movements, station activities, and subsystems (power, ATC, automatic fare collection, and communications) following operating rules and SOPs set forth in WMATA's MSRPH, supporting Operations Administrative Procedures (OAPs), and temporary and permanent orders.

The ROCC monitors and controls train movements through three consoles, designated as:

- Operations 1 (Ops 1) - Red Line;
- Operations 2 (Ops 2) - Blue/Orange/Silver Lines; and
- Operations 3 (Ops 3) - Blue/Yellow/Green Lines (Blue Line south of Rosslyn).

Two rail traffic controllers or RTCs staff each console—a radio controller and a train "buttons" controller. The console is designed so that the radio- and train- RTC positions can be worked from either side of the console. One RTC can also work the console in the absence of the other. The radio controller communicates with train operators by radio and is responsible for ensuring conformance with policies and procedures and for keeping train operators and personnel informed of all unusual occurrences on the rail transit system. The radio controller also communicates with supervisors and maintenance personnel in the field. The buttons controller is responsible for such tasks as setting route alignments and signals, setting train performance levels, and coordinating the addition or replacement of trains when necessary.

The ROCC, employing a central computer system called the Advanced Information Management or AIM system, implements train control strategies as necessary to regulate traffic flow. These control strategies may be preprogrammed strategies that are carried out automatically by the central control mainframe computer, or they may be strategies implemented manually by ROCC line controllers. The AIM system provides a visual display and alarm status monitoring for train positions, switch positions, signal status and malfunctions, and status of support systems such as ventilation, drainage, fire and intrusion alarms, traction power system status, and drainage pumping station alarms. RTCs must respond to alarms and notifications from the AIM system to manage service and ensure the proper functioning of equipment and systems.

Between stations, the RTCs can manually control train movements by changing signal aspects or switch alignments at interlockings at certain control points or through direct communication with train operators via a two-way radio system. RTCs also use indicators available in the AIM system to program reminders in the visual display system regarding the presence of workers on the rail transit ROW, and to highlight unusual situations, manual blocks, or issues with signals.

The MOC, also part of the ROCC, is responsible for coordinating and monitoring all personnel and equipment responding to emergencies, revenue train delays, unusual occurrences, equipment, and facility malfunctions having the potential to disrupt or affect revenue service on the rail and bus systems. The MOC directs the performance of preventive maintenance activities in accordance with OAP 200-3 and with applicable manufacturers' recommended maintenance practices. The MOC also uses the following OAPs: 200-5, 200-9, 200-27, 202-5, 204-1, 208-1, 210-3, 210-4, 210-6, and CMNT SOPs 1.04, 1.05 and 1.06, to direct corrective and supportive maintenance activities.

- **Finding R-1: WMATA's Rail Operations Control Center is significantly understaffed.**

Depending on the day of the week and the level of service required, WMATA's ROCC typically controls the movement of between 124 and 144 passenger trains per day on the Metrorail system. In addition, the ROCC controls access to the ROW for inspections, emergency repairs, scheduled

maintenance activities, and during the OWL nighttime shift, for a large volume of work activity, stemming from corrective maintenance requirements and over 200 capital projects, the majority of which are focused on rehabilitating, upgrading or maintaining critical rail transit infrastructure. Given the size of the Metrorail system and volume of passenger service and maintenance activities, WMATA's ROCC is one of the busiest control centers in the transit industry.

In 2012 and 2013, WMATA's executive leadership team conducted a workload assessment for the ROCC, including a comprehensive review of ROCC requirements and activities, including plans for the new Silver Line and eight-car train implementation. As a result, for 2014, WMATA increased staffing by budgeting for the following positions to the ROCC:

- Director (1)
- Superintendents (2)
- Assistant Superintendents (7)
- Rail Traffic Controllers (52)
- Rail Service Liaisons (4)
- Rail Operations Information Center Superintendent (1)
- Rail Operations Information Specialists (19)
- MOC Superintendent (1)
- MOC Assistant Superintendents (6)
- MOC personnel (20 Supervisors plus 5 Service Dispatchers)

At the time of FTA's SMI, while most ROCC positions were staffed at or close to their budgeted levels, WMATA's ROCC had 34 Rail Traffic Controllers on staff, almost 20 positions below authorized levels. These 34 RTCs fill what is arguably the most challenging job at WMATA, providing 24 hour, seven-day-a-week coverage for both radio and button functions across the three desks that control all six Metrorail lines and the midnight OWL maintenance period.

Because of the difficulty of the controller function, and the limited number of RTCs, the safety and efficiency of the entire Metrorail operation depends on the experience, skills and decision-making capabilities of this very small number of employees. Due to collective bargaining limitations of 12 hours worked within a 24-hour period (8-hour shift plus 4-hours of overtime), WMATA's ROCC has not been a central focus of the agency's Fatigue Management Risk Program because RTCs are afforded the opportunity for 8-hours of uninterrupted sleep between shifts.

However, FTA's SMI team found that, in spite of WMATA's efforts to enhance staffing, the ROCC remains, in the words of one Assistant Superintendent, "an over-time driven room." Due to the around-the-clock nature of ROCC operations, individual RTCs may work six or even seven 12-hour days per week.

In interviews, ROCC personnel reported that overtime pay compensates for what they consider to be the lower salaries offered to WMATA's RTCs when compared to controllers or dispatchers in other industries or public safety agencies.

Even with overtime available for RTCs, however, ROCC management struggles with ensuring coverage for all shifts, and Superintendents and Assistant Superintendents also work long hours to support the functioning of the ROCC.

- **Finding R-2: RTC re-certification has not occurred as required.**

Given the dynamic nature of operating rail transit systems, where methods and procedures change frequently, personnel assigned to the control center environment must receive periodic retraining or recertification. WMATA, following industry safety standards, set an annual requirement for RTC re-certification.

The purpose and intent of re-certification is to ensure that RTC personnel are current with regard to newly developed standards, procedures and rules as they apply to the operating system. For example, since WMATA last updated its rulebook in 2014, the agency has issued over 40 temporary and permanent orders, initiated major construction on Phase 2 for the Silver Line, placed the 7000-series vehicle in service, and returned to ATO on the Red Line during peak service hours. Several new projects have been undertaken to upgrade infrastructure, and operations and maintenance personnel face a dynamic range of issues in the field, which must be managed and coordinated with the ROCC.

Further, as requirements and standards are implemented or modified for the ROCC, it is essential to determine the extent to which assigned personnel are conversant with such changes. The re-certification process typically includes presentation material and written exams. In some instances, observations of RTC performance may also be included. When re-certification is achieved, the employee's personnel record or training file is updated accordingly.

Records requested and reviewed by FTA's SMI team confirmed that RTCs had not been re-certified since 2012, though WMATA's internal procedures and System Safety Program Plan require annual re-certification. Given the changes to WMATA's operating environment since 2012, FTA finds this failure to re-certify RTCs as a significant breach in WMATA's program to ensure their on-going proficiency in WMATA's operating requirements, rules and changing infrastructure and equipment.

- **Finding R-3: RTCs receive limited refresher training and no road days.**

FTA's SMI team documented high levels of overtime in WMATA's ROCC, and, due to low RTC staffing levels, an unwillingness or inability to remove RTCs from duty for training or road days. Outside of scenarios and scripts reviewed with RTCs by the ROCC Assistant Superintendents, FTA's SMI team was only able to verify an extremely limited amount of refresher training provided to RTCs since 2012, typically targeted to a particular program, such as Roadway Worker Protection. Further, FTA's SMI team found that RTCs, because of their value to the operation of the rail transit system, rarely leave the ROCC.

FTA's SMI team confirmed that no "road days" or "field familiarization" days were scheduled or readily available for RTCs – most veteran RTCs interviewed had not seen the field or roadway in

over six years. For the Silver Line, RTCs were provided a DVD of the alignment, rather than an actual tour. Veteran RTCs cited this lack of recent field experience as a major challenge in the performance of their work for a dynamic and changing system.

- **Finding R-4: There is a high level of noise and distraction in the ROCC, and a lack of electronic controls in the AIM system to prevent errors.**

In addition to the three RTC desks, the ROCC contains desks used by the Maintenance Operations Center for Power, ATC and Communications, Plant, and Elevators and Escalators, as well a Car Maintenance desk, Office of Emergency Management (OEM) desk, the Rail Operations Information Center (ROIC) and the Public Address Announcer along with the Social Media desks. All of these desks monitor radio transmissions using speakers listened to by their controllers, specialists and personnel. With no headsets or earphones used by ROCC personnel, multiple speakers broadcasting radio channels throughout the room contributes to noise and distraction in the ROCC, and background interference on radio communications.

FTA's SMI team also observed Assistant Superintendents or Superintendents requesting information from an individual RTC by "yelling down" to their location. This practice also contributes to the overall noise and disruptive atmosphere in the ROCC. When interviewed, several RTCs stated that the ROCC was a "noisy" office, and that the desk speakers contributed to the ambient noise when transmitting over the radio to the field.

To assess the safety performance of ROCC since 2012, FTA's SMI team met with WMATA's Safety and Environmental Department and the TOC to review completed accident investigation reports, including ROCC incident reports and supervisor reports, along with corrective action plans and status, for the following recent incidents where RTC errors or miscommunication between an RTC and a train operator resulted in trains being directed into work zones, through red signals, or where power was unintentionally restored in a work zone:

- March 6, 2012 – D& G Junction – RTC routed a train into an active work zone.
- April 24, 2012 – Rosslyn – The first car of a six-car consist derailed at a switch just after ROCC instructed the operator to pass a red signal and traverse the switch (which was not clamped).
- October 31, 2012 – East Falls Church – RTC sent a Prime Mover into work area after authorizing the work crew to enter the ROW.
- November 7, 2012 – Landover – RTC restored power to an area with roadway workers present.
- January 30, 2013 – Anacostia – self-evacuation of stranded passengers from a train resulting from miscommunication.
- May 13, 2013 – red signal violation by Train 713 related to miscommunication.
- May 28, 2013 – red signal violation by Train 923 related to miscommunication.
- August 7, 2013 – third rail power energized in a work area.
- August 15, 2013 – rail buggy derailed when ROCC failed to confirm that it had cleared an interlocking and threw a switch.

- October 14, 2013 – collision in West Falls Church Service & Inspection Shop when train operator was not informed that a pair of cars of the train in motion had its brakes cut out, and the operator thus was unable to stop the train in time.
- January 11, 2014 – RTC instructed a train operator to offload a train that was not fully berthed at the platform.
- September 17, 2014 – ROCC permitted a prime mover to enter a work zone.
- December 29, 2014 – Near miss involving workers in the ROW at King Street Station.

Through this process, FTA's SMI team confirmed a high level of activity and distraction for RTCs. Also, in several instances, the lack of a formal checklist regarding the steps to be taken to manage or troubleshoot a particular situation, combined with the lack of a clear radio repeat-back from the field, resulted in both the ROCC and the train operator making mistakes that impacted the safety of train operations. FTA's SMI team also confirmed that WMATA does not require train operators who request permission to either enter a main track, or turn a train for a return trip, to acknowledge receipt of the updated radio announcements from the ROCC regarding the location of wayside workers.

FTA's SMI team also confirmed that the AIM system, used to visually display and monitor system performance, generates a high volume of alarm indications that must be managed by RTCs at their desks. In the aftermath of the June 22, 2009 Fort Totten accident, the NTSB focused on the large volume of alarms related to the signal and train control system (thousands per day, most of which were generated and then dismissed automatically by the AIM system if RTCs did not take action). While there have been improvements in this situation, the AIM system still generates a high level of "noise" to be filtered out by individual RTCs, including hundreds of notifications per day. WMATA has re-committed to reviewing protocols for alarms in the ROCC to identify critical versus non-critical notifications, and to reduce RTC responsibilities for non-critical notifications.

As a result of this review, FTA also identified the lack of electronic blocks or prohibits available for RTCs to prevent specific train movements and to manage unusual situations. Due to the way the AIM system interfaces with the wayside train control system, there are limitations regarding the ability of RTCs to enforce temporary speed restrictions or absolute blocks electronically with prohibits that would stop or slow a train on the ROW.

Several RTCs interviewed by FTA's team indicated that absolute blocks were time-consuming to implement electronically on the AIM system, and not always practical or encouraged during busy periods. For the WMATA system, speed restrictions are enforced wayside with speed couplers, however, in cases of temporary speed restrictions, verbal commands from RTCs issued over the radio are relied upon to reduce speeds until wayside controls can be implemented. In the reviewed accident reports, FTA's SMI team observed inconsistencies in the level of acknowledgement and repeat-back regarding safety critical verbal commands from RTCs to train operators. Many of WMATA's peer transit agencies have the capability to enforce speed restrictions electronically from the ROCC.

The ROCC also uses advisory "blue man" blocking devices to protect the Roadway Worker in Charge (RWIC) or personnel along the roadway; however, these blocking devices are just visual

reminders that appear on the AIM display regarding the presence of workers. RTCs can still route trains or clear signals into that affected track or block segment.

FTA's SMI team finds that ready availability of additional electronic controls would have prevented several of the accidents reviewed by FTA, WMATA and TOC, and would have helped RTCs better manage the level of noise and distraction in the ROCC.

- **Finding R-5: WMATA RTCs are required to perform many tasks outside of industry standards.**

WMATA's RTCs are required to perform many tasks outside of industry standard practices (i.e., WMATA does not have a Power Director position, or specific desk for managing RWP issues or access, and RTCs are also responsible for documentation regarding trouble reports and other issues on the mainline that is then picked up by the appropriate MOC or CMNT desk person). With these added responsibilities, RTCs often create bottlenecks that exacerbate track access issues for work crews and can slow response to certain situations.

For example, due to the volume of calls and activities, individual RTCs working specific line desks may be unable to follow-up with maintenance personnel who have called in from the field, leaving them waiting, sometimes for hours, for permission, authorization, or verification that a command or activity controlled from the ROCC is functioning as intended. This situation can be a deterrent to the inspection and testing of safety-critical systems related to communications, fire/life safety, accessibility, and intrusion detection.

FTA's SMI identified many opportunities to remove work from RTC desks to reduce distraction, bottlenecks and inefficiencies during regularly scheduled passenger service, off-peak service, and the OWL shift. FTA's SMI team also discussed with WMATA the possibility of separating the six Metrorail lines into six or more separate desks to more evenly distribute the workload. Currently, while the Blue/Orange/Sliver Line desk, nicknamed "The Monster", handles a disproportionate volume of calls and activities, all three desks experience a high level of activity compared to peer transit agencies.

- **Finding R-6: Radio discipline is poor.**

FTA's SMI team confirmed in interviews and observations at the ROCC that radio discipline is not actively enforced to reduce radio congestion and miscommunication. FTA's SMI team noted that RTCs often did not listen long enough to make sure the channel was not being used before beginning transmission. Required identifications were not consistency provided from train operators or field units and personnel. Word-for-word repeat-backs were rarely observed between RTCs and train operators or field personnel, and transmissions were not always formally ended or acknowledged.

FTA's SMI team also observed confusion in communication resulting from lack of proper protocol for language and terminology used over the radio – to include 100 percent word-for-word read-back for safety-related instructions and unusual train movements. Interviews and

observations in rail yards and on trains confirmed the difficulty of understanding radio communications in certain situations.

In light of its review of recent accidents where miscommunication played a major role, FTA's SMI team believes that WMATA must do more to ensure field personnel and train operators understand directions and communications. For example, the Port Authority Trans-Hudson (PATH) established a program to require and manage word-for-word read-backs for mandatory directives issued for all unusual situations related to starting up service in the restored World Trade Center station under manual block operations, including: manual block operations (bypassing red or inoperative signals), single tracking without signal indication, roadway workers entering the ROW, and unusual train movements or safety situations (energizing and de-energizing the third rail). FTA's SMI team discussed with WMATA personnel how a similar approach could improve the quality of radio communication on the Metrorail system.

- **Finding R-7: WMATA's ROCC lacks formal procedures, manuals and checklists.**

WMATA's RTCs are largely veterans, who have worked many different jobs at WMATA prior to becoming controllers, such as bus operator, train operator, field supervisor, and interlocking operator. FTA's SMI team found that these veterans have established a strong culture regarding how things should be done in the ROCC. This approach reflects the variety of Metrorail's operations, the fluidity of daily activities and events, and the fact that most veteran RTCs prefer to run the Metrorail system largely based on their past experience and the information "in their heads" as opposed to the consistent and dedicated use of checklists, transfer records, and AIM system electronic tracking tools.

As part of the investigation into WMATA's management of the smoke incident at L'Enfant Plaza station, on February 11, 2015, the NTSB issued Urgent Safety Recommendation R-15-9 to WMATA related to the lack of detailed written tunnel ventilation procedures for ROCC staff:

> "Develop and implement detailed written tunnel ventilation procedures for operations control center staff that take into account the probable source location of smoke and fire, the location of the train, the best evacuation route, and unique infrastructure features; these procedures should be based on the most effective strategy for fan direction and activation to limit passengers' exposure to smoke."

In interviews and observations, FTA's SMI team learned that many veteran RTCs questioned the effectiveness of the traditional checklist-based dispatching tools used in other industries and recommended by the NTSB. FTA's SMI team also found that while WMATA issued memos and other documentation to ROCC personnel regarding roles, responsibilities and requirements, and while specific contact information and other work sheets were available, a formally compiled, reviewed and updated "ROCC Manual" with all office procedures and interpretations of rules or instructions pertaining to the RTC's duties and use of the AIM system was not available. FTA's SMI team also did not find any checklist tools or system or station schematics available for RTCs to dispatch service or manage incidents.

This situation creates significant challenges for WMATA. As senior RTCs are retiring, they take with them the critical information they use to manage the system. Also, the lack of written tools, checklists and procedures makes it more difficult to train new RTCs and to conduct formal evaluations regarding the performance of veteran and new RTCs alike.

Finally, the lack of written checklists and commitment to their use means that WMATA as an agency does not fully direct the daily administration of the information used by RTCs to guide the system. Interviews with technicians in Car Maintenance, for example, indicated that vehicle trouble-shooting information provided to train operators by RTCs was often incorrect, and that consistent use of a trouble-shooting checklist would greatly enhance performance of this critical function. Interviews with other departments, including the Power branch and ATC technicians, highlighted issues with misused terminology, incorrect or vague language, and poor directions for activities that would be improved with the dedicated use of checklists by RTCs. Other industries, from aviation to the medical profession, have demonstrated the importance of checklist tools in preventing avoidable failures, better managing emergencies, and ensuring the consistent management of daily activities.

- **Finding R-8: Personal cell phones are used by RTCs in the ROCC.**

FTA's SMI team members observed WMATA's RTCs carrying and using their personal cell phones while on-duty. FTA's SMI team also found that WMATA's cell phone policy for the ROCC, which allows ROCC personnel to carry and use their cell phones if they step away from their desks is vague, easy to violate, and contributes to distraction in the ROCC. WMATA has a strong electronic device policy imposed on all other safety-sensitive personnel but has elected to exclude the ROCC.

- **Finding R-9: No formal transfer records are used when RTCs complete shift briefings.**

While WMATA plans to allocate RTCs with 30 minutes of overlapping shift time to coordinate the transfer of information from the previous shift; the current practice is less formal. For example, FTA's SMI team observed the transfer between two "Button Operators", which consisted of the verbal communication "True Blue" – a term used to indicate that several workers are on the roadway with "TAW" (Train Approach Warning) protection, and nothing else stated. The transfer between the two "Radio Operators" was written into a log book with no information listed other than a few track circuit locations that were problematic. The outgoing RTC also did not log off on the AIM system, allowing the incoming RTC to utilize the AIMS system under another name. No signature was written anywhere in the logbook. At other times, FTA's SMI team observed shift briefings occurring informally between RTCs as coats were being put on and bags being gathered up to leave, with nothing formally written down or signed.

- **Finding R-10: WMATA does not use industry standard rules reviews and scenario testing activities.**

FTA's SMI team did not witness RTCs working with each other or management to review and reinforce critical ROCC procedures at any point during its observations in the ROCC, nor did FTA find that WMATA conducts routine "tabletop exercises" for RTCs. Most of the discussion and interaction between supervisory personnel and RTCs observed by FTA's team focused on RTC activities related to trouble-shooting trains and single-tracking, the most commonly performed activities at the ROCC to manage disabled trains and ATC or track failures requiring emergency repairs. Interviews confirmed that, while major incidents were reviewed with the RTCs and supervisory staff, there was very limited simulation or practice for other events, such as broken rails, third rail power shut downs, passengers who jump or fall onto the rails, sick customers, derailments, station and tunnel fires, and other types of service disruptions or emergencies.

FTA's SMI team also did not find that RTCs went through monthly tabletop drills/scenarios or weekly SOP reviews. These are industry standard practices designed to enhance the proficiency of RTCs and ensure their overall awareness regarding operating rules, temporary and permanent orders, and how they should be interpreted and carried out in the field under chancing operating conditions. FTA also confirmed that WMATA does not have a formal program of efficiency testing for RTCs to ensure their conformance with rules and SOPs.

- **Finding R-11: WMATA faces major challenges in recruiting and training new RTCs.**

Over the last few years, WMATA has been attempting to bring in controllers and dispatchers with military, aviation, and transportation experience. However, WMATA has been unable to successfully recruit, train, qualify and retain new RTCs. A major hiring and training effort over the last 5 years has only increased the total number of RTCs in the ROCC by 3 positions since 2011 – from 31 RTCs to 34 RTCs.

At the time of the SMI, in the most recent class of 12 new trainees from external agencies, only four RTC trainees made it through the program to obtain certification, and only two of the four RTC trainees were actually working in the ROCC. This situation reflects a very poor return in training investment, and a major challenge for WMATA moving forward.

- **Finding R-12: WMATA's training program for new RTCs is inadequate.**

FTA's SMI team identified major gaps in training for new RTCs:

- A Third Party Vendor developed the key modules for new RTCs regarding the operation of the AIM system and the performance of their duties;
- This vendor had not worked previously as an RTC and did not have a background in ROCC operations;
- High-level sign-offs and approvals were provided for the training by WMATA personnel, however, in-depth reviews and workshops were not conducted to fully vet the materials;

- No performance standards have been developed for being a WMATA RTC, and therefore, could not be used to guide the training or the evaluation of new RTC performance;
- An incomplete approach to testing or certification was developed by the vendor, and RTC trainees were used to develop or complete test questions; and
- No mentor program was established for new RTCs as part of the training.

FTA's SMI team identified inconsistencies, errors, and missing and unfinished sections in the training materials and PowerPoint presentations used to train new RTCs on the AIM system and their roles and responsibilities. The lack of formal printed and electronic tools to support the dispatching of service further exacerbates the impacts of the weak training program.

WMATA has used vendors, RTCs and Assistant Superintendents to deliver training, but due to the poor quality of materials and the number of gaps in training, new RTCs face enormous challenges in mastering the material. Due to significant resource limitations, WMATA has no dedicated trainer for new RTCs to work with them through the entire process. WMATA also only has four AIM system simulators to train new RTCs, but classes may have up to 12 trainees, so trainees are not able to complete all exercises and miss valuable lessons.

The poor quality of initial classroom training increases reliance on on-the-job training. However, since veteran RTCs manage events in the way they believe is effective, their preferences for handling incidents may or may not correspond to what new RTC trainees have been taught in the classrooms, or WMATA's formally established interpretations of the written rules and SOPs.

Further, FTA's SMI team found that, due to the potential loss in overtime, there is a clear financial disincentive for veteran RTCs to support changes in processes and tools that would make additional hiring easier. Therefore, FTA's SMI team found that veteran RTCs have no vested interest in training or teaching new RTCs, and, based on the extremely low success rate for new RTCs, it is clear that the reliance on on-the-job training has not been effective.

