

Tri-State Oversight Committee



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DRPT

Three-Year Safety and Security Review of the Washington Metropolitan Area Transit Authority

Automatic Train Control / Signals

Elements 15 and 16

Review Conducted: February and March 2015

Draft Report: September 18, 2015

Final Report: November 12, 2015

Introduction

Representatives from the Maryland Department of Transportation (MDOT), the District of Columbia Department of Transportation (DDOT), and the Virginia Department of Rail and Public Transportation (DRPT) comprise the Tri-State Oversight Committee (TOC), which provides regular oversight of the Washington Metropolitan Area Transit Authority (WMATA) Metrorail system. To comply with State Safety Oversight Final Rule 49 Code of Federal Regulations Part 659 (Part 659), the Federal Transit Administration (FTA) requires states to designate a State Safety Oversight (SSO) agency to administer safety and security programs for rail transit and fixed guideway systems within their jurisdictions. Specifically, 49 CFR Part 659 requires TOC to conduct an on-site safety review of each element of the WMATA System Safety Program Plan (SSPP) at least once every three years. These reviews must assess WMATA's implementation with all 21 elements of its SSPP and seven elements of its Security and Emergency Preparedness Plan (SEPP), along with related plans and procedures. Beginning in 2013, the TOC has split its Three-Year Safety and Security Review topic areas into separately occurring reviews spread out during a three-year period.

The following report documents the observations and findings of the TOC's review of Automatic Train Control and signals maintenance. Generally, this review focused on whether WMATA's maintenance program complies with its own written plans as well as industry standards and best practices. These topics are the responsibility of the Automatic Train Control Branch (ATCS), with support and internal auditing from the Department of Safety and Environmental Management (SAFE) and Quality Assurance and Warranty (QAAW). The relevant SSPP elements for this review were all or part of:

- Element 15: Maintenance Audits/Inspections
- Element 16: Training and Certification

The TOC Program Standard and Procedures defines WMATA requirements for these elements in Section 12 and in Appendix B. Specific requirements are cited further, below.

Methodology

In advance of the review, the TOC requested and reviewed relevant WMATA plans, procedures, checklists, and reports. The on-site portion of the review occurred Feb. 4-6, 2015. During the on-site review sessions, the review team interviewed WMATA personnel and reviewed various documents and records to assess compliance with procedures. The reviewers also observed preventive maintenance inspections and talked with front-line personnel. Persons interviewed (except front-line personnel) and documents reviewed are noted at the end of this report. As the review progressed, TOC representatives discussed preliminary findings and addressed questions from WMATA personnel. This report identifies conditions evident during the review period, regardless of the current progress of potential remediation activities.

Subsequent to the completion of the TOC review, the Federal Transit Administration conducted a series of WMATA reviews during March, 2015. TOC was a participant in the FTA review of Signals and Train Control conducted March 18-19, 2015. Additional information obtained during the FTA review including interviews, documentation and field observations is also incorporated in this report. TOC received further records and information from WMATA and FTA in April 2015.

A Finding may refer to an instance of WMATA operating out of compliance with an applicable internal or external written requirement, plan, policy, rule, standard, or procedure. Findings may also refer to instances whereby WMATA may technically be conducting business in compliance with existing WMATA, TOC, or FTA procedures and requirements; however, there may be no relevant written plan, policy, or procedure in place, or the existing plan, policy, or procedure is not in accordance with industry best practices. Findings may be safety-critical in nature regardless of whether the issue identified is “non-compliant”.

If a Finding is identified, WMATA is required to develop an appropriate Corrective Action Plan (CAP) and take action to achieve compliance with applicable requirements. WMATA is required to formally respond in writing, and is strongly urged to develop an appropriate CAP to update relevant plans, policies, rules, and/or procedures, or to address a particular identified resource or organizational issue. If WMATA determines no CAP is necessary, the agency must complete a hazard analysis in accordance with its hazard management procedure in order to justify taking no action and accept the level of risk associated with the finding.

This review, including all findings presented in this report, intends to assist WMATA with enhancing system safety throughout Metrorail. WMATA received a draft of this report and provided comments, which were considered for integration into this Final Report. **Upon receipt of this Final Report, WMATA has 45 days to submit formal CAPs in response to the “Required Actions” listed after each finding.** Each proposed CAP must include the planned action, person responsible, and estimated completion date.

The TOC would like to thank WMATA personnel for their time, cooperation, and forthrightness throughout the review process.

Current Conditions

Organization and Staffing

Inspection and maintenance of the Metrorail train control system is the responsibility of ATCS within the Office of Systems Maintenance (SMNT) within WMATA’s Department of Transit Infrastructure and Engineering Services (TIES). ATCS policies, processes, functions, and responsibilities are described in detail in the Automatic Train Control Branch Maintenance Control Policy, Rev 3, July 1, 2014 (BMCP). This document describes ATCS performance measures, safety and hazard management programs, security, quality assurance, maintenance programs, training programs, and Maximo

records management. The policy also includes a complete inventory of train control components requiring inspection and maintenance by ATCS.

ATCS is organized into four Maintenance Divisions, each headed by a Regional Manager. Each Division is assigned responsibility for the inspection and maintenance of ATC equipment for specific Metrorail line segments and train control rooms (TCRs). In addition, there are nine ATCS Field Offices based at Metro rail yards. There are three Work Groups assigned to each Field Office, one for each work shift, requiring a total of 27 Work Groups. ATC maintenance and inspection is performed during all shifts. Work Groups consist of train control Technicians who report to a Shift Supervisor. Each Field Office is assigned between eight and 23 TCRs, including yards and the ATC equipment on the alignment between the TCRs. The Shift Supervisors and a Maintenance/Inspection Supervisor for each Division report to the Regional Manager for that Division. The four Regional Managers report to the Assistant Superintendent, who reports to the Superintendent of Automatic Train Control. Roles and responsibilities for all management and supervisory positions are described in the BMCP. Overall, ATCS has four Regional Managers, a Manager for the N-Line, five Maintenance/Inspection Supervisors, 27 Shift Supervisors and 218 ATC Technician positions, according to staffing reports updated February 2, 2015. Only three of the 218 Technician positions are vacant according to the reports. The personnel and TCR assignments for each Maintenance Division are summarized in the table below:

