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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: October 15, 1982

Forwarded to:

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SAFETY RECOMMENDATION(S)

R-82-55 through -77

About 1630, e.s.t., on January 13, 1982, Washington Metropolitan Area Transit Authority (WMATA) northbound Blue/Orange Line train No. 410 derailed at the Smithsonian Interlocking on the downtown subway (Metrorail) line in Washington, D.C. While being operated manually, train No. 410 had been unintentionally routed into a crossover track at the interlocking. Without requiring a supervisor, who was at the location, or the train operator to ascertain that it was safe to do so, the WMATA Operations Control Center (OCC) allowed the supervisor to back the train out of the crossover track. As this was being done, the rear car derailed and struck the end of a reinforced concrete barrier wall separating the two main tracks in the subway tube. The aluminum sidewall of the car was severed and the main passenger compartment was breached. Of the approximately 220 passengers on the car, 3 were killed and 25 were injured. Damage to property was estimated to be $1,325,000. 1/

Following the accident, it was learned that the control fusetron governing the remote throwing of switch 1A at Smithsonian Interlocking from reverse to normal position had failed 3 days before the accident. This failure generated a "Class 1" train control fail alarm on the video display screen in the OCC. Because of the large number of incoming alarms, mostly of the less serious, train-oriented "Class 2" type, and the fact that only 15 alarms could be displayed simultaneously, the switch 1A alarm was displayed only briefly. However, the alarm was repeatedly printed on the train control alarm log between January 10 and 13. Nevertheless, the OCC personnel failed to acknowledge the alarm and to report it to Maintenance Control as required. It was also learned that although maintenance personnel were at the fusetron six times following the failure, they apparently failed to observe that the fusetron's popup failure indicator was in the up or failed position.

About 40 minutes before the accident occurred, the OCC reversed crossover switches 1A and 1B of the interlocking to detour six National Airport-bound trains around a disabled train standing on the D-2 track at the Federal Triangle Station. After this detour operation was completed, the OCC attempted to return switches 1A and 1B to normal position. Switch 1B threw as commanded, but switch 1A connecting the crossover track with the D-1 track remained in reverse position because of the failure of a wayside control fuse in the automatic train control (ATC) system. The OCC personnel could not

1/ For more detailed information, read Railroad Accident Report—"Derailment of Washington Metropolitan Transit Authority Train No. 410 at Smithsonian Interlocking on January 13, 1982" (NTSB-RAR-82-6).

tell which of the switches had failed to align in normal position since, by design, the cathode ray tube (CRT) video display screen at the OCC could only indicate that the position of the two switches did not correspond as required. Because the switches were not correspondingly aligned, the interlocking signals displayed a red "stop" aspect and could not be cleared. As a result, all trains could only be operated manually through the interlocking.

A WMATA standard operating procedure required the establishment of a temporary 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 in the ATC system such as occurred in this instance. Rail Transportation Supervisor No. 31 (supervisor) was sent to Smithsonian Interlocking by the OCC, as required, to align and block the affected switches for normal main track movement, and to manually control the movement of trains through the interlocking. However, the OCC concentrated on restoring National Airport-bound train operations instead of first determining which of the switches had failed to throw as commanded, and gave the supervisor fragmented, imprecise, and incomplete instructions. But given the manner in which the supervisor was instructed to work, the last thing left to be done was the one thing that should have been done first.

After placing the interlocking under the control of the supervisor without first determining the position of switch 1A, the OCC ordered two National Airport-bound trains to proceed through the interlocking. This was a serious safety violation that could have resulted in a collision between opposing trains. Subsequently, the OCC instructed the operators of opposing trains Nos. 410 and 906 to approach the interlocking and to operate through it on the instructions of the supervisor. However, the operator of train No. 906 did not hear and acknowledge this radio transmission and the OCC made no further attempt to contact the train operator. In further violation of the rules and safe practice, the OCC did not stop train No. 410 pending clarification of the situation but allowed it to proceed into the interlocking. The OCC also failed to impose a special speed restriction through the interlocking and the supervisor did not inform the operator of the intended route for his train.

