**UNITED STATES DEPARTMENT OF TRANSPORTATION**

**Federal Transit Administration**

**[Special Directive No. 17-1, Notice No. 1]**

# Special Directive Under 49 U.S.C. § 5329 and 49 CFR Part 670 Required Actions to Address Findings from Traction Power Electrification System Investigation at the Washington Metropolitan Area Transit Authority

**AGENCY:** Federal Transit Administration (FTA), U.S. Department of Transportation (DOT).

**SUMMARY:** The FTA issues Special Directive 17-1 to require the Washington Metropolitan Area Transit Authority (WMATA) to address findings resulting from an investigation into the condition and safety performance of WMATA's traction power electrification (TPE) system. This Special Directive is being released concurrently with FTA's TPE System Investigation Final Report (December 9, 2016). The Special Directive mandates that WMATA complete 47 required actions within the Metrorail system to address 22 safety findings in four (4) distinct categories of review: (1) roles, responsibilities and resources for the TPE system; (2) TPE system infrastructure; (3) TPE system inspection and maintenance programs; and 4) capital projects to upgrade and replace or rehabilitate TPE system components.

**FOR FURTHER INFORMATION CONTACT:** For program matters, Angela Dluger, Director, FTA WMATA Safety Oversight Office, telephone (202) 366–5303 or Angela.Dluger@dot.gov; for legal matters, Candace Key, Attorney Advisor, FTA, telephone 202–366–9178 or Candace.Key@dot.gov.

## SUPPLEMENTARY INFORMATION:

### Background

Over the last year, WMATA has experienced a sharp increase in the number of TPE system-related failures and incidents. Since the FTA assumed temporary safety oversight of the Metrorail system on October 26, 2015, WMATA has reported 70 safety events resulting from electrical arcing in the TPE system at insulators, cables, connector assemblies, and track fastening components. Each of these 70 events required emergency response, and some of these events resulted in the partial or full shutdown of a station or the evacuation or off-loading of a passenger train. The FTA WMATA Safety Oversight (FWSO) Office initiated this investigation to ensure sufficient corrective action for these events, and also to address concerns raised during prior FWSO inspections, which highlighted the deteriorated condition of WMATA's traction power infrastructure.

FWSO's investigation confirmed that the safety performance of WMATA's TPE system has deteriorated with age, deferred maintenance, and increased exposure to water and moisture with contaminating materials. FWSO's investigation also finds that key components designed to provide insulation resistance for both the traction power positive and negative return systems have been

compromised and are no longer performing as originally specified.
FWSO also found that, while WMATA has taken many positive steps to create a new traction power maintenance department and establish a new cable inspection program, the agency still does not have sufficient personnel resources to complete required preventive and corrective maintenance on the TPE system. Recruitment and training of TPE system electrical mechanics lags behind need, and corrective maintenance work orders are backlogged for both high voltage equipment and cable plant. New demands for managing power outages for SafeTrack and other maintenance activities further strain WMATA's TPE system resources.

A recurrent factor/element in many of the arcing/fire events experienced by WMATA over the last year is the presence of mud and standing water, leading to arcing, which is often the result of debris and clogged drains restricting the free flow of water entering the system. In numerous inspections and investigations regarding WMATA's track conditions, FWSO has found that track and tunnel drainage defects have not been adequately identified and prioritized for repair, allowing cables and connectors laying on or near the trackbed to become encased in mud, water and other contaminants. WMATA is working to address several FTA findings and required actions regarding this situation.

FWSO's investigation also found that the use of temporary cable connectors on the running rails, combined with the poor quality installation of insulators and track fasteners in some locations, and the generally poor condition of the insulating materials in some floating slab tunnel sections, introduces the potential for issues with the control of negative return power, stray current corrosion, and increases the likelihood of electrical arcing and flashovers.

Budget limitations and changing maintenance priorities have also influenced the condition and performance of the TPE system. In recent years, in response to changing budgetary and staffing conditions, WMATA eliminated preventive maintenance programs to test traction power feeder cables for cable insulation integrity and to predict failures. Cleaning programs in tunnels were eliminated or cut back to the point that they failed to keep pace with the buildup of metallic dust and particles generated by normal train operation. WMATA's corrosion control testing program was largely limited to interlockings and special requests, with very limited testing of rail and third rail fastening systems and components.

