

NATIONAL TRANSPORTATION SAFETY BOARD
Public Meeting of May 3, 2016
(Information subject to editing)

Washington Metropolitan Area Transit Authority (WMATA) L'Enfant Plaza Station
Electrical Arcing and Smoke Accident,
January 12, 2015
NTSB/RAR-16-XX

This is a synopsis from the NTSB's report and does not include the Board's rationale for the conclusions, probable cause, and safety recommendations. NTSB staff is currently making final revisions to the report from which the attached conclusions and safety recommendations have been extracted. The final report and pertinent safety recommendation letters will be distributed to recommendation recipients as soon as possible. The attached information is subject to further review and editing to reflect changes adopted during the Board meeting.

Executive Summary

On January 12, 2015, at 3:15 p.m. eastern standard time, Washington Metropolitan Area Transit Authority (WMATA) southbound Yellow Line train 302, with about 380 passengers on board, stopped after encountering heavy smoke in the tunnel between the L'Enfant Plaza station and the Potomac River bridge in Washington, DC. The operator of train 302 told the Rail Operations Control Center (ROCC) that the train was filling with smoke and he needed to return to the station. The WMATA ROCC allowed train 510, following train 302, to enter the L'Enfant Plaza station, which also was filling with smoke. Train 302 was unable to return to the station before power to the electrified third rail, which supplied the train's propulsion power, was lost. Some passengers on train 302 evacuated the train on their own, and others were assisted in evacuating by first responders from the District of Columbia Fire and Emergency Medical Services Department (FEMS). As a result of the accident, 91 people were injured, including passengers, emergency responders, and WMATA employees, and one passenger died. WMATA estimated the total damages to be \$120,000.

The National Transportation Safety Board (NTSB) has been concerned with the safety of the WMATA rail system since 1970, when it conducted a special study of the proposed transit rail system while it was still under construction. The resulting report, NTSB/RSS-70/1, *Study of Washington Metropolitan Area Transit Authority's Safety Procedures for the Proposed Metro System*, resulted in one safety recommendation to WMATA to "develop the capability within WMATA for system safety engineering and apply system safety principles to all aspects of the proposed [rail] system to identify, assess, and correct those deficiencies identified by the analysis." This accident is the 13th WMATA rail accident investigated by the NTSB since WMATA rail began operation in 1976. The NTSB has issued 101 safety recommendations to WMATA since 1970.

The investigation of this accident revealed a range of safety issues and conditions at WMATA that illustrate the transit organization's lack of a safety culture:

- **WMATA response to smoke report.** A smoke detector near the location of the heavy smoke activated at 3:04 p.m. but was not displayed at the Rail Operations Control Center (ROCC) because of a loose wire that prevented communication with the Advanced Information Management System. Other nearby smoke detectors activated later, and those were displayed at the ROCC, but WMATA had no procedures for response to smoke detector activations. WMATA's standard operating procedure states that at the first report of smoke, all trains should be stopped in both directions, but this did not happen on the day of the accident. Instead, the ROCC told the operator of a train carrying revenue passengers to look for smoke, which was WMATA's routine response to reports of smoke or fire.
- **Tunnel ventilation.** The WMATA station and tunnel ventilation systems were designed in the 1970s when no industry standard existed for emergency ventilations for subway transit systems. The systems were designed for heat removal and temperature control, not for emergency smoke removal. Over the years since WMATA began operation, several studies have identified the need for emergency smoke removal and have recommended increasing the capacity of ventilation fans. Investigators learned that control operators in the ROCC were not trained on strategies for configuring station and tunnel ventilation fans, and therefore, on the day of the accident, the under-platform fans in the L'Enfant Plaza station were turned on in exhaust mode, blanketing train 302 in smoke and pulling smoke into the station.
- **Railcar ventilation.** WMATA did not instruct train operators how to shut down the railcar ventilation systems because there was no written procedure. In addition, operators had to ask the ROCC for permission to shut them down, and then the ROCC provided the specific steps to the train operators. However, those steps did not shut down all the ventilation systems on all the cars immediately. Therefore, on the day of the accident, smoke was pulled into most of the railcars on train 302 through the fresh air intakes.
- **Emergency response:** On the day of the accident, the District of Columbia Office of Unified Communications, which maintains the 911 emergency call system, was slow in processing the first 911 call reporting the smoke. First responders reported that when they arrived at the L'Enfant Plaza station, they were directed to the wrong tunnel to look for train 302. Evacuating passengers reported that egress through the tunnel was difficult because of dim lighting and obstacles along the safety walkway. The FEMS incident commander appeared to ignore the WMATA Metro Transit Police incident commander and did not take into account the multiple agencies involved in the response and the consequent need for elevation to a Unified Command structure.
- **Oversight and Management:** In the years since the 2009 accident at Fort Totten, substantial improvements have not been made, and many of the same safety