After train No. 410 passed into the crossover track because switch 1A had not been aligned for normal movement, the supervisor repeatedly called for the operator to stop. The operator complied, but before the train stopped it had trailed through switch 1B into the D-2 main track. Assuming it was safe to do so, the supervisor asked the OCC for permission to pull the train back. The OCC radio controller heard the supervisor repeatedly tell the train operator to stop, was told by the supervisor that they could not run trains until he pulled the train back, and should have seen the "phantom" track circuit occupancies that appeared on the CRT screen as train No. 410 moved through the crossover. Despite this evidence that train No. 410 had probably run through switch 1B, the controller and his superior in the OCC allowed the supervisor to make the reverse movement which resulted in the derailment.

Although WMATA officials stated that the maximum permissible speed in a crossover track of a manually operated interlocking was 5 miles per hour, the supervisor was operating train No. 410 in maximum power when the derailment occurred. As a result, the train accelerated to the maximum unregulated speed of 15 miles per hour possible under WMATA's manual Mode 2 operation before the overspeed feature automatically initiated loss of power and braking. Had the train been operated at the prescribed 5 miles per hour, impact with the barrier wall might have been avoided or at least had only minimal effect. The train would have been stopped short of the barrier wall altogether had the derailed car been equipped with a functioning derailment detection bar system.

Supervisors and employees involved in this accident did not have a proper understanding of what was constituted by "restricted speed" although the term was used liberally in the conduct of operations. WMATA did not define "restricted speed" in its rules and procedures, but apparently considered it to be the minimal 15 miles per hour enforced by the overspeed control.

During the 40-minute period preceding the accident, at least five other Blue/Orange Line trains were being operated in the manual Mode 2 in addition to trains Nos. 410 and 906 at Smithsonian Interlocking. In this operating mode, the trains could be moved across the entire line, through successive zero miles per hour track circuits and past red interlocking signals without stopping as long as speed was kept below the nominal 15-mile-per-hour setting of the overspeed control. The investigation developed that the operation of trains in manual Mode 2 was commonplace, particularly during peak traffic periods when trains have heavy passenger loads and operating headway is reduced to 3 minutes. WMATA is the only automated rapid transit system which permits unregulated operation of revenue trains without overspeed protection or some form of limiting collision-avoidance protection such as train orders, clearance forms, or wayside block signals. As long as such operation is permitted, the potential for train collisions will continue to exist.

This accident, as well as a 1977 side collision between two WMATA trains at the Rhode Island Avenue Interlocking, demonstrated the inability of WMATA's cars to withstand relatively low-speed side impacts even when delivered at a narrow angle. Collision of the car with the barrier wall probably occurred at a speed of less than 10 miles per hour, yet the car's lightweight aluminum sidewall extrusions and underframing were insufficient to prevent the wall from deeply penetrating the car.

Any substantial separation between the cars, such as occurred in this accident, will result in a parting of the trainline and immediate shorting out of the entire battery power system rendering all emergency systems inoperative. Lighting is lost as well as the intercom and radio systems for communication. Had a WMATA policeman with a portable radio not been on the derailed car and had other supervisors who also had radios not been nearby, there would have been a substantial delay in reporting the derailment and injuries.

WMATA's cars do not have removable emergency exit windows and there are no posted instructions enabling passengers to find and operate the manual emergency door controls. As a result, the passengers had to knock out the windows when the conditions in the derailed car became unbearable. WMATA has not had a program to educate passengers on emergency procedures. Further, the OCC delayed shutting down two traction power circuit breakers and failed to command open a third to prevent automatic reclosure. As a result, the third rail was energized as the passengers were being evacuated and were walking alongside it.