FWSO also confirmed that programs to replace and upgrade critical TPE infrastructure, including tiebreakers and cable plant, have not been sufficient for the age of the system or the demand placed on it. While approximately 80 percent of primary positive feeder cables have been replaced on the Metrorail system in the last 15 years, most secondary cables, which connect the primary cables to the contact rail or traction power substations, or which bridge engineered gaps in the contact rail system, are original with the Metrorail system. The age and degraded condition of this secondary cabling system now presents a single point of failure for sustained electrical arcing events and fires.

Further, FWSO found that previous power load studies and assessments, conducted by WMATA to support engineering studies to determine power requirements for 100 percent 8-car train operation, do not accurately reflect the deteriorated condition and performance of WMATA's cable plant. Incomplete information regarding the condition and performance of the aging TPE infrastructure, used in these assessments, indicates that additional upgrades and cable replacement will be

required to adequately and safely power 100 percent 8-car train operation.
Since FWSO assumed temporary safety oversight of Metrorail, WMATA has taken a number of critical steps to address deficiencies within its TPE system. In response to National Transportation Safety Board (NTSB) Safety Recommendation R-15-25, WMATA initiated and has almost completed a program to ensure that its power cable connector assemblies are properly constructed and installed, including the weather tight seals that prevent intrusion by contaminants and moisture. WMATA has enhanced its visual and thermal inspection program for its TPE cable plant, including jumper and transition cables. WMATA has also begun eliminating third rail expansion joints in tunnels, and has developed new work instructions to ensure that electrical cables are correctly installed, secured off the ground, and appropriately bolted to the contact rail. WMATA recently reinstated its tunnel cleaning program and insulator cleaning program in specific locations; is expanding its cable replacement program; and is re-starting plans to upgrade both its positive and negative electrical return system to manage 100 percent 8-car train operation. WMATA is testing new insulators that can be removed for cleaning and then re-installed. To better address challenges with TPE system state of repair, WMATA is reviewing roles and responsibilities for inspecting, testing and maintaining its TPE system elements, and just created a new department with exclusive responsibility for high voltage TPE system maintenance.

Finally, on May 11, 2016, FTA issued an immediate action letter, which directed WMATA to complete repairs to TPE system components on the Red Line between Medical Center and Van Ness and on the Blue/Orange/Silver Line between Potomac Avenue and the D&G junction. As a result of WMATA's maintenance activity in these locations, the number of arcing events has been reduced. For example, on the Red Line, WMATA experienced 18 arcing incidents in this area between March 1 and June 14, 2016, including four major events at the end of April and early May. Since June 15, 2016, WMATA has only experienced 8 relatively minor events in this area.

**FTA Special Investigation**

In June 2016, as part of its on-going oversight of WMATA's accident investigation program, the FTA accepted a request from WMATA's Department of Safety and Environmental Management (SAFE) to conduct a special investigation of the agency's TPE system failures. WMATA proposed this approach to resolve 58 open accident investigations, all related to electrical arcing in the TPE system, on file with the FTA dating back to the beginning of the year. To complete its investigation, WMATA SAFE used a multi-disciplinary task force comprised of WMATA personnel supplemented by an American Public Transportation Association (APTA) peer review, and engineering, organizational and staffing assessments completed by the HNTB Corporation.

The FTA recognizes WMATA's clear progress in completing this investigation, which reviews systemic issues regarding the inspection, maintenance and performance of the TPE system, and provides greater transparency for the public and WMATA's employees regarding how the agency is evaluating and managing these events. WMATA's investigation also addressed many of the issues and concerns discussed between FTA and WMATA over the last year, and jointly investigated in the field.

WMATA SAFE delivered its draft report to FWSO on October 19, 2016. The findings and recommendations set forth in the WMATA report generally are consistent with the findings and

required actions set forth in FWSO's report, and, to the extent feasible, FWSO has incorporated the 32 recommendations from the draft WMATA report into the findings and required actions issued through Special Directive 17-1. FTA will formally review and approve WMATA's draft investigation report in the near future.