Maint. Division	Work Group	Field Office Location	Assigned Line Segments	Line TCRs	Yard TCRs	Shift Supv	ATC Tech
Div. 1	1,2,3	Shady Grove	A06-A15	11	4	3	25
Div. 1	4,5,6	Brentwood	A05-B05	11	1	3	22
Div. 2	1,2,3	Alexandria	C07-C15, J Line	16	1	3	25
Div. 2	4,5,6	W Falls Church	C01-C06, K Line	15	5	3	25
Div. 2	7,8,9	Fisher Av TCR	N Line	11		3	25
Div. 3	1,2,3	New Carrollton	D Line, G Line	20	3	3	27
Div. 3	4,5,6	Branch Av	F Line	11	4	3	23
Div. 4	1,2,3	Greenbelt	E Line	10	6	3	23
Div. 4	4,5,6	Glenmont	B06-B11	6	2	3	23
<i>Totals</i>	<i>27</i>	<i>9</i>	<i>N/A</i>	<i>111</i>	<i>26</i>	<i>27</i>	<i>218</i>

Some Technicians are assigned to 21 particular TCR locations for the AM and PM shifts. This distribution facilitates responses to ATC incidents. Technicians work a five-day schedule, primarily Tuesday-Saturday or Sunday-Thursday. The largest number of Technicians is scheduled to work Tuesday-Thursday, ranging between seven and 10 per work group. On other days, between three and five technicians are scheduled per work group. Technicians are classified based on experience, training, and testing. Technician grades (levels) from highest to lowest are AA, A, B, C, and Helper (H). Certain Preventive Maintenance and Inspection (PMI) procedures require a Technician AA or A. Other PMI procedures may be performed by a Technician B or C, but Helpers do not perform PMIs

on their own. New hires begin as Helpers and receive initial familiarization training. Advancement to any level requires one year at the previous level and passing a test for the next level.

AA/A Technicians account for 24% of filled positions, Helpers account for 29%, and B/C account for 46%. The large number of Helpers is due to new hires for replacement of recently retired personnel plus new positions required for the Silver Line opening in 2014. Overall, 56% of PMI procedures require AA/A Technicians, but many of these procedures are performed less frequently than those which can be performed by B/C Technicians. Based on the required PMI frequency and units of equipment requiring each PMI procedure, AA/A Technicians are generally required for about 18% of all PMI performed, although this does not account for the specific time required to complete each procedure. A February 2, 2015, report of ATC Maintenance Division staffing by work group indicates a minimum of two AA Technicians per work group on the AM shift and a minimum of one AA Technician and one A Technician per work group on the PM and midnight shifts. This allocation of AA/A Technicians assures that these personnel are assigned to all work groups for all shifts.

A separate ATC Production Division provides construction, inspection, testing, production, and support services with 16 Supervisors and 84 Technicians. This Division is responsible for major ATC construction and modification projects such as the replacement of Alstom Generation 2 modules with Generation 4. This Division was previously part of ATCS but is now under Capital Development.

Maintenance Requirements

A complete inventory of ATC components is included in Appendix A of the BMCP for each TCR location. A list of 22 components, by TCR, includes cabling, impedance bonds, marker coils, wayside signals, switch mechanisms, ATP Modules, equipment racks, and relays. The complete component list as it appears in the BMCP is included in the Appendix to this report with the total quantities of each asset for the entire ATC system ("Metrorail ATC Assets"). The inspection and maintenance program for these ATC components is described in detail in ATCS procedures 1000, 2000, and 3000. ATCS developed each of these documents to identify all procedures, schedules, and reporting forms required for the inspection and maintenance of ATC components and systems:

- ATC-1000, Instructions for Testing and Inspection of ATC Apparatus and Systems, Rev 2, 8/26/14 – provides documentation of 30 procedures, schedules, and reporting forms for ATC inspections and tests, performed at intervals from monthly to 10 years for cable, relays, switches, routing/locking, and track circuits.
- ATC-2000, System Integrity Maintenance Practices, Rev 1, 1/16/13 – provides descriptions of ATCS practices and standards, ATC systems and components, and the processes to be followed to assure safe operation, inspection, maintenance, and testing.
- ATC-3000, Preventative Maintenance Instructions and Technical Procedures Manual, Rev 1, 8/21/14 – provides documentation of 22 procedures, schedules, and reporting forms for track circuit adjustments and ATC inspections and tests,

performed at intervals from weekly to two years for TCRs, interlockings, wayside, Train to Wayside Communications (TWC), Remote Terminal Units (RTU), Intrusion Detection Warning (IDW) and snowmelters.

A complete list of ATC-1000 and 3000 procedures and frequencies is included in the Appendix to this report. Each procedure description identifies reference documents, Technician qualification requirements, performance frequency, special tools and equipment, criteria for determining inspection or test results, and step-by-step instructions for performing the procedure. Procedure general instructions state that special tools and test equipment must be calibrated when required; but the individual procedures do not indicate which tools are required to be calibrated. Specific forms for recording inspection and test results are identified for all procedures. Forms are identified by the procedure number to which they apply. All completed forms, referred to as data sheets, are required to be on file at the appropriate ATC Field Office for the location inspected. Copies of certain records are also kept at the TCR where the inspection was performed, available in binders for Technician reference. The ATC-1000 and 3000 procedure documents indicate that most records are to be filed at TCR and Field Office locations, but in practice, records for many procedures are available only at the Field Office. All personnel have access to procedures online, and hard copies are located at Field Offices and TCRs. Individual procedures are also incorporated into inspection work orders. All PM forms incorporated with the ATC-1000 and 3000 procedures are identified by procedure number and revision date and provide fields to record locations and dates, signatures of Technicians and Supervisors, test results, and remarks. Only two procedure forms provide fields to record calibration information (1001 for Test Unit and 1013 for Oscilloscope).

