



National Transportation Safety Board

Washington, D.C. 20594

Railroad Accident Brief

Accident No.: DCA-06-FR-005
Transit System: Washington Metropolitan Area Transit Authority Metrorail System
Train: Metrorail Red Line train
Location: Near Dupont Circle Metrorail station, Washington, D.C.
Date: May 14, 2006
Time: 10:16 a.m.¹
Fatalities: 1
Type of Accident: Train strikes wayside worker

Synopsis

About 10:16 a.m. on Sunday, May 14, 2006, a southbound Washington Metropolitan Area Transit Authority (WMATA) Metrorail Red Line subway train struck and killed a Metrorail employee as the train was about to enter the Dupont Circle station in Washington, D.C. The employee was an automatic train control system mechanic who had been working with two other mechanics at the interlocking² just north of the Dupont Circle station. All three mechanics had moved between the two main tracks north of the interlocking in order to stay clear of a northbound train that was leaving the station. As the southbound accident train was arriving, the other two mechanics remained in the clear between the two trains as they passed and were not injured. According to signal system data logs, the southbound train was moving about 40 mph as it traveled past the interlocking.

Events Preceding Accident

About 6:00 a.m. on May 14, 2006, train controllers working the Red Line console at WMATA's Metrorail Operations Control Center³ noticed an anomaly with the track circuit⁴ at the interlocking just north of the Dupont Circle station. The controllers notified the Maintenance

¹ All times in this brief are eastern daylight time.

² The Metrorail system uses double main tracks designated track 1 and track 2. On this section of the Red Line, southbound trains (toward downtown Washington, D.C.) typically use track 1, and northbound trains use track 2. The *interlocking* is a crossover track that allows trains, when necessary, to move from one main track to the other.

³ The *Operations Control Center* coordinates and dispatches all train movements on the Metrorail system.

⁴ The *track circuit* detects the presence of trains and the positions of switches in order to provide for safe train operation. The Metrorail system operates under an automatic train control system that was designed to allow for fully automated train operations requiring very little direct involvement from train operators.

Operations Center, which dispatched an automatic train control system mechanic (referred to in this brief as the “first mechanic”) to Dupont Circle to troubleshoot the system. After reaching the station, the mechanic took readings of the electronic equipment in the train control room and then asked for and received permission from the control center to go wayside in the tunnel to make a visual inspection of the interlocking. (Trains were not running at that time because weekend Metrorail service did not begin until 7:00 a.m.)

About 7:00 a.m., the mechanic reported to the control center that he was clear of the tracks and that the problem with the track circuit had apparently cleared itself. Shortly thereafter, intermittent problems with the track circuit were again reported. Another automatic train control system mechanic (referred to in this brief as the “senior mechanic,” who was struck and killed) on duty at Metrorail’s Brentwood Yard radioed the first mechanic, telling him that he (the senior mechanic) and another mechanic (referred to in this brief as the “second mechanic”) were on their way to assist with the troubleshooting. The first mechanic then returned to the train control room, where he was soon joined by a maintenance helper who had come to help.

The senior mechanic and the second mechanic arrived at the Dupont Circle station about 9:00 a.m., at which time the senior mechanic assumed the lead in directing the work of the crew. Oscilloscope readings showed a slight deviation from normal, so the crew decided to make a second wayside inspection. The maintenance helper stayed behind in the control room as the three mechanics entered the tunnel to examine the interlocking.

Before beginning the work, the second mechanic asked the control center for permission to go wayside to conduct an inspection. The control center controller granted permission and then made a radio broadcast to all train operators on the Red Line that workers were wayside near the Dupont Circle station. No subsequent radio broadcasts were made regarding the work.

Metrorail rules for safety while working on the right-of-way are provided in the *Metrorail Safety Rules and Procedures Handbook*. Rule 4.180b stated:

Prior to entering the track area, contact OCC [the Operations Control Center] for mainline access..., indicating the work area and the purpose of the work. If required, a request shall be made for OCC... to make periodic radio announcements to Train Operators.