To comply with Special Directive 17-1, WMATA must develop a corrective action plan to address the 22 findings of the FSWO report and the 47 required actions to WMATA, set forth below. WMATA TPE system staff, engineers, specialists and contractors have also identified many of these required actions as critical to strengthening the safety performance of the TPE system. FWSO will review, provide feedback on and request changes as appropriate, and approve WMATA's corrective action plan and will monitor and work with WMATA to oversee the completion of the required actions.

**DIRECTIVE AND REQUIRED ACTIONS:**

In accordance with 49 U.S.C. § 5329, 49 CFR § 670.27, and the authority delegated to the FTA Administrator by the Secretary of Transportation, 49 C.F.R. § 1.91, the FTA directs WMATA to take the following actions:

| **TPE Investigation Category 1: Roles, Responsibilities and Resources** | | | |
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| **Finding** | | **Required Action** | |
| Finding 1 | Multiple WMATA departments have responsibility for critical TPE system inspection, maintenance, and repair activities, preventing clear ownership of the TPE system and identification of systemic issues and priorities. | FTA-TPE-17-001-a | WMATA must conduct an assessment to determine if all TPE system program components should be integrated into a single department with sole responsibility for managing, inspecting, maintaining, repairing, and upgrading the TPE system. At a minimum, this assessment must include those elements of TPE system inspection, maintenance, and repair currently performed by TRPM; third rail inspection and maintenance work currently performed by TRST; negative return system inspection and maintenance activities performed by ATC; cable replacement activity performed by IRCM; engineering services provided by PWRS; and lock-out/tag-out procedures implemented by the ROCC and [Maintenance Operations Center] MOC. |
| | | FTA-TPE-17-001-b | WMATA must implement the results of the assessment conducted to address FTA-TPE-17-001-a following a schedule reviewed and approved by FTA. |

| TPE Investigation Category 1: Roles, Responsibilities and Resources | | | |
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| **Finding** | | **Required Action** | |
| Finding 2 | WMATA ROCC and MOC personnel are not sufficiently proactive in managing TPE concerns during emergencies. | FTA-TPE-17-002-a | WMATA must develop and provide TPE system awareness training for ROCC and MOC personnel. |
| | | FTA-TPE-17-002-b | WMATA must revisit SOP #2: Emergency Removal and Restoration of Third Rail Power Mainline to consider: 1) removal of power during smoke conditions, especially with corresponding third rail power outages caused by unknown conditions, and 2) a requirement to de-energize third rail power at the adjacent power substation or tie breaker, provided the situation does not strand a train that needs to be moved from the smoke condition. |
| Finding 3 | Insufficient resources are available to support the testing, inspection, and maintenance of WMATA's TPE system. | FTA-TPE-17-003-a | WMATA must amend or update the TRPM workload assessment completed by the HNTB Corporation to address the results of FTA-TPE-17-001-a. |
| | | FTA-TPE-17-003-b | WMATA must develop a 5-year plan for staffing to implement results of the revised workload assessment, reflecting the results of FTA-TPE-17-001-a. |
| | | FTA-TPE-17-003-c | WMATA must evaluate options for using contractors to complete its TPE system corrective maintenance backlog and outstanding preventive maintenance requirements in the near-term and implement results. |
| | | FTA-TPE-17-003-d | WMATA must perform a cost benefit analysis with regard to repairing or replacing the out-of-service vacuum vehicle and implement the results. |
| | | FTA-TPE-17-003-e | WMATA must improve the functionality of the thermal imaging car to more accurately pick up cable hot spots. |