Calibration Requirements

The BCMP describes the management process and responsibilities for annual calibration of testing and measuring equipment. An equipment inventory is maintained in Maximo, and a Test Equipment Calibration Report can be generated to identify equipment that is out of date. Reports indicate the test equipment asset number and description, calibration due date, person to whom the test equipment is assigned, and facility where the test equipment is located. The user is to submit test equipment to SMNT's Shop and Material Support (SAMS) group prior to the due date. TOC reviewed two calibration reports generated January 1, 2015. The report for ATCS Equipment Due for Calibration in the Next 45 days (for personal issue equipment) listed 240 units of calibrated equipment, of which 78% had expired dates going back to 2008. The report for ATCS Equipment Due for Calibration in the Next 30 days (for ATC test equipment) listed 642 units of test equipment, of which 87% had expired dates going back to 2008. A report provided for the FTA review on March 16, 2015, listed 1,412 units of calibrated equipment of which 34% was past due for calibration. The report does not indicate the status of calibrated equipment units. It is not known if expired units are still at WMATA or in use, or if they have been turned in to SAMS for calibration. ATCS personnel reported that equipment turned in to SAMS remains on the calibration report until SAMS opens a work order. QAAW personnel indicated their audits determined that some equipment in the calibration inventory no longer exists. ATCS personnel indicated that many of the units in the reports

are no longer in use, including non-digital radios. The inclusion of inactive equipment, equipment that no longer exists, or equipment already submitted to SAMS makes it difficult to use the report to pinpoint calibrations due for active equipment.

Preventive Maintenance and Inspection

Maximo generates PMI work orders based on the required schedule. The schedule is determined for each ATC component and type of PMI procedure as described in the Instructions for Testing and Inspection of ATC Apparatus and Systems (ATC-1000) and Preventative Maintenance and Technical Procedures Manual (ATC-3000). Each ATC Division has a Maintenance/Inspection Supervisor responsible for Maximo scheduling. ATCS allows a 20-day grace period to complete open PM work orders with a compliance target of 98%. The open work order list for PM contained 28 open work orders, which is a relatively small portion of the inspections and tests scheduled in a month. However, ATCS personnel explained that open PM work orders are not tracked beyond three months past due. This may not be a concern for weekly or monthly PMIs, but the majority of procedures are on a quarterly to five-year schedule. After three months, the completion of these PMIs would still be relevant. During the FTA review, ATCS provided a 2014 summary report of scheduled and completed PMs, as well as monthly reports of PMs completed in June and December of 2014. A copy of the ATCS PM Summary 2014 Report is included in the Appendix to this report, showing completion of 15,790 PMs in 2014. The monthly reports of PM completion by type, date, and location indicate that the total number of PMs completed, as well as individual PMs by type, is consistent with the annual scheduled requirement shown in the 2014 summary report. While the overall completion rate of 99% for the 31 PM types listed in the 2014 Summary is quite good, completion rates for individual PMs are a concern, particularly for PM that is scheduled infrequently. The highest completion rates are for weekly, monthly, quarterly, semi-annual, and some annual procedures; the lower completion rates are for 14 PM procedures on a one- to five-year schedule. The following list from the summary report shows the lowest completion rates by PM type:

PM DESCRIPTION	SCHEDULED	COMPLETED	%	MISSED
ATCS, 2 YEAR, AC VANE RELAY INSPECTIONS AND TESTS	35	30	86%	5
ATCS, 2 YEAR, APPROACH, TIME, SIGNAL INDICATION LOCKING TESTS	32	27	84%	5
ATCS, 1 YEAR, AUTOMATIC TRANSFER SWITCH INSPECTION & TEST	107	83	78%	24
ATCS, 5 YEAR, HF TRACK CIRCUIT CAB ROADWAY TRANSMIT LEVEL TEST	42	22	52%	20
ATCS, 4 YEAR, DC VITAL RELAY INSPECTIONS AND TESTS	35	9	26%	26
ATCS, 3 YEAR, IDW TEST	13	11	85%	2
ATCS, 5 YEAR, OPEN DOOR COMMAND SPILLOVER TEST, MASTER	48	32	67%	16
ATCS, 1 YEAR, RTU INSPECTION & TEST	98	95	97%	3
ATCS, SNOWMELETER INSPECTION AND TEST	55	49	89%	6
ATCS, 2 YEAR, SWITCH DETECTOR AND ROUTE LOCKING TESTS	33	26	79%	7
ATCS, 2 YEAR, SWITCH INDICATION LOCKING TESTS	36	27	75%	9
ATCS, 1 YEAR, TIME RELEASE, TIMING RELAYS / DEVICES TESTS	71	56	79%	15
ATCS, 2 YEAR, TRAFFIC LOCKING TESTS	27	22	81%	5
ATCS, 1 YEAR, WAYSIDE PUSHBUTTON BOX INSPECTION & TEST	30	21	70%	9

PM frequency requirements are identified for 30 procedures in ATC-1000 and 12 procedures in ATC-3000. Additional documentation provided for the FTA review included a file titled "ATC PM Schedule Worksheet 2/23/15." This worksheet shows the PM schedule for most of the PM procedures by month for each TCR location. Schedules by month are shown for each year from 2012-2018. The following ATC-1000 and ATC-3000 procedures are not scheduled:

- 1001 Cable Insulation Resistance Test – no schedule shown for this PM; 10-year testing was completed; 53 cables are being tested annually until replaced.
- 1012A-6 – Ansaldo STS/US&S AFTC Open Bond Line Test – listed on the 2/23/15 PM schedule but not listed on the ATCS PM Summary 2014 Report.
- 1013 – GRS ATP Module Generation 2 Parasitic Oscillation Test – no schedule shown for this PM, which was listed as completed on the ATCS PM Summary 2014 Report.
- 3002B – TCR Quarterly Inspection (ATP Modules) - listed on the 2/23/15 PM schedule but not listed on the ATCS PM Summary 2014 Report.
- 3004 – ATC Wayside Inspection – no schedule shown for this PM, performed with 1012C – Track Circuit Shunt Verification Test.
- 3013 – TABIL Inspection and Test – no schedule shown for this PM which is required every 2 years according to ATC-3000.
- 1011B – TCR Ground Validation Test – this PM is not listed on the schedule; required every 2 years according to ATC-1000.
- 1012E – Code Rate Frequency Test – this PM is not listed on the schedule, required annually according to ATC-1000; must be entered into Maximo for PM Work Order scheduling.