A related rule, Rule 4.180.1, stated:

OCC shall make periodic (20-minute) radio announcements to inform Train Operators of those locations at which... maintenance actions are being performed within the dynamic outline⁵] of a train. These announcements shall be made as

⁵ *Dynamic outline*, or dynamic envelope, refers to the total area occupied by a moving train. It not only incorporates the physical dimensions of the equipment but also accounts for suspension travel, overhang on curves, or lateral motion along the track.

deemed necessary and as requested by the maintenance personnel performing the work.

The workers did not request that a speed restriction be placed on trains passing through the area even though Metrorail right-of-way procedures allowed employees to request speed restrictions when necessary for personal safety or for safe passage of trains. Automatic train control maintenance supervisors told the National Transportation Safety Board that the control center discouraged such restrictions because of their effect on train schedules.

The workers turned on the overhead lights at the site of the interlocking, then went wayside. The first mechanic said he had been the lookout while the more experienced mechanics had conducted the inspection.

The *Metrorail Safety Rules and Procedures Handbook*, Rule 4.180h, stated:

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.

The procedures did not include a method to ensure that all members of a work crew were made aware of approaching trains or that all workers were in the clear before those trains arrived.

During the visual inspection of the interlocking, the crew found that some C-bonds⁶ were missing but found nothing else that could be associated with the reported track circuit problem. All three employees then returned to the train control room, which was upstairs, to find shunt straps to replace the missing C-bonds if it became necessary. About 9:45 a.m., the first and second mechanics went back downstairs while the senior mechanic and the maintenance helper remained in the train control room. The senior mechanic adjusted the output to the track circuit relay, after which the circuit appeared to function normally. With the problem apparently resolved, the crew decided to make a full adjustment of the track circuit before departing the station.

Adjusting the track circuit required that the two wayside mechanics place shunts⁷ at various locations while the senior mechanic made final adjustments in the train control room. Again the first mechanic was the lookout while the second mechanic placed the shunts. As the work was underway, trains continued to run, which required the two employees working wayside to occasionally clear the work area for passing trains. They later said that they had not discussed in advance where they would go to clear for trains but that they had either cleared to the opposite

⁶ *C-bonds* are copper wires that bridge a rail joint to provide electrical continuity from one rail section to the next.

⁷ A *shunt* is used to form an electrical bridge to simulate the presence of a train in the circuit.

track or crossed the track and climbed over the third rail⁸ onto one of the safety walkways along either side of the tunnel.

The *Metrorail Safety Rules and Procedures Handbook*, Rule 4.181, stated:

Before permitting employees to be on the track, the person in charge of a work crew shall have an understanding with all crew members as to where each person will go when it is necessary to clear the track for vehicle movement. All crew members should clear on the same side of the track.

The leader of the Dupont Circle work crew (the senior mechanic) did not conduct a job briefing before starting the wayside work or when the number of workers or the nature of the work changed. Such briefings were not required by the rules and procedures handbook.

Accident Sequence

After completing the track circuit adjustments, the senior mechanic asked that a shunt be placed on the problem track circuit to verify that it was operational and could detect a train occupying the circuit. When the shunt failed to indicate the presence of a train, the senior mechanic went wayside to discuss the location of the shunt with the other two mechanics. (The maintenance helper remained in the train control room.) During this discussion, a northbound train approached the Dupont Circle station platform on track 2. The second mechanic said he recalled having called out to announce to the other two workers that a train was coming into the station. Both the first and second mechanics said that as the northbound train continued into the station, they had felt an increase in air pressure in the tunnel, which they associated with the approach of a southbound train on track 1.

The second mechanic said that he had called out again to announce that trains were on both tracks and that the first mechanic had repeated back the message. As the northbound train made its station stop, all three workers started walking to the area between the two main tracks north of the interlocking. The second mechanic took a position adjacent to a metal rack that secured cables descending from the tunnel ceiling to the floor. The first mechanic said that he walked north past the second mechanic and onto a concrete safety walk between the two tracks.⁹

A passenger, who had been on the station platform awaiting the arrival of the southbound train on track 1, reported having seen the three workers prepare for the departure of the northbound train by moving between the tracks. The witness stated that all three workers had appeared to be standing with their backs to track 1. The two mechanics stated, and video evidence and eyewitness statements confirmed, that the senior mechanic had moved to an open area between the tracks adjacent to the crossover. Video evidence also revealed that, at this

⁸ A *third rail*, running along the outside of the two main tracks, provides about 750 volts of electricity to power the trains.

