

Washington Metropolitan Area Transit Authority Hi-Rail
Maintenance Vehicle Strikes Two Wayside Workers Near the
Rockville Station
Rockville, Maryland
January 26, 2010



Accident Summary Report

NTSB/RAR-12/04/SUM
PB2012-916304



**National
Transportation
Safety Board**

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Railroad Accident Report

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490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2012. *Washington Metropolitan Area Transit Authority Hi-Rail Maintenance Vehicle Strikes Two Wayside Workers Near the Rockville Station, Rockville, Maryland, January 26, 2010. Railroad Accident Report NTSB/RAR-12/04/SUM.* Washington, D.C.

Abstract: On January 26, 2010, about 1:40 a.m., a hi-rail vehicle—a truck or automobile that can be operated on either highways or rails—operating about 0.9 miles north of the Washington Metropolitan Area Transit Authority Rockville Metro Station struck and fatally injured two automatic train control technicians who were working on the right-of-way replacing an impedance bond between the tracks. The hi-rail vehicle was traveling down the track in the reverse gear at about 13 mph.

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Abbreviations and Acronyms

APTA	American Public Transportation Association
ATC	automatic train control
CFR	<i>Code of Federal Regulations</i>
CM	chain marker
DOT	U.S. Department of Transportation
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
MOC	Maintenance Operations Center
MSRPH	<i>Metrorail Safety Rules and Procedures Handbook</i>
NTSB	National Transportation Safety Board
OCC	Operations Control Center
OSHA	Occupational Safety and Health Administration
ROW	right-of-way
RWIC	roadway worker-in-charge
SOP	standard operating procedure
TOC	Tri-State Oversight Committee
U.S.C.	<i>United States Code</i>
WMATA	Washington Metropolitan Area Transit Authority

Executive Summary

On January 26, 2010, about 1:40 a.m., a hi-rail vehicle—a truck or automobile that can be operated on either highways or rails—operating southbound about 0.9 miles north of the Washington Metropolitan Area Transit Authority Rockville Metro Station struck and fatally injured two automatic train control technicians who were working on the right-of-way replacing an impedance bond between the tracks. The hi-rail vehicle was traveling down the track in the reverse gear at about 13 mph.

The safety issues discussed in this report are the following:

- Inadequate procedures within the Washington Metropolitan Area Transit Authority Operations Control Center for protecting roadway workers
- Inadequate procedures within the Washington Metropolitan Area Transit Authority Operations Control Center to coordinate work between two separate roadway worker work groups
- Inadequate communication between roadway worker work groups
- Inadequate Federal agency oversight of roadway worker policies and procedures
- Lack of requirements for automatic backup alarms on hi-rail vehicles

The National Transportation Safety Board determines that the probable cause of the accident was inadequate safeguards by the Washington Metropolitan Area Transit Authority to protect roadway workers from approaching hi-rail vehicles, and to ensure hi-rail operators were aware of any wayside work being performed.

Contributing to the accident was the inadequate communication of vital information concerning ongoing work by the Operations Control Center; the lack of an appropriate and effective lookout by the hi-rail vehicle operator and crew to carefully observe the track on approach; and the ineffective lookout for trains and/or hi-rail vehicles on the part of the automatic train control technicians.

Safety recommendations are being issued to the Federal Transit Administration and the American Public Transportation Association.

1 Investigation and Analysis

1.1 Accident Narrative

On January 26, 2010, about 1:40 a.m., two Washington Metropolitan Area Transit Authority (WMATA) automatic train control (ATC) technicians¹ who were working on the right-of-way (ROW) were struck and fatally injured by a hi-rail vehicle² that was operating southbound about 0.9 miles north of the Rockville Metro Station. At the time of the accident, the temperature was 39° F with overcast clouds; the winds were from the west-northwest at 9 mph.

The accident occurred in Rockville, Maryland, on WMATA's Red Line A-2 track at stationary marker, also known as chain marker, (CM)³ 852+30.

Under normal operating conditions, the A-2 track is the northbound track and the A-1 track is the southbound track.⁴ WMATA's Red Line is, essentially, a U-shaped configuration with the Shady Grove Metro Station at the end of one north-south leg, the Glenmont station at the end of the other leg, and the Metro Center station in downtown Washington, D.C., in the middle. (See Figure 1.)

¹ Throughout the rest of this report, the fatally injured technicians will be referred to as ATC No. 1 technician and ATC No. 2 technician.

² A *hi-rail vehicle* is a truck or automobile with retractable-flanged wheels that permit it to be operated on either highways or rails.

³ *Stationary markers* are commonly referred to as chain markers, which are signs to identify a specific location on the track. The chain markers are used as a linear measurement in 100-foot increments with the additional footage appearing after the plus sign (+) for a location on the ROW track.

⁴ The track in the accident area was designated A-1 (for inbound traffic traveling south toward Metro Center in downtown Washington, D.C.) and A-2 (for outbound traffic traveling north and away from Metro Center). Although generally considered "inbound" and "outbound," the two main tracks were capable of accommodating trains operating in either direction.



Figure 1. WMATA system track map, including the Red Line.

1.2 Operations Information

Normal Red Line train movements are controlled by an ATC system. Typically, WMATA's hi-rail maintenance vehicles and other on-track maintenance equipment are not equipped to operate with an ATC system. Instead, the authority to move the self-propelled vehicles is directed by the Operations Control Center (OCC),⁵ which issues absolute block⁶ movement authorities.

The employees operating trains and other on-track vehicles and those performing maintenance, repairs, and inspections on the Red Line are governed by the WMATA operating rule book, *Metrorail Safety Rules and Procedures Handbook* (MSRPH), dated January 2004. Rules can be modified or supplemented by the issuance of special orders. Rules pertinent to this accident are found in the MSRPH and in applicable special orders. One such special order was WMATA Special Order 07-06, dated November 9, 2007, regarding working on the ROW. This special order states in part:

Duties and Responsibilities for Employees:

4.180: When it is necessary for employees to walk beyond the platform end gate where the walkway is not protected by a handrail, or to walk or work on tracks around moving trains or track equipment, they shall:

a. Expect rail vehicle movement at any time, in either direction, on either track. ...

i. Maintain a careful lookout in both directions to ensure that approaching trains and track equipment are seen before they become hazards. ...

l. When working at a stationary location, ensure that one person is designated to be the lookout for passing vehicles and to monitor the appropriate radio frequency.

m. When work is such that the entire crew must perform it, i.e. no lookout, implement an alternative method of protecting the work area (e.g., insertion of switch crank, application of shunt strap, etc.) prior to the work being started. This method must be authorized by OCC prior to implementation.

Figure 2 shows the hi-rail vehicle at the location of the accident.

⁵ The *Operations Control Center* communicates and controls the movement of trains and other track equipment over the entire WMATA Metrorail system.

⁶ *Absolute block* is a section of track between two specific locations onto which no train, hi-rail vehicle, or track equipment is permitted to enter while it is occupied by another train.



Figure 2. The striking hi-rail vehicle at the accident location.

