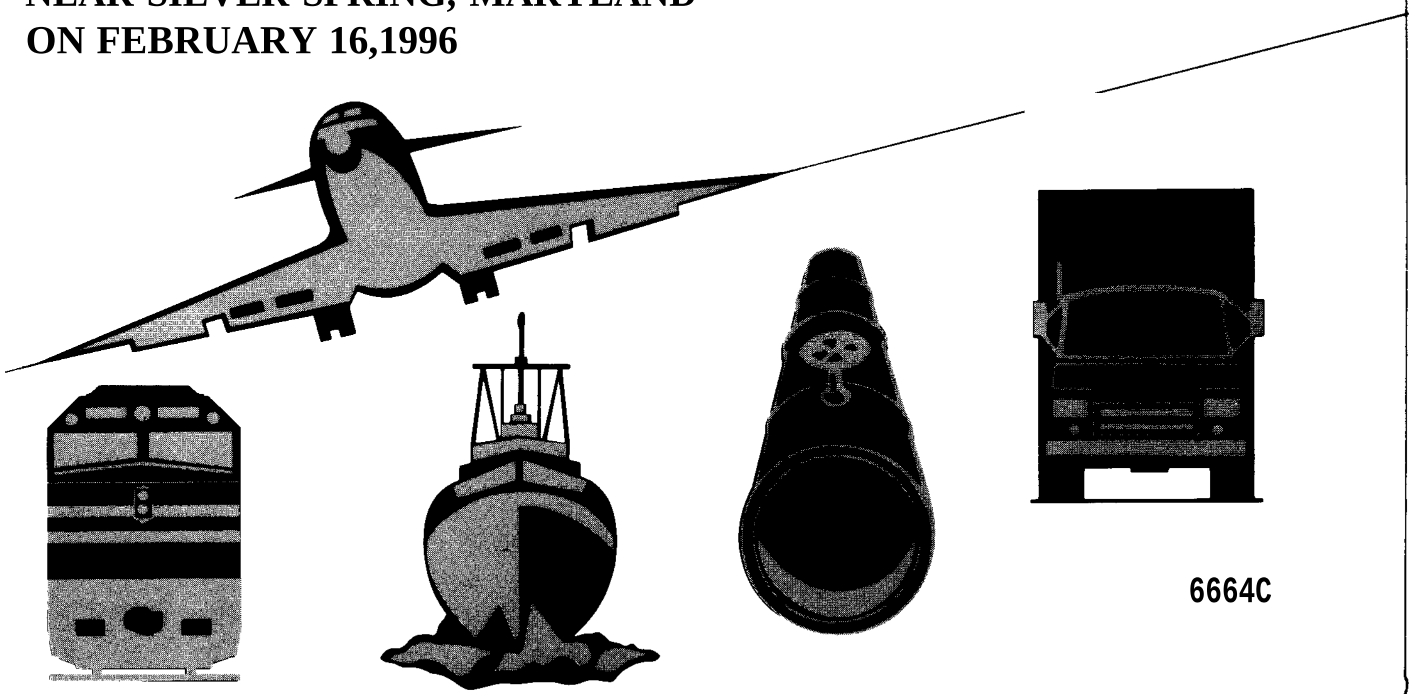
PB97-916302
NTSB/RAR-97/02

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, DC 20594

RAILROAD ACCIDENT REPORT

COLLISION AND DERAILMENT OF MARYLAND RAIL COMMUTER *MARC* TRAIN 286 AND NATIONAL RAILROAD PASSENGER CORPORATION *AMTRAK* TRAIN 29 NEAR SILVER SPRING, MARYLAND ON FEBRUARY 16,1996



6664C

U.S. GOVERNMENT PRINTING OFFICE: 1989 0-942-865

Abstract: On February 16, 1996, Maryland Rail Commuter (MARC) train 286 collided with National Railroad Passenger Corporation (Amtrak) passenger train 29 near Silver Spring, Maryland. All 3 CSXT operating crewmembers and 8 of the 20 passengers on MARC train 286 were killed in the derailment and subsequent fire. Eleven passengers on MARC train 286 and 15 of the 182 crewmembers and passengers on Amtrak train 29 were injured.

The major safety issues discussed in this report are the performance and responsibility of the MARC train 286 crewmembers, the oversight of CSXT signal system modifications, the Federal oversight of commuter rail operations, the lack of positive train separation control systems, and the adequacy of passenger car safety standards and emergency preparedness. In addition, the Safety Board examined the use of the reverser during an emergency brake application, the effectiveness of the computer-aided train dispatching recordkeeping, the crashworthiness of locomotive fuel tanks, and the contents of the CSXT and MARC operating agreement.

