

Log R-401

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: MAR 19 1982

Forwarded to:
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SAFETY RECOMMENDATION(S)
R-82-8 through -18

About 1630, e.s.t., on January 13, 1982, Washington Metropolitan Area Transit Authority (WMATA) Blue/Orange Line Train 410 derailed at the Smithsonian interlocking 1/ in Washington, D.C. While being operated manually, Train 410 had been unintentionally routed from the northbound main track into a crossover track and passed into the switch to the southbound main track. When a supervisor attempted to back the train clear of the crossover track, the former lead car derailed and struck a concrete curtain wall separating the two main tracks. The curtain wall penetrated the car near the left center door, peeled the car side open, and caused the failure of the upper and lower side sill extrusions as well as lateral floor beam and intercostal beam attachments. There was substantial displacement of windows, seats, and interior trim panels. As a result of damage to the support structure, a section of floor dropped out and roof panels dropped into the penetration area. Of the approximately 220 passengers on the car, 3 were killed and 24 were injured.

The accident occurred on WMATA's "downtown" trunk subway used by both the Blue and Orange Lines between Rosslyn and Stadium-Armory stations. In this 6 1/2-mile section there are 11 intermediate stations and 5 double-crossover interlockings with the interlockings generally about 1 mile apart. The subway is double track with established direction of traffic on each track. Originally, the crossover tracks were not intended for use in routine operations but rather were provided to permit continued single-track operation while an emergency or other abnormal condition existed. However, the Safety Board's ongoing investigation of this accident has developed that due to widespread mechanical and control problems with WMATA trains, the use of the crossover tracks has become commonplace.

For about a half-hour before the accident, WMATA's Operations Control Center (OCC) had been unable to align the northbound facing point crossover switch at the Smithsonian interlocking to its normal main track position by remote command because of a wayside control malfunction. However, the remote command did throw the switch at the other end of the crossover so that it was aligned for normal movement on the southbound main track. The OCC had no way of knowing how either switch was actually aligned, because the oscilloscope at the OCC was so designed that it could indicate only

1/ WMATA defines an interlocking as "An arrangement of signals and signal appliances so interconnected that their movements succeed each other in proper sequence." Smithsonian, or DO2, interlocking consists of double crossover tracks connected by switches to the two main tracks. The interlocking limits are the switchpoints of the opposing switches of each crossover track.

that the switch positions did not correspond under the circumstances. Therefore, a transportation supervisor was sent to the interlocking to manually align the crossover switches and direct trains through the interlocking. Because of the control malfunction, it was necessary for train operators to switch from the fully automatic Mode 1 to manual operation before they could leave the Smithsonian or Federal Triangle stations, which are on each side of the interlocking, and approach and pass through the interlocking. WMATA operating rules required OCC authorization before a train operator could change from fully automatic Mode 1 to manual operation.

A manually operated WMATA train is subject only to the protection of the onboard overspeed device, and as long as the train is operated below the overspeed setting (nominally 15 mph) the train can be operated continuously through a succession of track circuits even though the allowable speed command for those circuits is zero miles per hour. There are a number of sharp curves on the Blue/Orange trunk line, many of which are located in the approaches to station platforms and interlockings. The combination of curvature and the curtain wall between the tracks reduces forward visibility at these critical locations. This is the case at Smithsonian interlocking, where the track sections between the interlocking limits and the adjacent station platforms are laid entirely in 7-degree 30-minute curves and their spirals. There is no automatic train stop or other collision-avoidance system which would prevent a manually operated train from colliding with a standing train in a limited visibility location.

According to the supervisor in charge of the OCC at the time of the accident, it was the practice to remove trains which could not operate in the fully automatic mode from service during off-peak hours. However, because of a general shortage of equipment, manually operated trains were routinely kept in service during rush hours when nominal operating headway on the Blue/Orange Trunk Line is reduced from 6 to 3 minutes. As many as three or four manually operated trains might be in service simultaneously.