1.2.1 Preaccident Events

On the evening before the accident, the shift change in the OCC was at 10:00 p.m. Two OCC operators were assigned to the Red Line for the 10:00 p.m. to 6:00 a.m. shift. One of the OCC operators (Operator No. 1) who came on duty told investigators that a counterpart going off duty said that the ATC No. 1 and No. 2 technicians were working between the Rockville and Shady Grove stations on a train control system problem at CM 852 on the A-2 track. The second operations control center operator (Operator No. 2) came into the OCC after this conversation and was briefed by Operator No. 1. Investigators were told that, typically, one OCC operator communicates with trains and maintenance personnel via radio and telephone, while the other operates the control panel. At a point early in the shift, the two OCC operators swapped positions.

Prior to the accident, WMATA operations were transitioning from revenue train operations to nightly maintenance activities. Most maintenance work is prescheduled on a general order form that outlines what equipment and crews will be needed at which locations. The first two on-rail maintenance vehicles were dispatched out of the Shady Grove Metro Station while operating under absolute blocks on the A-1 track. WMATA rules require the OCC to establish absolute blocks to move on-rail work equipment to or from work areas.

On the night of the accident, the ATC No. 1 technician and the ATC No. 2 technician were troubleshooting ATC system problems on the A-2 track between the Shady Grove and Rockville stations that had been reported earlier in the day. The ATC No. 1 technician had made temporary modifications to the equipment in the train control room to establish train speed

restrictions through the area where they were working. The technicians were performing their troubleshooting under traffic, clearing the tracks when trains approached. They were assisted by an ATC helper who was with them on the wayside and another ATC technician who was some distance away from them in the train control room. The normal shift change time for ATC employees is 10:30 p.m. However, on that day, the ATC supervisors at the Shady Grove station conferred and determined that it would be best if the ATC No. 1 technician and the ATC No. 2 technician continued to work on the problem at CM 852. Around 11:00 p.m., the night-shift ATC helper arrived with another ATC technician and transported the afternoon-shift ATC helper and the third afternoon-shift ATC technician to the Rockville station, where they could take the final train of the evening and go off duty. The night-shift ATC supervisor told National Transportation Safety Board (NTSB) investigators that he needed the ATC helper to perform other job duties. He also spoke with one of the ATC technicians on the wayside who confirmed they could continue their work without the assistance of the helper. This effectively changed the original roadway work group from three employees to only two.

As noted earlier, WMATA rules require that employees on the ROW “maintain a careful lookout in both directions ...” and if working in a stationary location, designate an employee to be a lookout. The afternoon-shift ATC technician who had been in the train control room told investigators that the ATC No. 1 technician working on the ROW told him that the afternoon-shift ATC helper had been designated as a lookout; however, it is not known if either the ATC No. 1 technician or the ATC No. 2 technician was designated as a lookout after the ATC helper left about 11:00 p.m. The ATC No. 1 technician and the ATC No. 2 technician continued their work on the A-2 track at CM 852.

On the night of January 25, 2010, several on-rail maintenance vehicle movements were scheduled to depart the Shady Grove station. The first two units, both self-propelled flatcars, known as prime movers (vehicles PM-44 and SV-01), were authorized with absolute blocks to operate on the A-1 track, past the location of the ATC No. 1 technician and the ATC No. 2 technician on the A-2 track. When interviewed after the accident, the crewmembers of PM-44 indicated that they were not advised of the presence of either of the ATC technicians on the A-2 track and were surprised to see them on the ROW. The operator of the second prime mover (SV-01) proceeded from the Shady Grove station on the A-1 track with absolute block authority. This prime mover operator told investigators that he also had not been advised that employees were working on the ROW at CM 852.

At 11:42:08 p.m., the ATC No. 1 technician on the ROW called the OCC on the telephone and told the operator that there was a bad impedance bond⁷ on track A-2, CM 852+00, and that track circuits A-2, CM 852 and A-2, CM 846 would not be operating while the bond was being changed. The OCC operator offered to notify other work groups in the area of the work being done at CM 852 and asked the ATC No. 1 technician to provide a cell phone number. The ATC No. 1 technician asked, “They know the chain marker we’re at, right? Can you relay that to them?” Operator No. 1 agreed to arrange for the additional workers to contact the ATC No. 1 technician on the cell phone.

⁷ An *impedance bond* (also known as a “Wee-Z bond”) is a device used to transmit frequency signals into the rails. These bonds are split between blocks. Each one acts as a transmitter for one block and a receiver for an adjacent block.

The ATC No. 1 technician provided a cell phone number, and the OCC operator agreed to give the number to anyone entering the work area so they could communicate directly with the technicians. The ATC No. 1 technician stated that he and the ATC No. 2 technician would watch for any equipment entering the work area.

The third maintenance vehicle to depart the Shady Grove station was the striking hi-rail vehicle (15802). The four track workers⁸ on board had been assigned to inspect and replace third-rail cover boards⁹ on the A-2 track between the Shady Grove and Rockville stations.

Operator No. 2 was handling the communication with the leadman on hi-rail vehicle 15802 and indicated in interviews a belief that Operator No. 1 had communicated to the leadman on the hi-rail vehicle a contact cell phone number for the two ATC technicians. However, recorded audio tapes of the conversation between the first OCC operator and the hi-rail vehicle showed that the operator did not give the contact cell phone number to the hi-rail crew.

At 11:55:27 p.m., the hi-rail operator contacted the OCC operator by telephone and was told to move down to CM 787+00 on the A-2 track, located south of where the ATC No. 1 technician and the ATC No. 2 technician were working. Operator No. 2 stated, "... would take them down track A-2 at Twinbrook¹⁰ and bring them back to keep traffic because they have a loss of shunt down there between Rockville and Shady Grove and ATC is still working on it wayside."

In a subsequent conversation with the leadman for the hi-rail crew, the OCC operator said that ATC personnel were working between the Rockville and Shady Grove stations. However, the OCC operator did not give the leadman a CM location, or the ATC No. 1 technician's cell phone number. The NTSB concludes that had the OCC operators provided the crew of striking hi-rail vehicle 15802 with the cell phone number of the ATC No. 1 technician and instructions to coordinate their work, the accident could have been prevented.

The next and final radio communication between the OCC operator and the ATC No. 1 technician occurred at 12:05:13 a.m., when the OCC operator notified the ATC No. 1 technician that an engine was being moved on the A-1 track and that the hi-rail vehicle was clear of the A15-08 signal (which is located north of the where the ATC technicians were working) on the A-2 track. The ATC No. 1 technician stated that he was "momentarily" clear of the track and that the ATC No. 2 technician would monitor the radio and "stand clear if he sees a train." No further radio communication between the OCC and the ATC No. 1 technician was recorded.

The last absolute block movement authority transmitted to hi-rail vehicle 15802 was to move from interlocking signal A15-06 to clear signal A15-08 and to then stand by for further instructions. After making a series of movements at the Shady Grove interlocking,¹¹ hi-rail

⁸ The four workers consisted of the leadman, the hi-rail operator, and the two track laborers.

⁹ *Third-rail cover boards* are fiberglass covers designed to protect the electrified third rail, which provides power to trains.

¹⁰ Twinbrook is the next station stop, located south of the Rockville Metro Station.

¹¹ *Interlocking* is defined as an arrangement of signals and signal appliances so interconnected that their movements must succeed each other in correct sequence.

vehicle 15802 reported being clear of signal A15-08 on the A-2 track. The interlocking signals are located just south of the Shady Grove station. (See figure 3.) The OCC operator authorized a red tag traction power removal¹² to the hi-rail vehicle pursuant to Standard Operating Procedure (SOP) #28 at 1:26:24 a.m. The leadman requested and was given permission to perform a hot stick¹³ test at CM A-2 936+00, which is located just south of the Shady Grove station. The last instruction from the OCC operator to the leadman of hi-rail vehicle 15802 was to “place shunts per SOP.” This was a reference to Sections 28.2.f.5 and 28.2.f.6 in WMATA SOP #28, “Removal and Restoration of Third Rail Power for Work by WMATA Maintenance Forces – Mainline Revenue System.” This was published in the WMATA MSRPH dated January 2004.