FTA's SMI also found that some new RTC trainees struggle with maintaining a complete rulebook, updated with all temporary and permanent orders issued since 2014. WMATA informed FTA that the agency hopes to issue a new Metrorail rulebook in 2017; currently an electronic version is available on WMATA's intranet which contains the 2014 rulebook and the roughly 40 temporary and permanent orders since the 2014 rulebooks was finalized as separate PDF files. FTA's SMI team was unable to find a master assembled and collated electronic rulebook, with the temporary and permanent orders inserted into the electronic file. While this is not unusual in the rail transit industry, the lack of a collated rulebook has significantly impacted RTC trainees from other industries, where updated, assembled copies of rulebooks must be maintained at all times, and are used as vital references to govern controller work activity.

Finally, new RTCs lack the opportunity to participate in emergency drills or exercises. FTA's SMI team found that new RTCs generally had very limited experience with emergency situations in the Metrorail environment. WMATA's development of scripts and written case studies and scenarios should further support the training of new RTCs.

- **Finding R-13: WMATA's accident investigation process does not look at the ROCC or individual RTCs, and their potential involvement in the accident under investigation.**

FTA also found that WMATA's accident investigation process, with some exceptions, generally does not look at the performance of the ROCC or the individual RTCs, but typically focuses on the train operator. For example, most of the accident investigations reviewed by FTA's SMI team and conducted for incidents involving the ROCC do not:

- Include recertification information for RTCs in the accident investigation report.
- Interview RTCs involved in incidents following the same process as used for train operators.
- Include transcript of audio recordings in investigation report, and review and assess quality of radio communication and radio transmission.
- Include hours of service information for RTCs as well as train operators.
- Make findings regarding the need for hazard analysis if SOPs or rules are changed in response to an accident, if SAFE finds that such additional analysis is warranted (outside the usual rule revision and update process).
- Include summaries of detailed employee information that is maintained in hard copy at the Divisions.
- Include efficiency check and quality check information from Rail Transportation and Rail Operations Support, to accompany other information provided by supervisors.
- Review level of coordination between Button and Radio Controllers as standard part of report for any incident in which the ROCC is significantly involved.

FTA's SMI team finds that in most accident investigations, ROCC management has not experienced the same opportunity to learn from mistakes, errors and incidents as other groups within Rail Transportation. In this manner, the ROCC has also been largely immune to the consequences of accidents to which its members, organization, procedures, practices or training programs may have contributed.

In a few instances, FTA also determined that WMATA had not ensured that RTCs involved in incidents were taken for mandatory post-accident drug and alcohol testing as per 49 CFR Part 655.44.

- **Finding R-14: While it has improved, the quality of WMATAs radio system is still poor in some locations.**

While WMATA's digital radio system is clearer than the analog version, there is still major distortion and feed-back in the field, and from the ROCC, and a significant number of radio dead spots still exist. Many WMATA employees throughout the agency ranked poor radio performance as their top safety issue. FTA's team observed dropped words and communications as commonplace occurrences. "I can't hear you, Central" is a frequent radio transmission from the field.

Follow-on interviews with WMATA's Communications Department (COMM) revealed that not all locations within the WMATA system are included in the design for radio coverage, including fan shafts, vent shafts and emergency evacuation stairwells, refuge areas and elevator shafts, and transition areas from above ground to underground coverage including station entrances and portal entrances.

All other locations on the Metrorail system have full radio coverage and any report of a dead spot is treated as a system failure and maintenance forces are dispatched to investigate and correct the problem. COMM receives approximately three reports a day for radio system "Dead Spot" in these covered locations. Representatives from both the ROCC and COMM acknowledge that there are a number of improvements that can be made to the radio system to enhance system reliability, such as installation of an alarm system on all bidirectional amplifiers to allow maintenance forces to respond more rapidly, and replacement of the current tunnel antenna cable with a newer higher capacity antenna cable.

WMATA's Capital Improvement Plan 136 is underway to address some but not all of the needed enhancements. For example, this project is replacing most below-ground radiating coaxial cable with higher capacity, bigger cable for less loss, better radio frequency propagation, and more capacity. Additional enhancements will require more capital project funding.

Required Actions

Safety Directive 15-1 identifies 21 required actions to be taken by WMATA to address safety deficiencies in established programs governing ROCC operations, management, training and evaluation.

| **Metrorail Category 1: Inadequate Rail Operations Control Center Staffing and Procedures** | | | |
|---|---|---|---|
| Findings | | Required Actions (specified in Safety Directive 15-1) | |
| Finding R-1 | WMATA's Rail Operations Control Center is significantly understaffed. | R-1-1-a | WMATA must fully staff the Rail Operations Control Center. |
| Finding R-2 | RTC re-certification has not occurred as required. | R-1-2-a | WMATA must complete and maintain required annual re-certifications for Rail Traffic Controllers. |
| Finding R-3 | RTCs receive limited refresher training and no road days. | R-1-3-a | WMATA must establish a program to provide each Rail Traffic Controller with mandatory road days for territory familiarization and to keep up with changing system elements. |
| | | R-1-3-b | WMATA must require all Rail Traffic Controllers to obtain and maintain Level 4 Roadway Worker Protection training and certification. |
| Finding R-4 | There is a high level of noise and distraction in the ROCC, and a lack of electronic controls in the | R-1-4-a | WMATA must complete its assessment regarding the identification of critical versus non-critical notifications and alarms in the Rail Operations Control Center, and options for removing non-critical notifications must be implemented. |

| **Metrorail Category 1: Inadequate Rail Operations Control Center Staffing and Procedures** | | | |
|---|---|---|---|
| Findings | | Required Actions (specified in Safety Directive 15-1) | |
| | AIM system to prevent errors. | R-1-4-b | WMATA must conduct an engineering assessment, and implement the results regarding options to reduce noise in the Rail Operations Control Center, including ambient noise and feedback from the radio system. |
| | | R-1-4-c | Until such time as electronic records of train movement are readily available to on-duty Rail Traffic Controllers, WMATA must ensure that its Rail Traffic Controllers maintain a paper-based record of all mainline train movements, signal by-passes, and unusual movements. |
| Finding R-5 | WMATA RTCs are required to perform many tasks outside of industry standards. | R-1-5-a | WMATA must ensure Rail Traffic Controller workload and distraction do not interfere with the safe and efficient movement of trains. |
| Finding R-6 | Radio discipline is poor. | R-1-6-a | WMATA must establish and enforce a proper protocol for language and terminology that is used over the radio – to include 100 percent word-for-word read-back for safety-related instructions and unusual train movements. |
| | | R-1-6-b | As part of the radio protocol required in R-1-6-a, WMATA must establish an approach for communicating and managing all speed restrictions that requires two-way communication between the ROCC and train operator and takes full advantage of available electronic AIM system features. |
| Finding R-7 | WMATA's ROCC lacks formal procedures, manuals and checklists | R-1-7-a | WMATA must establish procedural checklists for Rail Operations Control Center staff to implement the Standard Operating Procedures attached to the Metrorail Safety Rules and Procedures Handbook. |
| | | R-1-7-b | WMATA must enhance RTC reference materials to direct internal operations at the Rail Operations Control Center, including the use of the Advanced Information Management system, visual schematics of WMATA stations and facilities, and internal ROCC administrative policies and procedures. |
| Finding R-8 | Personal cell phones are used by RTCs in the ROCC. | R-1-8-a | WMATA must establish a clear policy that prohibits distractions from the use of cell phones and other electronic devices in the Rail Operations Control Center. |
| Finding R-9 | No formal transfer records are used when RTCs complete shift briefings. | R-1-9-a | Until such time as electronic transfer records are implemented, WMATA must ensure that its Rail Traffic Controller use paper-based logs with formal signatures. |
| Finding R-10 | WMATA does not use industry standard rules reviews and scenario testing activities. | R-1-10-a | WMATA must establish an on-going "efficiency" testing program for Rail Traffic Controllers to evaluate their in-service performance and competency. |
| Finding R-11 | WMATA faces major challenges in recruiting and training new RTCs. | R-1-11-a | WMATA must establish an independent committee to evaluate and monitor the recruitment of Rail Traffic Controller trainees, the quality and performance their training, and the certification of new candidates. |

| **Metrorail Category 1: Inadequate Rail Operations Control Center Staffing and Procedures** | | | |
|---|---|---|---|
| Findings | | Required Actions (specified in Safety Directive 15-1) | |
| Finding R-12 | WMATA's training program for new RTCs is inadequate. | R-1-12-a | WMATA must overhaul, correct, revise and improve its training program for Rail Traffic Controllers. |
| | | R-1-12-b | WMATA must establish performance standards to be qualified for all positions in the Rail Operations Control Center. |
| Finding R-13 | WMATA's accident investigation process does not look at the ROCC or individual RTCs. | R-1-13-a | WMATA must expand the focus of its accident investigation process to include an active review of the actions of the ROCC, and to ensure that RTCs whose performance could have contributed to the accident are taken for mandatory post-accident drug and alcohol testing as per 49 CFR Part 655.44. |
| Finding R-14 | While it has improved, the quality of WMATA's radio system is still poor in some locations. | R-1-14-a | WMATA must expedite activities underway to modify the radio system design to add coverage to the areas that currently are not part of the system design, including tunnel ventilation and fan shafts, safe and refuge areas, and tunnel portals. |
| | | R-1-14-b | WMATA must assess and prioritize for additional radio enhancements not covered by Capital Improvement Plan (CIP) 136. |

## 5.2 Category R-2: Ineffective Training, Operational Testing, and Rules Compliance Programs

FTA's SMI team identified five findings related to the limited availability of training for WMATA's operations and maintenance personnel, and three findings related to WMATA's implementation of operational testing and efficiency check programs for Metrorail personnel.

Situation

An effective training program for new and existing employees with accurate documentation is critical for safe operations. FTA's SMI team identified specific and potentially serious issues related to WMATA's ability to ensure compliance with critical roadway worker protection (RWP) training. Further, FTA's SMI team found that, while WMATA has developed a series of very strong initial training courses for operations and maintenance personnel, there is lack of focus on follow-up and refresher training, a lack of resources devoted to training, a lack of availability of training, and a lack of strategy for ensuring the technical competence of WMATA personnel.

For many positions, from RTCs to technical specialists in Power, Track, ATC and COMM, the overall training is inconsistent and often fragmented, supplemented by on-the-job training from veteran personnel who have not been instructed regarding how to provide this training and who may not carry out specific tasks or functions exactly as required by WMATA rules and procedures.

Finally, WMATA lacks an efficient recordkeeping system of employee training.

- **Finding R-15: Maintenance and Operations Departments have not ensured the RWP training program is being conducted as required. Annual refresher and biennial re-certification requirements for Level II and Level IV are behind schedule.**

FTA's SMI team found that WMATA's maintenance and operations departments face significant challenges in ensuring their personnel are scheduled to receive the required Roadway Worker Protection (RWP) refresher and re-certification training. Records produced by WMATA indicate that the RWP training program has fallen significantly behind in meeting annual requirements for RWP refresher training and biennial requirements for re-certification training for Level II and Level IV qualified individuals.

Based on observations made by members of FTA's SMI team regarding expired endorsement stickers on RWP cards and some confusion among front-line workers in answering questions regarding RWP refresher and re-certification training requirements, FTA requested WMATA's records on RWP training. WMATA supplied these records, which show that WMATA is not keeping up with refresher training and requalification as required in the RWP Manual and Training Program.

At the time of the SMI, electronic records provided by Technical Skills & Maintenance Training, the department responsible for the RWP training program, showed that exactly 2,500 WMATA employees had not received the required annual refresher training, and 295 employees had not been recertified and/or requalified as specified in WMATA's RWP Manual and Program. However, records kept by individual departments, based on RWP cards issued to employees, indicated that the electronic records provided to FTA might not accurately reflect status of refresher training and requalification. Some maintenance departments are using photocopies of RWP cards to manage separate RWP refresher and requalification tracking systems.

These photocopy records do not match up with the agency's official records from Technical Skills & Maintenance Training, and generally show a much greater level of conformance with WMATA requirements.

As illustrated in the table below, WMATA has three levels of RWP training and qualification:

- RWP Level I: Restricted Level
- RWP Level II: Limited Access Level
- RWP Level IV: Roadway Worker In Charge
- Note: *There is no Level III training*

Each level requires initial training, annual refresher training, and either five-year or two-year requalification training. A recertification exam and/or practical must also be completed. Refresher training can be provided by an Instructor or through a computer-based training (CBT) module.

**Table 9. RWP Training and Requalification Requirements**

| | INITIAL TRAINING | REFRESHER TRAINING | REQUALIFICATION TRAINING |
|---|---|---|---|
| LEVEL I | 1 day Instructor led training<br><br>*RWP Access badge issued after successful completion* | ½ day Instructor led or Computer-based Training (CBT) training each year after Initial Training<br><br>*RWP badge endorsement sticker is issued after each successful completion* | Repeat of Initial Training after 4 years of Refresher Training<br><br>*RWP Access badge issued after successful completion* |
| LEVEL II | 2 days Instructor led training<br><br>*RWP Access badge issued after successful completion* | ½ day Instructor led or CBT training the year after Initial or Requalification Training<br><br>*RWP badge endorsement sticker is issued after each successful completion* | 1 day Instructor led training the year after Refresher Training<br><br>*RWP Access badge issued after successful completion* |
| LEVEL IV Prerequisite: Completion of Level II & one (1) year roadway experience | 5 days Instructor led training<br><br>*RWP Access badge issued after successful completion* | ½ day Instructor led or CBT training the year after Initial or Requalification Training<br><br>*RWP badge endorsement sticker is issued after each successful completion* | 1 or 2 day Instructor led training the year after Refresher Training<br><br>*RWP Access badge issued after successful completion* |

WMATA has updated the RWP Manual and Program twice: in May 2012 and June 2014. Major changes include: New Cardinal Rule, Update to Good Faith Challenge information, Update to Job Safety Briefing information, Update to Watchman location when performing safety role (from a place of safety), Update to alternative means of reporting/raising safety concerns that are not Roadway specific, and Update to forms of available protection to workers under any type of protection (mobile/fixed).

Without the refresher training, it is unclear how these changes have been communicated to WMATA's employees. The RWP program, which was developed and implemented after eight WMATA employees lost their lives in accidents on the ROW between 2005 and 2010, has significantly improved safety on the ROW.

WMATA's failure to ensure that employees are available for CBT or Instructor-led refresher training, and failure to enforce this refresher training as a key eligibility requirement for working on WMATA's ROW (as either a train operator or Maintenance of Way worker) is a serious finding, in violation of the first Cardinal Rule in the RWP program: "All employees, regardless of rank or title, shall be RWP trained and qualified before entering the Authority Roadway."

- **Finding R-16: Technical training for Operations and Maintenance Departments is under-resourced and fractured, currently provided by five different departments and IT, is insufficiently directed and resourced, and relies significantly on on-the-job-training (OJT) which is informal and lacks oversight.**

Based on interviews, records reviews, and field observations conducted across several technical disciplines, FTA's SMI team also discovered that there is no enterprise-wide strategy for technical training to ensure the proficiency of WMATA personnel, and many gaps exist for

operations and maintenance departments. Training is under-resourced and fractured, provided by five different WMATA departments and the Department of Information Technology (IT).

WMATA's Technical Training Department (TTDC) is currently housed within WMATA's Transit Infrastructure and Engineering Services (TIES) division. Technical Skills & Maintenance Training (TSMT), located in Operations Management Services (OPMS), manages WMATA's RWP training program. WMATA's corporate training department is housed within the Office of Talent Management (HRTM) within the Human Resources Department. Rail Operations and Quality Training (ROQT), within Rail Transportation (RTRA), trains Rail Operations personnel, while Rail Operations Support, also within RTRA certifies operations personnel, and conducts in service evaluations. Finally, WMATA's Safety Department provides certain environmental, occupational safety and general safety training courses.

FTA's SMI team generally found that while strong technical courses have been developed in many areas, there are insufficient resources available to provide enough offerings to adequately train and refresh personnel. As a result, there is great reliance on informal, on-the-job training, which is not standardized or overseen. Operations personnel do not have adequate training facilities (2.5 classrooms), no simulators, and face significant challenges in establishing professional service standards, adult learning strategies, and taking advantage of technology to bring the field into the classroom.

For maintenance personnel, while great strides have been made in some areas (elevators and escalators, for example), many other areas rely primarily on on-the-job training. FTA's SMI team also found that while initial and advanced technical training for ATC technicians, Power branch (POWR) specialists, and Track and Structures (TRST) personnel developed by TTDC has been very well received, limited training offerings have created long wait lists. TTDC reports that, in some instances, they can only meet 20 to 40 percent of demand for training.

In other cases, TTDC has been able to address demand, but over a much longer time-frame than originally requested by the technical department. The opening of the Silver Line and recent retirements in ATC and POWR have exacerbated this challenge for TTDC. Rail Car Maintenance personnel and representatives from several other departments also reported a lack of qualified personnel to fill shifts to allow maintenance technicians to complete needed training in a timely fashion.

For COMM personnel, technical training has restarted after several years of little or no training except for new hires. Approximately 10% to 15% of COMM supervisors and technicians have received training; however, this is a branch-wide number, and there are pockets of COMM where 50 percent or more in a particular unit have received training. Because communications technology changes so rapidly, training course curriculum needs to be updated frequently. While both TTDC and COMM have considered bringing in outside vendors to provide training, neither COMM nor TTDC have the resources available to cover these costs.

- **Finding R-17: WMATA does not have a clear strategy for the development or delivery of emergency response training to WMATA's frontline personnel, or for managing the logistical challenges associated with coordinating familiarization training with local emergency responders.**

Like with technical training, FTA's SMI team found that WMATA has not established a clear strategy or plan regarding the development and delivery of emergency response training to WMATA's frontline personnel. After the event of September 11, 2001, the Transportation Security Administration (TSA) and the Department of Homeland Security (DHS) initially provided WMATA with grants and support in developing emergency response plans, tools, training, and also in assessing vulnerabilities of operations to security and emergency situations. Over the years, however, this funding has become more limited, and WMATA has been forced to suspend several key training programs, including its Management Emergency Response Training (MERT) program, which provided emergency training for operations managers, frontline supervisors and frontline employees. While drills and exercises necessarily include train and/or bus operators, field supervisors and the ROCC, these exercises only reach the handful of personnel who participate. WMATA has not been able to identify a consistent funding source to support on-going emergency preparedness training for frontline personnel.

The complexity of WMATA's emergency planning in the National Capital Region necessarily limits participation to representatives of WMATA's Office of Emergency Management or Metro Transit Police Department. However, since WMATA's Rail Operations Training Departments are not represented during the emergency planning process, it is very challenging for them to know if new rules, temporary and permanent orders, training, and the lessons learned documents published by RTRA or RTTO reflect the contents of emergency plans and the understanding of local emergency responders.

FTA's SMI team found that WMATA's Office of Emergency Management does not review emergency training developed by the Rail Operations Departments, and has no way to know if information on emergency management has been effectively communicated to frontline employees. WMATA's Office of Emergency Management does coordinate with the other WMATA Departments through the process used to develop and update the Rail and Bus Rulebooks, the agency-wide Emergency Operations Plan, the System Safety Program Plan, and the Security and Emergency Preparedness Plan.

While WMATA actively engages its jurisdictional partners in emergency response training, including the use of its Emergency Response Training Facility in Landover, Maryland which includes a "mock" subway tunnel and an emergency railcar "roll-over" simulator to train fire, rescue, police, emergency and transit personnel from Maryland, Virginia and the District of Columbia, changing Regional priorities and reductions in grants from DHS and TSA have also impacted the agency's ability to ensure that its partners particularly in the District of Columbia, routinely receive familiarization training that covers the critical elements of responding in the subway tunnel environment, including management of key passenger communication and tunnel ventilation systems.

FTA's SMI team found that since WMATA's ROCC moved from the Jackson Graham Building in downtown Washington, D.C. to the Carmen E. Turner facility in Landover, Maryland, several years ago, WMATA has not conducted regular tests at Jackson Graham regarding the capabilities of the old ROCC to perform as a back-up control center in the event of an emergency. Use of this facility could also potentially support emergency response training and other training of new RTCs.

- **Finding R-18: Rules compliance checks of operational personnel are inconsistent, and an inadequate number of checks are performed.**

To ensure the proficiency, professionalism, and safety of rail transit operations, in addition to an on-going training program, rail transit agencies also establish programs to conduct announced and unannounced operational testing. FTA's SMI determined that announced and unannounced testing of operational personnel (including train operators, Station Managers, Interlocking Operators) at WMATA is not being conducted consistently or effectively.

Rail Transportation field supervisors are responsible for conducting 60 rules compliance checks on station managers and 60 rules compliance checks on train operators each month. As a goal, not a requirement, rail transportation field supervisors should check on new rail transit operators at least five times per month.

In reality, FTA's SMI team found that rail transportation field supervisors only have the opportunity to check approximately half of the operators in their field divisions more than once per month. In addition, not all train operators are checked every month. Further, new supervisor trainees interviewed by FTA's team were not able to correctly identify the number of required field checks or to describe the process they would use to conduct them.

While rail supervisors have an electronic form that identifies multiple elements to be checked to ensure the safety and quality of rail transit operation, they are only required to enter a single observation per train operator, as opposed to a complete report.

Monthly reports generated by Rail Operations Support, the quality control and quality assurance division within Rail Transportation, demonstrate rates of between 20% and 40% noncompliance when they check for specific safety critical rules related to train berthing, door operation, RWP procedure adherence, and speed restrictions. On the other hand, monthly reports compiled by rail supervisors for the same areas of rules compliance, looking at the same operating divisions, typically demonstrate less than 1% noncompliance. Given that an issue is so rarely identified by rail supervisors, FTA questions the accuracy and thoroughness of these reports.

Due to resource limitations, Rail Operations Support typically only observes between 10 and 50 train operators each month, with a focus on a specific operating rule or issue. FTA's independent field reviews and observations, conducted during the SMI using WMATA's standard forms and processes, found similar levels of non-compliance in most areas (20% to 40%), though FTA's SMI identified 100% non-compliance with the "5-second" rule, recently implement to support train operator situational awareness and prevent wrong-side door openings and inappropriate train movements.

- **Finding R-19: Rail Transportation is not ensuring that field supervisors conduct required rules compliance checks on station managers and train operators.**

Records pulled from the electronic system used to track the checks performed by rail supervisors show significantly decreasing numbers of reports since 2010, when the system was fully implemented:

| Year | Number of Submissions |
|---|---|
| 2008 | 24,480 |
| 2009 | 107,727 |
| 2010 | 138,488 |
| 2011 | 128,348 |
| 2012 | 104,325 |
| 2013 | 95,991 |
| 2014 | 75,358 |
| 2015 (thru March) | 12,633 |
| Total | 687,350 |

WMATA is transitioning from its current Blackberry electronic reporting system to a new Windows-based system, and Blackberries are no longer being issued. In the interim, supervisors without Blackberries are not conducting (or at least not reporting) checks. The number of total reported rules checks has fallen by almost 50 percent from 2010, while the number of trains in service has remained constant or increased with the opening of the Silver Line in 2014.

WMATA has invested considerable time and resources in a system that does not appear to support the agency's understanding regarding the performance of its train operators. Interviews with train operators indicated the while Platform Line Instructors (PLIs) offered very helpful feed-back on train operations during initial training, many rail supervisors do not take the time to conduct face-to-face meetings with train operators to review their performance, convey operational testing results, and discuss potential issues, challenges, or opportunities for improvements.

- **Finding R-20: New supervisors are not familiar with rules compliance checks requirements.**

Field supervisors indicated that they received little training on how to conduct ride checks and no training on how to conduct operational testing. Many field supervisors interviewed by FTA's SMI team had not seen or were not aware of the results of monthly assessments compiled to document that performance of train operators.