After the OCC became aware of the switch problem in the Smithsonian interlocking, two manually operated southbound trains were allowed to pass through the interlocking about 2 minutes apart on the basis of radio instructions from the OCC. The instructions to the first train were in violation of WMATA signal rules, and the instructions to the second train were never acknowledged. Neither train was actually authorized to operate in the manual mode. About 2 1/2 minutes after instructing the second southbound train, the OCC told northbound Train 410 and a third southbound train to approach the interlocking and operate through it on the instructions of the supervisor at the location. Only Train 410 acknowledged this communication. Neither train was told what route it was to take through the interlocking. The OCC did not make a second effort to contact the third southbound train, and Train 410 was not ordered to hold its position pending clarification of the situation. Train 410's proceeding through the crossover track could have resulted in a head-on or side-rake collision, with the opposing trains each moving as fast as 15 mph.

A WMATA standard operating procedure provides for the establishment of absolute block operation (restricting the occupancy of a track section between specific locations to only one train at a time) whenever there is a failure of the wayside automatic train control system (ATC) or when it is necessary to cut out the operation of a train's overspeed device en route. However, the Safety Board believes that in order to eliminate the possibility of train collisions, the absolute block procedure should specifically be required in all instances where it is necessary to operate trains manually with stations being designated as the limits of all absolute blocks.

A WMATA rule prohibits employees attempting to back a train through a switch that has been run through without instructions from the OCC or a yard supervisor. However, the Safety Board's investigation has developed that the OCC authorized the reverse movement of Train 410 which resulted in its derailment before the OCC determined if a switch had been run through or if it was otherwise safe to make a reverse movement. The Safety Board learned that reverse movements are commonly made in crossover tracks on the WMATA without determining that it is safe to make the reverse movement. The Safety Board believes that a broader rule which places responsibility on the OCC to determine that a reverse movement is safe before it is authorized is needed to prevent a recurrence of this type of accident.

A single controller was handling all radio traffic on the entire Metrorail System and there was a continuous flow of problem reports over the radio channels at the time. This possibly contributed to the OCC's failure to properly instruct the trains at the Smithsonian interlocking. The supervisor in charge was an experienced, qualified controller, and he attempted to take over the handling of one of the two operations radio channels. However, he was unable to do so since the only available extra headset was inoperative. After the accident, the OCC supervisor had to leave the OCC room to go to the transit police dispatcher and maintenance command center elsewhere in the building because the internal "hot line" intercoms used to communicate with those offices were also out of order.

The supervisor in charge of the OCC had not ridden over the Blue/Orange trunk line since it was opened to service, and he lacked a close working familiarity with the physical characteristics of the subway in the accident area. However, the supervisor and other OCC personnel were not required to periodically refresh their knowledge of the system. Although WMATA has revised its original operating rules and has issued a number of new or revised operating procedures, there has been no formal program for periodic retraining of rail supervisors and employees on the rules and procedures. Neither the OCC supervisor nor the controller directly involved in this accident had a good working knowledge of rules and procedures, and neither man had received any retraining in this area.

The transportation supervisor who had been instructed to align the crossover switches at the Smithsonian interlocking and to subsequently direct trains through the interlocking stated that he had only performed these functions three or four times in the 3 years he had been a supervisor. Further, he said that he had not received formal retraining on rules and procedures since he had been qualified as a train operator 2 years earlier. Although he was authorized by the OCC to back Train 410 in an effort to clear the crossover track, the supervisor stated that he had not determined beforehand whether the train had run through the switch. The Safety Board believes that the supervisor lacked adequate training and experience to deal properly with the operating situations that existed prior to the derailment.

Following the derailment, the circuit breakers opened automatically on the third-rail power circuits for both tracks between the Smithsonian interlocking and the Federal Triangle station. However, the OCC did not take the precaution to command the breakers open to insure that they did not close automatically later and energize the third rail. After the evacuation of the damaged car had begun, the breaker for the southbound third-rail circuit closed and the third rail was energized. The damaged car was still in contact with the third rail so as to create a hazard to passengers still on the car, those in the process of evacuating the car, and rescue workers at the scene. The OCC was aware that the third-rail power circuits for both tracks were deenergized and could have kept open the breaker for the southbound third-rail circuit on command.