The maintenance supervisor, crew leader, or escort shall notify OCC before work begins to confirm that shunt straps, limit lights and third rail warning devices (safety equipment) are in place. If an interlocking is within the protected work area, ensure that switches are in the desired positions and the procedures outlined in 28.2 (section f., number 4.a. and b.) have been followed and the protected work area has been established.

OCC shall then verify track occupancy at the locations of the shunt straps, as specified in the General Order.

¹² The issuance of a red tag order begins the process of removing power to the rails so that personnel can safely perform work.

¹³ A *hot stick* is a field testing device that measures the presence or absence of electrical current in the third rail.

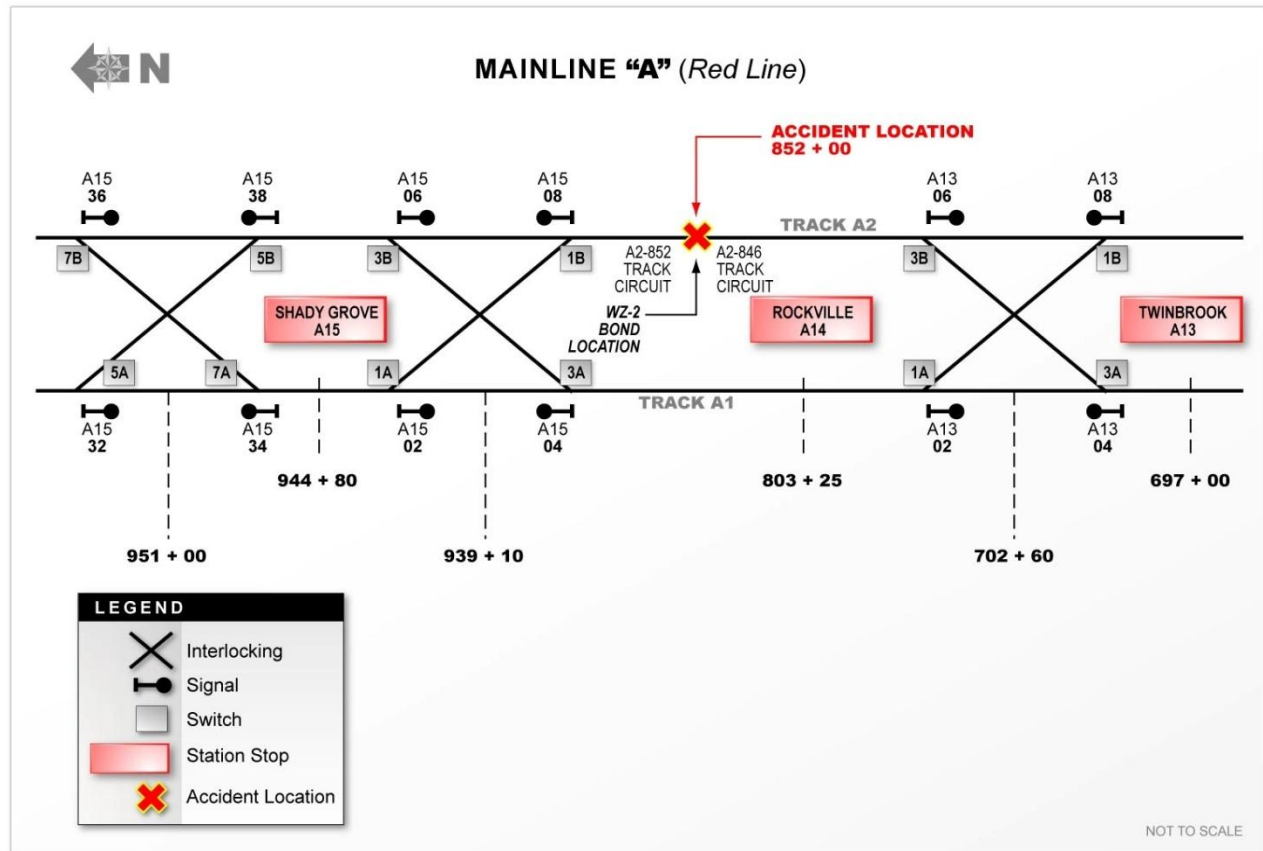


Figure 3. Track map of WMATA Red Line, showing accident location.

This procedure requires the red tag holder (in this case, the leadman of the hi-rail 15082 crew) to request permission to confirm by hot stick testing that the third rail was de-energized and to “protect the work area” by installing reflective mats, shunt straps, and red limit lights at “each end of the protected work area.”

Prior to receiving permission from the OCC to move, the hi-rail vehicle began traveling in the reverse direction on track A-2 from the Shady Grove station, toward a point just north of the Rockville station. Before reaching its destination, the hi-rail vehicle struck and fatally injured the ATC No. 1 and No. 2 technicians.

Interviews conducted by the NTSB revealed that prior to the accident, several maintenance employees understood that the OCC operator’s permission to establish a red tag work area conveyed authority to move to the far end of that work area, slightly north of the Rockville station. The operator for hi-rail vehicle 15802 stated, “Once the supervisor, leadman, gets permission to place his first shunt, they tell him, place your shunts in accordance with the SOP. Once I place the first shunt, I’m on my own or the leadman—we’re on our own to go and set the work area up without any direction from Central Control [OCC].” Similarly, the track department supervisor told investigators that permission was not needed to move hi-rail vehicle 15802 to the south end of the red tag work area “once Central [OCC] gives him okay, permission to install your shunts, to establish your work area so they’ll know where he’s working at, then that unit became under the control of ...” the leadman.

During interviews, the leadman of the hi-rail crew also indicated that he was working in compliance with WMATA rules in place at the time of the accident when he received permission to enter the work area and perform the hot stick test: “WMATA rules state that no one should be in that area other than your vehicle because you were provided with the red tag authority.” The track department supervisor also agreed that the hi-rail crew was working in compliance with WMATA rules. WMATA SOP #28 states that all personnel must be clear when power is restored, but mentions nothing on the presence or absence of personnel on the ROW when the red tag area is established. The OCC operator who gave the leadman of hi-rail vehicle 15802 permission to “place shunts per SOP” indicated to investigators that this permission only authorized the leadman to set up the north end of the red tag work area and that the hi-rail vehicle crew needed absolute block authority to move the vehicle south. The OCC operator added, “I’ve never experienced it where they (a hi-rail vehicle crew) would just move the unit without getting an absolute block. If I haven’t released that work location to you (a crew), then that unit is still being governed by my instruction.” Both OCC operators indicated to investigators that hi-rail vehicle 15802 was not authorized to leave the Shady Grove station and that when the hi-rail operator notified them of the accident, they were surprised to learn that the unit had moved.

The NTSB concludes that, without clear written procedures, there was confusion among operating personnel at the OCC and vehicle operators regarding when field crews were authorized to move on-rail equipment within red tag work areas.