Finally, FTA's SMI team found that WMATA has no Heavy Railcar Simulators to support rail operator training and evaluation programs. FTA's SMI team believes that use of this technology could greatly improve WMATA's ability to train, re-train and evaluate train operators, field supervisors, and RTCs, especially given the challenges of accessing the ROW for these purposes.

This technology has worked very effectively at New York City Transit and other rail transit systems.

- **Finding R-21: Some newly promoted field supervisors, who have not previously operated rail vehicles, are not sufficiently trained to relieve train operators on the mainline.**

During interviews and field observations, FTA's SMI team also found those rail transportation supervisors, RTCs and other positions that may have to operate trains or direct train movements are not always proficient or confident in mainline train operation. Some newly promoted rail supervisors have not operated rail transit vehicles in revenue service previously. Due to limited ability to access the mainline, most train operator training takes place in the rail yard. Limited vehicle availability (to put service on the Silver Line) further heightens the challenge of providing trains for training on the mainline.

While train operator trainees get extensive on-the-job training with existing train operators to build their skills prior to operating service on the mainline, field supervisors and RTCs do not (they move on to other training modules). As a result, some field supervisors are fearful and hesitant to relieve train operators on the mainline, or to assume operation of the train for any reason (since they are held to the same discipline matrix as train operators for any events in service). Several train operators informed members of FTA's SMI team that this situation means that the rail supervisors are unwilling to provide them with relief for restroom breaks or other personal matters.

- **Finding R-22: WMATA must ensure that two-year re-certifications are being performed for train operators.**

FTA's SMI team also followed up with Rail Operations Support regarding the performance of the two-year re-certifications required for train operators and interlocking operators. In response to FTA's request, WMATA produced 485 re-certification records for the 14-month period January 1, 2014 through February 28, 2015. Based on the total number of train operators and interlocking operators, this level of documentation generally conforms to the number that should be completed in order for WMATA to maintain the two-year cycle.

Given the critical importance of this function for ensuring the proficiency of train operators, especially in light of other FTA findings regarding weaknesses in rules compliance programs discussed above, FTA's SMI team finds that Rail Operations Support staffing is critical to ensuring the on-going completion of this program, and that any reductions in staffing levels would impact the ability of the department to complete these re-certifications as required by WMATA policy and the System Safety Program Plan.

Required Actions

Safety Directive 15-1 identifies 22 required actions to be taken by WMATA to address safety deficiencies related to operations and maintenance training and the performance of operational testing and rules compliance programs.

| **Metrorail Category 2: Ineffective Training, Operational Testing and Rules Compliance Programs** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding R-15 | Maintenance and Operations Departments have not ensured the RWP training program is being conducted as required. Annual refresher and biennial re-certification requirements for Level II and Level IV are behind schedule. | R-2-15-a | Each WMATA Department with Roadway Worker Protection-trained and qualified employees must coordinate with Technical Skills & Maintenance Training to get or establish an accurate status on each employee's refresher and requalification training. |
| | | R-2-15-b | Each WMATA employee with lapsed refresher training or requalification must repeat the initial training and qualification for his or her level as specified in WMATA's roadway worker protection training program. |
| | | R-2-15-c | WMATA's Information Technology Department must work with Technical Skills & Maintenance Training to develop a long-term solution to tracking employee status and ensuring that Computer-Based Training records, classroom records and employee records are accessible to all departments. |
| | | R-2-15-d | WMATA must include annual Roadway Worker Protection refresher and requalification time in overall work scheduling protocols and requirements. |
| Finding R-16 | Technical Training for operations and maintenance departments is under-resourced and fractured, currently provided by five different departments and IT, is insufficiently directed and resourced, and relies significantly on on-the-job-training (OJT) which is informal and lacks oversight. | R-2-16-a | WMATA must conduct a coordinated study to prioritize technical training needs for maintenance personnel, and operations training for Rail Traffic Controller, Train Operators, and Field Supervisors. |
| | | R-2-16-b | WMATA must evaluate whether re-organization or consolidation of training functions would improve the agency's ability to manage, schedule, budget for, develop, oversee and assess training and ensure that training material remains up-to-date. |
| | | R-2-16-c | WMATA must establish a comprehensive training program to communicate the new "Fire Life Safety 1000 -- Inspection, Testing and Maintenance Procedure" to WMATA Operations and Maintenance personnel. |
| | | R-2-16-d | WMATA must establish formal guidance for maintenance employees responsible for providing on-the-job training. |
| Finding R-17 | WMATA does not have a clear strategy for the development or delivery of emergency response training to WMATA's frontline personnel, or for managing the logistical challenges associated with coordinating familiarization training with local emergency responders. | R-2-17-a | WMATA's Office of Emergency Management must conduct a formal review of the Metrorail Safety Rules and Procedures Handbook, the supporting Standard operating Procedures, and the new checklists, tools and desk references developed by the Rail Operations Control Center to ensure conformance with WMATA's emergency plans and the understanding of local jurisdictions as reflected in region-wide emergency operations plans. |
| | | R-2-17-b | WMATA's Office of Emergency Management must conduct a formal review of all training provided to frontline, supervisory and ROCC personnel regarding the actions required to be performed during an emergency to ensure its conformance with WMATA's emergency plans and the understanding of local jurisdictions as reflected in region-wide emergency operations plans. |

| **Metrorail Category 2: Ineffective Training, Operational Testing and Rules Compliance Programs** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| | | R-2-17-c | WMATA must establish an approach for delivering updated emergency response training to front-line Train Operators, Supervisors, Stations Managers, Rail Traffic Controllers, and other personnel. |
| | | R-2-17-d | WMATA must review and update its approach to providing familiarization training to local emergency responders, and ensure that emergency responders have ample opportunities to learn and practice activating and using fire life safety equipment and systems, including ventilation fans, fire suppression system, standpipes, communication equipment, and other systems. |
| | | R-2-17-e | WMATA must test its backup Rail Operations Control Center on a quarterly basis and demonstrate the ability to safely control train traffic. |
| Finding R-18 | Rules compliance checks of operational personnel are inconsistent. | R-2-18-a | WMATA must require Rail Supervisors to complete meaningful rules checks on Train Operators, not just single observation items, unless directed as part of a special emphasis program. |
| | | R-2-18-b | WMATA must establish documentation and a training program to ensure that Rail Supervisors know how to conduct and record meaningful rules checks of Train Operators, and how to discuss results with Train Operators. |
| Finding R-19 | Rail Transportation is not ensuring that field supervisors conduct required rules compliance checks on station managers and train operators. | R-2-19-a | WMATA must develop a formal operations testing program to include active, fail-safe testing of all employees responsible for operating or directing the safe movement of trains. |
| | | R-2-19-b | WMATA must document operational testing requirements and test results to improve the utility of the program as part of a robust testing and observation program. |
| Finding R-20 | New supervisors are not familiar with rules compliance checks requirements. | R-2-20-a | WMATA must improve the quality and consistency of training for new Rail Supervisors to include purpose and requirements for rules checks. |
| Finding R-21 | Some newly promoted Field Supervisors, who have not previously operated rail vehicles, are not sufficiently trained to relieve train operators on the mainline. | R-2-21-a | WMATA must establish a minimum number of trips per month that each Rail Supervisor must complete on the mainline to ensure the sufficiency of his or her skills. |
| | | R-2-21-b | WMATA must review Supervisor Daily Activity Reports to ensure that Supervisors are completing required activities, including the minimum number of established trips per month. |
| Finding R-22 | WMATA must ensure that two-year re-certifications are being performed for Train Operators. | R-2-22-a | WMATA must review its schedule of in service evaluations to ensure sufficient time is available for each Train Operator to receive his or her two-year re-certification. |
| | | R-2-22-b | WMATA's Information Technology Department must work Rail Operations Support to develop a long-term solution to tracking Train Operator re-certification status and the results of any other in service examinations or activities completed. |

## 5.3 Category R-3: Insufficient Track Time for Maintenance

Average weekday Metrorail ridership has fallen from a high of 750,431 in 2008 to 721,804 in 2014 (not counting the Silver Line Extension to Tysons Corner). Since 2012, WMATA has worked to encourage riders "at all times of day, making all kinds of trips"[2] not just rush hour commuting. These policies, which keep trains on the tracks later in the evening and with greater frequency through the weekends, holidays, and in support of special events, are occurring at a time when the maintenance demands of aging equipment and deteriorating infrastructure are increasing. Further, with the expansion of the Silver Line, WMATA now has more trains in service than at any time in its history, and more equipment and infrastructure to be maintained.

Situation

Over the last decade, WMATA has operated its service with extremely tight track maintenance windows. Closed from midnight to 5 a.m. on weekdays, and from 3 a.m. to 7 a.m. on Friday and Saturday nights, WMATA provides maintenance departments with limited nighttime (OWL) access to track and wayside equipment. WMATA also performs maintenance work during off-peak periods. With only two tracks, shared by multiple Metrorail lines in the downtown core of the system, WMATA does not have the option, available for some peer rail transit systems, to re-route passenger service around maintenance work zones using a third or fourth track.

Key WMATA maintenance departments with responsibilities on the rail ROW, such as Track and Structures, POWR, ATC, and COMM, generally perform corrective maintenance and repairs during the OWL shift. Inspections and testing to ensure the safe condition and performance of infrastructure elements are conducted during off-peak service (typically 10:00 a.m. to 2:00 p.m.).

Specific rehabilitation, replacement or restoration projects may be conducted with or without contractor support during the OWL shift, during "early outs" (periods where service may be stopped or limited to 20-30 minute headways beginning at 10:00 p.m. on a specific portion of a Metrorail line), through weekend shutdowns (where a specific station or section of a station may be shut-down during the weekend), and during holiday weekend work shutdowns (when a significant portion of a Metrorail line is shutdown for a 2-day or 3-day holiday weekend, and coordinated work is performed across many maintenance departments to rehabilitate, repair, test, and thoroughly clean the rail system infrastructure).

WMATA also can initiate single-tracking at any time, to manage emergency repairs or scheduled maintenance, or in support of "early outs" and shutdowns. Using interlockings, crossovers and pocket tracks, single-tracking options configure routes so trains in both directions share the same track, providing maintenance personnel with access to the out-of-service track.

[2] http://www.wmata.com/about_metro/board_of_directors/board_docs/100914_4BCombinedColor.pdf

- **Finding R-23: Current OWL nighttime maintenance window typically allows between 90 minutes and two hours of on track time to complete work.**

Interviews, field observations and records reviews show that many of the most significant challenges to WMATA's maintenance program stem from shrinking access to the track during OWL service; increasing limitations in "early-outs", weekend and holiday shutdowns; and reductions in the use of single-tracking to support scheduled maintenance. In interviews, records reviews, and field observations of WMATA's evening and late night/early morning maintenance activities, FTA's SMI team found that on most nights, WMATA work crews responsible for maintaining critical Metrorail system components, including track, traction power, signal and train control, communications systems, and other structural elements, have between 90 minutes and two hours of actual track time during which to perform work.

According to interviews with WMATA maintenance personnel, this situation represents a decrease from the track time previously available for work prior to 2012. Given the poor state of repair of some system components, many WMATA maintenance managers indicated they do not consider even three hours of track time per evening sufficient for a two-track system providing WMATA's level of service. Veteran maintenance employees reported their frustration and concern at watching the window of available time on track tighten over their careers from six hours per night when the system was new, to four-to-five hours through the early 2000s, to three-to-four hours until the last few years, where it has now fallen, on some nights, below two hours, while the condition and performance of the system worsens. FTA's SMI team generally found that maintenance employees at all levels of the WMATA organization, from the front-line to senior management, identified the limited maintenance window as their single biggest safety challenge.

FTA's SMI team observed OWL shift work on March 23 (into the morning on March 24) and on March 24 (into the morning of March 25). On the March 23 OWL shift, for what should have been a simple T-bar replacement, and with the heightened scrutiny due to the presence of FTA's SMI team, the contractor was still not able to get access onto the work site until 2:00 a.m., and the contractor had to start clearing the site at 4:00 a.m., leaving only two hours of productive time. Interviews with WMATA personnel on the site indicated that sometimes contractors do not access the work site until 2:30 a.m. and still must begin clearing at 4:00 a.m. The impacts of this limited work window can be exacerbated by communication and logistical challenges. For example, during the course of the T-bar replacement observed by FTA's SMI team, it became clear that the Power branch work crew had the wrong size T-bar. The T-bar connects to power and ATC cables, however, ATC personnel were not on the job site, and there was confusion whether the ATC department had been consulted in the planning of the work. Since there was no time to bring new parts or personnel to the work site, or to complete a field modification, the original equipment had to be restored for revenue service, and no actual replacement work was accomplished in this location.

On the March 24 OWL shift, FTA observed the performance of interlocking testing conducted by the ATC department under emergency rights established in WMATA's General Order and Track Rights System (GOTRS). Due to the priority in GOTRS, testing began at approximately 1:15 a.m. at the Largo interlocking and concluded around 4:00 a.m. Five total tests were

scheduled as part of the biennial testing program for the interlocking. Four sets of tests generally proceeded as required (traffic locking, approach and time locking and signal indication locking, switch detector and route locking, and wayside push button boxes); however, there was insufficient time for ATC personnel to complete the fifth test (time release, timing relays and timing devices), which had to be re-scheduled. While at the interlocking, FTA's SMI team observed two track locations in extremely poor condition; the first site had missing third rail cover boards with an accumulation of detached vehicle "shoes" at a wayside pushbutton location, and the second site had loose wedges on Switch 1B on Track 2, which allowed the switch to move under reverse train movements.

While these items were reported to the Maintenance Operations Center, and work orders were issued for their repair, interviews with ATC and Track personnel, and reviews of inspection and maintenance records, indicate that it is difficult for Track personnel, under the current track allocation schedule, to get sufficient access to interlockings to conduct routine maintenance which would improve their general condition. For example, the signal supervisor at the Largo interlocking had previously reported similar conditions.

While WMATA's executive leadership team reports that new work processes, machinery and equipment have improved the agency's production per time rate, and that less work now has to be performed in specific areas, such as tie replacement or for rehabilitation projects that have already been completed on a given line, than during the 2010 to 2012 time period, FTA's SMI team found that limited track time creates numerous challenges for WMATA's maintenance departments and for safe condition of WMATA's critical track, power and ATC infrastructure.

- **Finding R-24: WMATA has reduced other options for track access, including holiday weekend work shut-downs, early outs, and single-tracking.**

FTA's SMI team also discovered that maintenance opportunities formerly available through other means, such as holiday weekend work shut-downs, early outs, and single-tracking, have also been cut back in an effort to expand service and reduce customer inconvenience. For example, in 2014 and so far in 2015, the number of holiday weekend shutdown days available for maintenance has been reduced from 9 days per year (3, three-day shutdowns per year) to 4 days per year (2, two-day shutdowns). New limitations were placed on early outs and single-tracking, due to service expansion for special events at the National Mall, Nationals Park, Wolf Trap, FedEx Field, Verizon Center, RFK Stadium, Patriot Center, Smith Center, Strathmore, and holiday events. During the month of December, early outs and single-tracking were effectively stopped altogether on several lines to support holiday shopping and events throughout the national capital region.

During a presentation to the WMATA Board of Directors in October 2014, limiting and suspending trackwork was presented as a positive action to increase ridership. Information presented to the Board of Directors included the following language relating to the impact of further reductions in trackwork:

> "As reported previously, Metro has reduced the intensity of weekend trackwork closures. Customers have noticed and responded, and weekend ridership has increased in recent months. We expect this trend to continue." [3]

WMATA's commitment to serve its customers with extended Metrorail service for special events and weekend activities comes with a corresponding and significant impact on the condition and performance of the Metrorail system, and potentially the safety of critical infrastructure components.

- **Finding R-25: Due to lack of track time, WMATA's maintenance departments must consistently re-schedule work, and, as a result, have growing maintenance backlogs, dating back to 2012 and 2013.**

As a result of the shrinking maintenance window, records show that up to 30 percent of planned maintenance work must be re-scheduled due to lack of track access. As a direct consequence, WMATA's maintenance departments collectively have accumulated thousands of backlogged work orders dating back to 2012 and 2013. Lack of track access has left WMATA's maintenance managers struggling to prioritize the most significant and safety critical repairs for completion, while deferring and re-scheduling most other work.

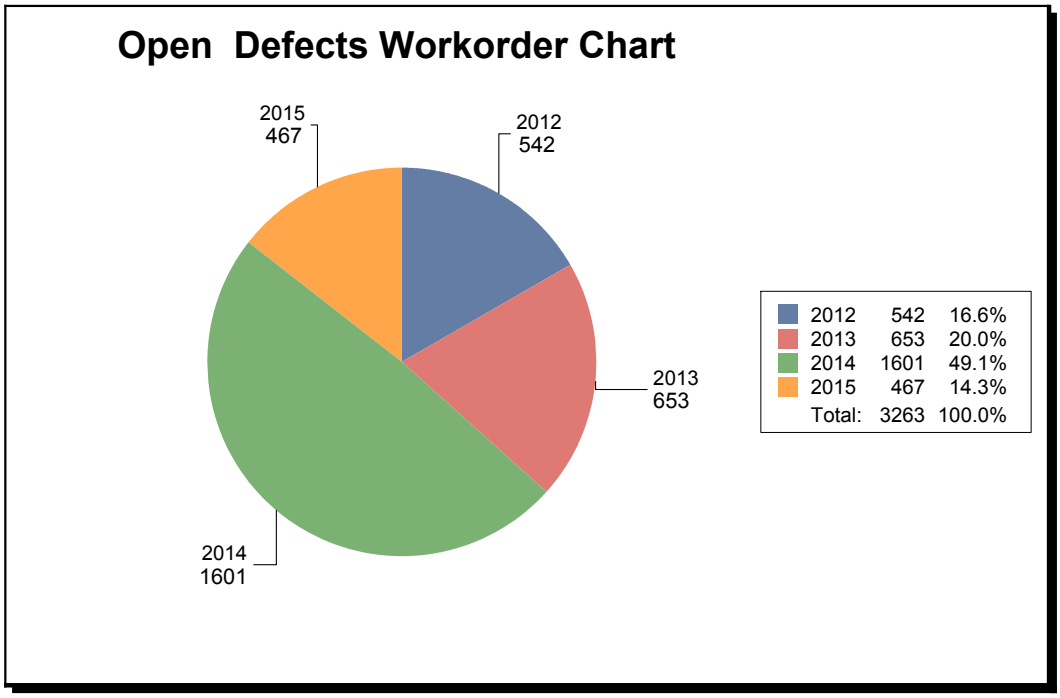
For example, WMATA's Track and Structures department addresses all Black, Red or Yellow conditions (Priority 1 Defects) that impact the speed of trains as a priority. Generally, Track and Structures personnel are able to address these items in a timely manner (2 hours to 1 week). A daily speed restriction report is distributed to monitor what Priority 1 defects are still current and which defects have been cleared.

However, between January 1, 2012, and February 18, 2015, the Track and Structures Department also issued 3,263 work orders for Priority 2 Defects that still remain open. Priority 2 defects do not require speed restrictions, but do require repair. Typical items include battered rail, wheel burns on rail, side wear, top wear, minor chipping, corrugation, missing third rail cover boards, and leaks. Priority 2 defects also must be constantly monitored because, individually, or in combination at a specific location, they can escalate into Priority 1 conditions that require speed restrictions.

The graphic below highlights the number of open work orders remaining for Priority 2 defects since 2012.

[3] Please see: http://www.wmata.com/about_metro/board_of_directors/board_docs/100914_4BCombinedColor.pdf.

**WMATA Track and Structures Open Work Order Defects, 2012 through 2015**




Track and Structures management indicated that additional access to specific locations, provided through reductions in restrictions on single-tracking during off-peak service and late night hours, would enable track maintenance personnel to begin to address this backlog. On-going rail replacement (about 12 miles per year) also supports improvements in the condition of track.

FTA's SMI team also determined that WMATA's Power branch, within the Office of System Maintenance, has over 1,700 open work orders, dating back to 2012, largely as a result of limited track access. WMATA's Power branch adds between 15 and 30 new open work orders to this total each month. These work orders relate to traction power substations and tiebreaker stations, including transformers, rectifiers and switchgear, cables, insulators, as well as the electrification systems for critical drainage pumping stations, ventilation fans and equipment, communications systems, emergency power systems, and lighting. To tackle this growing list of open work orders, and to keep current moving forward, Power branch managers estimate that a 10-15% increase in staffing is required to accommodate the work load.

Due to the emergency nature of many repairs to the ATC system, and their critical importance to passenger operations, FTA's SMI team found only 173 open ATC work orders in WMATA's maintenance information management system. However, the ATC department has struggled with completion of its track circuit replacement program, falling significantly behind schedule, in part due to the challenges of obtaining track time for their staff and contractor personnel, which has increased the cost of the overall track circuit replacement program. In addition, ATC managers have been unable to complete certain types of cable replacement activities. These issues will be discussed in the next section of this report.

Finally, at the time of FTA's SMI, COMM had 380 open work orders in the system. Most of these work orders related to alarms received in the ROCC from the AIM system. While charged with the responsibility to investigate and resolve AIM system alarms, COMM faces significant challenges in getting track time to re-create the conditions that might have triggered the alarm. For example, failures that occurred under eight-car train conditions in peak service may not replicate under lower power levels in off-peak service or late at night.

- **Finding R-26: Efficiencies can be obtained to improve the way in which WMATA's workers and contractors currently access the ROW.**

While there are many challenges involved in accessing the ROW with the personnel and equipment required to perform work, members of FTA's SMI team observed that the process to remove third rail power and bring equipment to the work site involved multiple delays from the ROCC, in waiting for authorized movements and activities. FTA noted that, during all OWL observations, appropriate work safety rules were adhered to and the work site was properly set up with lanterns, track jumpers and monitoring devices.

However, as discussed in greater detail earlier in this report, FTA's SMI team also believes that WMATA's ROCC can maintain safety while increasing field productivity. For example, the approach taken by the ROCC to bringing down power each evening, and restoring power in the early morning, could be improved through the use of a Power Director position (like many of WMATA's peers), less distraction for controllers and dispatchers, better radio discipline, and better training.

FTA's SMI team also recognizes that WMATA's management of logistics and scheduling to ensure efficient and effective use of the available track time could be improved. In environments of limited track access, larger, extremely well-managed crews working together in the same location to complete multiple tasks simultaneously may offer the best solution to balance operational and infrastructure needs. This type of work planning, scheduling and management requires considerable integration and coordination across departments, contracts, and with the Rail Operations Control Center.

Interviews with maintenance supervisors and managers in WMATA's TIES department highlighted the impacts of later service and less track access. TIES managers have taken steps to survey key work sites prior to conducting the work to ensure as built drawings are current, manuals are available, the work site is appropriately setup, and that updates to drawings/manuals uploaded to WMATA's document storage system. TIES also coordinates with the Rail Operations Control Center to support earlier start times (10 p.m.) in locations that do not require track access (offsite TPSS, tie breaker rooms, etc.).

However, TIES reports that, other than for emergency maintenance situations that impact revenue service, the ROCC does not generally prioritize maintenance work to ensure the most effective schedule or implementation, i.e., work could be prioritized by quickest to setup, work that needs longer period to conduct, etc. instead of by the discretion of controllers in the Rail Operations Control Center. Also, TIES managers pointed out that only one person represents all of the maintenance disciplines in the Maintenance Operations Center. This single position

coordinates all maintenance activity with the Rail Traffic Controllers during the OWL shift, so decisions are not made to maximize the ability of multiple work crews from multiple departments to complete objectives during the limited track time.