As a result of its investigation, the Safety Board issued recommendations to the FRA, the FTA, the CSXT, the MTA/MARC, the U.S. Department of Transportation, the Federal Emergency Management Agency, the Governor and the General Assembly of Maryland, the Association of American Railroads, the Montgomery County Emergency Management Agency, the Baltimore County Emergency Management Agency, the Baltimore City Emergency Management Agency, the Metropolitan Washington Council of Governments, the Jefferson County Commissioners, the Berkeley County Commissioners, the American Short Line Railroad Association, the Brotherhood of Locomotive Engineers, the United Transportation Union, the International Brotherhood of Teamsters, and the American Public Transit Association. In addition, the Safety Board reiterated safety recommendations to the FRA, the General Electric Company, and the Electro-Motive Division of General Motors.

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

Information about available publications may be obtained by contacting:

National Transportation Safety Board
Public Inquiries Section, RE-51
490 L'Enfant Plaza, SW
Washington, DC 20594
(202) 314-6551

Safety Board publications may be purchased, by individual copy or by subscription, from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
(703) 605-6000

COLLISION AND DERAILMENT

OF MARYLAND RAIL COMMUTER *MARC* TRAIN 286

AND NATIONAL RAILROAD PASSENGER CORPORATION *AMTRAK* TRAIN 29

NEAR SILVER SPRING, MARYLAND

FEBRUARY 16, 1996

RAILROAD ACCIDENT REPORT

Adopted: July 3, 1997
Notation 6664C

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, DC 20594

CONTENTS

EXECUTIVE SUMMARY vii

INVESTIGATION
Accident Narrative 1
Injuries… 7
Damages 7
Track and Signals 8
MARC Train 286 8
Amtrak Train 29 8
MARC Train 286 Crew Information 8
Engineer 8
Conductor 9
Assistant Conductor 10
Amtrak Train 29 Crew Information 11
Engineer 11
Assistant Engineer 11
Train Information 12
MARC Train 286 12
Amtrak Train 29 14
Postcollision Train Information 14
MARC Train 286 14
Amtrak Train 29 17
Track and Signal Information 17
Tracks 17
Signals 20
Operations Information 22
CSXT Train Operations 22
Operational Efficiency Testing 24
MARC Train Radio Communication 24
MARC Train 286 Passenger Load Data 25
CSXT and MARC Operating Agreement 25
Meteorological Information 26
Medical and Pathological Information 26
MARC Train 286 26
Amtrak Train 29 26
Toxicological Information 28
Emergency Response 28
Montgomery County Fire and Rescue Services 28
Montgomery County Disaster Plan 29
Amtrak, MARC, and CSXT 29
Survival Aspects 30
MARC Train 286 Occupant Evacuation 30
Firefighter Evacuation Action 32

Tests and Research 32
Locomotive Event Recorders 32
MARC Train 286 and Amtrak Train 29 Movement 32
Sight Distance 33
Signals 34
Stopping Distance 34
Passenger Train Air Brakes 35
Cab Control Car 7752 Doors 35
MARC Passenger Coach Car Interior Materials 35
Fuel Oil Presence 36
Postaccident Actions 36
National Transportation Safety Board 36
Federal Railroad Administration 37
Maryland Mass Transit Administration and Maryland Rail Commuter 38
CSX Transportation Inc. 38
National Railroad Passenger Corporation 39
Cooperative Organization Activities 39
Other Information 39
Maryland Mass Transit Administration 39
MARC Train Accidents 40
Maryland Department of Labor and Industry 40
Brunswick Line Signal Modifications 41
Federal-Grant-Requested Signal Project 41
CSXT Signal System Modification Design 43
CSXT Traincrew Roster Consolidation 44
Locomotive Fuel Tanks 45
Cellular Service Communication 45

ANALYSIS

General Factors 46
Accident Narrative Review 46
MARC Train 286 Engineer Performance 47
MARC Train 286 Crewmember Responsibility 49
Traincrew Voice Recording 51
CSXT Signal System Modification Oversight 52
Federal Commuter Rail Operations Oversight 54
Positive Train Separation Control Systems 55
Passenger Car Safety Standards 58
Emergency Lighting 61
Emergency Windows 62
Exterior Emergency Door Release 62
Interior Materials 63
Cab Control Car Structural Crashworthiness 64
Emergency Preparedness 66
Reverser Use during Emergency Braking 69
Computer-Aided Recordkeeping 70
Locomotive Fuel Tank Crashworthiness 70
CSXT and MARC Operating Agreement 72