| TPE Investigation Category 2: Infrastructure | | | |
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| **Finding** | | **Required Action** | |
| Finding 4 | Traction power cables are often loose on the ground, subjecting them to contamination, vibration, and damage from movement. | FTA-TPE-17-004-a | WMATA must implement its program to secure traction power cables off the ground. |
| Finding 5 | WMATA does not implement a consistent program regarding the testing, inspection, and maintenance of its negative return system. | FTA-TPE-17-005-a | WMATA must discontinue the practice of using clamped bonds as a permanent installation. |
| | | FTA-TPE-17-005-b | WMATA must locate and replace all clamped bonds with drilled rail web/bolted crimped cable connections, suitable for permanent installations. |
| | | FTA-TPE-17-005-c | WMATA must appropriately train and assign personnel to correctly install and maintain all negative return system components, including drilled rail web running rail bonds. |
| | | FTA-TPE-17-005-d | WMATA must assign maintenance personnel to inspect and repair any running rail bonded joints that are physically compromised, missing, or inadequate to perform their required function. |
| | | FTA-TPE-17-005-e | WMATA must document negative return system defects in the maintenance and repair trouble ticket system (Maximo) and assign responsibility for timely repairs. |
| Finding 6 | WMATA has not performed required inspections and preventive maintenance on its floating slab tunnel sections to ensure insulation resistance and the use of functioning sacrificial anodes. | FTA-TPE-17-006-a | WMATA must establish and implement an inspection, testing, maintenance, and repair program for its floating slab track, running rail insulation and sacrificial anodes. |
| Finding 7 | WMATA has not finalized its new requirements for third rail insulator design, procurement, installation, cleaning, and replacement. | FTA-TPE-17-007-a | WMATA must establish its new insulator design specifications for composite (fiberglass) and porcelain insulators, including the two-piece insulator discussed with FWSO to facilitate more efficient and economical insulator replacement activities. |
| | | FTA-TPE-17-007-b | WMATA must revise the current insulator replacement work instruction to include proper storage, transportation, and handling of insulators to reduce damage to new insulators before and during installation. |
| | | FTA-TPE-17-007-c | Based on the design specifications established in FTA-TPE-17-007-a, WMATA must establish insulator mortality rates and implement cyclical replacement program for each type of insulator used on the Metrorail system. |

| TPE Investigation Category 2: Infrastructure | | | |
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| **Finding** | | **Required Action** | |
| | | FTA-TPE-17-007-d | Based on the design specifications established in FTA-TPE-17-003-a, WMATA must develop and implement a formal program for cleaning insulators, including proposed work instructions to ensure the safety of WMATA employees. |
| | | FTA-TPE-17-007-e | WMATA must establish a formal quality testing and inspection program to ensure conformance of the delivered insulators with WMATA's specifications and requirements. |
| | | FTA-TPE-17-007-f | Based on the design specifications established in FTA-TPE-17-003-a, WMATA must ensure new insulator anchors are installed to WMATA standards including providing epoxy insulating dielectric material to ensure that the anchor bolts do not provide an electrical path to structural ground. (See WMATA's Track Standards TRST 1000 section 13- Contact Rail). |
| | | FTA-TPE-17-007-g | WMATA must develop a plan to identify and correct the installation of insulator anchors without appropriate epoxy insulating dielectric material. |
| Finding 8 | WMATA has not consistently implemented its third rail insulator grout pad repair and replacement plan. | FTA-TPE-17-008-a | Consistent with WMATA's track fastening plinth replacement requirements, WMATA must develop and implement a third rail grout pad replacement program for supporting insulators. |
| Finding 9 | There is insufficient dielectric insulation for cable terminations used in the traction power system. | FTA-TPE-17-009-a | WMATA must conduct an assessment and implement results regarding the identification of additional methods to provide improved dielectric insulation in the area of cable terminations, such as non-tracking heat shrink, utilizing alternative products for cable transitions at duct lines, and providing additional physical barriers where there is close clearance to metallic structures. |
| Finding 10 | WMATA does not take full advantage of substation circuit breaker settings to better prevent and detect low fault trips. | FTA-TPE-17-010-a | WMATA must evaluate the traction power DC feeder breaker settings at substations and tie breakers to determine the optimal settings for various track side conditions, including instantaneous short circuit ratings, time over current settings, and rate of rise settings. |
| | | FTA-TPE-17-010-b | WMATA must provide criteria and test results for circuit breaker relay settings to FWSO for evaluation. |
| | | FTA-TPE-17-010-c | WMATA must develop and submit to FWSO its program plan for installing, testing, and evaluating the effectiveness of the use of MPR relays for detecting low level faults. |