Required Actions

Years of underfunding and tremendous regional growth have resulted in underinvestment and significant deterioration Metrorail's core transit infrastructure and assets over the last decade. However, while WMATA has developed and launched new initiatives, including billions of dollars in projects under MetroForward and Momentum, to bring the system into a better state of repair, without the ability to access to the ROW to make repairs and enhancements, it is unlikely that these initiatives will deliver the intended results. Ultimately, FTA's SMI team finds that WMATA must establish a better balance between maintenance work and customer convenience.

Safety Directive 15-1 identifies four required actions to be taken by WMATA to address findings made regarding track time available for maintenance activities:

| **Metrorail Category 3: Insufficient Track Time for Maintenance** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding R-23 | Current OWL nighttime maintenance window typically only allows between 90 minutes and two hours of on track time. | R-3-23-a | WMATA must ensure that a process is in place for identifying and scheduling sufficient track time to complete required inspection, testing and maintenance activities. |
| Finding R-24 | WMATA has reduced other options for track access, including holiday weekend work shut-downs, early outs, and single-tracking. | R-3-24-a | WMATA must establish firm limits on minimum track time for inspection, testing and maintenance activities per month, and revisit limits annually. |
| Finding R-25 | Due to lack of track time, WMATA's maintenance departments must consistently re-schedule work, and, as a result, have growing maintenance backlogs, dating back to 2012 and 2013 | R-3-25-a | WMATA must develop and implement staffing plans to eliminate maintenance work orders backlogs and manage on-going workload in track and structures, traction power, communications, and automated train control departments. |
| Finding R-26 | Efficiencies can be obtained to improve the way in which WMATA's workers and contractors currently access the right-of-way. | R-3-26-a | WMATA must improve interdepartmental coordination and communication to take full advantage of track time. |

## 5.4 Category R-4: System-wide Maintenance Issues

FTA's SMI team identified seven findings related to the performance of maintenance activities on the Metrorail system.

Situation

WMATA's TIES department includes 13 offices that are responsible for the engineering and maintenance of all Metrorail infrastructure and vehicles. TIES develops and oversees the maintenance staffing and programs implemented by TRST; Systems Maintenance (SMNT), including the ATC branch, the POWR branch, the COMM branch, the Automatic Fare Collection (AFC) branch, and the Storerooms and Material Logistics Shop (SAMS); CMNT; ELES; as well as supporting information and procedures from CENI and CENV.

In addition to maintenance projects and facilities that support on-going operations, coordinated through the Office of Major Capital Projects (MCAP), TIES also manages WMATA's Office of Capital Program Delivery (CPDO), including new capital improvement projects managed through the offices of Infrastructure Renewal Programs (IRPG), System Renewal Program (SRPG), and Track Allocation and Support Services (TASS).

WMATA's Plant Department (PLNT) is responsible for maintaining all WMATA facilities and grounds, including building repairs, minor concrete and asphalt repairs, maintaining tiles in stations, providing system-wide custodial services and landscaping services, maintaining signage, managing the station rehabilitation program, maintaining mechanical equipment systems, including the fire/life safety systems (fire suppression, tunnel ventilation fans), drainage pumping stations, wet and dry sprinklers, and emergency exits. PLNT also coordinates and implements WMATA's response to severe weather incidents.

WMATA has established a comprehensive program of preventive maintenance and inspection procedures. FTA's SMI team reviewed the staffing and implementation of maintenance procedures and programs with WMATA maintenance employees in the field. Interviews, field observations and records reviews confirmed that, in the absence of regulated safety standards, WMATA maintenance and engineering departments generally adopt voluntary industry standards and practices, such as those developed by APTA and the American Railway Engineering and Maintenance-of-Way Association (AREMA), and recommendations and requirements from Original Equipment Manufacturers (OEM).

In response to incidents, changes in performance or requirements, or changes in suppliers or available parts, WMATA's engineering team develops engineering modification instructions, which are then incorporated into procedures, bulletins, instructions provided to maintenance workers and contractors performing work. WMATA maintains a comprehensive set of design criteria, and has an established configuration management and safety certification process.

- **Finding R-27: Documented maintenance procedures and standard operating procedures are not implemented as required.**

WMATA maintenance departments make a general effort to comply with all required inspection schedules. Overall, FTA found much evidence regarding a high level of general conformance with inspection schedules. However, in specific instances, FTA's SMI team also found that, due to ROW access limitations, staffing limitations, or coordination challenges in working with other

departments or divisions, such as the ROCC, scheduled preventive maintenance activities or inspections had been missed or fallen behind.

For example, on March 23, 2015, FTA's SMI team found during a review of the test records in a specific Train Control Room that test ATC3004 - Wayside Inspection - a quarterly test, was last recorded as being performed in June 2014, nine months earlier. As another example, FTAs SMI team observed that periodic inspection procedures for Rail Car Maintenance require that undercar chemical solution cleaning be performed on collector assemblies, friction brake discs, shock absorbers, vertical link assemblies, gear boxes and other apparatus. However, trucks that were sent to Brentwood Shop for repair and overhaul had a buildup of grease indicating that the undercar cleaning process was deficient in some areas. FTA's SMI team also noticed poor track and switch conditions in interlockings, water and drainage issues on track on part of the Red Line, and an accumulation of dust and grime in ventilation shafts, as well as a level of accumulated dust and grime on third rail insulators that would seem to indicate that not all basic elements of inspection or maintenance activity were performed as required.

FTA's SMI team also found during an ATC interlocking test that testers did not have the latest version of the test procedures (2013 version instead of 2014), and that the procedures call for measuring voltages, but do not provide the acceptable range of values. The tester used a guideline of approving results within 10% of the reading from the prior test. However, a check of prior records for the cab signal transmit level test found that the 2014 test level was almost 100% higher than the test in 2015 and the previous 2013 test. This clearly is not within the acceptable parameters of the test.

In another example, in observing contract work on the OWL shift, FTA's SMI team found some general confusion over who was responsible for inspecting and approving the contractor's work prior to returning it to revenue service. While inspectors are responsible for ensuring contractor work is sufficient, FTA's SMI team did not observe inspectors at any sites reviewed as part of the SMI. Further, after observing a few poorly planned or performed work elements involving POWR and ATC contractors, several representatives who spoke with FTA's SMI team indicated that contractor quality is a concern, and contractors are sometimes required to partially re-conduct work that was already completed, including the need for escort and track access again.

- **Finding R-28: Walking track inspection resources have been cut in half.**

Track inspectors who spoke with members of FTA's SMI team voiced concern that after an NTSB hearing into a November 30, 2006, accident in which two trackwalkers were struck and killed near Eisenhower Avenue Station, WMATA changed its policy regarding two-men track walking crews. WMATA determined that one of the two trackwalkers would be converted to a watchman position, while the other trackwalker would conduct track inspections.

Track inspectors noted that this decision effectively cut the track inspection capability of each 2-man team in half without changing the responsibilities or procedures in any other meaningful way. Track inspectors feel that they cannot adequately inspect both running rails and third rail in the time allotted with one track walker, and they strongly recommend the reintroduction of a 2-man track walker team along with a watchman to enhance the inspection process. Track

department managers acknowledged the challenges of balancing the safety of workers with the safety of the condition of the track. The earlier pilot program with flaggers for 2-man track inspection crews was discontinued due to lack of funding.

- **Finding R-29: All ATC alarms and issues must be communicated to ATC for investigation, repair and analysis.**

The NTSB has closed all safety recommendations issued to WMATA in the wake of the 2009 Fort Totten collision directly related to ATC. Specifically to respond to the NTSB, WMATA completed an extensive system safety analysis of the entire ATC system, commenced a program to replace all Alstom Generation II track circuits, greatly enhanced the use of its Track Circuit Monitoring Tool, established a Loss of Shunt alarm detection system in the ROCC, and established new inspection and maintenance procedures (ATC-1000, 2000 and 3000).

These actions significantly reduced the number of loss of shunt incidents, including alarms, temporary instances of bobbing and actual events, from over 400 per day to approximately 3 per day. While loss of shunt (LOS) events still occur on the WMATA train control system, FTA finds that WMATA has come in-line with its rail transit agency peers in terms of the number of these events. LOS in the rail transit industry can occur for a wide range of reasons, including rusty rails, leaves on tracks, arcing, and unbalanced negative return currents in the running rails.

WMATA continues to use its track circuit monitoring algorithm to review the performance of the system and to identify the more significant LOS occurrences in real-time at the ROCC. WMATA's ATC unit works to identify and correct the conditions that cause the LOS events and reduce the number of alarms at ROCC. ATC coordinates more closely with other departments, such as POWR, on negative return issues and traction power sub-station cable replacement programs, which also can affect LOS occurrences.

During interviews with ATC personnel, it became apparent that there were issues regarding how ATC alarms are communicated from the ROCC. Namely, FTA's SMI team discovered that the ROCC does not always open a work order on an ATC alarm or issue, if the RTC or MOC desk personnel believe that ATC is already aware of the issue. For example, during the SMI, ATC managers were not aware of two recurring non-vital ATC alarms that representatives at WMATA's ROCC stated "are known to everyone" and so were not reported through formal work orders. ATC appreciates that ROCC still receives a high number of alarms. The fact that the IT department, and not ATC or CENI manages the AIM system, may contribute to the problem. ATC managers believe that responsibilities for the AIM system should be transferred to the Engineering Department.

- **Finding R-30: WMATA's program for measuring, documenting and addressing the potential impacts of stray negative return current on the condition of WMATA's infrastructure is not documented in a formal plan to ensure coordination across departments and contractor services.**

WMATA implements an industry best practice by conducting quarterly Thermographic Image Testing of the entire traction power distribution system. This testing assists WMATA POWR

personnel in locating "hot spots" in the traction power system for review, investigation, maintenance or repair. WMATA also has a specialty contractor that performs corrosion surveys, track to earth testing, and rail to earth testing, to determine the extent of stray current presence and to prepare mitigation strategy reports including recommendations to repair or replace items as necessary to limit stray current activity.

These practices greatly strengthen WMATA's ability to identify and address the impacts of stray current based on the results of findings from testing and surveys, and to address corrosion caused by electrolysis. While FTA's SMI team recognizes many of these tools as industry best practices, interviews with POWR personnel indicated that critical coordination and planning activities required to ensure that all results from these surveys and tests performed by contractors are addressed could be enhanced, and that planning in place to incorporate "stray current" findings and mitigations into new projects and on-going maintenance activities could be improved.

WMATA's Electrical Mechanical Engineering unit is of the opinion that stray negative return currents are one of the primary causes of power-related smoke conditions and deficient track conditions. WMATA's ATC units also report concerns regarding the impacts of stray negative return current on the performance of the signal and train control system. The aging of WMATA's infrastructure, and the increasing current draw required to operated 8-car trains has likely increased this problem.

FTA's SMI team was not supplied with a formal plan that identifies all of the activities that WMATA is taking across departments and with contractors to monitor the impacts of stray negative return on their maintenance needs and to ensure that findings and mitigation strategies are fully integrated into on-going maintenance, procurement, and new project requirements.

- **Finding R-31: ATC resource challenges potentially impact service expansion.**

FTA's SMI team discovered staffing challenges in the ATC unit due to the recent retirements of 10 ATC supervisors and the challenges of training new personnel for the Silver Line. FTA also found differing perspectives within WMATA regarding the appropriate staffing level for the ATC unit. Assistant superintendents and supervisors within the ATC unit reported to FTA that because they did not receive approval for sufficient positions to staff the Silver Line, they have had to assign the positions allocated for WMATA's fatigue management program to the Silver Line to staff the new line, and their personnel are still working long hours. WMATA's executive leadership team disagreed that additional positions were needed, and pointed out that overall staffing in ATC's home department of System Maintenance has increased by over 150 positions for the Silver Line. These increases were shared across the ATC, POWR, COMM, and AFC units.

The recent retirements in the ATC unit, which were not managed with a formal contingency or succession plan, have led to a major loss of experience and knowledge in the unit. New hires coming into the unit have the required licenses or certifications for ATC technicians, but still require specific training modules and on-the-job training to work on specific pieces of WMATA equipment in an independent capacity. At the current time, while WMATA's ATC training program is technically strong, due to resource constraints, there are limited offerings of required

courses. For example, FTA's SMI team found that less than 15% of ATC staff has received training on the new Silver Line ATC. While this training was sufficient to cover the first job pick among ATC technicians, as a result of the most recent job pick, four technicians were working on the Silver Line who had not received training. At the time of the SMI, ATC was working to address this issue, and ensure that these individuals received the required training.

FTA's SMI team also found that with the retirements and limitations in training required for advancement, available ATC personnel interviewed in several different field locations reported working longer hours.

- **Finding R-32: WMATA has no formal program for reviewing the proficiency of maintenance field staff.**

Across a variety of WMATA Maintenance Departments, there is no formal program for reviewing the proficiency of field staff. Job posting requirements and WMATA's extensive hiring and screening processes ensure that maintenance personnel are certified, licensed or accredited as required for their discipline or craft when they are hired into WMATA. WMATA also tracks employee activity to maintain required certifications, licenses and accreditations. However, while WMATA maintenance personnel meet the requirements to practice their general disciplines or crafts (i.e., electrician, electronics technician, mechanic, carpenter, plumber, etc.), they are not formally evaluated for their proficiency in working on WMATA systems and equipment. With exceptions, such as for high-voltage technicians and the operators of specific on-track equipment, examinations are generally limited to individuals seeking to qualify for promotions. Therefore, reliance is often placed on fellow workers to advise the supervisor if another individual's work is not up to par. This situation can create challenges in identifying and effectively managing or re-training employees whose work does not conform to WMATA's established SOPs, OAPs, and standards.

Across maintenance departments, many WMATA frontline maintenance personnel noted that while supervisors currently do what they can to support on-the-job training and mentoring of employees, there are not sufficient resources in place to create a formal program for supervisory inspections to observe the performance of maintenance, to look at quality of work in the field, and to formally intervene to re-train employees.

- **Finding R-33: Inventory "stockouts" have impacted maintenance operations. Material control stock out items are reported by Superintendents in Rail Car Maintenance, Traction Power and Plant as a serious concern in the performance of maintenance activities and ensuring equipment availability, however mitigations have not been implemented.**

Finally, FTA's SMI team found that WMATA's maintenance activities are being impacted by inventory "stockouts" of critical parts. "Stockouts" is a term that means out of stock inventory for a specific part or item. When a part is not available to support scheduled or corrective maintenance, then this maintenance activity must be deferred or parts must be obtained from other sources (i.e., other vehicles removed from service).

Material control stock out items are reported by Superintendents in Rail Car Maintenance, Traction Power and Plant as a serious concern in the performance of maintenance activities. For example, in Rail Car Maintenance, brake pad shortages protracted for over three months and forced the cannibalization of brake pads from out of service rail cars and trucks in process for rebuild. A review of stock outs for August 2014 and March 2015 (two random points in time) disclosed that 170 items in August 2014 and 270 items in March 2015 were unavailable for maintenance requirements. Brake hoses, red insulating paint, disc brake assembly, and brake calipers were among the stock out items.

Required Actions

Safety Directive 15-1 identifies seven required actions to be taken by WMATA to address safety deficiencies in system-wide maintenance issues.

| **Metrorail Category 4: System-wide Maintenance Issues** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding R-27 | Documented maintenance procedures and standard operating procedures are not implemented as required. | R-4-27-a | For all major departments with inspection and maintenance responsibilities for critical infrastructure, WMATA must establish and/or update a preventive maintenance and inspection testing quality audit process to ensure compliance with established maintenance and testing practices, and to monitor missed or incomplete preventive maintenance activities and/or inspections. |
| Finding R-28 | Walking track inspection resources have been cut in half. | R-4-28-a | WMATA must review the workload and inspection territory assigned to track inspectors, and leverage non-track inspectors to perform watchman duties. |
| Finding R-29 | All ATC alarms and issues must be communicated to ATC for investigation, repair and analysis. | R-4-29-a | WMATA must ensure that ROCC reports all signal alarms and notifications to ATC. |
| Finding R-30 | WMATA's program for measuring, documenting and addressing the potential impacts of stray negative return current on the condition of WMATA's infrastructure is not documented in a formal plan to ensure coordination across departments and contractor services. | R-4-30-a | WMATA must develop a plan to document roles and responsibilities, activities, and points of coordination regarding its program to measure, document and mitigate the impacts of stray negative return current. |

| Metrorail Category 4: System-wide Maintenance Issues | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding R-31 | ATC resource challenges potentially impact service expansion. | R-4-31-a | WMATA must assess adequacy of Automatic Train Control staffing levels resulting from the addition of the Silver Line. |
| Finding R-32 | WMATA has no formal program for reviewing the proficiency of maintenance field staff. | R-4-32-a | WMATA must ensure that each department within Transit Infrastructure and Engineering Services creates a formal program of Supervisory inspections to observe maintenance, look at quality of work in the field, and formally intervene to evaluate, re-train (if necessary), and enhance the professional development of employees. |
| Finding R-33 | Inventory "stockouts" have impacted maintenance operations. Material control stock out items are reported by Superintendents in Rail Car Maintenance, Traction Power and Plant as a serious concern in the performance of maintenance activities and ensuring equipment availability, however mitigations have not been implemented. | R-4-33-a | Each WMATA Department impacted by inventory stockouts must develop a recovery or corrective action plan to ensure equipment availability and to manage delays. |

## 5.5 Category R-5: Fire/Life Safety and Emergency Preparedness

FTA's SMI team identified two findings regarding WMATA's fire/life safety and the management of the infrastructure conditions that contribute to smoke and fire events.

Situation

WMATA's biggest corrective maintenance challenges occur for infrastructure elements with shared responsibilities across departments. Based on extensive field reviews, records reviews, including work orders and corrective maintenance inspections, interviews and observations, FTA's SMI team determined that, against a general backdrop of attempted conformance with maintenance requirements, enhanced coordination is needed across WMATA departments with shared responsibility for maintaining critical infrastructure to ensure prioritized response to defects and failures.

- **Finding R-34: Priority maintenance work for Fire/Life Safety (FLS) systems and other critical infrastructure with shared departmental responsibilities for inspection and maintenance is not completed as required.**

Shared maintenance responsibilities across departments for critical infrastructure items such as traction power cables at expansion joints, fire/life safety systems, the AIM system, elements of

the signal and train control system, and passenger communication systems are not always understood in the field or acted on in assigning and completing corrective maintenance work orders. Specifically for WMATA's critical fire/life safety systems, FTA's SMI team identified several instances where supporting departments did not complete priority repairs required in the tunnel ventilation system in a timely manner. For example, two ventilation fans in WMATA's deepest tunnel location were locked out for over six months waiting for the Power branch to complete a repair. Repairs for transfer switches and communication cables also lagged. Updates to the AIM system to enhance the visual display to more accurately depict the location of key fire/life system have also received lower priority than other maintenance initiatives and activities.

FTA's SMI team also identified confusion among WMATA maintenance employees regarding the definition of key terms and conditions essential to prioritizing reports regarding serious fire/life safety malfunctions in traction power, track, signal and train control system, and the remote terminal units that support the AIM system visual display. For example, FTA's team found confusion over the definition of an "arcing insulator." FTA's SMI team found a variety of terms from "sparkling" to "smoking" applied to insulators that diminish the severity of the report. "Arcing" insulators must be investigated and replaced immediately; insulators described with other terms do not.

WMATA is developing a "Fire/Life Safety 1000" maintenance procedure, to clarify roles and responsibilities, and outline expectations regarding how departments should work together to coordinate and prioritize inspection, maintenance and repair of these system components. This procedure is being based on the agency's "ATC 1000" procedure developed in the wake of Fort Totten accident to ensure an enhanced focus on the testing and maintenance of track circuits and other wayside equipment.

- **Finding R-35: WMATA must do more to prevent and manage conditions that cause smoke in tunnels.**

Based on review of safety data reported to the FTA NTD, FTA's SMI team observed that WMATA has been experiencing a growing number of fires and smoke events, whether related to the changing performance of the traction power system as it manages new electricity demands for 8-car trains, changing weather conditions requiring sudden spikes in energy consumption for heating or cooling, increased debris on tracks and grime build-up on insulators and other traction power system components, or other causes.

In 2014, WMATA experienced almost twice as many events requiring fire suppression as in 2013 (29 versus 15). For the first four months of 2015, WMATA has experienced 2 major fire events and 10 events requiring suppression, and is on target to exceed last year's total.

Washington Metropolitan Area Transit Authority – Heavy Rail Fires

| Fire Type | 2013 | 2014 | 2015* |
|---|---|---|---|
| Major Fires | 0 | 1 | 2 |
| Non-major Fires** | 15 | 28 | 10 |
| Total | 15 | 29 | 12 |

*Includes January through April
**Non-major fires are those that do not meet a reporting threshold but require suppression

Source: National Transit Database, 5/31/2015

In reviewing this issue, FTA's SMI team confirmed that while WMATA does have smoke detectors at specific locations, currently WMATA does not have the means to determine the exact location of a source of smoke in the tunnel network. This lack of on-the-ground information regarding the exact location of smoke can complicate both the reporting of and response to these events.

Follow-up interviews with WMATA maintenance personnel demonstrated some confusion regarding which department was responsible for specific inspection and maintenance activities that will reduce the likelihood of smoke or fire on the WMATA system. For example, TRST personnel responsible for maintaining the third rail cover board and third rail supports (insulators) revealed considerable confusion regarding the responsibility of inspecting cabling around third rail expansion joints. While this cabling is technically the responsibility of POWR, some TRST personnel indicated that they inspect these cables and report problems to POWR, while other TRST personnel do not. Correspondingly, some POWR personnel interviewed by the SMI team were not aware of their responsibility to inspect the condition of these joints, assuming this activity was performed by TRST. Also, there was no clear understanding regarding responsibility for cleaning older third rail insulators that have accumulated steel dust and grime and that can cause smoke conditions. Responsibility for cleaning these insulators, and requirements surrounding their maintenance or replacement, are still being defined by WMATA's engineers and maintenance team.

WMATA discontinued a program to test the insulation resistance of power cables several years ago, opting instead for replacement. However, funding ran out for this program, and cable replacement has largely stopped. To address this issue, WMATA recently identified specific steps that will be taken to inspect the condition of all third rail jumper cables located in tunnel sections and provide an "engineering and operations report" on their condition and installation.

Also, as a result of the January 2015 incident, WMATA has decided to conduct an assessment regarding required replacements of high voltage third rail jumper cables with low smoke/low halogen cables. WMATA is also installing mechanical protection on third rail jumper cables potentially exposed to wear from vibration against other materials. WMATA also committed to

inspect and review ground fault detectors on third rail circuit breakers, and to perform an operational analysis to determine whether WMATA can limit current flow through the electrical infrastructure by running trains at 45 miles per hour in the system core. WMATA also established a schedule of quarterly drills to exercise capabilities to manage emergency events in tunnel and on elevated structures.

Required Actions

Safety Directive 15-1 identifies seven required actions to be taken by WMATA to address FTA's findings regarding WMATA's management of fire/life safety issues and concerns.

| **Metrorail Category 5: Fire/Life Safety and Emergency Preparedness** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding R-34 | Priority maintenance work for Fire/Life Safety (FLS) systems and other critical infrastructure with shared departmental responsibilities for inspection and maintenance is not completed as required. | R-5-34-a | WMATA must complete its "Fire/Life Safety 1000" maintenance procedure, to clarify roles and responsibilities, and outline expectations regarding how departments should work together to coordinate inspection, maintenance and repair of these system components. |
| Finding R-35 | WMATA must do more to prevent and manage conditions that cause smoke in tunnels. | R-5-35-a | WMATA must establish clear definitions for infrastructure conditions requiring immediate or emergency action, such as "arcing insulator." |
| | | R-5-35-b | WMATA must address third rail insulator cleaning and replacement requirements and third rail jumper cable inspection and replacement requirements as part of the "FLS 1000" procedure, or in separate but referenced procedures. |
| | | R-5-35-c | WMATA must improve its ability to detect the location of smoke in its tunnel network. |
| | | R-5-35-d | WMATA must resume its program for cable insulation resistance testing for its power cables. Insulation resistance testing should be performed on power cables every 10 years. |
| | | R-5-35-e | WMATA must replace all defective power cables that have been identified by traction power inspectors and maintainers. |
| | | R-5-35-f | WMATA must set a schedule of drills to assess the effectiveness of WMATA's response to smoke in tunnel and station conditions. |

## 5.6 Category R-6: Condition and Performance of Tunnel Ventilation System

FTA's SMI team identified three findings related to the condition and performance of WMATA's tunnel ventilation system.