During the 30 minutes preceding the accident, widespread equipment breakdowns caused long delays, created the need for several single-track runaround operations, and severely disrupted operations over the entire system. This, in combination with weather conditions and the early release of downtown office workers, led to the overcrowding of stations and trains and placed enormous stresses on the OCC personnel. Although bad weather had been predicted and WMATA had been told of the early release, WMATA operating officials had failed to invoke the storm alert standard operating procedure to prepare for the situation.

The WMATA ATC system was designed to provide "fully automated train operations" by means of a control computer in the OCC. The computer was supposed to monitor total system performance, perform the various ATC functions, and select the various strategies necessary to regulate train operations. Supervisory controllers were responsible for monitoring the CRT's, responding to alarms, and for initiating action when an emergency or other problem occurred that the ATC system could not handle. It was not intended that the controllers manage the routine train operations, but they had assumed this role as difficulties with the ATC and frequent train breakdowns regularly disrupted normal operations. It is evident that the ATC system never became completely functional or fully reliable. The OCC facility was neither designed nor adequately equipped for fully manual operation, and the controllers did not have the training and expertise necessary to manage train operations.

The Safety Board's investigation showed that potentially dangerous situations were frequently created by the OCC radio controller through the use of incomplete and nonstandard terminology during two-way radio traffic. This was particularly critical in light of the manner in which WMATA identifies its interlockings and signals on the Blue/Orange Line. Each of the interlockings had signals numbered identically, and to differentiate between them, WMATA had prescribed the interlocking identification -- CO2, DO2, KO2, etc, -- to be a part of the signal number. The controller habitually omitted the interlocking identification portion of the signal number in his transmissions to train operators. In combination with the unregulated speed feature of the Mode 2 operation, a misunderstanding could have resulted in a train inadvertently being advanced past a signal. It was further revealed that many verbal instructions issued to the OCC personnel by higher authority did not conform to the rules and standard operating procedures.

WMATA had afforded very little formal training to the OCC personnel and virtually none to the rail transportation supervisors. The personnel in the OCC urgently needed to acquire a working knowledge of the rules and procedures, the physical characteristics of the rail system and the fundamentals of rail transit operation. Although train operators received an extensive initial training course, the quality of this course and the capability of the instructors were never evaluated. There was no provision for periodic retraining and recertification. Although WMATA had been urged in the past to place its Metrorail training program under the aegis of a management-level, man-system specialist, this had never been done.

Because WMATA's radio repeater system in the subway could not accommodate the District of Columbia Fire Department's radio frequencies, the Fire Department had to rely on the Metrorail telephone line and messengers to communicate between the accident site and the Fire Department's command posts. Although the Safety Board understands that WMATA has contracted to have the entire subway radio repeater system modified to correct the problem by 1983, effective interim measures should be immediately put in place to provide emergency forces with adequate communications ability.

Although WMATA and the Fire Department had jointly conducted disaster simulation drills prior to the accident, these drills would have been more valuable had they also involved rescue units from the suburban areas, the Metropolitan Police, and area hospitals. The investigation revealed that, following the accident, the hospitals had not been informed prior to the arrival of the injured, the police had not cleared routes from the accident site to the hospitals, and there was no area-wide disaster plan under which rescue units outside the District of Columbia could play a meaningful role in a major emergency.

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

Immediately implement an indepth continuing training program for controllers and their superiors in the Metrorail Operations Control Center which includes instruction in the rules, procedures, and fundamentals of rail transit operations; familiarization with all Metrorail operations; radio protocol; and periodic testing and certification by a professional training specialist who is knowledgeable in rail transit operations. (Class I, Urgent Action) (R-82-55)

Establish a Training Department for Metrorail that is accountable to top WMATA management and is staffed by professional specialists in this field. (Class II, Priority Action) (R-82-56)

Evaluate the quality of the curriculum, instruction, training aids, and periodic certification process of the present Metrorail train operators' training course, and implement necessary improvements. (Class II, Priority Action) (R-82-57)