management deficiencies remain today. The Tri-State Oversight Committee has lacked sufficient resources, technical capacity, and enforcement authority to provide the level of oversight needed to ensure safety at WMATA. The TOC also has not met the requirements of the Moving Ahead for Progress in the 21st Century Act (MAP-21) that was enacted in 2012,. This accident also identified deficiencies in the safety oversight of WMATA by the Federal Transit Administration.

As a result of this accident, the NTSB issues safety recommendations to the Federal Transit Administration, the mayor of the District of Columbia, the District of Columbia Office of Unified Communications, the District of Columbia Fire and Emergency Medical Services Department, the National Capital Region Emergency Preparedness Council, and the Washington Metropolitan Area Transit Authority.

Findings

1. Electrical arc tracking was aided by the presence of contaminants and moisture on third rail cables and inside cable connector assemblies.
2. The Washington Metropolitan Area Transit Authority's third rail electrical power cable systems are susceptible to electrical arc tracking at improperly constructed power cable connector assemblies, which can lead to short circuits that can generate fire and smoke in tunnels.
3. The electrical short circuit initiated from either the consumed or the damaged cable connector assembly.
4. Intrusion of water at the electrical arcing site contributed to the severity of the accident.
5. The electrical arcing that resulted in the consumption of the cables that were resting against the tunnel wall was the origin of the smoke at the accident location.
6. Including leak inspections with WMATA tunnel structural inspections was not effective in identifying leaks.
7. The Washington Metropolitan Area Transit Authority tunnel repair program was not effective in mitigating recurring water intrusion like that found in the southbound Yellow Line tunnel.
8. Water intrusion into the Yellow Line tunnel south of L'Enfant Plaza predated the adjacent construction of the Wharf project, and therefore the construction was not a factor in the initiation of the electrical arcing.
9. The Washington Metropolitan Area Transit Authority did not have a written procedure for operating ventilation fans in response to smoke and fire events in a tunnel.

10. The Washington Metropolitan Area Transit Authority did not have effective training on the proper operation of tunnel ventilation fans.
11. The Washington Metropolitan Area Transit Authority failed to address the capacity problems of the ventilation system that were identified by engineering studies.
12. Had the maintenance procedures in place at the time of the accident been followed correctly, the fault in the remote control of the fans could have been identified and corrected during the scheduled monthly inspection.
13. The conditions discovered after the accident—the inability to execute remote commands to the tunnel ventilation system, the tripped overload breakers, the defective remote terminal unit card, and the deficient automatic transfer switch, automatic voltage regulator, and motor control center—resulted from the Washington Metropolitan Area Transit Authority’s inadequate maintenance.
14. The Washington Metropolitan Area Transit Authority did not comply with its ventilation fan inspection and maintenance procedures.
15. The Washington Metropolitan Area Transit Authority was not following its tunnel-washing and insulator-cleaning procedure.
16. At the time of the accident the Washington Metropolitan Area Transit Authority did not have a procedure for train operators to follow that would immediately shut down the ventilation systems on all the railcars in a train.
17. When the operator of train 302 shut down the ventilation system, only the ventilation system on the leading railcar shut down immediately, and the ventilation systems of all the other railcars remained operational.
18. The requirement for a train operator to receive permission from the Rail Operations Control Center to shut down the ventilation systems on a train, and the lack of a procedure for shutting down all the ventilation systems on a train from the lead railcar, contributed to the smoke entering the railcars in train 302.
19. The Rail Operations Control Center supervisor failed to ensure that the emergency procedures contained in Standard Operating Procedure #6 were followed by the control operators.
20. Had the Washington Metropolitan Area Transit Authority followed its standard operating procedures and stopped all trains at the first report of smoke, train 302 would not have been trapped in the smoke-filled tunnel.
21. The Washington Metropolitan Area Transit Authority put passengers at risk by routinely using trains with revenue passengers to investigate reports of smoke or fire.