Situation

WMATA's tunnel ventilation system is used to retain or remove heat generated by trains and to support air quality in the tunnels and underground stations. Tunnel fans and fan shafts/vent shafts are also used to remove smoke from the tunnels in the event of fire or other conditions. Tunnel fans are reversible and are controlled by the ROCC; they also can be operated locally from the control panel near the fan. The fans and dampers work together to evacuate smoke. Vent shaft dampers close to seal the vent shaft and allow smoke or fumes to be pulled to the fan shaft and ejected outside. The static condition of the fans is OFF. They are only designed to move air in emergencies or during work efforts.

WMATA has 85 total fan shaft/vent shaft sites, including 82 sites that house fans, and three fan control rooms for fans with wayside locations. With the Silver Line extension, WMATA has just under 400 total fans. Older fans have a rated capacity of 50,000 cubic feet per minute (air flow). Newer fans have significantly higher rated capacities.

The majority of WMATA's fan shafts have units that contain three to six fans with 5-foot blades that operate in series and are controlled pneumatically. In ten shafts, WMATA has the newer programmable logic control (PLC) boxes to test and operate the fans locally. The Silver Line is equipped with two sets of brand-new jet fans.

At the fan shaft, when conducting inspections or repairs, WMATA's PLNT mechanics have access to a selector switch on the fan controls, which gives them the following options:

- Remote (this is the default setting that gives ROCC the ability to operate remotely, coming out of this position triggers a remote control abnormal alarm at the ROCC),
- Off,
- Local Supply, and
- Local Exhaust.

At ROCC, the controllers have access to a fan menu, which gives them the following options:

- Auto Exhaust – In this setting, the mode of operation is set to exhaust and the fans will operate automatically in exhaust mode only as follows:
    - When the tunnel temperature reaches 95 degrees, one fan will come on line.
    - If the tunnel temperature continues to climb and reaches 96 degrees, a second fan comes on line. The process will continue for each additional increase of 1 degree if there are more than 2 fans in that location.
- Auto Supply – In this setting, the mode of operation is set to supply and the fans will operate as described above, except in supply mode.
- Emergency On Exhaust – This option commands all fans on in exhaust mode (fans will

come on line sequentially after programmed timed delay between each fan).
- Emergency On Supply – This option commands all fans on in supply mode (fans will come on line sequentially after programmed timed delay between each fan).
- Fan Automatic On – This command places the fans in a state to run automatically as defined above. The mode of operation (exhaust or supply) will be in the same direction of the last commanded mode setting.
- Fan Emergency On – This option commands all fans on. The fans will operate in the same direction of the last commanded mode setting (exhaust or supply).
- Fan Emergency Off – This option commands all fans off.

The ventilation system display on the AIM system conveys very basic data: users at the ROCC can select a fan to view its basic condition (whether it is under local or remote control, whether it is in supply or exhaust, whether the system is behaving abnormally). RTCs can select fans to run in automatic exhaust or supply or emergency exhaust or supply (overrides tunnel conditions and forces fans to run).

RTCs have very little diagnostic information regarding fans or their performance once activated. RTCs interface with the fans mostly as requested during scheduled preventive maintenance inspections. RTC interaction is limited to remote control of the fans in both directions, and confirmation to maintenance employees that the AIM system displays the appropriate fan status. Due to the age of the fans and control boxes, and the limitations of the AIM system, RTCs cannot confirm the status of the fans as available for remote operation, though alarms are indicated initially whenever a fan is taken out of remote.

On the AIM system, the alphanumeric codes used to indicate both stations and fan shafts do not correspond perfectly: for example, FA07 (fan shaft 07) does not correlate to A07 (station A07), but rather to A05 (station A05). The different alphanumeric schemes can cause confusion for RTCs and mechanics conducting preventive maintenance checks with ROCC and during incidents and emergencies.

As discussed in the Fire/Life Safety section of this report, different WMATA Departments have responsibility for the inspection and maintenance of the various components that comprise WMATA's many emergency systems, including the tunnel ventilation system. Specifically for the tunnel ventilation system:

- PLNT is responsible for the mechanical infrastructure of the tunnel fan system and the associated electronic and mechanical controls. PLNT handles the low voltage (120 volt) components, including all mechanical and pneumatic elements of the system. PLNT has no licensed electricians, or communications technicians, and relies on other departments for these capabilities. PLNT identifies its responsibilities as largely located in the fan shaft from the Data Transmission System (DTS) box back to the fan. PLNT has the greatest responsibility for the tunnel ventilation system. PLNT's Equipment (EQMT) group performs the Tunnel Ventilation inspections and maintenance activities. Each fan shaft receives monthly maintenance inspections.

- ATC technicians maintain the link from the DTS box to the ROCC and the AIM system,

which includes the remote terminal units (RTUs) located in the train control rooms.

- The ROCC has the ability to remotely operate the tunnel fans, and is responsible for processing alarms and addressing any issues by notifying the appropriate personnel.

- The ROCC also communicates with PLNT during monthly inspections to confirm, to the extent possible, the functioning of the fans and alarms, though often, due to the volume of activity experienced at ROCC, these tests may not be performed in a timely manner for PLNT personnel located remotely at the fan site. FTA's SMI team noted that the alphanumeric codes used to indicate both stations and shafts appear to cause some confusion between the ROCC and PLNT; FA07 (fan shaft 07) does not correlate to A07 (station A07), but rather to A05.

- POWR inspects and maintains the motor control center and transfer switches, and also maintains the automatic voltage regulator. POWR is responsible for all high-voltage elements of the tunnel ventilation system (460/480 AC), including emergency trips and circuit breakers.

- Emergency personnel have the ability to control the fans locally during an emergency. They coordinate with ROCC to gain access to the system.

Electronic communications between the fan system and ROCC travel in both directions, with the ROCC able to send commands to the fan and the fan relaying a signal received response as well as some basic information as to fan system status. The ROCC can send five basic commands: 1) Emergency off; 2) Emergency on; 3) Remote control auto; 4) Supply; and 5) Exhaust. In response, the fan system can send 10 responses to the ROCC: 1) Accept emergency off; 2) Accept emergency on; 3) Accept remote control auto; 4) Accept supply; 5) Accept exhaust; 6) Damper abnormal alarm; 7) Operation abnormal alarm; 8) Low (45 degree) tunnel temperature alarm; 9) High (95 degree) tunnel temperature alarm; and 10) Remote control abnormal alarm.

If the ROCC initiates emergency fan operations, vent shaft dampers close and fan shaft bypass dampers close. The fan dampers open, and the fans run as commanded (exhaust or intake; default is exhaust and unless commanded otherwise, fans run in exhaust). After a 20 second delay between the signal and the first fan energizing, the first fan energizes, with each subsequent fan energizes an additional 10 seconds after the last. Fans will continue running until they receive an "off" command. If commanded to run in reverse order, fans will reverse the above process after a 20 second delay. These delays allow the fans to get up to speed before adding another load to the system.

"Remote control abnormal" alarms are triggered at the ROCC if there is a loss of air pressure (vent shaft and bypass dampers return to their closed position and fan dampers open) OR during loss of electrical power events. The motors have a tolerance of approximately +/- 10% of 460V. Transfer switches will trip the source from normal to emergency when the power drops too low. The unit being turned to local control or off by a maintenance employee performing work can also trigger these alarms.

"Operation abnormal" alarms are triggered if fans fail to rotate or rotate in the wrong direction as indicated by air flow sensors located on either side of the fan blades. "Damper abnormal" alarms are triggered when fan dampers fail to open as monitored by a limit switch on the fan. There are no vent shaft damper alerts. Each of these alarms requires a visit by a mechanic to identify the issue.

On February 11, 2015, the NTSB issued Urgent Safety Recommendation R-15-8 to WMATA:

> "Assess your subway tunnel ventilation system to verify the state of good repair and compliance with industry best practices and standards, such as those outlined in the National Fire Protection Association (NFPA) 130, Standard for Fixed Guideway Transit and Passenger Rail Systems."

In the weeks prior to FTA's SMI, as requested by the NTSB, WMATA completed an extensive inspection of all ventilation fans and shafts. PLNT developed the schedule, which was provided to WMATA's Safety department and TOC, in advance, and a member of the Safety or Quality department accompanied PLNT staff on most of the inspections (some of the observers signed below the mechanic's signature line). TOC also observed inspections. The complete set of inspection checklists was provided to FTA's SMI team.

Using the checklists as a reference, FTA's SMI team split into two groups to conduct field observations of PLNT preventive maintenance inspections on WMATA's tunnel ventilation system. The ROCC was extremely responsive to the PLNT crews being observed by FTA's SMI team. According to PLNT personnel, the time to perform the PMIs was reduced dramatically as a result of this heightened attention from ROCC.

The table on the next page lists the defects identified by WMATA from their inspection of all fan shafts and fans. At the time of FTA's SMI, work was underway to address and resolve each item. FTA's on-site inspections confirmed the conditions in location FA-13 on the Red Line, where fans number 5 and 6 have been out of service and locked out since September 11, 2014, due to a low power issue.

FTA also confirmed an existing Work Order at this location pertaining to the Transfer Switch. When tested, the transfer switch did not work. This location is the deepest fan shaft on the WMATA system, and the most challenging to access. FTA's inspection also confirmed the condition and performance of fans in five other shafts, and the conformance of their condition to the inspection results documented on the corresponding forms.

| WMATA Fan Shaft Discrepancy Work List as of 3/18/2015 | | | | | |
|---|---|---|---|---|---|
| Location | # of Fans | DEPT | Reported Item | Corrective Action | ECD |
| FA-11 | 3 | PLNT/PWR | Fan #5 did not start (No power from MCC Panel to disconnect switch)<br>2 Fans operational | Circuit breaker has been replaced, but motor was found to be defective. New motor ordered (8-12 week lead time). Work order #11586296<br><br>Fan shaft at 66% operational capacity. | 5/27/2015 |
| FA-13 | 6 | PWR | 2 Fans locked out due to Low voltage condition in the fan shaft.<br>4 fans operational | SMNT/PLNT/CENI performed site visit 2/23/2015 to verify operation.<br>Contractor being scheduled to retrofit voltage regulator.<br>Two fans will be kept out of service to prevent entire panel from tripping out.<br><br>Fan shaft at 66% operational capacity. | 4/19/2015 |
| FA-14 | 4 | PWR | 1 fan locked out due to low voltage condition at in the fan shaft.<br>3 fans operational. | SMNT/PLNT/CENI performing site visit 2/23/2015 to verify operation.<br><br>Contractor is being scheduled to retrofit voltage regulator.<br>One fan will be locked out of service to prevent entire panel from tripping out.<br><br>Fan shaft at 75% operational capacity. | 4/19/2015 |
| FE-9 | 3 | PWR | Transfer switch stuck. Knife switch broken.<br>All fans are operational. | SMNT has ordered a new transfer switch.<br><br>Transfer switch is locked in normal mode.<br>Fan shaft at 100% operational capacity. | 4/15/2015 |

| WMATA Fan Shaft Discrepancy Work List as of 3/18/2015 | | | | | |
|---|---|---|---|---|---|
| Location | # of Fans | DEPT | Reported Item | Corrective Action | ECD |
| FL-1 | 4 | PLNT/PWR/ CENI | This site has a low voltage problem. Two of four fans trip intermittently<br>3 fans operational. | PLNT ordered new motor starters:<br>PLNT will install new PLC Control Cabinet:<br>Contractor will be scheduled to retrofit regulator:<br>One fan will be locked out of service to prevent entire panel from tripping.<br>Fan shaft at 75% operational capacity. | 3/20/2015<br>Completed 3/11/2015<br>4/23/2015 |

- **Finding R-36: Demonstration of compliance with required inspection and maintenance procedures must be improved.**

While FTA's SMI team generally found that the condition and performance of fans matched the status indicated on the inspection reports, FTA's SMI team also observed an extreme accumulation of dust and grime on the fan faceplates and the pneumatic control boxes. Interviews with PLNT personnel also highlighted the low priority assigned in ROCC to fan ventilation tests. RTCs may keep PLNT personnel waiting for hours before confirming indications or remotely turning on fans. Accessing the fan locations can require carrying tools and equipment down as many 20 flights of stairs into dark and confined spaces. Dust is a significant concern for workers, and many are now wearing optional respiratory protection provided by WMATA.

Ventilation system inspections are documented on paper-based forms that must be entered into WMATA's maintenance information management system by supervisors. In 2014, PLNT personnel performed over 37,000 preventive maintenance inspections and completed over 17,000 corrective maintenance work tickets annually (not just for tunnel ventilation but also for drainage pumping stations and a range of general plumbing, carpentry and maintenance activities). At the time of FTA's SMI, all PLNT field activity was documented on paper forms that then had to be inputted into the WMATA MMIS by PLNT Supervisors.

For preventative maintenance performed on the tunnel ventilation system, as with other PLNT field activities, the process of transitioning the paper reports to the MMIS requires two to three weeks, potentially delaying work orders and the review of critical data or information regarding the condition and performance of the fans. This process also keeps supervisors at their desks entering paper-based reports into the MMIS and limits their time to conduct independent audits and follow-ups in the field to assess the condition of fans and quality of inspections.

Given these challenges, and critical importance of the tunnel ventilation system in the event of an emergency, FTA's SMI team determined that PLNT managers currently do not have strong enough assurances regarding the performance or quality of monthly inspections. FTA's team also finds POWR and COMM, and the ROCC, have a tremendous amount of influence in the inspection, maintenance, testing and performance of this system. WMATA has recognized this issue, and is coordinating across departments to establish a quality audit process for the tunnel ventilation system as part of the agency's new Fire Life Safety 1000 inspection, testing and maintenance procedure.

- **Finding R-37: Newer technology will enhance the performance of inspections and their quality.**

The tunnel ventilation systems report through the DTS box to the RTUs, which are located within the train control rooms and report back into the AIM system. RTU's handle multiple inputs. If an input is down it may not be detected until the next monthly inspection. If the RTU input is down the AIM system display would not know unless the RTC attempts to exercise the fan site.

For the fans with PLC control boxes and for the Silver Line jet fans, PLNT can confirm the "absence of alarms" and ensure that all settings and communication from the fans to the DTS box are correct; for the pneumatic fans, PLNT can only confirm three of the 10 possible alarm settings that a fan can send to a DTS box as part of monthly maintenance. Since these alarm settings are designed to fail-safe, and should send a signal to ROCC upon their failure, maintenance and performance of signal capability was not initially considered in the maintenance program for these fans.

- **Finding R-38: WMATA's existing tunnel ventilation system was designed and installed before modern fire/life safety standards were issued for the rail transit environment, however, with growing passenger loads and eight-car trains, WMATA must look for opportunities to improve ventilation performance and capacity.**

Most of WMATA's pneumatically controlled fans are 30-40 years old and do not meet all requirements specified in NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems. In fact, many of WMATA's fans were designed and installed before NFPA 130's initial version was even issued in 1983. While these older fans do not meet modern air movement capacity standards, all of them are reversible, and can be controlled by the ROCC and also operated locally from the control panel.

Given the challenges in terms of available space and ducting in established tunnels and stations, WMATA engineers report that while replacing these fans with more modern equipment would improve capacity, currently available equipment, which would fit the existing dimensions of the shafts, would not bring the system into compliance with NFPA 130.

For the last decade or so, all WMATA design criteria require NFPA 130 compliance. For example, the Silver Line and associated new construction are compliant with NFPA 130 provisions. However, WMATA has made minimal changes to its ventilation system over time to address growing passenger loads and eight-car trains.

WMATA has reviewed other engineering and modification options to increase capacity, however, and while modifications can be made for some improvement in cubic feet of air flow per minute, drilling and tunneling for the space and new equipment required to bring the existing system into full compliance with modern NFPA 130 standards would likely cost billions of dollars.

Required Actions

Safety Directive 15-1 identifies four required actions to be taken by WMATA to address safety deficiencies related to FTA's findings on the inspection, maintenance and performance of WMATA's tunnel ventilation system.

| **Metrorail Category 6: Condition and Performance of Tunnel Ventilation System** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding R-36 | Documentation and scheduling of tunnel ventilation system inspections must be improved to ensure compliance with required procedures. | R-6-36-a | WMATA must establish a ventilation system testing quality audit process to ensure compliance with established maintenance and testing practices. |
| | | R-6-36-b | WMATA must automate inspection and maintenance record keeping for tunnel ventilation systems, drainage pumping stations, and other critical systems managed by the Office of Plant Maintenance. |
| Finding R-37 | Newer technology will enhance the performance of inspections and their quality. | R-6-37-a | WMATA must complete replacement of the pneumatic control boxes for ventilation fans with Programmable Logic Control systems within the next five years. |
| Finding R-38 | WMATA's existing tunnel ventilation system was designed and installed before modern fire/life safety standards were issued for the rail transit environment, however, with growing passenger loads and eight-car trains, WMATA must look for opportunities to improve ventilation performance and capacity. | R-6-38-a | WMATA must conduct an engineering assessment to identify ways in which to improve the performance and capacity of the tunnel ventilation system. |

## 5.7 Category R-7: Performance of Information Management Technology

FTA's SMI team identified four findings related to performance of information management technology used by WMATA's operating and maintenance departments.

Situation

As a result of interviews and records review with several operating and maintenance departments, FTA's SMI team found that documentation of initial and refresher training, certifications, professional licenses, and re-certifications is generally very poor. Over the last two years, in an effort to streamline and consolidate WMATA's recordkeeping systems, the agency's training and certification records were incorporated into an integrated Enterprise Learning Management (ELM) system.

- **Finding R-39: Difficulties with WMATA's ELM have forced departments to use work-arounds resulting in poor documentation of initial and refresher training, certifications, professional licenses and re-certifications.**

Although it appears that WMATA intended this transition to the ELM system to streamline the recordkeeping processes and procedures of all WMATA departments and to reduce the burden on individual entities and personnel, the system's ability to serve as an effective system of training records management is questionable at the present time. Many WMATA managers find the ELM system to be complicated, inflexible or difficult to use to track training. As a result, many departments at WMATA have developed work-arounds and tracking tables in Microsoft Excel, Access or Word. As discussed in earlier sections of this report, regarding confusion over training records for RWP refresher and requalification training, FTA's SMI team found that, due to challenges in using the ELM system, WMATA's managers do not have real-time access to their training records, nor do they have full confidence in the training records tracking system.

- **Finding R-40: WMATA's MMIS, in its current configuration, is cumbersome and challenging to use for many WMATA maintenance employees.**

FTA's SMI team also found that WMATA's use of its MMIS could be improved significantly to prioritize safety-critical maintenance work. FTA's SMI team identified numerous instances where WMATA's MMIS was not used as designed due either to poor data entry, lack of training, or lack of maintenance manager access to specific fields or information. Reports on safety critical maintenance activities were not readily available.

To address the lack of training and wide-spread skill in use of the MMIS, most WMATA maintenance departments have subject matter experts available to screen data and generate reports. Such screening is necessary because issues with data entry and work order creation must be managed manually to ensure accurate reports. In many cases, reports or data from the MMIS are exported to other programs for trending and analysis. Therefore, due to both the complexity of the maintenance management information system, and the generally poor quality of data entry, WMATA maintenance managers and supervisors cannot generate reports directly to help them manage their employees and activities, but must rely on specialists within their departments or within specific quality and reliability functions.

During the onsite interviews, FTA's SMI team requested MMIS reports to verify maintenance activities. In one example, a number of the reports were not readily available to CMNT and it was necessary for CMNT to contact support groups to acquire the reports. For example, during discussions regarding material shortages it was noted that on occasion WMATA would lose as many as 66 collector shoes in one day due third rail alignment issues. When asked for a report to show the total number of collector shoes lost in the previous year, CMNT was not able to quickly produce the report. Such reports should be easily accessible to enable budgeting and establishing reorder quantities to prevent material stockouts as well as to identify causal issues to implement mitigations.

- **Finding R-41: WMATA's IT Department lacks necessary authority to ensure that all WMATA departments use IT applications in the same manner to ensure data sharing, coordination of training, and conduct of audits in a consistent manner.**

FTA's SMI team also determined that information technology and computer-based applications established at WMATA to improve efficiency, transparency and effectiveness of operations and

maintenance activities are not meeting expectations. WMATA's Department of Information Technology faces numerous challenges in working toward an enterprise-based approach where all WMATA departments use the same IT applications in the same manner, and can share data, coordinate training, and conduct audits and reviews in a consistent manner.

Through the course of the SMI, FTA's team learned that WMATA's IT Department cannot dictate how the other WMATA Departments use IT products, so while the IT Department can identify short-comings in coordination, training, and data quality, it does not have the authority to mandate how IT projects and systems are managed by the other departments.

While every IT project is managed following a fairly consistent framework, with a project manager assigned, identified internal and external customers, and an engagement strategy that includes a charter with base requirements, a budget, assumptions, a list of interdisciplinary team members, and an Executive Steering Committee, the decisions of the individual departments ultimately drive the technology deployment. Representatives from IT reported to FTA that they strongly opposed the timing of the decisions made to upgrade both the agency's ELM and maintenance information management system, but ultimately did not control the approach or process.

IT also faces limitations in contracts regarding training and manuals. For example, IT has a restricted training budget for the AIM system, and WMATA's MMIS and ELM systems. IT's contracts typically include initial support for train-the-trainer with WMATA personnel, but follow-on training must be coordinated, arranged and funded separately. For example, training for upgrades to the AIM system (like the recent Silver Line upgrade), which is owned by Rockwell Collins, was provided to WMATA under contract for both the IT organization and the Rail Operations Quality Training Department. Additional training or re-training in the AIM system technology would have to be scheduled independently and would require additional funding.

- **Finding R-42: Proactive safety analysis of information provided by Operating and Maintenance departments is not routinely conducted.**

Finally, in reviewing the performance of WMATA's information management technology system, FTA's SMI also reviewed the Safety Measurement System application developed by WMATA's Safety and Environment Management Department. FTA finds that while SAFE continues to expand and enhance its program activities and to grow its departmental capabilities, more can be done to support WMATA's Operating and Maintenance Departments in identifying and managing safety issues and concerns.

Throughout the conduct of the SMI, FTA's team found additional opportunities for SAFE to conduct more proactive analysis of information identified by operating and maintenance departments; to provide more active support for efficiency and proficiency testing of operational and maintenance personnel, and to conduct more thorough accident and incident investigations. Further, SAFE may be better equipped than other departments to incorporate WMATA's RWP training program into its other suite of safety training activities, and to have its Trainers and SAFE Officers enforce RWP refresher and re-certification requirements.