FINDINGS 73
Conclusions 73
Probable Cause 75

RECOMMENDATIONS 75

APPENDIXES
Appendix A--Investigation and Hearing 81
Appendix B--Chronology of Signal Sequence 83
Appendix C--Chronology of Accident 87
Appendix D--Excerpts from CSXT Operating Rules 89
Appendix E--Organization Charts of CSXT and MDOT/MTA/MARC 97
Appendix F--Signal Incidents, Complaints, and False Proceed Indications 103
Appendix G--Fire Testing Results of MARC Car Interior Materials 105
Appendix H--Issuance of Urgent Safety Recommendations 109
Appendix I-- Federal Railroad Administration Emergency Order No. 20 115
Appendix J--MARC Train Service Schedule for Brunswick and Camden Lines 135
Appendix K--FRA Correspondence on Regulatory Authority of Commuter Railroad Operations 137
Appendix L--National Transportation Safety Board and Positive Train Control Systems 143
Appendix M--Acronyms and Abbreviations 145

EXECUTIVE SUMMARY

About 5:39 p.m. on February 16, 1996, Maryland Rail Commuter (MARC) train 286 collided with National Railroad Passenger Corporation (Amtrak) passenger train 29 near Silver Spring, Maryland. En route from Brunswick, Maryland, to Union Station in Washington, DC, MARC train 286 was traveling under CSX Transportation Inc. (CSXT) operation and control on CSXT tracks. MARC train 286 passed an APPROACH signal before making a station stop at Kensington, Maryland; proceeded as if the signal had been CLEAR; and, then, could not stop for the STOP signal at Georgetown Junction, where it collided with Amtrak train 29. All 3 CSXT operating crewmembers and 8 of the 20 passengers on MARC train 286 were killed in the derailment and subsequent fire. Eleven passengers on MARC train 286 and 15 of the 182 crewmembers and passengers on Amtrak train 29 were injured. Estimated damages exceeded $7.5 million.

The National Transportation Safety Board determines that the probable cause of this accident was the apparent failure of the engineer and the traincrew because of multiple distractions to operate MARC train 286 according to signal indications and the failure of the Federal Railroad Administration (FRA), the Federal Transit Administration (FTA), the Maryland Mass Transit Administration (MTA), and the CSXT to ensure that a comprehensive human factors analysis for the Brunswick Line signal modifications was conducted to identify potential sources of human error and to provide a redundant safety system that could compensate for human error.

Contributing to the accident was the lack of comprehensive safety oversight on the CSXT/MARC system to ensure the safety of the commuting public. Contributing to the severity of the accident and the loss of life was the lack of appropriate regulations to ensure adequate emergency egress features on the railroad passenger cars.

The major safety issues discussed in this report are the performance and responsibility of the MARC train 286 crewmembers, the oversight of CSXT signal system modifications, the Federal oversight of commuter rail operations, the lack of positive train separation control systems, and the adequacy of passenger car safety standards and emergency preparedness. In addition, the Safety Board examined the use of the reverser during an emergency brake application, the effectiveness of the computer-aided train dispatching recordkeeping, the crashworthiness of locomotive fuel tanks, and the contents of the CSXT and MARC operating agreement.

On March 12

Emergency Management Agency, the Metropolitan Washington Council of Governments, the Jefferson County Commissioners, the Berkeley County Commissioners, the American Short Line Railroad Association, the Brotherhood of Locomotive Engineers, the United Transportation Union, the International Brotherhood of Teamsters, and the American Public Transit Association. In addition, the Safety Board reiterates safety recommendations to the FRA, the General Electric Company, and the Electro-Motive Division of General Motors.

INVESTIGATION

Accident Narrative

On Friday, February 16, 1996, at 5:39 p.m., an eastbound Maryland Rail Commuter (MARC) train 286, operated by the CSX Transportation Inc. (CSXT) for the Maryland Mass Transit Administration (MTA) collided with the westbound National Railroad Passenger Corporation (Amtrak) passenger train 29, Capitol Limited. (See figure 1.) The accident occurred during a blowing snowfall near milepost (MP) BA 8.49[1] at a railroad location, referred to as Georgetown Junction, about 1 mile west of Silver Spring, Maryland. (See figure 2.) The snow accumulation on the ground at the accident site was 5 inches. (See figure 3.) Both trains were operating on the double main tracks owned and maintained by the CSXT.