22. The Rail Operations Control Center supervisor failed to ensure that all trains in both directions were stopped after smoke was reported, which was inconsistent with the Washington Metropolitan Area Transit Authority standard operating procedure.
23. Rail Operations Control Center supervisors and control operators were not proficient in executing emergency response procedures.
24. The Public Service Radio System communication problems were identified but not remediated before the accident.
25. The Washington Metropolitan Area Transit Authority's radio-testing procedure in place at the time of the accident was insufficient to identify Public Service Radio System communication problems in a timely manner.
26. Communications between the District of Columbia Fire and Emergency Medical Services Department (FEMS) liaison in the Rail Operations Control Center and the FEMS incident commander were delayed and inefficient.
27. The District of Columbia Office of Unified Communications' call processing delayed the emergency response to the accident.
28. Without line identification and direction signage at tunnel entrances and in tunnels, emergency response personnel may have difficulty navigating, which may delay their response efforts.
29. The lack of emergency lighting in the tunnel and the conduit and junction boxes on the tunnel wall above the walkway were safety hazards to passengers evacuating through the tunnel.
30. The lack of safety standards or regulation addressing emergency evacuation routes, including design and lighting, led to obstructed and poorly illuminated walkways at the Washington Metropolitan Area Transit Authority that increased the risk of injury to people evacuating train 302 in the Yellow Line tunnel.
31. The lack of formal training criteria for the battalion chief position may pose unnecessary risk with respect to incidents requiring the incident command process.
32. The incident commander had not been effectively trained in the skills and practices of the incident command process.
33. The incident commander should have elevated the incident response to a Unified Command structure.
34. In the initial phase of the emergency response, the incident commander did not take appropriate immediate action to provide emergency assistance to passengers on train 302.

35. Quarterly emergency response drills, particularly those in tunnels, would better prepare Washington Metropolitan Area Transit Authority (WMATA) and local emergency response agencies to respond to emergencies on the WMATA system.
36. The District of Columbia Fire and Emergency Medical Services Department was unprepared to respond to a mass casualty event in the Washington Metropolitan Area Transit Authority's underground system.
37. The Washington Metropolitan Area Transit Authority missed the opportunity to improve its emergency response and procedures by not conducting an after-action review of its emergency response to the accident.
38. Despite its new authorities under the Fixing America's Surface Transportation Act, the Federal Transit Administration still lacks sufficient authority, expertise, and resources to assume temporary, direct safety oversight of rail transit agencies.
39. The structure of the Tri-State Oversight Committee (TOC) Executive Committee and its failure to effectively guide the TOC reduced the ability of the TOC to execute efficient and effective safety oversight of the Washington Metropolitan Area Transit Authority.
40. The projected establishment of the Metro Safety Commission will be delayed by the required legislation.
41. The Washington Metropolitan Area Transit Authority has not effectively used past safety investigations and studies to make lasting changes that become incorporated in its organizational safety culture.
42. Although the Washington Metropolitan Area Transit Authority has taken steps to improve its organizational safety since the 2009 Fort Totten accident, significant safety management deficiencies still exist within the organization.
43. Had the Washington Metropolitan Area Transit Authority effectively used its existing quality assurance program, it would have identified problems such as missing sealing sleeves and procedure non-compliance.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the Washington Metropolitan Area Transit Authority (WMATA) L'Enfant Plaza station electrical arcing and smoke accident was a prolonged short circuit that consumed power system components resulting from the WMATA's ineffective inspection and maintenance practices. The ineffective practices persisted as the result of (1) the failure of WMATA senior management to proactively assess and mitigate foreseeable safety risks, and (2) the inadequate safety oversight by the Tri-State Oversight Committee and the Federal Transit Administration. Contributing to the accident were WMATA's failure to follow established procedures and the District of Columbia Fire and Emergency Medical Services Department's being unprepared to respond to a mass casualty event on the WMATA underground system.