| TPE Investigation Category 2: Infrastructure | | | |
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| **Finding** | | **Required Action** | |
| | | FTA-TPE-17-010-d | WMATA must evaluate the addition of transfer trip circuitry for de-energizing feeds from adjacent power stations during troubled conditions and implement results. |
| Finding 11 | Power cable insulation is contaminated. | FTA-TPE-17-011-a | WMATA must develop and submit to FWSO its program for cleaning and drying contaminated cables to improve surface resistivity, including proposed work instructions to ensure the safety of WMATA employees. |

| TPE Investigation Category 3: Inspection and Testing | | | |
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| **Finding** | | **Required Action** | |
| Finding 12 | WMATA does not do enough to ensure the effectiveness of its manual and automated inspection programs. | FTA-TPE-17-012-a | WMATA must establish grading criteria for TPE system defects, similar to the defect system established for track, and must instruct inspection personnel in how to use them. These grading criteria must also address thermal imaging anomalies and include acceptable thermal variation criteria and action levels. |
| | | FTA-TPE-17-012-b | WMATA must establish a procedure to ensure that thermal imaging data is reviewed with all stakeholders and that automated inspections, which include data collection and analysis of TPE system components, are used collectively to identify trends and target areas for preventive maintenance or monitoring. |
| | | FTA-TPE-17-012-c | To enhance usefulness, WMATA must revise its thermal imaging summary report to include comparison reports from past thermal imaging runs. |
| | | FTA-TPE-17-012-d | WMATA must establish a procedure to ensure that TGV third rail data is compared with the reports filed by track inspectors and with previous TGV data to identify trends. Specifically, this procedure must ensure the geometry data from the TGV is reviewed for third rail gauge exceptions, especially in super-elevated track areas and floating slab construction; assess the re-gauging of the third rail per WMATA's Track Standards TRST 1000 section 13 - Contact Rail; and evaluate the need for corrective repairs when the system is out of tolerance. |
| Finding 13 | WMATA does not currently test cables to ensure insulation resistance. | FTA-TPE-17-013-a | WMATA must develop a meggering plan for cross bonded cables, especially in tunnel areas that are prone to water and muck infiltration, to determine their integrity. |

| TPE Investigation Category 3: Inspection and Testing | | | |
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| **Finding** | | **Required Action** | |
| | | FTA-TPE-17-013-b | WMATA must institute a cable testing program for jumper and transition cables located in the tunnel environment until these cables are upgraded and/or replaced. |
| Finding 14 | WMATA's corrosion testing program is currently limited to interlockings, signal system components, and special requests. | FTA-TPE-17-014-a | WMATA must implement a regular program of stray current and corrosion control testing, which should include, at a minimum, the following: track to earth electrical isolation, track to earth voltage, yard to mainline electrical isolation, shop to yard electrical isolation, mainline segregation, and cathodic protection systems. |

| TPE Investigation Category 4: Capital Projects | | | |
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| **Finding** | | **Required Action** | |
| Finding 15 | WMATA's load studies for 100 percent 8-car train operation were based on design criteria and did not include field assessments to confirm the actual condition of the TPE system infrastructure. | FTA-TPE-17-015-a | WMATA must re-evaluate previous current draw and load calculations to include field surveys to ensure that the actual condition of the cables and bonds are considered in the requirements analysis for 100 percent 8-car train operation. |
| Finding 16 | WMATA does not have a formal program for assessing the condition of relays at traction power substations prior to proposed upgrades. | FTA-TPE-17-016-a | WMATA must develop and implement a program for assessing the condition of relays at traction power substations to prioritize upgrade, replacement and/or repair. |
| Finding 17 | The cable replacement and upgrade program for 8-car train roll out has been deferred. | FTA-TPE-17-017-a | WMATA must re-instate its program for cable replacement to support 100 percent 8-car train operations, including the replacement of all primary and secondary TPE system cables, and must provide FTA with a timeline and project plan. |
| Finding 18 | WMATA's negative return system (at traction power substations) has not been upgraded to address plans for 50 percent and 100 percent operation of 8-car trains. | FTA-TPE-17-018-a | WMATA must revisit its cable upgrade program for 50 percent and 100 percent 8-car operational plan and develop a capital cable replacement program for substation negative return and wayside cross bonding. |
| Finding 19 | WMATA has suspended its contact rail expansion joint elimination program until further analysis is completed. | FTA-TPE-17-019-a | WMATA must provide FWSO with a written explanation regarding the suspension of this program. |
| Finding 20 | WMATA has deferred its third rail composite replacement program. | FTA-TPE-17-020-a | WMATA must explain the original intent of this replacement program, define the rationale for stopping the program, and clarify intentions to re-instate this program. |