The MARC train 286 was a "push-pull"[2] commuter train consisting of a locomotive unit on the rear end, two passenger cars, and a passenger coach cab control car in the lead. The engineer was operating the train from the cab control car in the push mode at the time of the collision. The MARC train 286 was in scheduled commuter service proceeding eastward on track 2 between Brunswick, Maryland, and Union Station, Washington, DC. The train departed Brunswick at 4:30 p.m. eastbound for a scheduled 5:30 p.m. arrival at Union Station with three CSXT operating crewmembers[3] (an engineer, a conductor, and an assistant conductor) on board. MARC train 286 had to make a "flag" station stop[4] at the Kensington, Maryland, station to board two waiting passengers. The train carried 20 passengers at the time of the collision. Before MARC train 286 stopped at Kensington, the engineer on the westbound MARC train 279 stated that as the two trains passed each other on adjacent tracks, he had heard a portion of the radio communication of the MARC train 286 engineer acknowledging the wayside signal 1124-2,[5] located about 1,000 feet west of Kensington station.

The westbound Amtrak train 29, with a 2-unit locomotive and 15 cars, departed Union Station about 5:25 p.m. en route to Chicago, Illinois. The Amtrak operating crew consisted of an engineer, an assistant engineer, a conductor, and an assistant conductor. Thirteen on-board service employees, a mechanical rider who was in the second unit, and 164 passengers were also on board the Amtrak train. The Amtrak train 29 had been routed onto track 2 from Union Station to Georgetown Junction to pass a stopped westbound CSXT freight train that occupied track 1 east of Georgetown Junction. The engineer of Amtrak train 29 stated he was operating on a

---

[1]The prefix BA stands for the Baltimore Division, Metropolitan Subdivision. All MP designations in this report are for that subdivision; henceforth the BA will not be shown.

[2]Train arrangement in which the motive power is at one end and a control cab car is at the other end, permitting the engineer to operate from either end of the train. The power is at the rear of the train when the train is configured for the push mode and at the front of the train when it is configured for the pull mode.

[3]Traincrews are employed and contracted by the CSXT to operate MARC commuter trains between Washington and Brunswick.

[4]The station is not a regularly scheduled stop. A train makes a flag stop to pick up passengers who are standing on the platform and are visible to the engineer. A train also makes a flag stop to discharge passengers who have requested the stop and notified the conductor when boarding.

[5]The signal would have been displaying an APPROACH indication, logically related to the STOP indication being displayed at Georgetown Junction because the crossover at the interlocking was aligned for a train movement from track 2 to track 1 for the westbound Amtrak train 29.