RECOMMENDATIONS

New Recommendations

To the Federal Transit Administration:

1. Issue regulatory standards for tunnel infrastructure inspection, maintenance, and repair, incorporating applicable industry consensus standards into those standards.
2. Issue regulatory safety standards for emergency egress in tunnel environments.

To the mayor of the District of Columbia:

3. Convene an independent panel of experts to (1) assess the District of Columbia Fire and Emergency Medical Services Department's preparedness to respond to mass casualty events in the Washington Metropolitan Area Transit Authority (WMATA) underground system, (2) identify and make recommendations to improve this preparedness, and (3) share the findings of that assessment with the other local jurisdictions with WMATA underground systems.

To the District of Columbia Office of Unified Communications:

4. Audit your public service answering point (PSAP) to validate compliance with the standards published by the National Emergency Number Association or another similar standards organization. The audit should (1) determine the average length of time that call takers use to process an emergency call and dispatch emergency service and (2) compare those results with those of other comparable PSAPs.
5. Upon completion of action satisfying Safety Recommendation R-16-XX, develop call-processing standards for the public service answering point (PSAP) to ensure that 911 calls are processed in accordance with those of other comparable PSAPs.
6. Train call takers for the public service answering point on the standards developed in Safety Recommendation R-16-XX and include the standards in recurrent training.

To the District of Columbia Fire and Emergency Medical Services Department:

7. Implement measures to train all command officers who will serve in the role of incident commander in the skills and practices of National Incident Management System incident command and unified command processes. This training should include regular refresher training.

To the Washington Metropolitan Area Transit Authority:

8. Review and revise your tunnel inspection, maintenance, and repair procedures to mitigate water intrusion into tunnels.
9. When the revision of tunnel inspection, maintenance, and repair procedures recommended in Safety Recommendation R-16-XX has been completed, train maintenance employees on the new procedures, and ensure that the procedures are implemented.
10. Improve the capacity of tunnel ventilation fans to conform to the requirements of National Fire Protection Association (NFPA) 130.
11. Develop location-specific emergency ventilation configurations based on engineering studies of the Washington Metropolitan Area Transit Authority tunnel ventilation system.
12. Develop and implement procedures for actions to be taken by Rail Operations Control Center personnel when smoke detectors alarm.
13. Once action to address Safety Recommendation R-16-XX is completed, train all Rail Operations Control Center personnel on the new procedures for responding to smoke alarms. This training should include regular refresher training.
14. Incorporate smoke alarms in periodic emergency drills and exercises.
15. Include in your efficiency testing program (rules compliance testing program) a specific test to ensure appropriate emergency actions are taken by Rail Operations Control Center supervisors and control operators in response to an alarm.
16. Install and maintain a system that will detect the presence and location of fire and smoke throughout the Washington Metropolitan Area Transit Authority tunnel and station network.
17. Develop procedures for regular testing of all smoke detectors.
18. Conduct a risk assessment before any preventive maintenance program is initiated, changed or discontinued.
19. Ensure that all train operators are trained and regularly tested on the appropriate procedure for emergency shutdown of railcar ventilation.
20. Incorporate a specific test in your efficiency testing program to ensure that train operators understand the procedure for emergency shutdown of railcar ventilation.
21. Revise Standard Operating Procedure #6 to clarify which trains should be stopped until the source of smoke is identified.