Corrective Maintenance

A Corrective Maintenance (CM) work order is opened when a repair or adjustment is required as a result of PM inspection or an incident report. ROCC issues an Incident work order if service is impacted. The Maintenance Operations Center (within the ROCC) then issues a corresponding CM work order. The BCMP describes the Maximo work order process, reporting for PM and CM, and the tracking of completion and failure trends. WMATA provided open work order lists for January 9, 2015, for AC Track Circuits, AF Track Circuits, Processors, Signals/Signs, and Track Switches. For 43 work orders that were open more than seven days, the average time open was 115 days. Nine work orders were open more than 180 days; the maximum was 692 days. ATC personnel reported that several work orders were kept open for observation based on a previously reported failure. Daily incident reports for three separate dates listed a total of three ATC incidents, with two showing CM work orders opened and in progress. There were also several incidents requiring ATCS response to implement speed restrictions due to rail conditions. A summary of 2014 ATCS CM work orders shows a total of 2,310 work orders listed for 20 failure codes. The majority of all CM work orders involved High Frequency Track Circuits (48%), followed by switch machines (17%). Work orders were open an average of 8.8 days. A summary of CM work orders by failure code is included in the appendix to this report.

QAAW

QAAW audit reports of ATCS PMI within the last two years indicate compliance was observed with no findings for performance of procedures 1008, 1011A, 1012A, and 1012C. QAAW also conducted an audit of test equipment calibration performance at Greenbelt Yard with no findings. A QAAW audit of Field Office recordkeeping had one finding due to PM documentation missing for one Switch Detector and Route Locking Test which is performed every two years. The QAAW - ATCS Report Status Log indicates there were 26 audits in 2012, 23 in 2013, and 18 in 2014. The audits covered performance of 12 different PMIs as well as calibration, recordkeeping and other activities at a variety of locations. For the 67 audits completed, 44 had no ATCS findings. The majority of discrepancies involved recordkeeping at Field Offices. Other discrepancies involved missing signatures on PMI forms, missing documentation at TCRs and calibration.

ATC Training Program

Technical training is the responsibility of Technical Training and Document Control (TTDC). The ATC technical training program consists of the following formal courses provided to Supervisors and Technicians:

- ATC Supervisor 4 Week Refresher Course
- ATC Tech 5 Week System Overview (Familiarization)
- ATC 19 Week Journeyman Class
- Silver Line – provided by vendors for new equipment

Training records indicate that 39 Supervisors completed the four-week Supervisor course in 2013-14, at which time there were 53 Supervisors among the various areas of ATC. The completion rate is 75% for all Supervisors and 83% for maintenance shift Supervisors.

The five-week familiarization course intended for new hires was completed by 94 employees between 2012 and 2015, including 28 C Technicians and 64 Helpers. Records for the Journeyman course show 67% of modules completed by 63 Technicians between 2001 and 2008. The training program lapsed after that time but has been resurrected as a new 19-week course for newer hires and Supervisors who did not receive the previous course that ended in 2008. Six Supervisors were enrolled in the new 19-week Journeyman course in 2014. The Journeyman course is offered two or three times a year for 10 Technicians at a time. A job code curriculum matrix illustrates the courses and training modules required for supervisors and technicians (AA, A, B, C, Helper). Training requirements are tied to each of the technician levels with study guides and tests for each. Course curricula, manuals, presentation materials, and study guides used for the training courses were provided for the review.

PM Observations

TOC conducted observations at two TCRs and a Field Office. At TCR A-13 (Twinbrook), TOC reviewed PM records and TCR logs, observed interlocking PM inspections 1012A, 1012B, 1012C and 3003, and interviewed ATC Technicians. At TCR A-11 (Grosvenor),

TOC reviewed PM records and TCR logs and interviewed ATC technicians. At Alexandria Field Office (C99), TOC reviewed PM records. Issues of concern resulting from the observations are described in the findings section of this report.

TOC reviewed completed forms used to record inspection and test results for several PM procedures. Specific records reviewed included forms for procedures 1002B, 1003, 1004A, 1006, 1007, 1008, 1009, 1010, 1011A, 1011B, 1012A, 1012B, 1012C, 1013, 1015, 3001, 3002A, 3002B, 3003, 3004, 3007, 3008, 3009, 3010, 3011, and 3012. Form content and completion intervals for records were generally in compliance with ATC procedures, with some exceptions as noted in the findings section of this report. ATC-1000 and ATC-3000 procedures indicate that all original inspection and test record forms should be filed with the Regional ATC Field Office, and copies are filed in the TCR location record book. In practice, records for inspections and tests conducted annually or less frequently are only filed at the Field Office and are not on file in TCRs. Also, copies of PM forms at the TCRs do not have Supervisor signatures, since only the original forms are submitted to the Field Office for review and signature.

An additional observation was conducted for the FTA review at Van Dorn (J02) for PMI 1008, 1012A-1, 1012A-2, 1012C, and 3002A. Documentation reviewed included completed forms for PMI 1002A, 1003, 1004A, 1006, 1007, 1008, 1009, 1010, 1011A, 1012A-2, 1012C, 3001, 3002A, 3003, 3004, 3007, 3008, and 3009. Records at this location appeared to be properly completed and signed. Copies of ATC-1000 and ATC-3000 being used from 2013 were not the most recent versions.

Findings

Required Actions to be discussed in FTA-TOC working group.