The next radio transmission from hi-rail vehicle 15802 was the initial notification of the accident, made to the OCC at 1:40:34 a.m. Figure 4 shows the accident location.

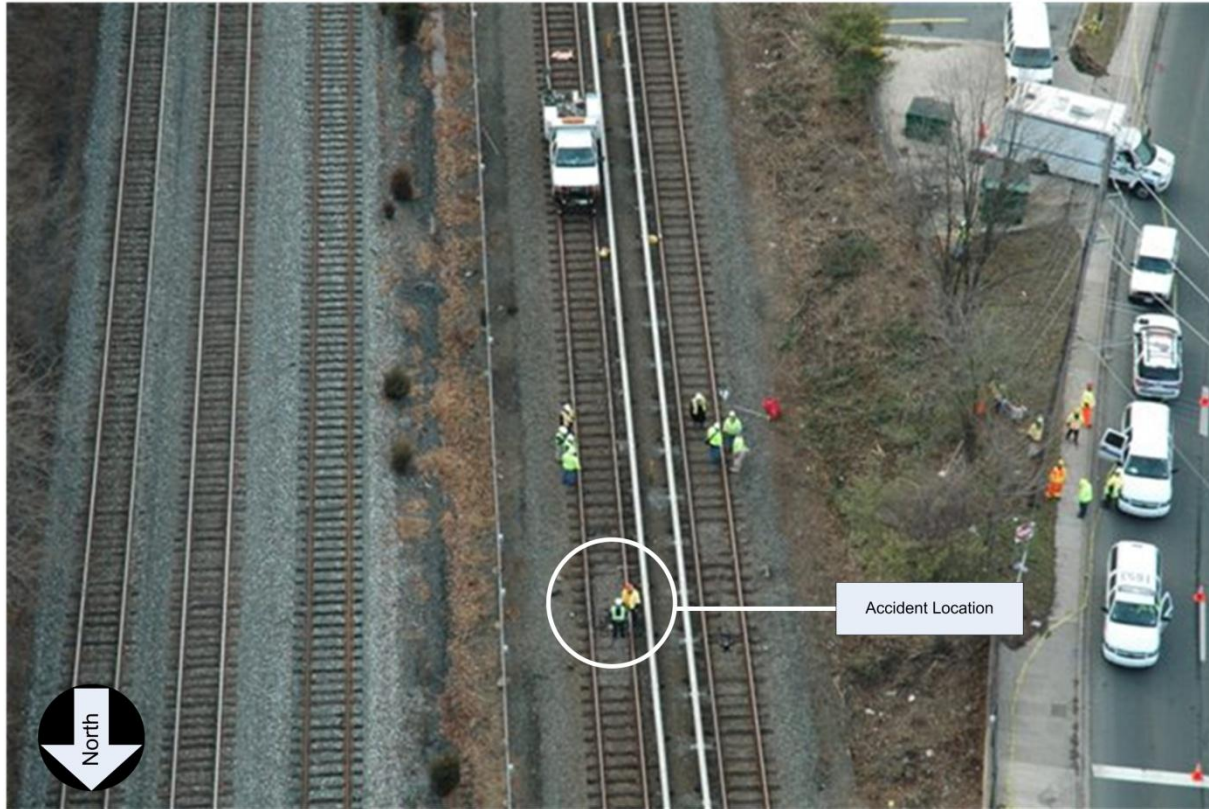


Figure 4. Aerial view of the accident location.

1.3 Postaccident Testing

1.3.1 Sight Distance Testing

At the time of the accident, the hi-rail vehicle operator was in the driver's seat, the leadman was in the passenger seat, and two laborers were in the rear seats. According to the hi-rail vehicle operator, he was moving the vehicle in reverse at an engine speed of about 1,500 rpm at the time of the accident.¹⁴ NTSB investigators determined during the sight distance and vehicle performance testing on April 23, 2010, that the calculated reverse vehicle speed at 1,500 rpm was about 13 mph.

To determine the distance that an approaching hi-rail vehicle could be visually detected in the dark by personnel on the ROW, observers were positioned at the accident location and instructed to note when they first observed the vehicle approaching. The hi-rail vehicle was operated in reverse, going south on the A-2 track, approaching the accident location. The light switches were set for the positions they were found in after the accident, with the roof-mounted strobe light bar and the rear-mounted rail lights (one on each side, similar to headlights) on. The hi-rail vehicle was equipped with a backup alarm, but it was deactivated by the use of the rail lights. Observers noted that the hi-rail vehicle lights first came into view when it was about

¹⁴ The operator could not reference the speedometer since it does not register speed when operated in reverse.

5,870 feet from the accident location. When operated at a speed of 13 mph, the lights of the hi-rail vehicle (and, subsequently, the vehicle itself) were in view for about 5 minutes while approaching the accident location.

1.3.2 Roadway Worker Visibility

To determine the distance from which a hi-rail vehicle operator could detect personnel on the ROW using the side-mounted rearview mirrors, cardboard boxes covered with reflective WMATA safety vests were placed in the gage of the track at the accident location to simulate the ATC technicians in standing and bending profiles. The hi-rail vehicle was then operated in reverse, going south on the A-2 track, approaching the accident location. The light switches were set to the “on” position, as they were found after the accident. The object of this test was for the test operator to observe the view from the hi-rail vehicle’s side-mounted rearview mirrors. The test operator noted that he could first see the reflection of the vests in the operator’s side-mounted rearview mirror when the vehicle was about 920 feet from the accident location. While the vehicle was moving at a speed of 13 mph, the operator could view the vests for about 40 seconds. As the hi-rail vehicle continued down the track toward the accident location, the test operator noted that the reflective vests remained within view in the operator’s side-mounted rearview mirror until the vehicle was about 150 feet from the accident location, at which time they were obscured from view by the hi-rail vehicle’s bed. The test operator observed that the passenger side-mounted rearview mirror was not very useful in viewing the track as he operated the hi-rail vehicle toward the accident location.

This simulation/test was repeated with the operator using the interior windshield-mounted rearview mirror. The object of this test was for the test operator to observe when he could first view the reflective vests. The test operator noted that he could first see the reflection of the vests when the vehicle was about 450 feet from the accident location. The vests continued to be visible for the remainder of the approach to the accident location. If the hi-rail vehicle was moving at a speed of 13 mph, the reflective vests would have been in view for about 23 seconds on approach to the accident location. The test operator noted that the view of the track in the interior windshield-mounted rearview mirror was partially obstructed by hanging straps in the bed of the hi-rail vehicle. These straps were in the same position as they were found after the accident.

On the last simulation/test, the test operator was instructed to scan both the side-mounted rearview and interior windshield-mounted rearview mirrors as he drove the hi-rail vehicle, mimicking the conditions at the time of the accident. The test operator noted that he could first see the reflection of the vests on the track in the operator’s side-mounted rearview mirror when the vehicle was about 920 feet from the accident location, which was his best view down the track. As in the earlier test of visibility from the side-mounted mirror, while the hi-rail vehicle was moving at a speed of 13 mph, the track vests were in view for about 40 seconds before being obscured from view by the hi-rail vehicle’s bed during the last 150 feet.

During the sight distance tests, the test operator noted that he was distracted by a very bright light mounted to the roof of a restaurant on Rockville Pike, near the accident location. The test operator also found lights from a nearby building to be distracting.