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| | | FTA-TPE-17-020-b | WMATA must review fault detection relay settings and determine if adjustments are required due to the new electrical properties for composite third rail. |
| Finding 21 | WMATA is not maintaining its cover board repair program. | FTA-TPE-17-021-a | WMATA must provide FWSO with its revised schedule for repairing all missing cover boards in the tunnel segments of the WMATA system. |
| | | FTA-TPE-17-021-b | WMATA must evaluate the current protection board design specification and enhance it to meet the NFPA 130 standard. |
| Finding 22 | Fastener failures, linked to stray current, have resulted in fault conditions at stud bolts. | FTA-TPE-17-022-a | WMATA must establish criteria for its fastener replacement program to improve insulation resistance. |

WMATA will have thirty (30) days from the issuance of this Special Directive to submit a petition for reconsideration to the Administrator to respond to the required actions set out in this directive, including providing additional information for consideration and proposing any equivalent alternate actions for consideration by FTA's Acting Administrator. This petition must be transmitted by email to the Administrator, through the Director, FTA WMATA Safety Oversight Office, using the contact information identified at the beginning of this Special Directive. A petition must meet the requirements of 49 CFR § 670.27(d). The Administrator will respond to WMATA within 90 days after receipt of the petition.

Within sixty (60) days of the issuance of this Special Directive, WMATA must submit a corrective action plan to FTA that identifies the specific activities that will be performed to address the required actions specified in this directive; the milestone schedule for completing the required actions; the responsible parties for each required action, and their contact information; and the verification strategy for ensuring the completion of required work. FTA will review and approve WMATA's corrective action plan, making any necessary revisions, and will monitor WMATA's progress in resolving each finding and required action. FTA will continue to conduct monthly meetings with WMATA to review WMATA's progress until such time as FTA determines that these meetings are no longer needed or may be conducted with less frequency.

In accordance with 49 CFR § 670.27(a), the FTA Deputy Administrator issues a Special Directive. Currently, the position of FTA Deputy Administrator is vacant, thus this Special Directive is issued under the authority delegated to the FTA Executive Director.

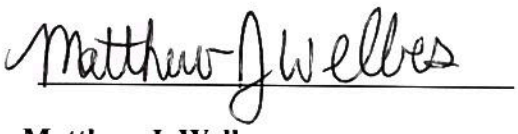
**Petitions for Reconsideration**

Within thirty (30) days of the issuance of this directive WMATA may petition for special approval to take actions not in accordance with this Special Directive or may petition for reconsideration. Any such petition must be submitted in accordance with 49 CFR § 670.27.

**Enforcement**

Any violation of this Special Directive or the terms of any written plan adopted pursuant to this directive will be managed in accordance with FTA's authorities under 49 U.S.C. § 5329, including but not limited to (1) withholding up to 25 percent of financial assistance to WMATA under 49 U.S.C. § 5307; (2) issuing restrictions, closures, or prohibitions on service (*e.g.*, mandatory speed restrictions, shutdown of a Metrorail line, complete system shutdown) as necessary and appropriate to address unsafe conditions or practices that present a substantial risk of death or personal injury under 49 U.S.C. § 5329(h); and (3) directing WMATA to use Federal financial assistance to correct safety deficiencies pursuant to 49 U.S.C. § 5329(g)(1)(D).

Issued on: December 9, 2016



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