Finding 1: The ATCS PM Summary 2014 report indicates low completion rates for several PMs with scheduled inspection intervals of one year or greater.

Compliance with schedule requirements is critical for components that are inspected and tested on an infrequent basis. The 2014 report indicates PM was not completed as scheduled for the following PMI: 1002A, 1002B, 1003, 1004, 1006, 1009, 1010, 1012A-3, 1012A-4, 3009, and 3012 (full PM descriptions by PM number are listed in the report appendix). WMATA reported that the target completion date for these PMs is missed due to limitation of track access and coordination of shared resources overnight.

Required Actions:

- WMATA as a whole must conduct an assessment of resources and factors that prevent completion of maintenance due to track allocation limitations.
- WMATA must implement new scheduling methods to prevent maintenance from being routinely deferred; this may include additional track shutdowns during service hours to complete routine safety inspections.
- (This CAP may be covered by proposed WMATA CAPs in response to FTA findings regarding track access from the Safety Management Inspection)

Finding 2: ATCS reports of equipment due for calibration contained more than 700 items that were past due, including many that are several years late.

ATCS indicated that many of items listed may no longer exist or are no longer used. The inclusion of tools that are no longer being used prevents ATC from having an accurate understanding of which tools are past due for annual calibration. Personnel may not be returning old equipment when they receive new tools.

Required Actions:

- ATCS and SAMS must conduct a full inventory of its tools in order to scrub Maximo and its tracking list of all tools no longer being used. ATCS or SAMS should provide a revised Maximo inventory list with obsolete tools removed and regained calibration compliance.
- ATCS and SAMS must develop a documented tool distribution control method so that new equipment/tools are not issued until old ones are returned, and the person receiving the old equipment removes it from the inventory and maintenance cycle in Maximo.

Finding 3: Some PMI procedures listed in ATC-1000 and ATC-3000 have performance frequency requirements but are not being scheduled or completed, according to ATCS PM schedules and reports.

The ATCS PM Summary 2014 Report does not show that PM was scheduled or completed for PMI 1011B, 1012A, 3002B, or 3013.

Required Actions:

- ATCS must meet the PM frequency requirements of ATC-1000 and ATC-3000 for the identified PMIs. ATCS should provide a printout or screenshots showing the tests added to Maximo as well as evidence of appropriate completion as scheduled.

Finding 4: Pre-printed Data Sheets with checkmarks already added were used for PM 3003.

Checklists should never be completed with items shown as acceptable in advance of an inspection. In one case, a Data Sheet was submitted with the printed checkmarks, but the inspection never occurred (made apparent by the lack of other information on the sheet).

Required Actions:

- ATCS must ensure any electronic copies of the 3003 Interlocking inspection Data Sheet are replaced with blank copies.
- ATCS must also update its Maintenance Control Policy regarding Data Sheet rules and procedures to specify that this practice is prohibited. A
- ATCS must provide its updated policy as well as a signed memorandum validating that all remaining pre-filled Data Sheets have been destroyed.

Finding 5: Many Data Sheets are not being returned to Field Offices for Supervisor sign-off and entry of defects into CM work orders.

It was unclear for these missing Data Sheets whether the inspection was never performed or a copy of the sheet was simply not sent to the Field Office. Either way, the Field Office is where Supervisors review the Data Sheets for proper completion and add any ATC-related repairs into Maximo under new work order tickets. This problem was specifically observed for the weekly interlocking inspection during all of July, September, and December 2014 at C97, October 2014 at C98, and November 2014 at J01 (as examples from just a portion of 2014 records at only the Alexandria Field Office). A related problem was that many types of overnight inspections did not have corresponding Data Sheets in the two TCRs that TOC visited.

Required Actions:

- ATCS must enforce a clear method to ensure that personnel turn in copies of their Data Sheets to both Train Control Rooms and Field Offices, regardless of varying current practices. ATCS should provide evidence of its enforcement (such as via Field Office paperwork audits).

Finding 6: Supervisor signatures were missing from batches of Data Sheets.

Data Sheets for certain shifts and Supervisors lacked Supervisor sign-off at the Field Office visited during the review. There was no method to verify Supervisors are completing elements of their job properly.

Required Actions:

- ATCS management must conduct quality control spot checks of Supervisors' work to ensure they are fully completing their duties (such as reviewing Data Sheets and adding defects to new work orders). ATCS must document a requirement for spot checks of Supervisors' work and provide evidence of these spot checks.

Finding 7: There is no prompt for tool serial numbers and calibration dates on most relevant Data Sheets. The only Data Sheets requiring calibration information are 1001 and 1013. Calibrated tools are critical for PMIs such as relay testing. For the relay testing Data Sheet in particular, there is no line to enter the tool information to ensure accuracy. Many procedures described in ATC-1000 and ATC-3000 indicate special tool requirements including a volt-ohm meter, digital multimeter, megohmmeter, oscilloscope, torque wrench, or other testing device.

Required Actions:

- ATC and/or CENI must add a line for tool serial numbers and calibration dates on all relevant Data Sheets.
- ATC and/or CENI must also consider identifying tools that require calibration in the Special Tools and Equipment section of ATC-1000 and ATC-3000 procedures. PM procedures should note the requirements to enter this data on the Data Sheets.

Finding 8: ATCS is not tracking inspections that are more than three months past due.

Supervisors' and managers' Maximo Start Centers (dashboards) show the number of past due inspections from the last month, and they can also query for three months' past due. However, there is no tracking list, Start Center option, or concerted effort to assess how many inspections are more than three months past due, at which point they may no longer receive attention. This information is especially critical for less frequent intervals such as annual or five-year inspections.

Required Actions:

- WMATA must add a Maximo Start Center option to see all past due inspections, and ATCS should regularly assess this information for maintenance scheduling as it currently does on a monthly basis. WMATA should provide evidence of new tracking of PMs that are past three months due (such as through screenshots of an enhanced Maximo Start Center).

Finding 9: WMATA ATC maintenance does not have a consistent process for closing work tickets once investigated, and Maintenance Operations Center (MOC) opening new tickets for each reported issue.