Required Actions

Safety Directive 15-1 identifies eight required actions to be taken by WMATA to address safety deficiencies related to the performance of information technology on the Metrorail system.

| **Metrorail Category 7: Performance of Information Management Technology** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding R-39 | Difficulties with WMATA's ELM have forced departments to use work-arounds resulting in poor documentation of initial and refresher training, certifications, professional licenses and re-certifications. | R-7-39-a | WMATA must evaluate the existing Enterprise Learning Management recordkeeping system and take corrective action, as necessary, to ensure accurate training, re-certification, and professional certification records are created, maintained, and readily accessible to appropriate managers and employees. |
| Finding R-40 | WMATA's MMIS, in its current configuration, is cumbersome and challenging to use for many WMATA maintenance employees. | R-7-40-a | WMATA must develop a training strategy for improving the capabilities of employees to enter, analyze and assess information into the agency's Maintenance Management Information System. |
| | | R-7-40-b | WMATA must establish a data reliability working group focused on maintenance information. |
| | | R-7-40-c | The Information Technology Department must coordinate with the Technical Training Department to ensure the availability of additional training on the use of WMATA's Maintenance Management Information System for WMATA's maintenance departments. |
| Finding R-41 | WMATA's IT Department lacks necessary authority to ensure that all WMATA departments use IT applications in the same manner to ensure data sharing, coordination of training, and conduct of audits in a consistent manner. | R-7-41-a | WMATA must assess data accessibility and coordination needed to support safety functions throughout the agency including the operations and maintenance departments. |
| | | R-7-41-b | The Information Technology Department must coordinate with Rail Operations Quality Training to ensure the availability of additional training for the Rail Operations Control Center staff on the Advanced Information Management system. |
| Finding R-42 | Proactive safety analysis of information provided by Operating and Maintenance departments is not routinely conducted. This negatively impacts ability of WMATA to provide more support for proficiency testing, conduct | R-7-42-a | WMATA operating and maintenance departments must work together to develop a strategy to more actively analyze, review, and assess rail operations and maintenance data from a safety perspective. |

| Metrorail Category 7: Performance of Information Management Technology | | |
|---|---|---|
| Findings | Required Actions (Specified in Safety Directive 15-1) | |
| more in-depth safety studies, reviews and accident/incident investigations. | R-7-42-b | WMATA must work with the Tri-State Oversight Committee and FTA to establish and pilot an enhanced investigation process for rail transit accidents, incidents and safety studies that identify systemic root causes and deficiencies. |

## 5.8 Category R-8: Outstanding Items from Previous FTA Audits and Reviews

As part of the SMI, FTA's SMI team review WMATA's progress in addressing critical upgrades and repairs to its train control system identified as a result of the NTSB investigation into the June 22, 2009 Fort Totten collision. FTA's SMI team also followed up with WMATA on the open item (Recommendation #2) from FTA's 2012 Safety and Maintenance Audit. This item relates to how the agency has managed the safety and engineering concerns associated with changes to its track installation and inspection program for continuous welded rail (CWR).

Situation

- **Finding R-43: Corrective Action Plans from the 2009 Fort Totten collision remain open, including 38 items from the System Implementation Gap Analysis Report (SIGAR), which have not yet been addressed.**

After the June 22, 2009 train collision near Fort Totten station, the NTSB made the following recommendations to WMATA (dated July 27, 2010):

- R-10-12: Conduct a comprehensive safety analysis of the Metrorail automatic train control system to evaluate all foreseeable failures of this system that could result in a loss of train separation, and work with your train control equipment manufacturers to address in that analysis all potential failure modes that could cause a loss of train detection, including parasitic oscillation, cable faults and placement, and corrugated rail.
- R-10-13: Based on the findings of the safety analysis recommended in R-10-12, incorporate the design, operational, and maintenance controls necessary to address potential failures in the automatic train control system.

WMATA contracted an independent consultant to perform a safety analysis of the automatic train control system to address the NTSB recommendations. This independent review was initiated in 2010 and all analysis has since been concluded and presented to the NTSB, who closed R-10-12 and R-10-13 on June 25, 2014.

The analysis resulted in a closeout plan, with all identified items to be tracked and closed in WMATA's Hazard Log and in the System Implementation Gap Analysis Report (SIGAR). Based on its review of WMATA's activity to complete corrective action plans developed to address needed improvements identified in this independent review of the signal and train

control system, FTA found that WMATA's ATC unit has fallen behind in keeping its schedule. While WMATA has closed out most signal-related NTSB recommendations from the 2009 Fort Totten collision, there are still 38 open items from the SIGAR that must be addressed. These are important items that will ensure the long-term safe performance of the signal and train control system.

Further, WMATA's program for replacement of the Alstom Gen II track circuit, which was susceptible to parasitic oscillations, is roughly 80 percent complete; however the program is more costly than originally anticipated, and the higher cost is adversely impacting other areas of the ATC budget. It is unclear if there are sufficient resources and staff available to complete this work by the proposed 2017 deadline.

Finally, FTA's SMI team found that the replacement of 53 cables with low insulation resistance readings has been deferred due to lack of funding. Field personnel reported that budgetary cuts and staffing limitations may also impact their ability to continue performing insulation resistance testing as required. WMATA's executive leadership team assured FTA that insulation resistance testing for ATC cables would not be discontinued under any circumstance.

- **Finding R-44: CWR installation and maintenance program changes have not been sufficiently evaluated.**

Sine 2012, FTA has been following up with WMATA regarding the agency's approach to installing roughly 12 miles of new track each year and to managing other repairs and track upgrades. At issue is FTA's concern regarding WMATA's process for managing continuous welded rail (CWR).

Rail lengths welded together that exceed 400 feet are considered CWR. Rail installed as CWR remains CWR, regardless of whether a joint or plug is installed into the rail at a later time. Temperature variations affect rail length. Rail expands (lengthens) when heated and contracts (shortens) when cooled. Rail neutral temperature is the temperature at which rail is neither in tension nor compression.

Designated rail laying temperatures have been established to provide specific desired rail neutral temperatures to prevent track buckling. When laying or adjusting CWR, the desired rail neutral temperature is determined based on the geographic location of the agency, the temperature variations, and other factors. The difference between the designated rail laying temperature and the actual rail temperature taken at the time of installation is called the temperature differential. CWR laying and adjusting procedures have been established to compensate for this temperature differential

While FTA has not issued standards for CWR installation, the Federal Railroad Administration (FRA) has specified requirements for freight and passenger railroads, including Amtrak and CSX, which run alongside WMATA tracks in specific locations, and are subject to the same temperatures and weather conditions.

FRA, in regulation 49 CFR 213.119, requires each railroad under its jurisdiction that uses CWR to develop a CWR Installation, Adjustment, Maintenance and Inspection Plan that includes de-stressing programs. For installation, FRA requires each railroad to:

- Refer to its established reference tables to identify the designated rail laying temperature in its area.
- Take the rail temperature and calculate the expansion required before making adjustments.
- Record the rail laying temperature, location and date on approved forms. These records may be retained in an electronic format per 213.241.
- While rail does not need to be adjusted when the actual rail temperature exceeds the designated rail laying temperature, railroads must use rail heaters or rail expanders to adjust the rail to the correct length when the actual rail temperature is less than the designated rail laying temperature.

While WMATA originally had a rail de-stressing program, over the last decade or so, this program has largely been eliminated in favor of a heat counter-measures program to closely monitor the temperature of the track, and to institute speed restrictions under certain conditions in an effort to prevent heat kinks or track buckles, such as occurred during WMATA's July 6, 2012 derailment near West Hyattsville. FTA also determined that WMATA experienced two heat-related track buckles in June 2014, both of which were identified before passenger trains were affected.

Upon review of WMATA's existing procedures, FTA's SMI team finds that WMATA's current "Track Maintenance & Inspection Manual" Revision 6 approved on March 16, 2015, is a comprehensive manual covering all necessary aspects of Track Inspection and Maintenance with the following exception:

- This revision primarily included WMATA's previous "Heat Countermeasures Program" with a version of a de-stressing program included but not yet implemented.
- This version is significantly reduced from earlier materials submitted to FTA, including a modified temperature range and the lack of fully documented calculations and accountability required on forms.

WMATA uses the Vertical Rail Stiffness Equipment (VERSE)[4] system for its heat counter-measures program. VERSE is a non-destructive method of measuring the Stress Free Temperature (SFT) of CWR using Hooke's Law (extension is directly proportional to the load) to calculate SFT. VERSE requires lifting the rail and logging the load and displacement at regular increments throughout the lifting cycle. The outputs from this process are routed via a dedicated signal condition system to a hand held computer. Along with some other data such as ambient rail temperature, rail profile and height of the rail, the handheld software produces the SFT result. The height of the rail is included to take account of rail wear/grinding, which will naturally affect the stiffness of the rail.

[4] VERSE is a non-destructive method of measuring the Stress Free Temperature (SFT) of CWR.

WMATA has faced some budgetary limitations in implementing the VERSE program and fully training and staffing crews to conduct the testing. WMATA currently expects to have the program fully implemented and staffed by the end of 2015.

The VERSE program is an industry-leading practice for monitoring the condition of CWR, however, it is not, in and of itself, designed to be a substitution for a CWR de-stressing program. In response to FTA's findings from 2012, WMATA has worked to establish a limited rail de-stressing program. However, as a result of the 2015 SMI, including interviews and further review of WMATA's Track Maintenance & Inspection Manual" Revision 6, FTA finds that WMATA's new procedure for establishing the preferred rail laying temperature must be reviewed to ensure that the likelihood of rail buckles is decreased.

WMATA's proposed "preferred rail laying" temperature range of +10 to -19 degrees F below the preferred rail laying temperature of 95 degrees F far exceeds the original measures WMATA previously provided to FTA (+10 to -10 degrees F below), which more closely reflect industry standards and FRA tables.

Using WMATA's new proposed temperature range, with the rail de-stressed to 76 degrees (95 degrees F minus 19 degrees), the buckle zone is reached when the rail temperature reaches 126 degrees F. (The buckle zone is 50 to 70 degrees F above the preferred rail laying temperature.) In this situation, on a sunny afternoon, the ambient temperature may only have to reach 86 degrees F before conditions could potentially trigger a track buckle.

Based on interviews with a wide range of representatives from the Track, Track Engineering and Quality Departments, many WMATA personnel voiced concern to FTA's SMI team members regarding this new procedure and the proposed temperature range. Given the potential implications for WMATA of a more rigorous de-stressing program (slowing down the pace of new CWR installation and requiring additional de-stressing methods and procedures and more track time), FTA's SMI team finds that there are considerable disincentives associated with rail de-stressing, and that an entirely independent engineering analysis, reviewed by FTA, should be performed to ensure the validity of the preferred rail laying temperature range proposed in WMATA's Track Maintenance & Inspection Manual Revision 6.

Required Actions

Safety Directive 15-1 identifies five required actions to be taken by WMATA to resolve the outstanding items from FTA's 2012 Safety and Maintenance Audit.

| **Metrorail Category 8: Outstanding Items from Previous FTA Audits and Reviews** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding R-43 | Corrective Action Plans from the 2009 Fort Totten collision remain open, including 38 items from the System Implementation | R-8-43-a | WMATA must assess the resources assigned to the Automatic Train Control Department to ensure their sufficiency to carry out critical work, including completion of the program for replacement of the Alstom Gen II track circuits by 2017. |
| | | R-8-43-b | WMATA must expedite actions to address Corrective Action Plans from |

| **Metrorail Category 8: Outstanding Items from Previous FTA Audits and Reviews** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| | Gap Analysis Report (SIGAR), which have not yet been addressed. | | 2009 Fort Totten collision, including the 38 open items from the System Implementation Gap Analysis Report (SIGAR). |
| | | R-8-43-c | WMATA must replace ATC cables with low insulation resistance readings. |
| Finding R-44 | CWR installation and maintenance program changes have not been sufficiently evaluated. | R-8-44-a | WMATA must complete required submittals to FTA to close-out 2012 Safety and Maintenance Audit Recommendation #2 relating to the WMATA's rail de-stressing program. |
| | | R-8-44-b | WMATA must conduct an independent engineering assessment regarding the Critical Rail Neutral Temperature and Preferred Rail Laying Temperature Range established in "Track Maintenance & Inspection Manual" Revision 6 approved on March 16, 2015, to ensure that the likelihood of rail buckles is decreased. WMATA's proposed range (+10 to -19 degrees below the preferred rail laying temp of 95) is 9 degrees below WMATA's original measures and does not conform to industry standards and recommended practices. |

# 6.0 Metrobus Findings and Required Action

FTA organizes its discussion regarding the findings and required actions from its SMI at WMATA Metrobus into five over-arching categories of safety critical concerns:

- Category B-1: Concern over the Protection of Metrobus Operations Personnel
- Category B-2: Limited Availability of Training for Operations and Maintenance Personnel
- Category B-3: Inconsistent Operational Testing and Rules Compliance Checks
- Category B-4: System-wide Maintenance Issues
- Category B-5: Lack of Information Management System Technology

Within these categories, FTA makes specific findings based on the results of interviews, document and records reviews, field observations, and independent inspections, testing and measurements. In Safety Directive 15-1, FTA issues required actions that WMATA must take to address the findings described in each category of this SMI report. Safety Directory 15-1 also establishes required response times, a process for FTA approval of work plans, and the FTA's approach to the monitoring of the implementation WMATA's work plans.

## 6.1 Category B-1: Concern over the Protection of Metrobus Operations Personnel

FTA's SMI team found that WMATA's employees generally consider the potential for assaults by passengers as the greatest safety issue faced on Metrobus operations. This issue affects both bus operators and members of the public if the assaults occur while the bus or wheelchair lift is in motion, or while passengers are boarding or alighting the bus vehicle.

### Situation

Since 2012, over 175 assaults have occurred against bus operators on the Metrobus system. Assaults, which include instances where bus operators are punched, slapped, spit on, have objects thrown at them, or are shoved, pulled or pushed, often occur in response to requests made by bus operators for passengers to pay fares. A review of data reported to the FTA NTD indicates that as many as 50 percent of bus operator assaults nationwide can be traced back to fare disputes or issues regarding the performance of fare media and fare vending machines.

The potential for bus operator assaults is well known at WMATA, and monitored by the agency; however, it is a challenging problem, and with many other demands on resources throughout the system, the agency has struggled with establishing a coordinated and cohesive approach.

- **Finding B-1: WMATA has not addressed operator assaults (by passengers) at a level commensurate with the number of occurrences.**

Assaults on operators have caused worker absence, productivity issues, and increased levels of stress for the victim and for coworkers. Even minor incidents can be precursors to more serious

violence against operators. The Metro Transit Police Department or MTPD tracks operator assaults and prepares a special report, outlining specific areas and routes that have increased assault totals. Bus operator assaults at WMATA increased by nearly 37 percent in 2014, and the first quarter of 2015 saw 2 only two less assaults than the first quarter of 2014.

MTPD consistently identifies fare evasion as a leading cause of operator assaults. MTPD tracks fare evasions by route, day of the week, and time of day, and also has generated heat maps, demonstrating significant problem areas.

In response, Metrobus initiated "We Care" customer service training for bus operators. While this program is focused on methods of engaging customers that will increase the customer service commendation rate and reduce the complaint rate, this training also emphasizes the reality that most assaults stem from fare evasion arguments. Therefore, this training discourages operators from escalating the issue with passengers. Operators are instructed to simply state the fare amount. If the passenger does not deposit the fare, operators are to record the fare evasion by pressing a set button at their console.

This approach also applies to the enforcement of other fare media, such as the "DC1" fare cards, which allow school children to ride for free only during specific hours, or other limited or special benefit fare cards. However, both MTPD officers and bus operators acknowledged that the environment created by following this approach, and allowing deferred, partial or non-payment of fares, particularly among certain groups, such as high school children riding buses after 8:00 p.m., creates its own challenges for the bus operator among other passengers.

During the SMI, observations of bus operations confirmed the results of interviews, highlighting frequently malfunctioning fare boxes. When riding and evaluating bus routes, FTA's SMI team members observed operators waving passengers to be seated without paying the fare. Under questioning in the field, bus operators demonstrated malfunctions in the fare boxes, including getting logged out of the fare box system and being unable to log back in. Operators also reported their concerns that consistent fare box malfunctions play a role in operator assaults when passengers become accustomed to riding for free and then are asked to pay a fare when the fare box becomes operational again.

In addition to the "We Care" program, Local Safety Committees at Bus Divisions also have Operator Assault Safety Awareness Initiatives, and WMATA also is installing retractable "driver shields" on about 100 buses each year. Operators will have the option of using these shields to provide greater separation from the public.

Metrobus maintenance officials noted that WMATA is the process of developing new programs to monitor and better address failures in fare vending equipment, and to improve radio communications. FTAs SMI team found that radio dead spots continue to exist with digital system, and that Rail ROCC calls currently "bleed" overtop MTPD calls, occasionally interfering with response to incidents. Also, due to the design and use of the radios, and the challenges of developing and offering refresher training, bus operators often accidentally push emergency alarm buttons, which require response from both BOCC and MTPD. FTA's SMI team observed the high number of the alarms at the BOCC.

Despite these efforts, assaults are on the rise and MTPD response to these issues is limited due to the constraints of MTPD Officer resources assigned to Metrobus. However, MTPD is attempting to proactively address the fare evasion and assault concerns by conducting a Fare Enforcement Initiative that will take place in Spring 2015, and also by creating an MTPD office at the Shepherd's Parkway division. This division experiences the highest level of assaults and fare evasions. MTPD is assigning its limited resources, both uniformed and casual clothes officers, to ride high incident routes at Shepherd's Parkway and other divisions at times of day when fare evasion data indicates incidents spike. This campaign is considered a pilot effort to curb fare evasion and assaults and will be evaluated for effectiveness after a reasonable period of implementation.

Required Actions

Safety Directive 15-1 identifies two required actions to be taken by WMATA to enhance the protection of bus operators from assaults and other acts of violence.

| **Metrobus Category 1: Concern over the Protection of Metrobus Operations Personnel** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding B-1 | WMATA has not addressed operator assaults (by passengers) at a level commensurate with the number of occurrences. | B-1-1-a | WMATA must expedite development of an agency-wide, coordinated strategy to address contributing elements to Bus Operator Assaults, including training, deployment of police and security resources, enhanced community outreach, and resolving fare box performance and reliability issues. To the extent practical, WMATA should incorporate findings from the forthcoming Transit Advisory Safety Committee (TRACS) report on this topic. |
| | | B-1-1-b | WMATA's Safety Department must increase its level of involvement in the Operator Assault Preventative/Awareness Safety Initiative at Local Safety Committees, and in the development of the overall strategy for enhanced protection of Bus Operators. |

## 6.2 Category B-2: Limited Availability of Training for Operations and Maintenance Personnel

FTA's SMI team found that although the delivery of new-hire technical training across all functions of WMATA Bus Transportation is generally strong, refresher and other training gaps exist within the Transportation and Maintenance Departments.

Situation

Although the delivery of new-hire technical training is generally strong, there is limited refresher training offered on a regular and periodic basis for Transportation or Maintenance personnel, and WMATA has had difficulty in maximizing the number of participants in the existing courses.

- **Finding B-2: Refresher and other training gaps exist within the Transportation and Maintenance Departments.**

Bus Maintenance has an extremely comprehensive and effective new-hire training program for bus mechanics that extends over a period of more than two months and covers all necessary mechanic skills required to carry out the job function. Bus Maintenance also manages a Mechanic Apprentice Program, and requires Automotive Service Excellence (ASE) certification of all mechanics. WMATA also provides a cash incentive program for mechanic performance, and generally encourages rapport and communication between Maintenance and Operations staff at bus divisions to assist in the evaluation of specific mechanical problems or concerns with bus vehicles or equipment. Presently, however, while mechanics are required to complete 40 hours per year of refresher training, to reinforce previously acquired knowledge and skills with special emphasis on safety, this training is not being completed by all mechanics on a regular and periodic basis. Due to the demand for mechanics, divisions have faced challenges in making mechanics available for this required refresher training. At the time of the SMI, WMATA reported that approximately 60 percent of available training slots had been filled by bus mechanics.

New-hire bus operator training takes place initially at the Carmen Turner facility and continues at the Division to which a new-hire operator is assigned. This training is comprehensive and includes both classroom and behind-the-wheel instruction utilizing division assigned training instructors and a cadre of vetted and trained Line Platform Instructors (LPI). Based on document reviews by the SMI Team, Bus Transportation training and curriculum meets industry standards.

However, the lack of availability of satisfactory classroom facilities, training buses, and training support technology presents the potential to negatively impact quality of training. Refresher training for bus operators is not being carried out as per program requirements. Many bus operators that were interviewed stated that they had not received refresher training of any type in many years. Training records indicate that refresher training for bus operators lags behind the agency's standards. There are many reasons for the lack of standardized refresher bus operator training, including limited availability of training instructor time, the need to carry out extensive retraining of bus operators based on performance deficits, and the need to deliver other training to bus operators, such as the "We Care" customer service initiative.

To get caught up, WMATA has set internal goals of providing refresher training for 3-4 bus operators daily, which will total 15-20 weekly refresher trainings, 60 monthly trainings, and 1,200 yearly trainings. While this level of training will not cover the entire bus operations staff, WMATA Metrobus personnel believe they can complete refresher training on a two-year cycle. Implementation of this program will require dedicated focus and attention to ensure training is offered and completed, and that bus operators are made available.

Training for SOM/street supervisors and SOM/office managers is informal and on-the-job based, thus training is not standardized and job performance throughout divisions is inconsistent. Training for BOCC Specialists is generally comprehensive but currently does not require a proficiency-testing component. BOCC Specialist refresher training is not performed at set intervals. Overall, technical skill training documentation within Transportation and Maintenance

is comprehensive but compartmentalized. WMATA is working to consolidate training documentation within its Enterprise Learning Management system, but consolidation is presently incomplete.

- **Finding B-3: WMATA does not have a current "BOCC Manual" which lists all office procedures and interpretations of rules or instructions pertaining to the BOCC Specialist's duties. There are no checklists available for BOCC Specialists to dispatch service or manage incidents.**

FTA's SMI team also found that the tools used to support training and proficiency of employees in the Bus Operations Control Center can be significantly improved. WMATA does not have a current "BOCC Manual" which lists all office procedures and interpretations of rules or instructions pertaining to the BOCC Specialist's duties. SOPs give advice on how to assist operators with troubleshooting vehicle issues, and the day-to-day rules are an assortment of printed memos and emails collected in a three-ring binder that also doubles as the BOCC Specialist Training Manual. There are no checklists available for BOCC Specialists to dispatch service or manage incidents. FTA's SMI found that BOCC troubleshooting is not viewed as effective by Bus Maintenance personnel, and that, because of the lack of formal documentation and refresher training, BOCC does not follow the same SOPs as BMNT for safety critical bus items.

Present protocols are heavy on paperwork, and BOCC Specialists are required to write a paper Detention Slip that must be hand-delivered to the "Double 0" at the front of the BOCC in order to request a Service Operations Manager (SOM/street supervisor) response to an incident. This has the possibility to delay BOCC response to operator issues and emergency situations. There are a high number of bus emergency silent alarm activations. Many of these are false alarms due to mechanical or operator error, but they require a response from MTPD and an SOM/street supervisor. The false alarm issue is compounded by the protocol that does not allow communication between the BOCC and an Operator after a silent alarm has been triggered. Field observations and interviews conducted by the SMI Team noted that the volume of false alarms experienced regularly has created a sense of complacency in the BOCC regarding an alert and places a drain on MTPD resources in responding to these false alarms. MetroBus operations is considering strategies that could help reduce the number of false alarms, but at this point has not determined what those strategies will be.