⁹ The two main tracks at the accident site are spaced at 14 feet on center, and the dynamic width of a Metrorail car is 10 feet 11 1/4 inches. Thus, the clearance between passing trains at this location is 3 feet 3/4 inch.

location, the senior mechanic was within the dynamic envelope of a train moving along track 1. (See figure 1.)

The operator of the northbound train said that she did not recall having heard any radio announcements regarding wayside workers near Dupont Circle but that she did see three workers at the other end of the station as her train pulled alongside the passenger platform. She said that when her train had serviced the station and was ready to depart, she signaled the crew by sounding the train horn. She said she received the *all clear* flashlight signal from the worker who appeared to be standing adjacent to track 1 and closest to the station (this was the senior mechanic). She said the other two workers appeared to have walked onto the safety walkway between the two tracks.

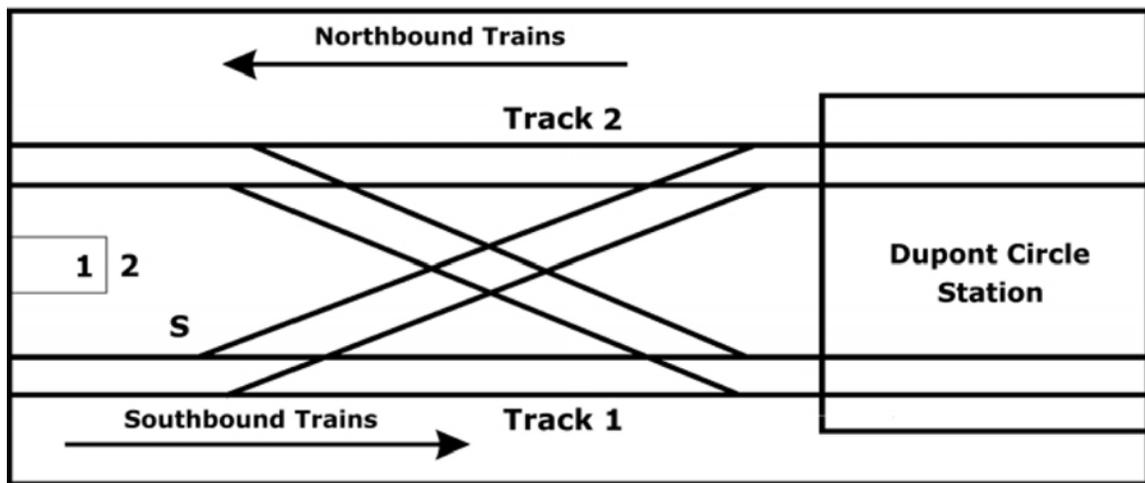


Figure 1. Approximate positions of the first mechanic (1), the second mechanic (2), and the senior mechanic (S) as the northbound train was leaving the Dupont Circle station and the southbound accident train was arriving.

The northbound train operator said that as her train departed the station she continued to look toward the nearest worker (the senior mechanic) until she had passed the work location. She said she then looked up and saw the headlights of an approaching southbound train on track 1.

The operator of the striking southbound train said that he remembered hearing an earlier announcement about wayside workers, but that he did not recall any details of the announcement. He said that as his train approached the Dupont Circle station, he saw the headlights of the northbound train and dimmed his train's lights. He said that as the two trains passed, he heard a loud "boom" followed by a flash of light on the left side of the train. The train brakes applied

automatically, at which time, the operator said, he pressed the emergency stop button. He then recharged the train air line and moved the train ahead until all six cars were along the platform.¹⁰

After the two trains had passed in the tunnel, the first and second mechanics did not see the senior mechanic. A search revealed that he had been struck and killed by the southbound train. They immediately notified the Operations Control Center.