ATCS was uncertain whether MOC opens a new work ticket each time an issue is reported or checks Maximo to see whether a ticket already exists. TOC observed one ATC corrective maintenance work order that was open for six months for "observation" in case similar reports occurred, since the mechanic could not find any problems. However, ATCS may not know of repeated issues if MOC declines to open a new work order based on the existing ticket. This makes it less possible to determine whether a trend is occurring. TOC observed similar issues regarding MOC work order ticket communication during its Triennial Review of elevator/escalator maintenance in December 2014.

Required Actions:

- MOC must set a standard protocol for when new work tickets are opened, the level of detail to be included, and whether Controllers should check for existing work orders or always open a new one.
- ATC must create and enforce a requirement in its MCP for work order tickets to be consistently closed once fully investigated rather than being kept open for observation.
- ATC must also create a method to regularly query MAXIMO to determine areas or components suffering repeated failures, and describe this method in the MCP.

Finding 10: The new annual code rate frequency test had not yet been added to Maximo as a regular preventive maintenance inspection.

This test, which corresponds with new procedure 1012E, resulted from the CH2M Hill Return to ATO safety analysis.

Required Actions:

- WMATA must add this new inspection to Maximo for regular scheduling, along with any additional inspections created or increased in frequency as a result of the Return to ATO report. ATCS should provide a printout or screenshots showing the tests added to Maximo.

Finding 11: There are no minimum requirements for ATCS Supervisors' quality control spot checks or rule compliance assessments of frontline personnel.

Although the MCP states that all Supervisors must conduct quality assessments of their teams' work, there was no evidence of this occurring regularly. For example, the Train Control Room log books at the two locations TOC visited (Twinbrook and Grosvenor) did not appear to have any signatures from Supervisors in the past year, despite a WMATA requirement for all persons entering Train Control Rooms to sign the log book.

Required Actions:

- ATCS must establish requirements in its MCP for quality control spot checks and resulting documentation to be completed by each Supervisor. ATCS should provide the revised MCP or supplementary procedures as well as evidence of documented spot checks. (Note: This is different than the separate finding that prescribes spot checks of Supervisor work; this finding relates to Supervisor sport checks of technician work)

Finding 12: There is no correlation between parts numbers stored in Maximo and actual Original Equipment Manufacturer (OEM) part numbers needed for maintenance.

For each diagram in the OEM manual, there is a list of parts by index number with a corresponding manufacturer's part number required to place an order from the manufacturer. However, the part numbers stored in Maximo are not the same as these OEM part numbers, and the Maximo part numbers do not have a diagram or index number for technicians to be able to identify them. Mechanics can obtain OEM manuals or call Supervisors to research part numbers, but they are not tied to Maximo. This inhibits the efficiency of the maintenance process and could cause wrong parts to be ordered.

Required Actions:

- ATCS must add pictures to part numbers in Maximo, consistently provide training it has developed regarding part numbers, and/or take other steps to ensure part numbers are easily accessible.

Finding 13: After initial training for ATC employees, the program is not structured with defined levels of knowledge and feedback to employees for promotion.

Based on discussions with ATCS and TTDC management, a 19-week training course traditionally considered a prerequisite for AA-level Technicians has not been provided to recent rounds of promoted Technicians. The course schedule was delayed due to an

influx of new personnel and an ATC instructor vacancy. Additionally, frontline personnel interviewed believed the advancement criteria were not well-defined; ATCS management does not provide feedback to employees who fail promotional tests regarding their areas of deficiency. They also stated that technical skill computer-based refresher training in addition to classroom training would be helpful. These issues may be preventing WMATA from qualifying AA-level Technicians, which are in need despite the department being almost fully staffed, according to ATCS.

Required Actions:

- TTDC must implement new courses and refresher training to coincide with each mechanic level.
- WMATA should provide an approved plan for training of employees before the employees can be allowed to take promotional tests that are tailored for a specific Technician level, including a process to provide feedback on deficiencies for personnel who fail.

Personnel Interviewed

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- *(Front-line mechanics' names are withheld from this report)*

Documents Reviewed

- Automatic Train Control Branch Maintenance Control Policy, 7/1/14, Rev 3
- ATC-1000 Instructions for Testing and Inspection of ATC Apparatus and Systems, 8/26/14, Rev 2
- ATC-2000 System Integrity Maintenance Practices, 6/3/2013, Rev1
- ATC-3000, Preventative Maintenance and Technical Procedures Manual, 8/21/14, Rev1
- Open Maximo Work Order Lists – 5, 1/9/15
- ATCS Equipment Due for Calibration in the Next 30 Days, 1/1/15
- ATCS Equipment Due for Calibration in the Next 45 Days, 1/1/15
- QAAW audit reports for ATCS – 22 for 2012-14
- ATC Field maintainer Training Course – Dulles Corridor Metro Project
- ATC Supervisor 4 Week Refresher Course (attendance records and course materials)
- ATC Tech 5 Week System Overview (attendance records and course materials)

- ATC 19 Week Journeyman Class (attendance records and course materials)
- TSSM Profile Sorts by Job Title / Code / Department – ATC
- ATC Mechanic Study Materials 8/08 – AA, A, B, C
- ATC Maintenance Division Organization Chart, 8/9/12
- ATC Phone Book
- December 2014 ATC Pick Updated 2/2/15
- Incident summary reports - 12/24/2014, 1/20/2015, 2/1/2015
- Work Order List, 2/1/15-2/15/15
- PM records at A13 Twinbrook
- PM records at A11 Grosvenor
- PM records at C99 Alexandria

Additional documents from the FTA review:

- QAAW - ATCS Report Status Log, 2012-14
- ATC PM Schedule Worksheet 2-23-15
- ATCS PM Work Order Schedule - June, 2014
- ATCS PM Work Order Schedule - December, 2014
- ATCS CM Work Order Summary for 2014
- ATCS PM Summary 2014
- ATC Test Equipment – Calibration List
- Systems Maintenance (SMNT) Budgeted Staffing, 2/26/15
- Pm records at J02 Van Dorn