In some types of hi-rail equipment, there are operator positions that face in the direction of travel at both ends of the vehicle and each end is symmetrical with similar outward visibility. This was not the case with the accident hi-rail vehicle, which was really intended to be operated primarily in the forward direction. The operator in this accident had to rely on the side and rearview mirrors for visibility in the direction of travel.

1.3.3 Audible Testing

The hi-rail vehicle was equipped with an audible-tone backup alarm; however, that alarm did not sound when the vehicle was operated in reverse at the scene of the accident. Investigators discovered that this was because the switch to the rail lights was found to be in the on position at the time of the accident. This switch is typically turned on whenever a hi-rail vehicle is operated in reverse on a track because it applies the rail lighting system and reverses the white and red lights that define the front and rear of the vehicle. WMATA's policy was that when operating in reverse, the rear of the vehicle, in effect, becomes the front. Therefore, the backup alarm is deactivated. WMATA representatives informed investigators that all of their hi-rail vehicles are set up in that manner. For the test, the rail lights' switch was toggled off, activating the auditory backup alarm on the hi-rail vehicle. As with the sight distance testing, observers were positioned at the accident location. This time, they were instructed to note when they heard the backup alarm of the approaching vehicle. Observers reported hearing the backup alarm when the vehicle was about 2,270 feet from the accident location. When moving at a speed of 13 mph, the hi-rail vehicle could be heard for about 2 minutes on approach to the accident location.

1.3.4 WMATA Personnel

Employee records were examined for the operator, leadman, track repairman, and laborer of hi-rail vehicle 15802; the two night-shift OCC operators; the roadway work crew members, including the ATC mechanic working in the control room; and the two fatally injured ATC technicians. These records indicated that all personnel were trained and qualified to perform their duties.

The NTSB investigation examined the work/rest histories for the two ATC technicians and the four crewmembers in the hi-rail vehicle. A 96-hour sleep/wake/work history was developed for each of these employees by using employee records and postaccident interviews. These 96-hour sleep/wake/work histories showed that the employees had regularly scheduled work shifts, with minimal amounts of overtime worked in the days preceding the accident.

The hi-rail crewmembers had been on duty for 3 hours 40 minutes at the time of the accident. Their time awake that day ranged from about 5 hours 40 minutes to 9 hours 40 minutes.

The normal work schedule for the ATC technicians was from 2:30 p.m. to 10:30 p.m. However, because they were finishing work on a track circuit problem, they continued to work past their normal 8-hour shift to complete the repair. The ATC technicians had been on duty for 11 hours 10 minutes at the time of the accident. No estimates of their time awake could be determined. However, examination of hours-of-service logs and interviews with family members did not indicate that the deceased ATC technicians suffered from fatigue-related risks, such as insomnia, obstructive sleep apnea, or other medical symptoms associated with fatigue.

The accident scenario did not provide the NTSB investigation with behavioral evidence for the actions and reactions of the ATC technicians or hi-rail driver in the moments leading up to the accident event. The NTSB concludes that there was insufficient information available to determine if fatigue was a factor in the accident. However, the NTSB concludes that employee training and qualifications were not factors in the accident.

1.4 Toxicological Findings

After the accident, WMATA performed toxicological tests on all nine involved WMATA employees, pursuant to Title 49 *Code of Federal Regulations* (CFR) Part 659. The results for all tested employees were negative for drugs and alcohol. The Office of the Maryland Chief Medical Examiner, in Baltimore, Maryland, also conducted toxicological tests of the fatally injured technicians, ATC No. 1 and ATC No. 2. These test results were also negative for drugs and alcohol.

1.5 WMATA Actions Taken Since Accident

On April 13, 2010, WMATA modified Operating Rule 3.87 in the MSRP. The previous permanent order that directed the trains to slow to 35 mph two stations prior to a known work area was eliminated and replaced with Permanent Order T-10-06. The introduction to this permanent order¹⁵ stated the following:

The requirement that all work crews have a watchman/lookout to provide local protection and sufficient warning of approaching trains;

The requirement to establish extra protection for crews when in blind spots preventing trains to move into the area until crews are clear, and;

The provision of a ROW Access Guide stipulating the type of protection needed when working anywhere on the ROW.

Other guidelines were also included in this permanent order, which was issued less than 3 months after the accident, and revised section 3.87(a) of the MSRP:

3.87: Rail vehicle operators shall maintain a constant lookout in the direction in which their vehicles are moving. When rail vehicle operators observe persons on the right-of way, they shall:

a. Sound mainline horn to warn those persons of the vehicle's approach. If personnel do not physically clear the right-of-way and appropriate acknowledgement of the horn signal is not received, the vehicle shall be brought to an immediate stop and the Train Operator shall contact the Operations Control Center (OCC) and await their instructions before moving the train. Train Operators shall report all near misses to OCC.

¹⁵ The issuance of a permanent order supersedes and revises an existing rule in the MSRP.

On April 13, 2010, WMATA also issued Permanent Order T-10-05, revising Safety Rule 4.176 in the MSRPH. The permanent order directed employees fouling¹⁶ a track to stay outside the clearance envelope for trains or on-track equipment on the active track when a train is approaching.

Individuals fouling a track shall step clear, as soon as there is evidence of a moving rail vehicle in their vicinity, remain as far as practicable from passing vehicles, and if possible, shall maintain a handhold until the vehicle has passed. While on the mainline, individuals shall not clear to the adjacent track(s). Clearing the tracks while on mainline means individuals on the ROW shall stay safely outside the dynamic outline or clearance envelope for trains or on-track equipment on the active track. Individuals on the railroad shall explicitly communicate what they are clearing when communicating with others and using the term clear.

Effective September 28, 2010, WMATA issued the *Roadway Worker Protection Manual–2010*, implementing its new roadway worker protection rules. Under the section called Cardinal Rules, WMATA included the following section:

Roadway Maintenance Machines shall not operate at speeds more than 10 mph within any working limits and shall be prepared to stop within 1/2 the range of visibility, be on the lookout for Roadway workers, obstructions, broken rail and misaligned switches.

Another one of the changes included in the revised *Roadway Worker Protection Manual–2010* was a definition of ample time, along with clarification of other applicable terms:

Requires workers to be in a position of safety not less than 15 seconds before a train or rail equipment moving at the maximum speed authorized on that track, can pass the location of the Roadway Worker; or sufficient levels of protection that permit workers time to clear the tracks without urgent movement (i.e. Exclusive Track Occupancy,^[17] Inaccessible Track,^[18] or Foul Time^[19]).

Exclusive Track Occupancy, Inaccessible Track, and Foul Time afford the appropriate level of protection for the roadway workers fouling the track during the performance of their duties. Roadway workers are required to use one of these methods if work conditions on the

¹⁶ *Fouling* means that trains, equipment, or personnel on a track are within the clearance zone needed for passing train or other rail vehicle movements.

¹⁷ In this manual, under its Definitions section, *exclusive track occupancy* is defined as “when the authority to permit train and track equipment to move into or through any given work limits rests solely with the roadway worker-in-charge (RWIC). This authority is transferred to the RWIC from the ROCC (*sic.*)”

¹⁸ *Inaccessible track* is defined as “a section of track where a physical barrier has been placed to prevent trains and/or track equipment from entering the work area (i.e., Derailers, barricade, rail out, etc.)”

