



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: April 19, 2006

In reply refer to: R-06-1 and -2

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The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

These recommendations address the lack of a rollback protection feature when trains are operated in the manual mode and the crashworthiness of Metrorail 1000-series railcars. The recommendations are derived from the Safety Board's investigation of the November 3, 2004, collision between two Washington Metropolitan Area Transit Authority (WMATA) Metrorail trains at the Woodley Park-Zoo/Adams Morgan (Woodley Park) station in Washington, D.C. and are consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Board has issued six safety recommendations, two of which are addressed to WMATA. Information supporting these recommendations is discussed below. The Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendations.¹

On Wednesday, November 3, 2004, about 12:49 p.m., eastern standard time, WMATA² Metrorail train 703 collided with train 105 at the Woodley Park station in Washington, D.C. Train 703 was traveling outbound on the Red-Line segment of the Metrorail system and ascending the grade between the Woodley Park and the Cleveland Park underground stations, when it rolled backwards about 2,246 feet³ and struck train 105 at a speed of about 36 mph. Train 703 was operating as a nonrevenue train; that is, it was not carrying passengers. Train 105, a revenue

¹ For additional information, see National Transportation Safety Board, *Collision Between Two Washington Metropolitan Area Transit Authority trains at the Woodley Park-Zoo/Adams Morgan Station in Washington, D.C., November 3, 2004*, Railroad Accident Report NTSB/RAR-06/01 (Washington, DC: NTSB, 2006).

² WMATA is responsible for the Metrorail and Metrobus systems that serve Washington, D.C., and the surrounding suburbs in Maryland and Virginia. Although WMATA is responsible for rail and bus services, this report focuses exclusively on the Metrorail system.

³ This estimate is based on calculations provided by WMATA.

train, was in the process of discharging and loading passengers at the Woodley Park station. There were about 70 passengers on board train 105. Some passengers had exited the train just before or during the collision. The District of Columbia Fire and Emergency Medical Service transported about 20 persons to local hospitals. Estimated property damages were \$3,463,183.

The National Transportation Safety Board determined that the probable cause of the November 3, 2004, collision between two WMATA trains at the Woodley Park station was the failure of the operator of train 703 to apply the brakes to stop the train, likely due to his reduced alertness. Contributing to the accident was the lack of a rollback protection feature to stop the train when operated in the manual mode.

WMATA officials had initially informed Safety Board investigators that they believed that all of their cars were equipped with a rollback protection feature. Later, it was determined that the rollback protection feature was available in the automatic mode for all equipment but only for the rehabilitated 2000- and 3000-series cars in the manual mode. Therefore, the Board issued an urgent safety recommendation to WMATA on November 22, 2004, because rollback protection was not available in the manual mode for all equipment:

R-04-9

Immediately revise the directions to train operators contained in your memorandums of November 7 and 9, 2004, to include specific written instructions for identifying and responding to an emergency rollback situation, and provide training to operators on the procedures to follow if such a rollback event occurs. (Urgent)

WMATA has sent the Safety Board two letters, dated November 23, 2004, and February 15, 2006, explaining the actions it has taken to address the rollback protection safety issues and the Board's related concerns raised by the November 3, 2004, accident. WMATA's guidance prescribes that a rollback is to be stopped by application of the train brake, but also allows for a rollback of 5 seconds before the operator must make a maximum brake application. If the train does not stop in another 4 seconds, the emergency brake is to be applied. The Board finds WMATA's 2004 and 2006 responses to be lacking in that WMATA has not addressed train speed during a rollback event. The Board's postaccident simulation testing found that trains that did not have the rollback protection feature could be controlled only by applying the train brakes when the train speed exceeded 2 mph in a rollback situation. However, WMATA has not provided a discussion in its written instructions and training that explains that once rollback speed exceeds 2 mph, the train cannot be stopped by applying forward power, and brakes must be applied.

Rollback protection is an engineered safety redundancy. The train operator is primarily responsible for safety in accordance with all established procedures. In the event a train operator fails to take appropriate action to prevent a train from rolling backwards within predetermined limits, the rollback protection feature is designed to safely stop the train. WMATA obviously saw value in this feature because its entire fleet was equipped with it in the automatic mode. WMATA also assumed its fleet was equipped with the rollback protection feature in the manual mode, but was unaware of the fact that it was not. Therefore, the Safety Board concluded that WMATA was unaware, at the time of the accident, that the rollback protection feature was generally not

available when a train was operated in the manual mode, and consequently no specific training was provided to operators about the lack of this feature on all cars. The Board could not determine why WMATA neglected to equip its fleet with the rollback protection feature in the manual mode or why WMATA was unaware of the lack of this safety redundancy feature within its entire fleet.