APPENDIX

Metrorail ATC Assets from BCMP Appendix A

Asset	Quantity
Cable (miles)	1,900.68
Ethernet Cable (miles)	6.71
Impedance Bonds	2,788
Junction Boxes	4,636
Loops	888
Markers	2,386
Push Buttons	177
Signs	1,008
Signals	382
Snow Melter Cases	97
Switch Machines	315
ATP Modules	2,971
Local Control Panel	82
Ground Detectors	261
Integrated Vital Processor	36
Non-Vital Processor	56
Power Supplies	1,195
Equipment Racks	2,145
Relays	42,972
Remote Terminal Unit	106
Station Processor	111
TWC Receiver/Transmitter	46
Ethernet Switch (MOXA 7828)	28
Ethernet Switch (MOXA 6726)	28

ATC 1000 - Instructions for Testing and Inspection of ATC Apparatus and Systems

Procedure	Frequency	Quantity
1001 Cable Insulation Resistance Test		108 TCR
1a. for wires & cables below 600V with frequency below 2kHz	10 years	
1b. when insulation resistance is less than 1M ohm but above 200K ohm	1 year	
2a. wires & cables below 600V with frequency 2kHz or greater	10 years	
2b. when insulation resistance is less than 10M ohm but above 2M ohm	1 year	
3. for wires and cables used for circuits above 600 Volts	10 years	
1002A – AC Vane Relay Inspection and Test		
1. Alternating current centrifugal type relay	1 year	
2. Alternating current vane type relay and direct current polar type relay	2 years	59 TCR
1002B – DC Vital Relay Inspection and Test	4 years	108 TCR
1003 – Switch Detector and Route Locking Test	2 years	64 TCR
1004 – Approach and Time Locking and Signal Indication Locking Test	2 years	60 TCR
1006 – Time Release, Timing Relays and Timing Devices Test	1 year	67 TCR
1007 – Switch Hand Crank Cut-out Restoration, CWP and Point Detector Test and Lubrication		
1. Machines with Mechanical Locking	quarterly	86 TCR
2. Trailable Machines without Mechanical Locking	monthly	
1008 – Switch Obstruction Test	monthly	86 TCR
1009 – Switch Indication Locking Test	2 years	67 TCR
1010 – Traffic Locking Test	2 years	60 TCR
1011A – TCR Ground Fault Inspection and Test	monthly	107 TCR
1011B – TCR Ground Validation Test	2 years	
1012A-1 – Ansaldo STS/US&S AFTC Detection Signal Level Test	quarterly	199 tests
1012A-2 – Ansaldo STS/US&S AFTC Cab Signal Transmit Level Test	annual	293 tests
1012A-3 – Ansaldo STS/US&S AFTC Cab Signal Level (Search Coil) Test	5 years	198 tests
1012A-4 – Ansaldo STS/US&S AFTC Open Door Command Spillover Test	5 years	180 tests
1012A-5 – Ansaldo STS/US&S Power Frequency Track Circuit Test	quarterly	75 tests
1012A-6 – Ansaldo STS/US&S AFTC Open Bond Line Test	2 years	110 tests
1012B-1 – Alstom/GRS AFTC Detection Signal Level Test	quarterly	with 1012A
1012B-2 – Alstom/GRS AFTC Cab Signal Transmit Level Test	annual	with 1012A
1012B-3 – Alstom/GRS AFTC Cab Signal Level (Search Coil) Test	5 years	with 1012A
1012B-4 – Alstom/GRS AFTC Open Door Command Spillover Test	5 years	with 1012A
1012B-5 – Alstom/GRS/Safetran Power Frequency (AC) Track Circuit Test	quarterly	with 1012A
1012C – Track Circuit Shunt Verification Test	quarterly	273 circuits
1012D – AF Track Circuit Receiver Output Test (for unintended signal)	annual	99 TCR
1012E – Code Rate Frequency Test	annual	
1013 – GRS ATP Module Generation 2 Parasitic Oscillation Test	6 months	66 tests
1014A – Grade Crossing Monthly Operation Test	monthly	1 TCR
1014B – Grade Crossing Annual Inspection	annual	1 TCR

1015 – IDW System Inspection and Test	3 years	32 TCR
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ATC 3000 - Preventive Maintenance Instructions and Technical Procedures Manual

Procedure	Frequency	PM Form
3001 – Train Control Room BOP Inspections	6 months	108 TCR
3002A – Train Control Room (TCR) Inspections	Weekly	107 TCR
3002B – TCR Quarterly Inspection (ATP Modules)	quarterly	199 tests
3003 – Interlocking Inspections	Weekly	62 TCR
3004 – ATC Wayside Inspection	quarterly	198 insp.
3005 – Track Circuit Adjustment Procedures		
3005A – Ansaldo STS/US&S Audio Frequency Track Circuits Adjustment	after CM	
3005B-1 – GRS Generation II AF Track Circuit Adjustment	after CM	
3005B-2 – ALSTOM Generation 3 AF Track Circuit Adjustment	after CM	
3005B-3 – ALSTOM Generation 4 AF Track Circuit Adjustment	after CM	
3005C – AC Track Circuit Adjustment	after CM	
3005D – Yard Storage Series Track Circuit Adjustment	after CM	
3005E – US&S – GRS Split AF Track Circuit Adjustment	after CM	
3006 – Power Supply Inspection and Test - FUTURE		107 TCR
3007 – TWC Inspection and Test	Annual	96 TCR
3008 – RTU Inspection and Test	Annual	96 TCR
3009 – Automatic Transfer Switch Inspection and Test	Annual	107 TCR
3010 – IDW Inspection	Annual	32 TCR
3011 – Snowmelter Inspection and Test	Annual	48 TCR
3012 – Wayside Pushbutton Box Inspection and Test	Annual	27 TCR
3013 – TABIL Inspection and Test	2 years	10 insp.
3014 – ATO Marker Inspection	as required	