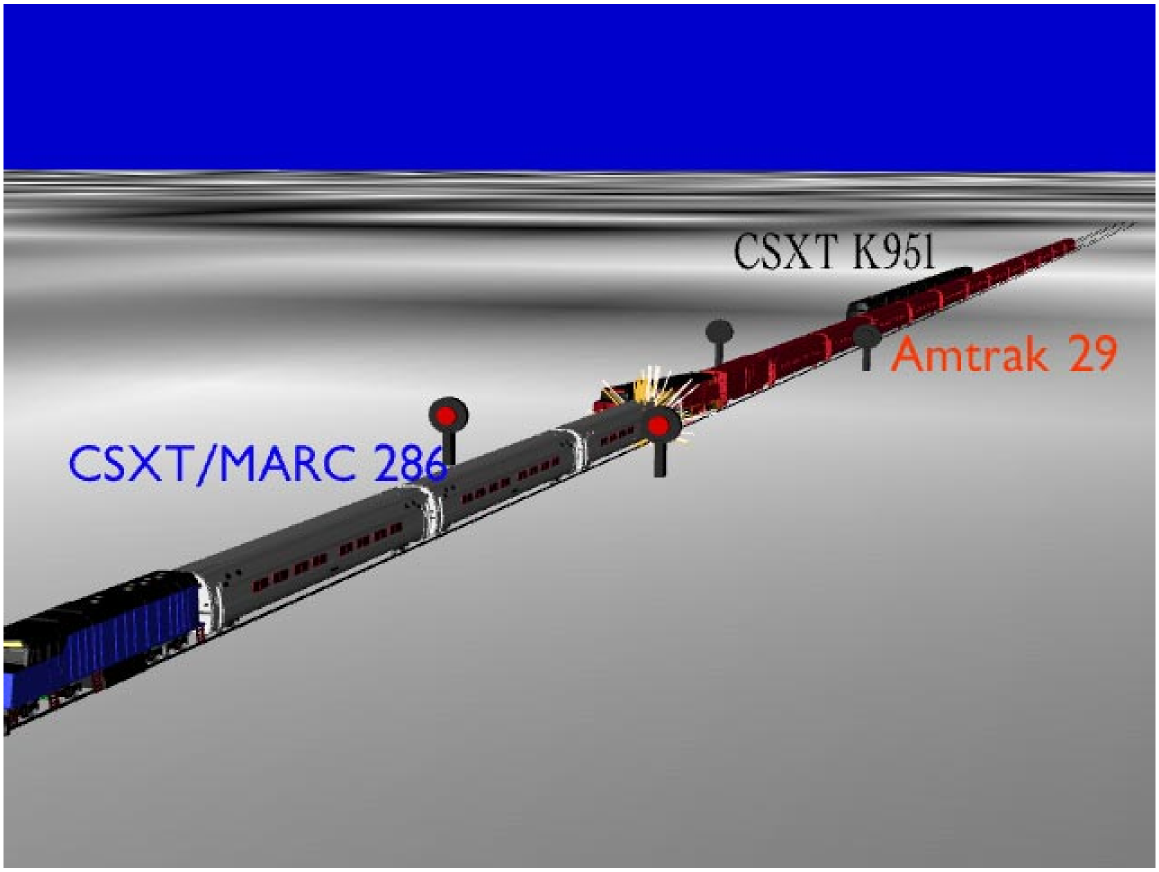


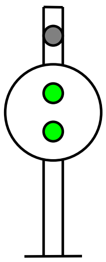
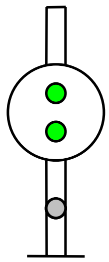
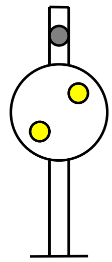
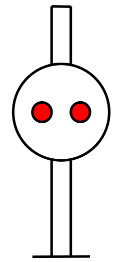
Figure 1--View of trains at point of impact.

MEDIUM CLEAR signal (see table 1) and was beginning to negotiate the crossover from track 2 to 1 at Georgetown Junction when the collision occurred. (See appendix B for the signal sequence chronology.)

The locomotive event recorder of MARC train 286 indicated that the train accelerated upon departing the Kensington station, slowed for a posted speed restriction, and then accelerated again. The engineer of MARC train 286 placed the train brakes in emergency about 2.18 miles from the Kensington station at a speed of approximately 66 mph. About 11 seconds after the emergency brake application and 7 seconds before impact, the train control lever (reverser) was recorded as being moved from reverse to forward. (The locomotive had been operating in the reverse position as a pusher locomotive before this.) The impact speed with Amtrak train 29 was about 38 mph.

The collision between the lead Amtrak unit and the MARC cab control car tore away the front left quadrant of the cab control car. The fuel tank on the lead unit was ruptured in the collision and sprayed fuel on the cab control car. All three MARC cars and the MARC locomotive derailed in the accident. Both Amtrak units and the first eight cars of train 29 derailed. The derailed Amtrak equipment consisted of six material handling cars, one baggage car, and a transition-sleeper car, which was the only occupied Amtrak car to derail. (See figure 4.)

Table 1.--*Key to CSXT signal indications*

CLEAR	MEDIUM CLEAR	APPROACH	STOP
			
Rule C-281	**Rule C-283**	**Rule C-285**	**Rule C-292**
Proceed.	Medium speed (30 mph) through turnouts, crossovers, sidings, and over power operated switches; then proceed.	Proceed prepared to stop at the next signal. Trains exceeding medium speed must immediately begin reduction to medium speed as the engine passes the APPROACH signal.	Stop.

Ten survivors from cab control car 7752 escaped after the accident through an opening between the diaphragms of the first and second car interior passageway of train 286. Two other survivors from the MARC train exited through an emergency window in the second car.

The CSXT AU[6] dispatcher was contacted about 5:41 p.m. by the traincrew of CSXT train K951, which was stopped on the adjacent track east of Georgetown Junction, that Amtrak train 29 had derailed while crossing over at Georgetown Junction. Also about 5:41 p.m., the Montgomery County [Maryland] Fire and Rescue Services (MCFRS) 911 dispatcher received approximately 12 telephone calls reporting the derailment and fire. At 5:44 p.m. the AU dispatcher contacted the MCFRS to notify it of the accident and was informed that it was already aware of the derailment. About 5:46 p.m. the first units arrived on scene.

During the emergency response activities, CSXT freight train Q401 and MARC train 281 had been operating, respectively, behind MARC train 286 and Amtrak train 29. These two trains had been stopped from approaching the accident scene by railroad wayside signal indication. Upon request to the CSXT AU dispatcher, the engineer of CSXT train Q401 received authorization from the dispatcher to separate the locomotive units from his train and to approach the accident site prepared to stop because of the emergency response personnel in the area. The locomotive from CSXT Q401 stopped about 775 feet west of the derailed locomotive of MARC train 286 about 6:20 p.m. The MARC train 281 engineer had also made a similar request to pull up behind

[6]The CSXT designates the train dispatcher that controls train movements on the Brunswick Line as the AU train dispatcher.