22. Revise your standard operating procedures to require that: (1) suitably trained, qualified, and properly equipped personnel investigate reports of wayside fire or smoke, and (2) these reports are not investigated using trains with revenue passengers.
23. Review and revise as necessary your Rail Operations Control Center emergency response procedures for smoke and fire.
24. Retrain Rail Operations Control Center supervisors on all standard operating procedures for emergencies.
25. Develop and incorporate a comprehensive program for training Rail Operations Control Center control operators in emergency response procedures including regular refresher training.
26. Conduct regular emergency response drills and develop a program to test the efficiency of the Rail Operations Control Center to ensure that standard operating procedures are properly followed during emergencies.
27. Install line identification and direction signage at tunnel entrances and inside tunnels.
28. Implement a regular schedule for the inspection and removal of obstructions from safety walkways and track-bed floors to ensure safe passageways for passengers to use during a tunnel evacuation.
29. Conduct emergency response drills with local emergency response agencies in accordance with National Fire Protection Association (NFPA) 130, document lessons learned, and develop and implement additional procedures as necessary to effectively respond to emergencies.
30. Revise your standard operating procedures to require that an after-action review be conducted of all emergency responses to events with passenger or employee fatalities, and publish the results, including both the successes and the potential deficiencies of your responses, to help ensure that deficiencies are appropriately remediated.
31. Review and revise your quality assurance program to ensure that regular quality assurance audits are included to identify and correct any elements of procedural noncompliance.

Previously Issued Recommendations

To the US Department of Transportation:

R-15-31 (Urgent)

Seek an amendment to Title 45 United States Code Section 1104(3) to list the Washington Metropolitan Area Transit Authority as a commuter authority, thus authorizing the Federal Railroad Administration to exercise regulatory oversight of the Washington Metropolitan Area Transit Authority's rail system. (Open - Unacceptable Response)

R-15-32 (Urgent)

After Title 45 United States Code Section 1104(3) is amended to include the Washington Metropolitan Area Transit Authority, direct the Administrator of the Federal Railroad Administration to develop and implement a plan to transition the oversight of the Washington Metropolitan Area Transit Authority's rail system to the Federal Railroad Administration within 6 months. (Open - Unacceptable Response)

To the Federal Transit Administration:

R-15-7 (Urgent)

Audit all rail transit agencies that have subway tunnel environments to assess (1) the state of good repair of tunnel ventilation systems, (2) written emergency procedures for fire and smoke events, (3) training programs to ensure compliance with these procedures, and (4) verify that rail transit agencies are applying industry best standards, such as NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems, in maintenance procedures and emergency procedures. (Open - Acceptable Response)

To the American Public Transportation Association:

R-15-11 (Urgent)

Inform your members of the circumstances of this accident and the risks posed by inadequate written procedures for ventilation processes during smoke and fire events in a tunnel environment. Urge your members to assess their procedures for verifying consistency with industry best practices, such as those outlined in the National Fire Protection Association's NFPA 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems*. (Closed - Acceptable Action)

R-15-12 (Urgent)

Urge your members to conduct regular training exercises that use written ventilation procedures to provide ample opportunities for employees and emergency responders to practice those procedures. (Closed-Acceptable Action)

To the Washington Metropolitan Transit Authority:

R-15-8 (Urgent)

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's NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems. (Open-Acceptable Response)

R-15-9 (Urgent)

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. (Open-Acceptable Response)

R-15-10 (Urgent)

As part of the implementation of the procedures developed in response to Safety Recommendation R-15-009, incorporate the use of the procedures into your ongoing training and exercise programs and ensure that operations control center staff and emergency responders have ample opportunities to learn and practice activating ventilation fans. (Open-Acceptable Response)

R-15-25

Promptly develop and implement a program to ensure that all power cable connector assemblies are properly constructed and installed in accordance with your engineering design specifications, including the weather tight seals that prevent intrusion by contaminants and moisture. (Open-Acceptable Response)