¹⁹ *Foul time* is defined as “a method of Roadway protection in which all trains and/or track equipment are STOPPED (*sic.*). The RWIC requests ROCC (*sic.*) to stop all traffic until the RWIC reports clear of the track. This is used only for short time periods in specific segments of track such as work areas, blind spots, and no clearance zones.”

track prevent them from moving to a place of safety at least 15 seconds prior to the arrival of a train or rail equipment moving at the maximum authorized speed.

WMATA has also implemented a program to upgrade from its standard headlights and quartz lights on hi-rail vehicles to high-intensity xenon lights, which will improve lighting for both night work and tunnel work. The upgrade will provide three times the amount of light and should have an extended illumination of 1,475 feet in front of and behind the equipment.

Currently, seven hi-rail vehicles have been retrofitted with the new lighting package. Nine other hi-rail vehicles are also slated to receive the upgraded lighting package. Priority for the lighting package upgrade will be based on need and the use of the hi-rail vehicle. The lighting package will include a backup camera and a dashboard-mounted internal monitor, upgraded lights, and shunt straps. (See figures 5, 6, and 7.) The approximate cost to upgrade the existing hi-rail equipment is \$4,000 per vehicle.

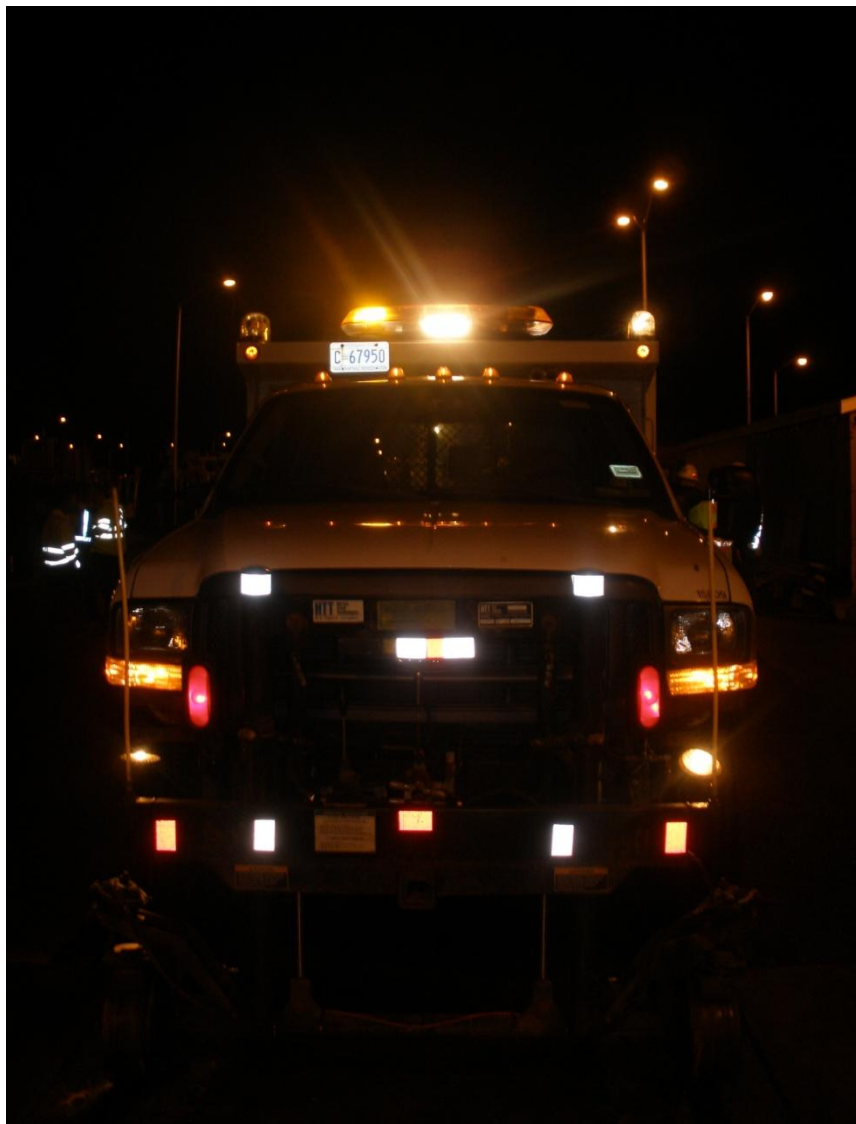


Figure 5. Front view of a hi-rail vehicle with the upgraded lighting package.



Figure 6. Rear view of a hi-rail vehicle with an upgraded lighting package.



Figure 7. Video screen for backup movements in a hi-rail vehicle retrofitted with the upgraded lighting package.

2 Safety Issues

2.1 Roadway Worker Protection Programs

2.1.1 Federal Government Regulation and Guidance

The U.S. Department of Transportation (DOT) consists of 11 individual operating administrations, one of which is the Federal Railroad Administration (FRA). The FRA promulgates and enforces railroad safety regulations, administers railroad assistance programs, conducts research and development to support improved railroad safety and policy, and consolidates government support of rail transportation activities.

The FRA governs the operation of standard-gage railroads that are part of the general railroad system of transportation, including freight, intercity passenger, and commuter railroads. Except under some very limited and clearly defined circumstances, the FRA does not regulate any urban rapid transit operation that is not connected with the general railroad system. The FRA enforces compliance with Federal regulations regarding hazardous materials, motive power and equipment, operating practices, track, and signal and train control. Within these five disciplines, detailed regulations provide for the safe operation of a railroad. The FRA regulations cover areas such as locomotive safety standards; event recorder standards; passenger-car equipment design and crashworthiness standards; control of drug and alcohol use; hours of service; passenger train emergency preparedness; qualification and certification of locomotive engineers; track standards; and the installation, inspection, maintenance, and repair of signal and train control systems.

The Federal Transit Administration (FTA) is another administration within the DOT. Through its grant programs, the FTA helps plan, build, and operate transit systems. Unlike the FRA, however, the FTA does not have statutory authority to promulgate safety regulations. The primary enforcement mechanism available to the FTA is the ability to withhold Federal funds from states that do not comply with the terms and conditions of its Federal assistance agreement. The FTA has established minimum safety requirements that all states and rail transit agencies must meet to receive Federal funding. These requirements include techniques for conducting inspections and testing; required maintenance audits and inspection programs; and procedures for employee training and certification.

The FTA has funded the development of voluntary consensus industry safety standards through the American Public Transportation Association (APTA), which issued the *Standard for Work Zone Safety*²⁰ on July 26, 2003.

In its enabling legislation, the FTA is prohibited from regulating the operations of a transit agency. Over time, Congress provided the FTA with safety regulatory authority in two areas: drug and alcohol use (“Prevention of Alcohol Misuse and Prohibited Drug Use in Transit Operations,” in 49 CFR Part 655) and state safety oversight (“Rail Fixed Guideway Systems:

²⁰ *Standard for Work Zone Safety*, APTA-RT-S-OP-004-03 (Washington, D.C.: American Public Transportation Association, 2003).

State Safety Oversight,” in 49 CFR Part 659). While the FTA’s Office of Safety and Security is responsible for the administration of the drug and alcohol program and the state safety oversight program, the FTA has no direct enforcement authority of these regulations.

However, after the collision on the WMATA system at the Fort Totten Metro Station²¹ that fatally injured 9 people and injured another 80 passengers, the FTA has sought congressional authority to eliminate the regulatory restriction in the Federal law. On December 7, 2009, the U.S. Secretary of Transportation transmitted a formal legislative proposal to Congress. Currently, legislation pending before Congress would eliminate the restriction and direct the DOT to develop and enforce national safety standards for public transportation agencies operating heavy rail on fixed guideways.