Figure 2--Aerial photograph of postcollision scene.

Figure 3--Map of collision area.

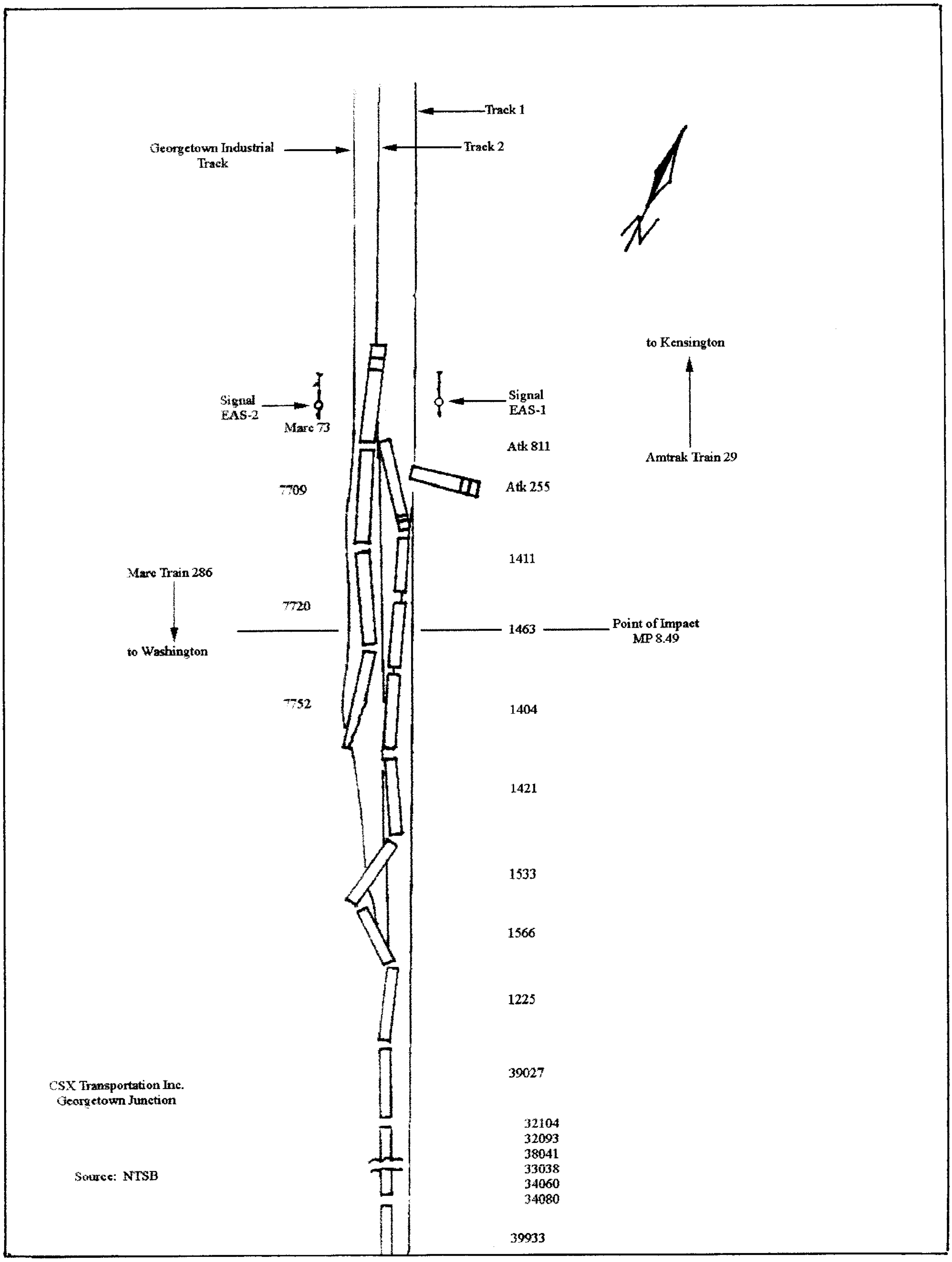


Figure 4--Schematic of postcollision site.