Modify the overspeed control on the Metrorail cars to enforce speed commands of the Automatic Train Protection subsystem to and including zero miles per hour. (Class II, Priority Action) (R-82-58)

Change the identification numbers of its interlockings and interlocking signals to eliminate possible misunderstandings which could result in a train improperly passing a restricting signal. (Class II, Priority Action) (R-82-59)

Require the Metrorail Operations Control Center personnel, rail transportation supervisors, and train operators to refer to all signals by their complete and proper designation. (Class II, Priority Action) (R-82-60)

Require that the Metrorail Operations Control Center personnel and transportation supervisors understand and implement provisions of Standard Operating Procedure No. 15 for the establishment of an absolute block when there is a failure in the Automatic Train Control system. (Class I, Urgent Action) (R-82-61)

Include in Metrorail operating rules a definition of restricted speed. Establish and require that all employees involved in the operation of trains understand and abide by the maximum allowable speed for trains being operated through an interlocking with inoperative track circuits. (Class II, Priority Action) (R-82-62)

Eliminate the practice of issuing verbal instructions to the Metrorail Operations Control Center personnel which modify or amend operating rules and standard operating procedures. (Class I, Urgent Action) (R-82-63)

Modify the automated alert system to segregate the "serious" physical plant-related Type 1 visual alarms from the less serious train-oriented Type 2 alarms, and to provide an audible indication of a Type 1 alarm which must be manually acknowledged. (Class II, Priority Action) (R-82-64)

Require that Type 1 automated alert alarms be immediately reported by the Operations Control Center to Maintenance Control for corrective action. (Class II, Priority Action) (R-82-65)

Require that maintenance forces inspect switch machine fusetrons while making their regular preventive maintenance inspections of the control system apparatus. (Class II, Priority Action) (R-82-66)

Provide train operators with some type of self-contained radios which will function in the event that auxiliary and emergency car power sources are lost. (Class II, Priority Action) (R-82-67)

Arrange for a comprehensive review of its Metrorail safety program and of its rules and procedures by a peer review board of the American Public Transit Association. (Class II, Priority Action) (R-82-68)

Provide all Metrorail Operations Control Center controllers and their supervisors with clear instructions that all automatic reclosing circuit breakers for the traction power sections in the affected area must be commanded open prior to the commencement of an evacuation of a train. (Class II, Priority Action) (R-82-69)

Require the installation of an adequate number of marked emergency escape windows on all new Metrorail cars and implement a program to similarly retrofit existing cars. (Class II, Priority Action) (R-82-70)

Equip each Metrorail car with an adequate number of self-contained, battery-powered emergency lights which will automatically illuminate the car interior in the event the car's auxiliary and emergency power is lost. (Class II, Priority Action) (R-82-71)

Post emergency information inside Metrorail cars at locations near the doors regarding the location and method of operation of the manual emergency door handle. (Class II, Priority Action) (R-82-72)

Retrofit existing Metrorail cars with derailment detector devices which will apply the brakes in emergency when a car wheel leaves the rail. Require that all new cars be so equipped. (Class II, Priority Action) (R-82-73)

Maintain the carborne monitors on existing Metrorail cars and require their installation on cars presently on order. Acquire the necessary equipment to read the monitor tapes. (Class II, Priority Action) (R-82-74)

Provide a portable radio, compatible with the Metrorail communication system, at each station kiosk for dedicated use by fire/rescue personnel. (Class II, Priority Action) (R-82-75)

Expedite the completion of its underground communication system. (Class II, Priority Action) (R-82-76)

In conjunction with the District of Columbia Fire Department, expand the scope and frequency of the Disaster Crash Simulations and include hospitals and fire/rescue units from surrounding jurisdictions. (Class II, Priority Action) (R-82-77)

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility ". . . to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (P.L. 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations. Therefore, we would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter.

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

Patricia A. Goldman

By: Jim Burnett
Chairman