2.1.2 State Safety Oversight

Under FTA regulations (49 CFR Part 659), each state is required to establish an oversight agency to carry out the oversight responsibilities specified in the regulation. The state oversight agency, which must be a state agency other than the transit agency itself, is charged with ensuring that each FTA-funded rail transit agency within that state develops and implements a safety management program that is consistent with the requirements of the regulation. Each rail transit system is also permitted to develop its own internal procedures, rules, and standards governing operating practices and maintenance standards. The oversight agency is limited by the regulation to reviewing the program submitted by the rail transit agency. The ability to develop and enforce safety regulations is limited to the authority granted by each state’s legislature.

WMATA was subject to oversight under FTA regulations through the Tri-State Oversight Committee (TOC), composed of members appointed by the District of Columbia, the State of Maryland, and the Commonwealth of Virginia.

TOC reviewed and approved the WMATA System Safety Program Plan, which is composed of 21 safety elements defined in 49 CFR Part 659. Under this plan, WMATA is responsible for an internal audit each year of its compliance with about one-third of the safety elements, so that over a 3-year period, compliance with all 21 elements is audited. WMATA communicates the results of these audits to TOC in an annual report.

TOC conducted a special study²² of WMATA roadway worker protection and issued a report on December 31, 2009. The study contained 18 findings related to WMATA’s ROW safety program and directed WMATA to develop corrective action plans to address each of them.

²¹ *Collision of Two Washington Metropolitan Area Transit Authority Metrorail Trains Near Fort Totten Station, Washington, D.C., June 22, 2009*, Railroad Accident Report RAR-10-02 (Washington, D.C.: National Transportation Safety Board, 2010). <<http://www.nts.gov>>

²² *Rail Transit Special Safety Study–Roadway Worker Protection* (Washington, D.C.: Tri-State Oversight Committee, 2009). This report is available on the TOC website at <<http://www.tristateoversight.org/>>.

2.1.3 Prior NTSB Recommendations to WMATA Relating to Roadway Worker Protection

As a result of its investigation of two separate accidents—one on May 14, 2006,²³ involving the fatal striking of a roadway worker by a WMATA Red Line train near the Dupont Circle Metro Station in Washington, D.C.; the other on November 30, 2006, involving the fatal striking of two roadway workers on its Yellow Line near the Eisenhower Avenue Metro Station in Alexandria, Virginia—the NTSB made the following safety recommendation to WMATA.²⁴

Review your *Metr rail Safety Rules and Procedures Handbook* and revise it as necessary to create additional layers of protection for wayside workers, including:

- Adding requirements for wayside pre-work job briefings to ensure that all workers are informed of their duties, of their respective roles in work crew safety, and of the areas that are to be used to stay clear of trains.
- Requiring that when train operators request permission to either enter a main track, or when a train is turned for a return trip, the train operators along the affected lines must acknowledge receipt of the updated radio announcement from the control center regarding wayside workers.
- Establishing procedures to be used for members of a work crew to acknowledge a lookout's warning that a train is approaching on a particular track from a particular direction before a lookout gives an *all clear* signal to a train. (R-08-01)

WMATA made several changes to its operating procedures in response to this safety recommendation, including the development of a toolbox safety meeting checklist and stand-alone, site-specific safety checklists for its daily work reports; the implementation of a procedure in which OCC operators announce every 20 minutes the location of all current corrective-maintenance action; and the study of ways to ensure lookouts are utilized in the most effective manner possible. WMATA also revised its *Metr rail Safety Rules and Procedures Handbook* and its *Roadway Worker Protection Manual*. Safety Recommendation R-08-01 is currently classified "Open—Acceptable Response." The NTSB has received additional information from WMATA on measures it has taken to further comply with this recommendation. This information is currently being reviewed, and a response will be issued upon the conclusion of the evaluation process.

²³ *Washington Metropolitan Area Transit Authority Train Strikes Wayside Worker Near Dupont Circle Station, Washington, D.C., May 14, 2006*, Railroad Accident Brief NTSB/RAB-08/01 (Washington D.C.: National Transportation Safety Board, 2008). <<http://www.nts.gov>>

²⁴ The recommendation letter, dated January 30, 2008, is available on the NTSB website at <<http://www.nts.gov>>.

Another result of those investigations was a safety recommendation to:

Establish a systematic program for frequent unannounced checks of employee compliance with Metrorail operating and safety rules and procedures. (R-08-02)

In response to this safety recommendation, WMATA developed a policy instruction program in which random unannounced checks are performed on a regular basis. Safety Recommendation R-08-02 is currently classified “Open—Acceptable Response.”

The NTSB also recommended that WMATA:

Perform periodic hazard analyses on the deficiencies identified by unannounced checks of employee compliance in response to Safety Recommendation R-08-02, and use the results to revise Metrorail training curricula or enforcement activities, as necessary, to improve employee compliance with operating and safety rules and procedures. (R-08-03)

As a result of this safety recommendation, WMATA began performing hazard analyses on deficiencies recognized as a result of the random checks. It also revised its training program to address the deficiencies identified in these analyses. WMATA also implemented a policy where operators are retrained on the areas in which they are found deficient, and, if necessary, removed from service until able to correctly perform their duties. Safety Recommendation R-08-03 is currently classified “Open—Acceptable Response.”

The final safety recommendation resulting from those investigations was that WMATA:

Promptly implement appropriate technology that will automatically alert wayside workers of approaching trains and will automatically alert train operators when approaching areas with workers on or near the tracks. (R-08-04)

In response to this recommendation, WMATA purchased wayside, carborne, and employee-mounted equipment in anticipation of developing a pilot program to test warning devices for roadway workers and train operators. Since the vehicle involved in the January 26, 2010, accident was a hi-rail vehicle, this equipment would not have been helpful in this particular instance. Safety Recommendation R-08-04 is currently classified “Open—Acceptable Response.” WMATA has provided the NTSB with information on additional measures it has taken to further comply with this recommendation.

2.1.4 Adequacy of Current Roadway Worker Protection Programs

Between 2002 and 2010 there were 20 roadway worker fatalities²⁵ on transit properties. Of those fatalities, 7 fatalities were WMATA roadway workers; the remaining 13 occurred on the Metropolitan Transit Authority New York City Transit; Chicago Transit Authority; Massachusetts Bay Transportation Authority; Sacramento Regional Transit District; San Francisco Bay Area Rapid Transit District; and Miami-Dade County Transit. While the FRA

²⁵ See appendix B.

has issued regulations at 49 CFR Part 214, Subpart C, which set roadway worker safety requirements that railroads must meet, the FTA does not currently have the authority to issue similar regulations to the transit industry. One of the required elements of a transit agency system's safety program plan under FTA regulations is a "description of the safety program for employees and contractors that incorporates ... safety requirements that employees and contractors must follow when working on, or in close proximity to, rail transit agency property; and processes for ensuring the employees and contractors know and follow the requirements." (49 CFR Section 659.19(r)) However, in light of this accident and the other fatalities cited above, the NTSB concludes that current transit roadway worker protection programs may be ineffective in ensuring roadway worker protection. Therefore, the NTSB recommends that the FTA issue guidelines to advise transit agencies and state oversight agencies on how to effectively implement, oversee, and audit the requirements of 49 CFR Section 659.19(r) using industry best practices, industry voluntary standards, and appropriate elements from 49 CFR Part 214, Subpart C—*Roadway Worker Protection*. Furthermore, the NTSB recommends that the FTA emphasize the effective implementation and oversight of 49 CFR Section 659.19(r) as part of its safety oversight program audits.