Amtrak train 29 and lend assistance. Approval was not received until about 6:56 p.m. but not from the dispatcher; instructions were received from the CSXT/MARC manager of passenger operations to move as close as possible to Amtrak train 29. Neither train movement was coordinated with the MCFRS incident commander (IC). The IC stated that when a citizen reported that a train was approaching the accident site, he had his staff activate radio tones and air horns to warn emergency responders to evacuate the accident site. (See appendix C for the accident chronology.)

The first firefighters to reach cab control car 7752 reported that the car was fully involved in fire and that they did not observe any survivors. They made several attempts to enter the cab control car. The fire was extinguished within 10 minutes, after which the firefighters were able to enter cab control car 7752. They were later assisted by members of the Montgomery County Police Department (MCPD) in the recovery of 11 victims for coordinating the identification and notification process with the Maryland medical examiner. At 3:50 a.m. on Saturday, February 17, 1996, the last victim was recovered, and the IC turned over the accident to the MCPD. At 4 a.m. the recovery operations were secured.

In the collision and subsequent fire, all 3 CSXT crewmembers and 8 passengers on MARC train 286 were fatally injured; 11 of the 12 MARC train survivors sustained from serious to minor injuries. The Amtrak engineer, assistant engineer, and mechanical rider sustained serious injuries; the conductor, the assistant conductor, two on-board service crewmembers, and eight passengers sustained minor injuries.

Injuries*

Table 2.--*Injuries sustained in Silver Spring railroad accident*

Type	MARC Train 286 Operating Crew	MARC Train 286 Passengers	Amtrak Train 29 Operating Crew	Amtrak Train 29 Employees	Amtrak Train 29 Passengers	Total
FATAL	3	8	0	0	0	11
SERIOUS	0	3	2	1	0	6
MINOR	0	8	2	2	8	20
NONE	0	1	0	11	156	168
TOTAL	3	20	4	14	164	205

*Based on the injury criteria (49 Code of Federal Regulations [CFR] 830.2) of the International Civil Aviation Organization, which the Safety Board uses in accident reports for all transportation modes.

Damages

The CSXT, the MTA/MARC, and Amtrak estimated the damages, and the MTA/MARC and National Transportation Safety Board estimated replacement costs, as follows:

Cars	$4,963,624
(includes replacement cost for MARC equipment)	
Locomotives	2,350,000
(includes replacement cost for Amtrak lead unit)	
Track/signals	200,000
Total	$7,513,624

Track and Signals--Three turnouts,[7] including their signal operating components, were destroyed. The turnout leading to the Georgetown industrial track and the westernmost crossover from track 1 to 2 were replaced and repositioned. A total of about 663 feet of track was replaced in main tracks 1 and 2. The track work was completed on April 12, 1996. Because of the turnout and track repositioning for the Georgetown industrial track, the eastbound absolute signal (EAS) for track 2 was replaced and relocated adjacent to track 2.

MARC Train 286--The locomotive of train 286 had minimal damage. The three MARC passenger cars, including cab control car 7752, sustained heavy damage and were considered totally destroyed by MARC.

Amtrak Train 29--The collision and derailment affected only the two locomotive units and the first eight cars of the Amtrak train, with the remaining cars in the consist sustaining no reported structural damage. The left rear side of the lead unit car body exterior, truck assembly, and fuel tank received substantial fire damage. The leading truck assembly of this unit was detached from the unit. Amtrak considered the unit totally destroyed. The second unit and the derailed passenger cars sustained minimal damage; they were to be repaired and returned to service.

MARC Train 286 Crew Information

Engineer--The 43-year-old engineer began working for the Baltimore & Ohio (B&O) Railroad on September 3, 1970, in the signal department but became a brakeman on February 16, 1971. He was promoted to engineer on April 15, 1974, and qualified over the territory that included Baltimore, Maryland, to Washington and Washington to Brunswick shortly thereafter. He operated freight trains and some passenger trains (from the extra board) before working as a yard engineer in Baltimore. In 1980, he became a CSXT employee through a merger.

In August 1994, he requalified over the territory in passenger service after leaving the yard engineer position and worked several different job assignments that included Washington to Brunswick trips. He became the regular engineer on the assignment that included MARC train 286 on January 1, 1996. The CSXT manager of passenger operations, who was his supervisor, testified that he was “one of the most professional engineers that we had out here. He did a real good job in everything that he did. He was consistent, he was concise.”

His most recent CSXT operating rules class was completed on February 25, 1995. His most recent engineer certification was December 31, 1995; the class designation was Train Service Engineer with no restrictions noted. His service record showed five instances of discipline; however, none were for operational failure. Seventy CSXT operational efficiency tests had been performed on the engineer during the previous 12 months; he had no reports of failure.