Required Actions

Safety Directive 15-1 identifies two required actions to be taken by WMATA to address limitations in available operations and maintenance training.

| **Metrobus Category 2: Limited Availability of Training for Operations and Maintenance Personnel** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding B-2 | Refresher and other training gaps exist within the Transportation and Maintenance Departments. | B-2-2-a | WMATA must develop a strategy and approach for developing, offering and updating refresher training as required in current policies and standards, for key categories of Transportation and Maintenance personnel, including Bus Operators, Street Supervisors, Bus Operations Control Center Specialists, and Bus Maintenance personnel. |
| Finding B-3 | WMATA does not have a current "BOCC Manual" which lists all office procedures and interpretations of rules or instructions pertaining to the BOCC Specialist's duties. There are no checklists available for BOCC Specialists to dispatch service or manage incidents. | B-2-3-a | WMATA must develop a Bus Operations Control Center Manual (with processes and procedures for Bus Controller Specialists) and a complete set of checklists for implementing Standard Operating Procedures and bus vehicle troubleshooting guidance. A clear accompanying process should be established for updating the Manual and training Specialists on its contents and updates. |

## 6.3 Category B-3: Inconsistent Operational Testing and Rules Compliance Checks

To ensure the proficiency, professionalism, and safety of bus operations staff, transit agencies establish programs to conduct announced and unannounced operational testing. FTA's SMI determined that, in a few key areas, announced and unannounced testing of bus operations personnel is not being conducted consistently or effectively.

Situation

- **Finding B-4: Bus pre-trip inspections are not being completed, documented, or monitored to the degree necessary to comply with internal WMATA SOPs or with industry standards.**

FTA's SMI team identified through onsite visits of six Metrobus garages and numerous interviews with bus operators, depot clerks, and other WMATA staff that bus pre-trip inspections are not being completed, documented, or monitored to the degree necessary to comply with internal WMATA SOPs or with industry standards. The bus pre-trip inspection form becomes part and partial to the legal operation of a bus under the federal and state issue of a Commercial Driver's License (CDL).

FTA's SMI team informed WMATA leadership that the industry standard for time allotted to complete an inspection is 15 minutes. WMATA bus operators are allotted ten minutes from check-in to pull out to complete a comprehensive pre-trip inspection. The clock starts once the operator checks in with the fare clerk. In most divisions the operator must then walk downstairs

and out to the bus yard, contact the Dispatcher for a bus assignment, and then walk across a large yard to find their bus.

FTA's SMI team noted at the Four Mile Division that Operators might be sent to a remote yard that requires accessing three different crosswalks to retrieve a vehicle. The ten minutes may have expired before the operator has reached the vehicle, prohibiting the possibility that operators can carry out a comprehensive pre-trip in the amount of time allotted. Observations and reviews of pre-trip cards by the SMI team indicated a large number of operators conduct only a cursory inspection, or none at all, due to lack of time allotted.

This has the possibility of exposing WMATA to liability in the case of death or injury resulting from a bus accident. Also, there appears to be an inadequate definition of a pre-trip inspection and lack of standardized communication on precisely how to complete the pre-trip inspection form. Fare Clerks at several divisions were unable to communicate to the SMI team what a properly completed pre-trip inspection form would look like. It also should be noted that WMATA uses one standard bus condition card (pre-trip inspection card) for all years, makes and models of vehicles.

FTA's SMI team uncovered indicators that bus operators and depot clerks do not fully understand the importance of the quality of pre-trip inspections and the implications of a less than comprehensive inspection, not only on passenger safety, but their own, as well.

FTA's SMI team finds that this issue affects the ability of maintenance to carry out its function, increases the potential for road calls, and lowers the safety profile of buses put into service. There appears to be limited enforcement of pre-trip inspections by management, including SOM/Office Managers and Assistant Superintendents.

- **Finding B-5: Within WMATA Bus Transportation, there are limited formal evaluations being conducted of the proficiency of bus operators. Although there are evaluation checklists and protocols to measure performance and proficiency of WMATA bus operators, the application of this process is not expansive, uniform, nor structured within established timeframes.**

FTA's SMI team also found that within WMATA Bus Transportation, there are limited formal evaluations being conducted to assess the proficiency of bus operators. Although there are evaluation checklists and protocols to measure performance and proficiency of WMATA bus operators, the application of this process is not uniform and structured within established timeframes. New-hire bus operators are formally evaluated after 30, 60 and 90 days; beyond that, on-board bus operator evaluations are randomly carried out by a variety of WMATA staff, including CQAL, supervisors and others.

For example, CQAL does the Passenger Service/ Operator Skills Audits, but very few of these ride checks take place compared to the number of vehicles in service and operators at Metrobus. FTA's SMI team found that, generally, bus operators that have been identified as needing retraining are formally evaluated, but those operators that do not need retraining are not regularly evaluated due to lack of staffing resources available to carry out these evaluations. Industry

standards, and WMATA's requirements specify that as part of annual refresher training requirements for all bus operators, behind-the-wheel Operator performance should be evaluated. However, because refresher training is not carried out regularly per this standard, formal evaluations of bus operators are not taking place as planned for and required.

WMATA has committed to strengthening its bus operation evaluation program, and also is using its new DriveCam program to monitor operator performance and identify operators in need of re-training or priority evaluation.

- **Finding B-6: WMATA BOCC Specialists and SOM/Street Supervisors are excluded from WMATA's fatigue management program.**

Finally, as noted in other sections of this report, FTA's SMI team commends WMATA for their industry-leading fatigue management program, which takes a science-based approach to limit the effects of fatigue on safe delivery of services. FTA's SMI team found that BOCC Specialists and SOM/street supervisors; however, have been excluded from this program. Given concerns regarding lengthy shifts with limited breaks, FTA's SMI team believes that WMATA's excellent program should be expanded to include BOCC Specialists and SOM/street supervisors.

Required Actions

Safety Directive 15-1 identifies four required actions to be taken by WMATA to improve the performance of operational testing and rules compliance checks.

| **Metrobus Category 3: Inconsistent Operational Testing and Rules Compliance Checks** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding B-4 | Bus pre-trip inspections are not being completed, documented, or monitored to the degree necessary to comply with internal WMATA SOPs or with industry standards. | B-3-4-a | WMATA must assess its overall approach to the performance of pre-trip inspections to determine the adequacy of time available for Operators to perform these inspections, the level of training available to Operators regarding the conduct of these inspections, and whether additional condition cards should be developed for different sub-fleets. |
| Finding B-5 | Within WMATA Bus Transportation, there are limited formal evaluations being conducted of the proficiency of Bus Operators. Although there are evaluation checklists and protocols to measure performance and proficiency of WMATA Bus Operators, the application of this process is not expansive, uniform, nor structured within | B-3-5-a | WMATA must establish and enforce a formal program to ensure that Supervisors assess Bus Operator performance. |
| | | B-3-5-b | WMATA must expand the total number and frequency of Passenger Service / Operator Skills Audits performed by Corporate Quality Assurance. |

| Metrobus Category 3: Inconsistent Operational Testing and Rules Compliance Checks | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| | established timeframes. | | |
| Finding B-6 | WMATA BOCC Specialists and SOM/Street Supervisors are excluded from WMATA's fatigue management program. | B-3-6-a | WMATA must establish a strategy and timeframe for extending the Fatigue Risk Management Program to all Bus Operations Control Center staff, including BOCC Specialists and the Street Operations Managers (SOMs), formerly Street Supervisors. |

## 6.4 Category B-4: System-wide Maintenance Issues

FTA's SMI team finds that WMATA experiences safety and reliability issues with some newly procured parts (i.e., bearings). WMATA employees noted that there is no formal testing process for newly procured parts to ensure their quality prior to implementation.

Situation

- **Finding B-7: The bus maintenance materials procurement process is not being executed in accordance with FTA standards meant to ensure the safety and quality of parts being purchased (FTA Circular 4220.1F).**

FTA's SMI team found that the bus maintenance materials procurement process is not being executed in accordance with FTA standards meant to ensure the safety and quality of parts being purchased. During the materials procurement process bus maintenance is asked to submit the salient characteristics to comply with FTA Circular 4220.1F. These characteristics are meant to ensure that there is both a competitive bid process as well as assurance that the procured parts meet their required size, life cycle, and reliability standards. During the interview process, WMATA employees noted reliability issues with materials procured through this method, including Absorbed Glass Mat (AGM) batteries, exhaust gas recirculation valves, and cooling, ignition and other emission system components.

FTA's SMI team found that WMATA does not have a for quality control process for newly procured parts to ensure their quality prior to implementation, though Bus Maintenance has both quality assurance and configuration management procedures at their disposal. FTA's SMI team found that new parts are procured and immediately installed onto vehicles.

This lack of review of newly procured parts presents the potential for reduced performance of the WMATA bus fleet as well as an increased safety risk for WMATA's passengers. Bus Maintenance should examine their process for both determining the salient characteristics of needed parts and testing the quality of parts received to ensure they meet required standards. WMATA's Metrobus system has committed to developing a more formal quality control process for parts.

- **Finding B-8: Newly delivered buses have body, system, and component problems.**

WMATA's Metrobus fleet reliability fell by 13 percent in 2014, as a result of mechanical failures causing buses to go out of service more frequently. Prior to 2014, bus fleet reliability had improved an average of 4.3% per year since 2003. While WMATA has set a performance goal of 8,000 miles between failure for its bus fleet in 2015, the agency is currently averaging about 6,535 miles between failure. Rates of failure so far in 2015 continue the downward trend in bus reliability.

FTA's review of maintenance records and incident reports indicated an unusually high number of defects and maintenance activities associated with recently purchased vehicles and vehicles less than 3 years old. During an interview with the engineer in charge, he indicated that the newly delivered buses seem to have too many body, system, and component problems, particularly with electronic and software components that were not previously discovered during WMATA's in-plant bus inspection process. FTA's requirements for this process, found at 49 CFR § 663.37, are designed to ensure that vehicles purchased with Federal funds meet contract requirements, including performance standards for reliability. FTA's requirements specify that grant recipients, purchasing 10 or more buses or vans with Federal funds, must conduct an in-plant inspection process to oversee and monitor the construction and assembly of the vehicles. This requirement does not specify that a resident inspector remain "full-time" at the "manufacturer's site throughout the period of manufacture." Although this may be recommended for some vehicle procurements, FTA's inspector requirement may be fulfilled through the use of periodic visits. For buses or vans produced by multiple manufacturers, the inspector is only required to visit the final stage manufacturer's facility.

While the in-plant inspector is required for purchases of ten or more buses or vans, the recipient must be certain that the inspector's report is equally comprehensive, regardless of the choice of inspection services. The number of visits and the length of each visit should be based on the recipient's level of comfort with the manufacturer's capabilities. It is the recipient's responsibility to ensure that the vehicles comply with the contract specifications. The purpose of the resident inspector's report is to assist the recipient in verifying that the vehicles meet the contract specifications.

It was reported to FTA's SMI that WMATA's Corporate Quality Assurance or CQAL staffing has decreased from 21 to 11 in the past few years, and that, as a result, CQAL no longer visits factory for inspections prior to bus acceptance, and the CQAL role is limited to acceptance testing only. WMATA's executive leadership team indicated that staffing had not been significantly reduced in CQAL because roles and responsibilities for specific bus quality assurance functions had also been re-distributed.

SAFE previously sent two representatives to perform an in-plant vehicle inspection, however WMATA staff reported that this inspection was not as thorough as a typical CQAL inspection, because it focused on different activities (safety certification versus quality inspection and control). In interviews, a wide range of WMATA's maintenance personnel attributed worsening bus vehicle performance to reduction in oversight of the bus vehicle manufacturing process.

Another source of concern regarding the condition of newer vehicles identified by FTA's SMI team related to vacancy rates and turnover of bus mechanic positions. WMATA's bus maintenance managers indicated that they are struggling to keep employees due to competition from the attractiveness of moving to rail or to outside of WMATA. In some divisions, two in 10 bus mechanic positions may be open, much higher than the 6 percent WMATA vacancy rate agency wide. This is due in large part to more attainable hiring standards for bus mechanics than the more specialized and less common requirements of an elevator/escalator or rail vehicle mechanic. A sizable percentage of WMATA bus maintenance staff has significantly fewer years of experience than their counterparts in rail or ELES.

This situation is complicated by the lack of administrative staff available to support all days and shifts in WMATA's bus maintenance facilities. Lack of support staff places a greater burden of paperwork and administrative tasks on schedule maintenance supervisors, which affects the ready availability of guidance and support for mechanics.

Required Actions

Safety Directive 15-1 identifies two required actions to be taken by WMATA to address safety deficiencies related to system-wide maintenance issues.

| **Metrobus Category 4: System-wide Maintenance Issues** | | | |
|---|---|---|---|
| Findings | | Required Actions (Specified in Safety Directive 15-1) | |
| Finding B-7 | The bus maintenance materials procurement process is not being executed in accordance with FTA standards meant to ensure the safety and quality of parts being purchased (FTA Circular 4220.1F). | B-4-7-a | WMATA must develop and implement a plan to bring its bus maintenance materials procurement process into compliance with FTA Circular 4220.1F. This plan must include a formal testing process for newly procured parts and enhancements to the process currently used to accept new bus vehicles. |
| Finding B-8 | Newly delivered buses have body, system, and component problems. | B-4-8-a | WMATA must conduct a resource evaluation regarding overall staffing and resources available to Corporate Quality Assurance and to other quality divisions and departments within Bus Maintenance and Bus Operations to support in-plant inspection and general maintenance materials procurement. Options to re-instate factory visits must also be considered as part of this assessment. |

## 6.5 Category B-5: Lack of Information Management System Technology

FTA's SMI team identified two findings related to automated systems and how enhanced information management could greatly improve Metrobus safety processes.

Situation

- **Finding B-9: Insufficient staffing and tools in place for collecting available Bus Operations data to support more proactive analysis from a safety perspective.**

FTA's SMI team generally found in interviews and field observations that neither Metrobus divisions nor the BOCC had sufficient staff to effectively enter, manage and analyze paper-based records. FTA's SMI team noted numerous vacancies in office manager positions and support that previously handled the data entry and management workload and supported the proactive collection and analysis of operations information and data.

FTA's SMI team generally found that while WMATA's Safety Department continues to expand and enhance its program activities, more can be done to support WMATA's Metrobus Transportation and Maintenance Departments in identifying and managing safety issues and concerns. Throughout the conduct of the SMI, FTA's team found additional opportunities for SAFE to conduct more proactive analysis of information identified by Metrobus Transportation and Maintenance departments.

- **Finding B-10: Proactive safety analysis of information provided by Operating and Maintenance departments is not routinely conducted. This negatively impacts ability of WMATA to provide more support for proficiency testing, conduct more in-depth safety studies, reviews and accident/incident investigations.**

The existing Safety Measurement System software is an industry best practice and an extraordinary tool for documenting, tracking and analyzing accident and incident data. It provides a strong database for accident and incident risk mitigation development. However, by nature, it is a reactive tool that comes into play fully after an accident occurs and does not serve as effectively as it could as a proactive tool in non-event hazard identification and analysis. Independent of the Safety Measurement System, hazard identification data is often not captured or the documentation of data is not centralized. Individual employees very often identify hazards and respond to them unilaterally without collecting data about the hazard and the mitigation in a centralized data pool. This lack of information and centralized documentation limits WMATA's ability to be proactive in its hazard and risk mitigation processes and also affects the monitoring of risk mitigation strategies. Although SAFE pursues root cause analysis of accidents that reach a Level 1 rating, analyses are often not conducted on lower level accidents. Equally, root cause analysis for lower level events at the division level is limited. A lower level accident has the potential to become a Level 1 accident if risk is not assessed and proactive risk mitigation strategies go unexplored.

WMATA utilizes the Local Safety Committees (LSC) at the division level to identify safety concerns and hazards. The SMI team found that there was no formal procedure for elevating safety concerns to the Department Safety Committee (DSC). One LSC in particular believed their concern was being actively addressed by the DSC when in fact the item had not been added to the DSC agenda.

A Safety Officer is not attached to each bus division so the role of the Safety Officer within a division is not as powerful as it could be. Safety Officers are often spread thin in trying to carry out their safety support mission. Additionally, each Safety Officer does not have an assigned response vehicle, making it difficult to respond to events that are a part of their safety job responsibilities.

Interviews and observations by the SMI teams indicated that Safety Officer duties and responsibilities are not as clearly defined as they could be, thus creating a lack of standardization of Safety Officer responsibilities that could possibly lead to certain job requirements going unaddressed.

Required Actions

Safety Directive 15-1 identifies three required actions to be taken by WMATA to enhance the use and performance of information technology on Metrobus.

| **Metrobus Category 5: Lack of Information Management System Technology** | | | |
|---|---|---|---|
| Finding B-9 | Insufficient staffing and tools in place for collecting available Bus Operations data to support more proactive analysis from a safety perspective. | B-5-9-a | Conduct an assessment determining the adequacy of resources available to support Bus Operations Control Center and Bus Superintendents with data entry and analysis. |
| Finding B-10 | Proactive safety analysis of information provided by Operating and Maintenance departments is not routinely conducted. This negatively impacts ability of WMATA to provide more support for proficiency testing, conduct more in-depth safety studies, reviews and accident/incident investigations. | B-5-10-a | WMATA must formalize the procedure for how a Local Safety Committee will elevate a safety concern to the Departmental Safety Committee. |
| | | B-5-10-b | WMATA must define the Bus Safety Officer roles and responsibilities and conduct an assessment determining the adequacy of resources available for Bus Safety Officers to complete these responsibilities. |

# Appendix A: WMATA Safety Actions

The Washington Metropolitan Area Transit Authority (WMATA) ordered fourteen early-action safety items in advance of the National Transportation Safety Board's (NTSB) report on the January 2015 L'Enfant Smoke Incident:

1. Create a Standard Operating Procedure (SOP) to require train operators to cut the train's environmental system (EV) immediately upon entering a smoke condition and independently of outside instruction. Previous SOPs permitted the train operator to cut the EV only after receiving instruction from the Rail Operations Control Center (ROCC).
2. Create an incident management SOP that requires personnel within the ROCC to maintain their desk location for the duration of the incident management process. This SOP is intended to reduce distraction from unnecessary interactions.
3. Set a schedule for quarterly emergency drills in coordination with the Metro Transit Police Department (MTPD) to encompass the next three years. The drill location shall rotate among a station, tunnel, and elevated portion of the wayside. Each drill shall also rotate among jurisdictions.
4. Design and implement signage for exterior doors to clearly identify emergency access points. This signage will assist emergency responders in identifying and utilizing emergency doors and access points.
5. Conduct inspections on all third rail jumper cables located in tunnel sections and provide an engineering and operations report on condition and installation.
6. Replace high voltage third rail jumper cables with low smoke/low halogen cables. This project is part of an on-going rehabilitation program.
7. Install mechanical protection on third rail jumper cables potentially exposed to wear from vibration against other materials.
8. Inspect and review ground fault detectors on third rail circuit breakers.
9. Perform an operational analysis to determine whether WMATA can limit current flow through the electrical infrastructure by running trains at 45 miles per hour in the system core.
10. Determine the feasibility of and report on installing zoned smoke detectors, including wireless detectors, using Emergency Trip Station (ETS) boxes to relay location and other data.
11. Replace or rehabilitate all lights in WMATA tunnels via a multi-year maintenance program.
12. Create a dedicated maintenance crew to continuously clear tunnel passageways of debris, equipment, or other potential obstructions.
13. Review protocols for alarms in the ROCC and identify critical versus non-critical notifications.
14. Establish a ventilation system testing quality audit process to ensure compliance with established maintenance and testing practices.

# Appendix B: NTSB Safety Recommendations to WMATA

| ACCIDENT DATE | DESCRIPTION | FATALITIES | INJURIES | EST. PROPERTY DAMAGE | NUMBER OF SAFETY RECOMMENDATIONS TO WMATA | RECOMMENDATION STATUS AS OF 4/29/2015 |
|---|---|---|---|---|---|---|
| 1/13/1982 | Derailment of Train 410 at Smithsonian Interlocking, Washington, DC. | 3 | 25 | $1.3 M | 34 | 27 Closed: Acceptable Action<br>3 Closed: Acceptable Alternate Action<br>4 Closed: Unacceptable Action |
| 6/19/1987 | Derailment of CSX Corporation freight railcars fouling Metrorail Red Line track near Takoma Park, MD station. | 0 | 0 | Not reported | 2 | 2 Closed: Acceptable Action |
| 9/5/1987 | Derailment of CSX Corporation freight railcars fouling Metrorail Red Line track near Fort Totten Station, Washington, DC. | | | | | |
| 9/17/1987 | Fouling of Metrorail Red Line track near Silver Spring, MD Station due to debris from a CSX Corporation train striking heavy construction equipment on CSX track. | | | | | |
| 1/9/1996 | Collision of Train T-111 with standing train at Shady Grove Station, Gaithersburg, MD. | 1 | 0 | Between $2.1M and $2.6M | 20 | 18 Closed: Acceptable Action<br>1 Closed: Acceptable Alternate Action<br>1 Closed: Superseded |
| 11/3/2004 | Collision Between Train 703 and Train 105 at the Woodley Park-Zoo/Adams Morgan Station, Washington, DC. | 0 | 20 | $3.5M | 3 | 2 Closed: Acceptable Action<br>1 Closed: Unacceptable Action |
| 5/14/2006 | Red Line Train Striking WMATA Wayside Worker near Dupont Circle Station, Washington, DC. | 1 | 0 | Not reported | 4 | 3 Closed: Acceptable Action<br>1 Closed: Acceptable Response |
| 11/30/2006 | Yellow Line Train Striking WMATA Wayside Workers near Eisenhower Avenue Station, Alexandria, VA. | 2 | 0 | Not reported | 4 (identical to the 4 Recs. issued after the 5/14/2006 accident) | |

| ACCIDENT DATE | DESCRIPTION | FATALITIES | INJURIES | EST. PROPERTY DAMAGE | NUMBER OF SAFETY RECOMMENDATIONS TO WMATA | RECOMMENDATION STATUS AS OF 4/29/2015 | |
|---|---|---|---|---|---|---|---|
| 1/7/2007 | Derailment of Train 504 near the Mount Vernon Square Station, Washington, DC. | 0 | 0 | $3.8M | 6 | 5 Closed: | Acceptable Action |
| | | | | | | 1 Closed: | Acceptable Alternate Action |
| 6/22/2009 | Collision of Train 112 and Train 214 near the Fort Totten Station, Washington, DC. | 9 | 52 | $12M | 18<br>1 to WMATA Board | 14 Closed: | Acceptable Action |
| | | | | | | 1 Closed: | Superseded |
| | | | | | | 3 Open: | Acceptable Response |
| | | | | | | 1 Closed: (Board) | Acceptable Action |
| 11/29/2009 | Collision of Train 902 with standing train at West Falls Church Station, Falls Church, VA. | 0 | 2 | $9M | 0 | N/A | |
| 1/26/2010 | WMATA Hi-Rail Maintenance Vehicle Striking WMATA Wayside Workers near Rockville Station, Rockville, MD. | 2 | 0 | Not reported | 0 | N/A | |
| 2/12/2010 | Derailment of Train 156 near the Farragut North Station, Washington, DC. | 0 | 3 | $174,000 | 0 | N/A | |
| 1/12/2015 | Smoke and electrical arcing accident between the L'Enfant Plaza Station and Potomac River Bridge, Washington, DC. | 1 | 86 | Under investigation | Under investigation<br>3 Urgent<br>1 Safety Recommendation | Under investigation | |