The NTSB recommends that the FTA notify all rail transit agencies regarding the circumstances of the January 26, 2010, accident near Rockville Metro Station and urge them to evaluate their roadway worker protection programs and procedures to ensure that they adequately and effectively address issues of appropriate training, communication, maintenance-vehicle movement authorities, flagging procedures, rules compliance, and the sharing of a work area by multiple work crews.

The NTSB recommends that the FTA advise all state safety oversight agencies of the circumstances of the January 26, 2010, accident near Rockville Metro Station and urge them to audit the roadway worker protection programs and the procedures of all rail transit operations in their states to ensure that they adequately and effectively address appropriate training, communication, maintenance-vehicle movement authorities, flagging procedures, rules compliance, and the sharing of a work area by multiple work crews.

2.2 Audible Backup Alarms

There are no FTA regulations regarding backup alarms on hi-rail vehicles used by rail transit agencies. The FRA has a regulation requiring all new hi-rail vehicles to be equipped with an automatic change-of-direction alarm or backup alarm that provides an audible signal at least 3 seconds long and distinguishable from the surrounding noise.²⁶ However, as discussed above, transit agencies, such as WMATA, are not subject to compliance with FRA regulations.

APTA has voluntary standards on roadway worker protection, but does not address hi-rail vehicle backup alarms. There is also a Federal Occupational Safety and Health Administration (OSHA) requirement that no employer shall use any motor vehicle equipment having an obstructed view to the rear unless the vehicle has a reverse signal alarm audible above the surrounding noise level or is backed up only when an observer signals that it is safe to do

²⁶ Title 49 CFR Section 214.523(c).

so.²⁷ Public entities like WMATA are exempt from Federal OSHA regulations unless those Federal requirements are adopted by the state. The state of Maryland has adopted and enforces the Federal OSHA standards. Maryland Occupational Safety and Health issued a “Citation and Notification of Penalty” to WMATA under Labor and Employment Article, Section 5-104(a) that the vehicle had an obstructed view to the rear and was not equipped with a backup alarm.

The FRA has already recognized that backup alarms are needed to ensure worker safety. The NTSB concludes that an audible backup alarm might have helped to prevent this accident. Therefore, the NTSB recommends that APTA establish guidelines and standards to require that all existing and new hi-rail vehicles be equipped with an automatic change-of-direction or backup alarm that provides an audible signal that is at least 3 seconds long and is distinguishable from the surrounding noise.

²⁷ Title 29 CFR Section 1926.601(b)(4).

3 Conclusions

3.1 Findings

1. There was insufficient information available to determine if fatigue was a factor in the accident.
2. Employee training and qualifications were not factors in the accident.
3. Had the Operations Control Center operators provided the crew of striking hi-rail vehicle 15802 with the cell phone number of the first automatic train control technician and instructions to coordinate their work, the accident could have been prevented.
4. Without clear written procedures, there was confusion among operating personnel at the Operations Control Center and vehicle operators regarding when field crews were authorized to move on-rail equipment within red tag work areas.
5. Current transit roadway worker protection programs may be ineffective in ensuring roadway worker protection.
6. An audible backup alarm might have helped to prevent this accident.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was inadequate safeguards by the Washington Metropolitan Area Transit Authority to protect roadway workers from approaching hi-rail vehicles, and to ensure hi-rail operators were aware of any wayside work being performed. Contributing to the accident was the inadequate communication of vital information concerning ongoing work by the Operations Control Center; the lack of an appropriate and effective lookout by the hi-rail vehicle operator and crew to carefully observe the track on approach; and the ineffective lookout for trains and/or hi-rail vehicles on the part of the automatic train control technicians.

4 Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following five safety recommendations: four recommendations to the Federal Transit Administration and one recommendation to the American Public Transportation Association.

To the Federal Transit Administration:

Notify all rail transit agencies regarding the circumstances of the January 26, 2010, accident near Rockville Metro Station and urge them to evaluate their roadway worker protection programs and procedures to ensure that they adequately and effectively address issues of appropriate training, communication, maintenance-vehicle movement authorities, flagging procedures, rules compliance, and the sharing of a work area by multiple work crews. (R-12-32)

Advise all state safety oversight agencies of the circumstances of the January 26, 2010, accident near Rockville Metro Station and urge them to audit the roadway worker protection programs and the procedures of all rail transit operations in their states to ensure that they adequately and effectively address appropriate training, communication, maintenance-vehicle movement authorities, flagging procedures, rules compliance, and the sharing of a work area by multiple work crews. (R-12-33)

Issue guidelines to advise transit agencies and state oversight agencies on how to effectively implement, oversee, and audit the requirements of 49 *Code of Federal Regulations* Section 659.19(r) using industry best practices, industry voluntary standards, and appropriate elements from 49 *Code of Federal Regulations* Part 214, Subpart C—*Roadway Worker Protection*. (R-12-34)

Emphasize the effective implementation and oversight of 49 *Code of Federal Regulations* Section 659.19(r) as part of your safety oversight program audits. (R-12-35)

To the American Public Transportation Association:

Establish guidelines and standards to require that all existing and new hi-rail vehicles be equipped with an automatic change-of-direction or backup alarm that provides an audible signal that is at least 3 seconds long and is distinguishable from the surrounding noise. (R-12-36)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Member

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Vice Chairman

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Member

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Member

Adopted: May 17, 2012

5 Appendixes

5.1 Appendix A: Investigation

The National Transportation Safety Board's Communication Center in Washington, D.C., gathered information concerning the Washington Metropolitan Area Transit Authority accident on the morning of January 26, 2010, which resulted in two employee fatalities. The investigator-in-charge was launched from the Washington, D.C., office. No hearings or depositions were held in conjunction with this accident.

Parties to the investigation included the Washington Metropolitan Area Transit Authority, Federal Transit Administration, Tri-State Oversight Committee, Federal Railroad Administration, and the Amalgamated Transit Union.

5.2 Appendix B: Roadway Worker Transit Fatalities 2002–2010

Year	Agency Name	Incident Date
2002	MTA New York City Transit	03/20/2002
2002	MTA New York City Transit	08/09/2002
2002	MTA New York City Transit	11/21/2002
2002	MTA New York City Transit	11/22/2002
2004	MTA New York City Transit	12/14/2004
2004	Chicago Transit Authority	10/14/2004
2005	Massachusetts Bay Transportation Authority	01/27/2005
2005	WMATA	10/01/2005
2006	WMATA	05/14/2006
2006	WMATA	11/30/2006
2007	MTA New York City Transit	04/24/2007
2007	MTA New York City Transit	04/29/2007
2008	Sacramento Regional Transit District	07/24/2008
2008	San Francisco Bay Area Rapid Transit District	10/14/2008
2009	Miami-Dade Transit	06/19/2009
2009	WMATA	08/9/2009
2009	WMATA	09/10/2009
2010	WMATA	01/26/2010
2010	WMATA	01/26/2010
2010	MTA New York City Transit	04/26/2010

Source: The Federal Transit Administration.