The rollback protection feature was readily available in the transit industry for the type of cars WMATA operated. One of WMATA's primary car building and refurbishing contractors had been installing and maintaining the rollback protection feature in manual mode on similar equipment for another transit agency for many years. Therefore, the Safety Board concluded that if the equipment on train 703 had been equipped with a rollback protection feature in the manual mode, the train could have been safely stopped, regardless of the train operator's action or inaction, and the accident could have been prevented.

In this accident, the last car of train 703 sustained damage that was vastly disproportionate to that sustained by the lead car of train 105. The carbody structure of car 1077 inboard of the collision posts failed, which demonstrates a fundamental flaw in the crashworthiness structural design of the 1000-series carbody. Even though the anti-climber showed indications of engagement,⁴ the last railcar of train 703 telescoped and overrode the leading end of the first railcar of train 105, sustaining a catastrophic loss of approximately 34 feet of survival space in the passenger compartment. However, the collision post elements of the lead car of train 105 remained intact, and the operator's cab was not compromised.

The Woodley Park station collision scenario was not much different from that of the January 1996 collision at the Shady Grove station.⁵ In that accident, the collision speed was calculated between 22 and 29 mph occurring on a 0.35-percent descending grade of straight track with the moving train telescoping 21 feet over the stopped equipment, severely compromising the occupant volume of the striking car. In the November 3, 2004, accident, the calculated speed of train 703 was 36 mph as it rolled backwards down a 3.72-percent descending grade of straight track and collided with stopped train 105 and telescoped 20 feet over it. Almost half of the passenger occupant volume of the striking car of train 703 was also severely compromised.

In WMATA's March 2002 response to the Safety Board's recommendation (R-96-37) to conduct a comprehensive evaluation of Metrorail cars and make modifications to improve their crashworthiness, WMATA stated that its consultant determined that it was neither practical nor desirable to add underframe reinforcement and that such modification possibly could result in more injuries. WMATA also stated that it would have been impractical to modify the 1000-series Metrorail cars before they are scrapped and it would be prohibitive to modify the 2000, 3000, and 4000 series when they are refurbished. As a result of this response, the Board classified Safety Recommendation R-96-37 "Closed—Acceptable Action" based on the

⁴ *Engagement* was indicated by the shear damage to the anti-climber flanges (teeth), which suggested that there was positive engagement with the anti-climber of the adjacent railcar (4018).

⁵ National Transportation Safety Board, *Collision of Washington Metropolitan Area Transit Authority Train T-111 with Standing Train at Shady Grove Passenger Station, Gaithersburg, Maryland, January 6, 1996*, Railroad Accident Report NTSB/RAR-96/04 (Washington, DC: NTSB, 1996).

information that WMATA's position on the existing fleet was reasonable and that the intent of the recommendation had been met.

The Safety Board concluded that the failure of the carbody (underframe) end structure of the 1000-series Metrorail cars may make them susceptible to telescoping and potentially subject to a catastrophic compromise of the occupant survival space. WMATA's evaluation, which determined that it was impractical to modify the 1000-series cars and their crashworthiness performance in collisions, in effect validates the scheduled retirement of the cars.⁶ Any replacement car should be designed with crashworthiness components for absorbing maximum energy in a collision and to transmit minimum acceleration to passengers without override or telescoping, as found in the current 5000-series railcars and specified for the 6000-series cars.

The National Transportation Safety Board therefore makes the following safety recommendations to the Washington Metropolitan Area Transit Authority:

Equip, as soon as possible, all existing and future train equipment with rollback protection for trains operated in the manual mode. (R-06-1)

Either accelerate retirement of Rohr-built railcars, or if those railcars are not retired but instead rehabilitated, then the Rohr-built passenger railcars should incorporate a retrofit of crashworthiness collision protection that is comparable to the 6000-series railcars. (R-06-2)

In addition, the Safety Board is disappointed that the Washington Metropolitan Area Transit Authority's response noted that it will not address train speed factors in its written instructions for identifying and responding to a rollback situation. Therefore, Urgent Safety Recommendation R-04-9, previously classified "Open—Acceptable Response," was reclassified "Open—Unacceptable Response."

The Safety Board also issued safety recommendations to the Federal Transit Administration. In your response to the recommendations in this letter, please refer to Safety Recommendations R-06-1 and -2. If you need additional information, you may call (202) 314-6177.

Acting Chairman ROSENKER and Members ENGLEMAN CONNORS, HERSMAN, and HIGGINS concurred in these recommendations.

[Original Signed]

By: Mark V. Rosenker
Acting Chairman

⁶ The 1000-series cars (292 cars) are currently scheduled for retirement between 2012 and 2015. The 4000-series cars (100 cars) will begin their mid-life rehabilitation in 2012. WMATA plans to have in service during 2006 its 5000- (192 cars) and 6000- (184 cars) series Metrorail cars and have completed the rehabilitation of the 2000- (76 cars) and 3000- (288 cars) series cars.