# Appendix C: Safety Directive 15-1 Tracking Matrix

**WMATA SMI Findings and Required Action Matrix**

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| **Metrorail Category 1: Inadequate Rail Operations Control Center Staffing and Procedures** | | | |
| Finding R-1 | WMATA's Rail Operations Control Center is significantly understaffed. | R-1-1-a | WMATA must fully staff the Rail Operations Control Center. |
| Finding R-2 | RTC re-certification has not occurred as required. | R-1-2-a | WMATA must complete and maintain required annual re-certifications for Rail Traffic Controllers. |
| Finding R-3 | RTCs receive limited refresher training and no road days. | R-1-3-a | WMATA must establish a program to provide each Rail Traffic Controller with mandatory road days for territory familiarization and to keep up with changing system elements. |
| | | R-1-3-b | WMATA must require all Rail Traffic Controllers to obtain and maintain Level 4 Roadway Worker Protection training and certification. |
| Finding R-4 | There is a high level of noise and distraction in the ROCC, and a lack of electronic controls in the AIM system to prevent errors. | R-1-4-a | WMATA must complete its assessment regarding the identification of critical versus non-critical notifications and alarms in the Rail Operations Control Center, and options for removing non-critical notifications must be implemented. |
| | | R-1-4-b | WMATA must conduct an engineering assessment, and implement the results regarding options to reduce noise in the Rail Operations Control Center, including ambient noise and feedback from the radio system. |
| | | R-1-4-c | Until such time as electronic records of train movement are readily available to on-duty Rail Traffic Controllers, WMATA must ensure that its Rail Traffic Controllers maintain a paper-based record of all mainline train movements, signal by-passes, and unusual movements. |
| Finding R-5 | WMATA RTCs are required to perform many tasks outside of industry standards. | R-1-5-a | WMATA must ensure Rail Traffic Controller workload and distraction do not interfere with the safe and efficient movement of trains. |
| Finding R-6 | Radio discipline is poor. | R-1-6-a | WMATA must establish and enforce a proper protocol for language and terminology that is used over the radio – to include 100 percent word-for-word read-back for safety-related instructions and unusual train movements. |
| | | R-1-6-b | As part of the radio protocol required in R-1-6-a, WMATA must establish an approach for communicating and managing all speed restrictions that requires two-way communication between the ROCC and train operator and takes full advantage of available electronic AIM system features. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| Finding R-7 | WMATA's ROCC lacks formal procedures, manuals and checklists | R-1-7-a | WMATA must establish procedural checklists for Rail Operations Control Center staff to implement the Standard Operating Procedures attached to the Metrorail Safety Rules and Procedures Handbook. |
| | | R-1-7-b | WMATA must enhance RTC reference materials to direct internal operations at the Rail Operations Control Center, including the use of the Advanced Information Management system, visual schematics of WMATA stations and facilities, and internal ROCC administrative policies and procedures. |
| Finding R-8 | Personal cell phones are used by RTCs in the ROCC. | R-1-8-a | WMATA must establish a clear policy that prohibits distractions from the use of cell phones and other electronic devices in the Rail Operations Control Center. |
| Finding R-9 | No formal transfer records are used when RTCs complete shift briefings. | R-1-9-a | Until such time as electronic transfer records are implemented, WMATA must ensure that its Rail Traffic Controller use paper-based logs with formal signatures. |
| Finding R-10 | WMATA does not use industry standard rules reviews and scenario testing activities. | R-1-10-a | WMATA must establish an on-going "efficiency" testing program for Rail Traffic Controllers to evaluate their in-service performance and competency. |
| Finding R-11 | WMATA faces major challenges in recruiting and training new RTCs. | R-1-11-a | WMATA must establish an independent committee to evaluate and monitor the recruitment of Rail Traffic Controller trainees, the quality and performance their training, and the certification of new candidates. |
| Finding R-12 | WMATA's training program for new RTCs is inadequate. | R-1-12-a | WMATA must overhaul, correct, revise and improve its training program for Rail Traffic Controllers. |
| | | R-1-12-b | WMATA must establish performance standards to be qualified for all positions in the Rail Operations Control Center. |
| Finding R-13 | WMATA's accident investigation process does not look at the ROCC or individual RTCs. | R-1-13-a | WMATA must expand the focus of its accident investigation process to include an active review of the actions of the ROCC, and to ensure that RTCs whose performance could have contributed to the accident are taken for mandatory post-accident drug and alcohol testing as per 49 CFR Part 655.44. |
| Finding R-14 | While it has improved, the quality of WMATA's radio system is still poor in some locations. | R-1-14-a | WMATA must expedite activities underway to modify the radio system design to add coverage to the areas that currently are not part of the system design, including tunnel ventilation and fan shafts, safe and refuge areas, and tunnel portals. |
| | | R-1-14-b | WMATA must assess and prioritize for additional radio enhancements not covered by Capital Improvement Plan (CIP) 136. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| **Metrorail Category 2: Ineffective Training, Operational Testing and Rules Compliance Programs** | | | |
| Finding R-15 | Maintenance and Operations Departments have not ensured the RWP training program is being conducted as required. Annual refresher and biennial re-certification requirements for Level II and Level IV are behind schedule. | R-2-15-a | Each WMATA Department with Roadway Worker Protection-trained and qualified employees must coordinate with Technical Skills & Maintenance Training to get or establish an accurate status on each employee's refresher and requalification training. |
| | | R-2-15-b | Each WMATA employee with lapsed refresher training or requalification must repeat the initial training and qualification for his or her level as specified in WMATA's roadway worker protection training program. |
| | | R-2-15-c | WMATA's Information Technology Department must work with Technical Skills & Maintenance Training to develop a long-term solution to tracking employee status and ensuring that Computer-Based Training records, classroom records and employee records are accessible to all departments. |
| | | R-2-15-d | WMATA must include annual Roadway Worker Protection refresher and requalification time in overall work scheduling protocols and requirements. |
| Finding R-16 | Technical Training for operations and maintenance departments is under-resourced and fractured, currently provided by five different departments and IT, is insufficiently directed and resourced, and relies significantly on on-the-job-training (OJT) which is informal and lacks oversight. | R-2-16-a | WMATA must conduct a coordinated study to prioritize technical training needs for maintenance personnel, and operations training for Rail Traffic Controller, Train Operators, and Field Supervisors. |
| | | R-2-16-b | WMATA must evaluate whether re-organization or consolidation of training functions would improve the agency's ability to manage, schedule, budget for, develop, oversee and assess training and ensure that training material remains up-to-date. |
| | | R-2-16-c | WMATA must establish a comprehensive training program to communicate the new "Fire Life Safety 1000 -- Inspection, Testing and Maintenance Procedure" to WMATA Operations and Maintenance personnel. |
| | | R-2-16-d | WMATA must establish formal guidance for maintenance employees responsible for providing on-the-job training. |
| Finding R-17 | WMATA does not have a clear strategy for the development or delivery of emergency response training to WMATA's frontline personnel, or for managing the logistical challenges associated with coordinating familiarization training | R-2-17-a | WMATA's Office of Emergency Management must conduct a formal review of the Metrorail Safety Rules and Procedures Handbook, the supporting Standard operating Procedures, and the new checklists and tools developed by the Rail Operations Control Center to ensure conformance with WMATA's emergency plans and the understanding of local jurisdictions as reflected in region-wide emergency operations plans. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| | with local emergency responders. | R-2-17-b | WMATA's Office of Emergency Management must conduct a formal review of all training provided to frontline, supervisory and ROCC personnel regarding the actions required to be performed during an emergency to ensure its conformance with WMATA's emergency plans and the understanding of local jurisdictions as reflected in region-wide emergency operations plans. |
| | | R-2-17-c | WMATA must establish an approach for delivering updated emergency response training to front-line Train Operators, Supervisors, Stations Managers, Rail Traffic Controllers, and other personnel. |
| | | R-2-17-d | WMATA must review and update its approach to providing familiarization training to local emergency responders, and ensure that emergency responders have ample opportunities to learn and practice activating and using fire life safety equipment and systems, including ventilation fans, fire suppression system, standpipes, communication equipment, and other systems. |
| | | R-2-17-e | WMATA must test its backup Rail Operations Control Center on a quarterly basis and demonstrate the ability to safely control train traffic. |
| Finding R-18 | Rules compliance checks of operational personnel are inconsistent. | R-2-18-a | WMATA must require Rail Supervisors to complete meaningful rules checks on Train Operators, not just single observation items, unless directed as part of a special emphasis program. |
| | | R-2-18-b | WMATA must establish documentation and a training program to ensure that Rail Supervisors know how to conduct and record meaningful rules checks of Train Operators, and how to discuss results with Train Operators. |
| Finding R-19 | Rail Transportation is not ensuring that field supervisors conduct required rules compliance checks on station managers and train operators. | R-2-19-a | WMATA must develop a formal operations testing program to include active, fail-safe testing of all employees responsible for operating or directing the safe movement of trains. |
| | | R-2-19-b | WMATA must document operational testing requirements and test results to improve the utility of the program as part of a robust testing and observation program. |
| Finding R-20 | New supervisors are not familiar with rules compliance checks requirements. | R-2-20-a | WMATA must improve the quality and consistency of training for new Rail Supervisors to include purpose and requirements for rules checks. |
| Finding R-21 | Some newly promoted Field Supervisors, who have not previously operated rail vehicles, | R-2-21-a | WMATA must establish a minimum number of trips per month that each Rail Supervisor must complete on the mainline to ensure the sufficiency of his or her skills. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| | are not sufficiently trained to relieve train operators on the mainline. | R-2-21-b | WMATA must review Supervisor Daily Activity Reports to ensure that Supervisors are completing required activities, including the minimum number of established trips per month. |
| Finding R-22 | WMATA must ensure that two-year re-certifications are being performed for Train Operators. | R-2-22-a | WMATA must review its schedule of in service evaluations to ensure sufficient time is available for each Train Operator to receive his or her two-year re-certification. |
| | | R-2-22-b | WMATA's Information Technology Department must work Rail Operations Support to develop a long-term solution to tracking Train Operator re-certification status and the results of any other in service examinations or activities completed. |
| **Metrorail Category 3: Insufficient Track Time for Maintenance** | | | |
| Finding R-23 | Current OWL nighttime maintenance window typically only allows between 90 minutes and two hours of on track time. | R-3-23-a | WMATA must ensure that a process is in place for identifying and scheduling sufficient track time to complete required inspection, testing and maintenance activities. |
| Finding R-24 | WMATA has reduced other options for track access, including holiday weekend work shut-downs, early outs, and single-tracking. | R-3-24-a | WMATA must establish firm limits on minimum track time for inspection, testing and maintenance activities per month, and revisit limits annually. |
| Finding R-25 | Due to lack of track time, WMATA's maintenance departments must consistently re-schedule work, and, as a result, have growing maintenance backlogs, dating back to 2012 and 2013 | R-3-25-a | WMATA must develop and implement staffing plans to eliminate maintenance work orders backlogs and manage on-going workload in track and structures, traction power, communications, and automated train control departments. |
| Finding R-26 | Efficiencies can be obtained to improve the way in which WMATA's workers and contractors currently access the right-of-way. | R-3-26-a | WMATA must improve interdepartmental coordination and communication to take full advantage of track time. |
| **Metrorail Category 4: System-wide Maintenance Issues** | | | |
| Finding R-27 | Documented maintenance procedures and standard operating procedures are not implemented as required. | R-4-27-a | For all major departments with inspection and maintenance responsibilities for critical infrastructure, WMATA must establish and/or update a preventive maintenance and inspection testing quality audit process to ensure compliance with established maintenance and testing practices, and to monitor missed or incomplete preventive maintenance activities and/or inspections. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| Finding R-28 | Walking track inspection resources have been cut in half. | R-4-28-a | WMATA must review the workload and inspection territory assigned to track inspectors, and leverage non-track inspectors to perform watchman duties. |
| Finding R-29 | All ATC alarms and issues must be communicated to ATC for investigation, repair and analysis. | R-4-29-a | WMATA must ensure that ROCC reports all signal alarms and notifications to ATC. |
| Finding R-30 | WMATA's program for measuring, documenting and addressing the potential impacts of stray negative return current on the condition of WMATA's infrastructure is not documented in a formal plan to ensure coordination across departments and contractor services. | R-4-30-a | WMATA must develop a plan to document roles and responsibilities, activities, and points of coordination regarding its program to measure, document and mitigate the impacts of stray negative return current. |
| Finding R-31 | ATC resource challenges potentially impact service expansion. | R-4-31-a | WMATA must assess adequacy of Automatic Train Control staffing levels resulting from the addition of the Silver Line. |
| Finding R-32 | WMATA has no formal program for reviewing the proficiency of maintenance field staff. | R-4-32-a | WMATA must ensure that each department within Transit Infrastructure and Engineering Services creates a formal program of Supervisory inspections to observe maintenance, look at quality of work in the field, and formally intervene to evaluate, re-train (if necessary), and enhance the professional development of employees. |
| Finding R-33 | Inventory "stockouts" have impacted maintenance operations. Material control stock out items are reported by Superintendents in Rail Car Maintenance, Traction Power and Plant as a serious concern in the performance of maintenance activities and ensuring equipment availability, however mitigations have not been implemented. | R-4-33-a | Each WMATA Department impacted by inventory stockouts must develop a recovery or corrective action plan to ensure equipment availability and to manage delays. |
| **Metrorail Category 5: Fire/Life Safety and Emergency Preparedness** | | | |
| Finding R-34 | Priority maintenance work for Fire/Life Safety (FLS) systems and other critical infrastructure with shared departmental responsibilities for inspection and maintenance is not completed as required. | R-5-34-a | WMATA must complete its "Fire/Life Safety 1000" maintenance procedure, to clarify roles and responsibilities, and outline expectations regarding how departments should work together to coordinate inspection, maintenance and repair of these system components. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| Finding R-35 | WMATA must do more to prevent and manage conditions that cause smoke in tunnels. | R-5-35-a | WMATA must establish clear definitions for infrastructure conditions requiring immediate or emergency action, such as "arcing insulator." |
| | | R-5-35-b | WMATA must address third rail insulator cleaning and replacement requirements and third rail jumper cable inspection and replacement requirements as part of the "FLS 1000" procedure, or in separate but referenced procedures. |
| | | R-5-35-c | WMATA must improve its ability to detect the location of smoke in its tunnel network. |
| | | R-5-35-d | WMATA must resume its program for cable insulation resistance testing for its power cables. Insulation resistance testing should be performed on power cables every 10 years. |
| | | R-5-35-e | WMATA must replace all defective power cables that have been identified by traction power inspectors and maintainers. |
| | | R-5-35-f | WMATA must set a schedule of drills to assess the effectiveness of WMATA's response to smoke in tunnel and station conditions. |
| **Metrorail Category 6: Condition and Performance of Tunnel Ventilation System** | | | |
| Finding R-36 | Documentation and scheduling of tunnel ventilation system inspections must be improved to ensure compliance with required procedures. | R-6-36-a | WMATA must establish a ventilation system testing quality audit process to ensure compliance with established maintenance and testing practices. |
| | | R-6-36-b | WMATA must automate inspection and maintenance record keeping for tunnel ventilation systems, drainage pumping stations, and other critical systems managed by the Office of Plant Maintenance. |
| Finding R-37 | Newer technology will enhance the performance of inspections and their quality. | R-6-37-a | WMATA must complete replacement of the pneumatic control boxes for ventilation fans with Programmable Logic Control systems within the next five years. |
| Finding R-38 | WMATA's existing tunnel ventilation system was designed and installed before modern fire/life safety standards were issued for the rail transit environment, however, with growing passenger loads and eight-car trains, WMATA must look for opportunities to improve ventilation performance and capacity. | R-6-38-a | WMATA must conduct an engineering assessment to identify ways in which to improve the performance and capacity of the tunnel ventilation system. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| **Metrorail Category 7: Performance of Information Management Technology** | | | |
| Finding R-39 | Difficulties with WMATA's ELM have forced departments to use work-arounds resulting in poor documentation of initial and refresher training, certifications, professional licenses and re-certifications. | R-7-39-a | WMATA must evaluate the existing Enterprise Learning Management recordkeeping system and take corrective action, as necessary, to ensure accurate training, re-certification, and professional certification records are created, maintained, and readily accessible to appropriate managers and employees. |
| Finding R-40 | WMATA's MMIS, in its current configuration, is cumbersome and challenging to use for many WMATA maintenance employees. | R-7-40-a | WMATA must develop a training strategy for improving the capabilities of employees to enter, analyze and assess information into the agency's Maintenance Management Information System. |
| | | R-7-40-b | WMATA must establish a data reliability working group focused on maintenance information. |
| | | R-7-40-c | The Information Technology Department must coordinate with the Technical Training Department to ensure the availability of additional training on the use of WMATA's Maintenance Management Information System for WMATA's maintenance departments. |
| Finding R-41 | WMATA's IT Department lacks necessary authority to ensure that all WMATA departments use IT applications in the same manner to ensure data sharing, coordination of training, and conduct of audits in a consistent manner. | R-7-41-a | WMATA must assess data accessibility and coordination needed to support safety functions throughout the agency including the operations and maintenance departments. |
| | | R-7-41-b | The Information Technology Department must coordinate with Rail Operations Quality Training to ensure the availability of additional training for the Rail Operations Control Center staff on the Advanced Information Management system. |
| Finding R-42 | Proactive safety analysis of information provided by Operating and Maintenance departments is not routinely conducted. This negatively impacts ability of WMATA to provide more support for proficiency testing, conduct more in-depth safety studies, reviews and accident/incident investigations. | R-7-42-a | WMATA operating and maintenance departments must work together to develop a strategy to more actively analyze, review, and assess rail operations and maintenance data from a safety perspective. |
| | | R-7-42-b | WMATA must work with the Tri-State Oversight Committee and FTA to establish and pilot an enhanced investigation process for rail transit accidents, incidents and safety studies that identify systemic root causes and deficiencies. |
| **Metrorail Category 8: Outstanding Items from Previous FTA Audits and Reviews** | | | |
| Finding R-43 | Corrective Action Plans from the 2009 Fort Totten collision remain open, including 38 items from the System Implementation Gap | R-8-43-a | WMATA must assess the resources assigned to the Automatic Train Control Department to ensure their sufficiency to carry out critical work, including completion of the program for replacement of the Alstom Gen II track circuits by 2017. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| | Analysis Report (SIGAR), which have not yet been addressed. | R-8-43-b | WMATA must expedite actions to address Corrective Action Plans from 2009 Fort Totten collision, including the 38 open items from the System Implementation Gap Analysis Report (SIGAR). |
| | | R-8-43-c | WMATA must replace ATC cables with low insulation resistance readings. |
| Finding R-44 | CWR installation and maintenance program changes have not been sufficiently evaluated. | R-8-44-a | WMATA must complete required submittals to FTA to close-out 2012 Safety and Maintenance Audit Recommendation #2 relating to the WMATA's rail de-stressing program. |
| | | R-8-44-b | WMATA must conduct an independent engineering assessment regarding the Critical Rail Neutral Temperature and Preferred Rail Laying Temperature Range established in "Track Maintenance & Inspection Manual" Revision 6 approved on March 16, 2015, to ensure that the likelihood of rail buckles is decreased. WMATA's proposed range (+10 to -19 degrees below the preferred rail laying temp of 95) is 9 degrees below WMATA's original measures and does not conform to industry standards and recommended practices). |
| **Metrobus Category 1: Concern over the Protection of Metrobus Operations Personnel** | | | |
| Finding B-1 | WMATA has not addressed operator assaults (by passengers) at a level commensurate with the number of occurrences. | B-1-1-a | WMATA must expedite development of an agency-wide, coordinated strategy to address contributing elements to Bus Operator Assaults, including training, deployment of police and security resources, enhanced community outreach, and resolving fare box performance and reliability issues. To the extent practical, WMATA should incorporate findings from the forthcoming Transit Advisory Safety Committee (TRACS) report on this topic. |
| | | B-1-1-b | WMATA's Safety Department must increase its level of involvement in the Operator Assault Preventative/Awareness Safety Initiative at Local Safety Committees, and in the development of the overall strategy for enhanced protection of Bus Operators. |
| **Metrobus Category 2: Limited Availability of Training for Operations and Maintenance Personnel** | | | |
| Finding B-2 | Refresher and other training gaps exist within the Transportation and Maintenance Departments. | B-2-2-a | WMATA must develop a strategy and approach for developing, offering and updating refresher training as required in current policies and standards, for key categories of Transportation and Maintenance personnel, including Bus Operators, Street Supervisors, Bus Operations Control Center Specialists, and Bus Maintenance personnel. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| Finding B-3 | WMATA does not have a current "BOCC Manual" which lists all office procedures and interpretations of rules or instructions pertaining to the BOCC Specialist's duties. There are no checklists available for BOCC Specialists to dispatch service or manage incidents. | B-2-3-a | WMATA must develop a Bus Operations Control Center Manual (with processes and procedures for Bus Controller Specialists) and a complete set of checklists for implementing Standard Operating Procedures and bus vehicle troubleshooting guidance. A clear accompanying process should be established for updating the Manual and training Specialists on its contents and updates. |
| **Metrobus Category 3: Inconsistent Operational Testing and Rules Compliance Checks** | | | |
| Finding B-4 | Bus pre-trip inspections are not being completed, documented, or monitored to the degree necessary to comply with internal WMATA SOPs or with industry standards. | B-3-4-a | WMATA must assess its overall approach to the performance of pre-trip inspections to determine the adequacy of time available for Operators to perform these inspections, the level of training available to Operators regarding the conduct of these inspections, and whether additional condition cards should be developed for different sub-fleets. |
| Finding B-5 | Within WMATA Bus Transportation, there are limited formal evaluations being conducted of the proficiency of Bus Operators. Although there are evaluation checklists and protocols to measure performance and proficiency of WMATA Bus Operators, the application of this process is not expansive, uniform, nor structured within established timeframes. | B-3-5-a | WMATA must establish and enforce a formal program to ensure that Supervisors assess Bus Operator performance. |
| | | B-3-5-b | WMATA must expand the total number and frequency of Passenger Service / Operator Skills Audits performed by Corporate Quality Assurance. |
| Finding B-6 | WMATA BOCC Specialists and SOM/Street Supervisors are excluded from WMATA's fatigue management program. | B-3-6-a | WMATA must establish a strategy and timeframe for extending the Fatigue Risk Management Program to all Bus Operations Control Center staff, including BOCC Specialists and the Street Operations Managers (SOMs), formerly Street Supervisors. |
| **Metrobus Category 4: System-wide Maintenance Issues** | | | |
| Finding B-7 | The bus maintenance materials procurement process is not being executed in accordance with FTA standards meant to ensure the safety and quality of parts being purchased (FTA Circular 4220.1F). | B-4-7-a | WMATA must develop and implement a plan to bring its bus maintenance materials procurement process into compliance with FTA Circular 4220.1F. This plan must include a formal testing process for newly procured parts and enhancements to the process currently used to accept new bus vehicles. |
| Finding B-8 | Newly delivered buses have body, system, and component problems. | B-4-8-a | WMATA must conduct a resource evaluation regarding overall staffing and resources available to Corporate Quality Assurance and to other quality divisions and departments within Bus Maintenance and Bus Operations to support in-plant inspection and general maintenance materials procurement. |

## WMATA SMI Findings and Required Action Matrix

| Findings by Category | | Required Action (Safety Directive 15-1) by Category | |
|---|---|---|---|
| | | | Options to re-instate factory visits must also be considered as part of this assessment. |
| **Metrobus Category 5: Lack of Information Management System Technology** | | | |
| Finding B-9 | Insufficient staffing and tools in place for collecting available Bus Operations data to support more proactive analysis from a safety perspective. | B-5-9-a | Conduct an assessment determining the adequacy of resources available to support Bus Operations Control Center and Bus Superintendents with data entry and analysis. |
| Finding B-10 | Proactive safety analysis of information provided by Operating and Maintenance departments is not routinely conducted. This negatively impacts ability of WMATA to provide more support for proficiency testing, conduct more in-depth safety studies, reviews and accident/incident investigations. | B-5-10-a | WMATA must formalize the procedure for how a Local Safety Committee will elevate a safety concern to the Departmental Safety Committee. |
| | | B-5-10-b | WMATA must define the Bus Safety Officer roles and responsibilities and conduct an assessment determining the adequacy of resources available for Bus Safety Officers to complete these responsibilities. |

## Appendix D: WMATA Organization Chart