ATCS PM Summary 2014				
PM	DESCRIPTION	SCHEDULED	COMPLETED	%
ATCACRIR	ATCS, 3 MONTH POWER FREQUENCY TRACK CIRCUIT TEST	314	314	100%
ATCACRLY	ATCS, 2 YEAR, AC VANE RELAY INSPECTIONS AND TESTS	35	30	86%
ATCATLOC	ATCS, 2 YEAR, APPROACH, TIME, SIGNAL INDICATION LOCKING TESTS	32	27	84%
ATCATSIN	ATCS, 1 YEAR, AUTOMATIC TRANSFER SWITCH INSPECTION & TEST	107	83	78%
ATCBOPIN	ATCS, 6 MONTH, BOP INSPECTION	228	227	100%
ATCCABRW	ATCS, 5 YEAR, HF TRACK CIRCUIT CAB ROADWAY TRANSMIT LEVEL TEST	42	22	52%
ATCCABTX	ATCS, 1 YEAR, HF TRACK CIRCUIT CAB TRANSMIT LEVEL TEST	200	200	100%
ATCCWP	ATCS, 3 MONTH RESTORATION, CWP AND POINT DETECTOR TESTS	363	361	99%
ATCDCRLY	ATCS, 4 YEAR, DC VITAL RELAY INSPECTIONS AND TESTS	35	9	26%
ATCGATEM	ATCS, 1 MONTH, GRADE CROSSING INSPECTIONS AND TESTS	12	12	100%
ATCGATEY	ATCS, 1 YEAR, GRADE CROSSING INSPECTIONS AND TESTS	1	1	100%
ATCGNDIN	ATCS, 1 MONTH, TCR GROUND FAULT INSPECTIONS AND TESTS	1361	1348	99%
ATCGRSPO	ATCS, 6 MONTH, GRS ATP MODULE GEN. 2 PARASITIC OSCILLATION TESTS	80	80	100%
ATCIDW3Y	ATCS, 3 YEAR, IDW TEST	13	11	85%
ATCIDWIN	ATCS, 1 YEAR, IDW INSPECTION	31	31	100%
ATCINTIN	ATCS, WEEKLY, INTERLOCKING INSPECTION	3516	3505	100%
ATCODCSP	ATCS, 5 YEAR, OPEN DOOR COMMAND SPILLOVER TEST, MASTER	48	32	67%
ATCSPDRE	ATCS, FALL SPEED RESTRICTIONS REMOVAL	12	12	100%
ATCRTUIN	ATCS, 1 YEAR, RTU INSPECTION & TEST	98	95	97%
ATCSNOIN	ATCS, SNOWMELETER INSPECTION AND TEST	55	49	89%
ATCSRLOC	ATCS, 2 YEAR, SWITCH DETECTOR AND ROUTE LOCKING TESTS	33	26	79%
ATCSWIND	ATCS, 2 YEAR, SWITCH INDICATION LOCKING TESTS	36	27	75%
ATCSWOBS	ATCS, 1 MONTH, SWITCH OBSTRUCTION TESTS	1076	1076	100%
ATCTCRIN	ATCS, WEEKLY, TCR INSPECTION	5854	5813	99%
ATCTIMER	ATCS, 1 YEAR, TIME RELEASE, TIMING RELAYS / DEVICES TESTS	71	56	79%
ATCKSIG	ATCS, 3 MONTH HF TRACK CIRCUIT DETECTION SIGNAL LEVEL TEST	847	846	100%
ATCTRLOC	ATCS, 2 YEAR, TRAFFIC LOCKING TESTS	27	22	81%
ATCTWCIN	ATCS, 1 YEAR, TWC INSPECTION & TEST	97	97	100%
ATCUNSIG	ATCS, 1 YEAR, HF TRACK CIRCUIT UNINTENDED SIGNAL TESTS	198	198	100%
ATCVERIF	ATCS, 3 MONTH, TRACK CIRCUIT SHUNT VERIFICATION TESTS	1162	1159	100%
ATCWPBIN	ATCS, 1 YEAR, WAYSIDE PUSHBUTTON BOX INSPECTION & TEST	30	21	70%

ATCS CM Work Order Summary for 2014		CM WO		avg days
FAILURE CODE ATCS001: SWITCH MACHINES		384	17%	3.3
FAILURE CODE ATCS002: HIGH FREQUENCY TRACK CIRCUITS		1098	48%	9.2
FAILURE CODE ATCS003: AC TRACK CIRCUITS		12	1%	19.6
FAILURE CODE ATCS004: REMOTE TERMINAL UNIT / DTS		132	6%	2.7
FAILURE CODE ATCS005: IDW (INTRUSION DETECTION		135	6%	8.3
FAILURE CODE ATCS006: PROCESSORS		78	3%	1.3
FAILURE CODE ATCS007: VITAL RELAYS		4	0%	9.6
FAILURE CODE ATCS008: LOCAL CONTROL PANEL		14	1%	0.7
FAILURE CODE ATCS009: TWC / STAP (TRAIN WAYSIDE		11	0%	2.9
FAILURE CODE ATCS010: DWELL TIMER		1	0%	1852
FAILURE CODE ATCS012: POWER SYSTEMS		20	1%	2.4
FAILURE CODE ATCS013: SIGNALS / SIGNS		270	12%	3.1
FAILURE CODE ATCS014: ATO STATION STOPPING		31	1%	8.6
FAILURE CODE ATCS015: ROUTE SELECTOR BOX		1	0%	3
FAILURE CODE ATCS016: SNOWMELTER SYSTEM		95	4%	37
FAILURE CODE ATCS018: EDGELIGHTS		4	0%	57
FAILURE CODE ATCS019: TRAFFIC		8	0%	12
FAILURE CODE ATCS020: TRACK AND ALARM INDICATION		1	0%	9
FAILURE CODE ATCS022: NEXT TRAIN SIGN		9	0%	32
FAILURE CODE ATCSSUPPORT		2	0%	0.6
		2310		8.8