The southbound train operator said that he was about to radio the control center about the incident when an announcement came over the radio that someone had been struck by a train on track 1 at Dupont Circle. All passengers were directed to exit, and the train was secured in place.

Sight-Distance Tests

Safety Board investigators conducted postaccident sight-distance tests at the Dupont Circle interlocking. The tests revealed that the workers could be seen and recognized as wayside workers at a distance of about 280 feet. At a train speed of about 40 mph, the train operator thus would have been able to detect the wayside workers about 5 seconds before the train traveled past their location.

Actions Taken in Response to Accident

On June 26, 2006, WMATA issued Special Order 06-05, which added an additional paragraph to the *Metrorail Safety Rules and Procedures Handbook*. The new paragraph, Rule 4.180k, follows:

4.180k. To protect mainline work crews engaged in work for a period of more than three minutes at a stationary location on the right-of-way, restricted speeds entering the work site shall be established by using one of the following methods.

The methods included the following, among others: place shunt straps at track locations that cause the automatic train control system to reduce train speeds to 15 mph through at least 30 percent of the work area, use the automatic train control system to implement temporary speed restrictions in the affected area, and take action to force red (*stop*) aspects at approaches to the work area until all workers can be confirmed to be in the clear. The speed restrictions did not apply to inspections (as opposed to “hands-on” work), but inspectors could ask for restricted speeds if deemed necessary for safety.¹¹

¹⁰ When the operator of the striking southbound train returned to his job after the accident, he was retrained on the proper procedures that are required after an emergency brake application.

¹¹ After another fatal accident on the Metrorail system about 6 months after the Dupont Circle accident, WMATA, on February 22, 2007, issued Special Order 07-01, which superseded Special Order 06-05 and provided additional operational restrictions for train operators approaching work areas. WMATA subsequently issued Special Orders 07-02 and 07-06, which further revised or supplemented wayside safety rules and procedures. For more information, see <<http://www.nts.gov/publicctn/2008/RAB0802.pdf>>, National Transportation Safety Board. *Washington Metropolitan Area Transit Authority Train Strikes Wayside Workers Near Eisenhower Avenue Station*,

Probable Cause

The National Transportation Safety Board determines that the probable cause of the Dupont Circle accident was the failure of the automatic train control system (senior) mechanic to stay clear of the approaching southbound train either because he was not aware of the presence of the train or because he lacked a physical reference by which to identify a safe area outside the train's dynamic envelope. Contributing to the accident were Washington Metropolitan Area Transit Authority Metrorail right-of-way rules and procedures that did not provide adequate safeguards to protect the wayside personnel from approaching trains, that did not ensure that train operators were aware of wayside work being performed, and that did not adequately provide for reduced train speeds through work areas. Also contributing to the accident was the lack of an aggressive program of rule compliance testing and enforcement on the Metrorail system.

Recommendations

As a result of its investigations of this accident and a November 30, 2006, fatal accident involving the striking of wayside workers by a Metrorail Yellow Line train,¹² the National Transportation Safety Board made the following safety recommendations to the Washington Metropolitan Area Transit Authority. (For more information about these recommendations, see the safety recommendation letter issued to the recipient.¹³)

To the Washington Metropolitan Area Transit Authority:

1. Review your *Metrorail 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.

Alexandria, Virginia, November 30, 2006, Railroad Accident Brief NTSB/RAB-08/02 (Washington DC: NTSB, 2008).

¹² See National Transportation Safety Board, *Washington Metropolitan Area Transit Authority Train Strikes Wayside Workers Near Eisenhower Avenue Station, Alexandria, Virginia, November 30, 2006*, Railroad Accident Brief NTSB/RAB-07/XX (Washington DC: NTSB, 2007). <<http://www.nts.gov/publictn/2008/RAB0802.pdf>>

¹³ The recommendation letter is available on the Safety Board's Web site at <www.nts.gov>.

- 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)
2. Establish a systematic program for frequent unannounced checks of employee compliance with Metrorail operating and safety rules and procedures. (R-08-02)
 3. 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)
 4. 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)

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