There were five WMATA supervisors and employees at the accident location immediately after the accident occurred who could have begun a timely evacuation of passengers to the Federal Triangle station platform, only 150 feet from the rear car of the train. Nevertheless, more than 1,100 passengers were kept aboard the undamaged rear five cars for as long as 30 minutes because no WMATA employee at the scene was authorized to begin evacuation of these cars.

WMATA has several written procedures for train evacuation in force, but their preferred procedure of evacuating passengers to an empty "rescue" train could not be used on January 13 due to the loss of third-rail power. The "last resort" method which was used necessitated the evacuation of passengers to track level. This included many time-consuming prerequisite conditions, including racking out and tagging circuit breakers at substations. A prolonged confinement of the passengers on the train was therefore unavoidable if the "last resort" procedure was followed in detail. Although the OCC's ability to ensure that power circuits remain deenergized before an evacuation is begun should be maintained, the procedures should be streamlined to permit a more timely evacuation of able-bodied passengers. WMATA rail supervisors and employees will need to be given greater responsibility with commensurate training to effectively handle evacuations on a timely basis.

Although a few of Train 410's passengers left the train by knocking out windows or by exiting through end doors between cars to jump to track level, most had no idea of what to do in the situation. WMATA has no program to educate subway passengers as to how they should respond before and during an evacuation of a train.

Therefore, the National Transportation Safety Board recommends that the Washington Metropolitan Area Transit Authority:

Modify its operating rules and standard operating procedures to require the establishment of an absolute block whenever it is necessary to operate a train in other than the fully automatic mode. (Class I, Urgent Action) (R-82-8)

Include in its operating rules a requirement that whenever it is necessary to operate a train manually, the Operations Control Center will not permit the train to proceed into the block to the next station as long as that block is occupied by another train. If there is an interlocking between the stations, require that the absolute block between the stations will apply to both main tracks unless the Operations Control Center has an oscilloscope indication that all crossover switches are aligned for main track movement. (Class I, Urgent Action) (R-82-9)

Include in its operating rules a requirement that train operators report to the Operations Control Center whenever they are unable to operate in the fully automatic mode, and enforce the operating rules requiring authorization by the Operations Control Center to change operating modes. (Class I, Urgent Action) (R-82-10)

Include in its operating rules a requirement that before a manually operated train is permitted to enter a block containing an interlocking, the Operations Control Center must instruct the train's operator as to the intended route for the train and receive proper acknowledgement from the operator. (Class I, Urgent Action) (R-82-11)

Modify its operating rules to prohibit the reverse movement of a train within interlocking limits until it has been established that no derailment has occurred, that switches are properly aligned, and that there are no conflicting train movements. (Class I, Urgent Action) (R-82-12)

Improve the maintenance and redundancy of the communications equipment in the Operations Control Center and of "hot line" intercoms between the Operations Control Center and the other Washington Metropolitan Area Transit Authority command centers to provide continuous communications between all centers. (Class I, Urgent Action) (R-82-13)

Provide radio communicating capability for the Operations Control Center that is commensurate with peak radio traffic demands of the expanding Washington Metropolitan Area Transit Authority rail system. (Class II, Priority Action) (R-82-14)

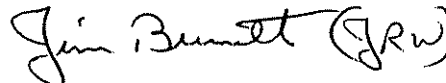
Upgrade the training given to rail transportation supervisors and assign them the necessary authority to effectively supervise train operations and correctly deal with the full range of operating situations. (Class I, Urgent Action) (R-82-15)

Implement a program of mandatory periodic instruction and examination on the combined book of operating rules and standard operating procedures, including emergency train evacuation procedures, for all rail supervisors and train operators. (Class I, Urgent Action) (R-82-16)

Amend its standard operating procedures to require the Operations Control Center (1) to require that, whenever a train emergency which requires evacuation is known to exist at a location between stations, all third-rail power circuits between the emergency location and the stations on each side of that location be deenergized as soon as all other trains have cleared the area, and (2) to direct the nearest qualified rail employee to begin the timely evacuation of passengers from the train. (Class I, Urgent Action) (R-82-17)

Implement a continuing program to educate passengers on the procedures to be followed when it is necessary to evacuate a disabled train. (Class I, Urgent Action) (R-82-18)

BURNETT, Acting Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.



By: Jim Burnett
Acting Chairman