The most recent railroad physical for the engineer of MARC train 286 was conducted on October 21, 1995, and it found him medically qualified. His distant vision was 20/20 uncorrected; his near vision was 20/35, although he had no difficulty reading and did not wear glasses nor was he required to do so to operate trains. His color perception was normal, and he had no hearing loss. The engineer’s father noted his son showed no signs of illness when he last saw him on February 14, and did not complain of any illness when they last spoke on February 15. In addition, the engineer expressed no concerns or health complaints when he spoke to a female acquaintance from Brunswick about 4 p.m. on February 16.

For each weekday since his most recent assignment began on January 1, 1996, the engineer kept essentially the same work schedule. According to CSXT records he also kept this

[7] An arrangement of switch point rails, crossover rails (frog), and closure rails that permit trains to be diverted from one track to another.

same schedule during the week before the accident. (See table 3.) His work schedule was 11 hours 35 minutes on duty and 12 hours 25 minutes off duty. He worked on four train runs each day with a break between each run. These breaks were scheduled to be 45 minutes, then 1 hour 15 minutes, and finally 2 hours, although these could vary depending on train delays.

On Friday, February 16, the day of the accident, the engineer reported for duty at 10:10 a.m. and departed from Camden Station with MARC train 251 as scheduled at 11 a.m. The train arrived 45 minutes late in Washington at 12:55 p.m. because of weather-related switch problems at Savage, Maryland. The next train he operated, MARC train 273 to Brunswick, departed 24 minutes late at 1:24 p.m. Snow delayed that run and he arrived 33 minutes late in Brunswick at 2:53 p.m. He departed Brunswick with MARC train 286 at 4:30 p.m.

Conductor--The 48-year-old conductor was hired by the B&O on October 27, 1969. He became a CSXT employee through a merger in 1980. He was regularly assigned to a yard job in Baltimore. According to his wife, he has always worked in the Baltimore rail yards (Curtis Bay or Locust Point) and not in regular freight service. His seniority was sufficiently high that when he worked in the yards, he was always off on weekends. During the last 2 years, he had also worked in passenger service on MARC trains when called. His passenger service assignments also provided weekends off, except for an occasional weekend train to the baseball stadium in Baltimore.

Table 3.--*MARC train 286 engineer's daily work schedule*

Time	Activity
10:10 a.m.	Report for duty at CSXT Riverside yard in Baltimore. Drive to Camden Station to operate MARC train 251.
11 a.m.	Depart with train 251 en route to Union Station.
12:10 p.m.	Arrive at Union Station. Stay in station until his next run.
1 p.m.	Depart station with MARC train 273 en route to Brunswick.
2:20 p.m.	Arrive at Brunswick terminal. Remain at Brunswick until time to operate return train 286 to Union Station. Telephone and talk to friend usually each day during this time.
4:30 p.m.	Depart Brunswick with train 286 en route to Union Station.
5:50 p.m.	Arrive at Union Station. Remain at terminal until time to operate (fourth) train 260.
8 p.m.	Depart with train 260 from Union Station to Baltimore.
9:13 p.m.	Arrive at Baltimore.
9:30 p.m.	Off duty.
9:45 p.m.	Arrive home after 15-minute drive.

He was promoted to freight conductor on January 1, 1992, and to passenger conductor on November 19, 1993. He successfully completed his most recent operating rules class on February 13, 1995. His service record showed three instances of discipline, two of which were for operating rules infractions. The first operating rules infraction was on May 11, 1981, for violation of rules 104-C and 105 by fouling a track before switches connected with the train movement were lined and not being properly prepared to stop within half the range of vision. A 5-day overhead suspension[8] was given. The second recorded instance was on July 27, 1981, when the employee was cited for a violation of rule 103-G, which resulted in a derailment and in a formal reprimand. (See Appendix D, Excerpts from CSXT Operating Rules.) Twelve CSXT operational efficiency tests had been performed on the conductor during the previous 12 months; no failures were reported.

The most recent railroad physical for the conductor of MARC train 286 was on June 17, 1993, which showed that he was medically qualified for his job; his visual acuity, degree of visual field, color sense, and hearing were all within acceptable ranges. His wife stated that he always slept well at night and had done so the night before the accident. She reported she did not know whether her husband had taken any medication on Friday, February 16, but he had not reported any illness to her. He did not have any medical conditions or take any medication on a regular basis.

During the 4 days before the accident, the conductor worked a daylight "yard job" at Curtis Bay. He awoke about 6 a.m. daily; worked at the rail yard until about 1:30 p.m. on Wednesday, February 14, and until 3 p.m. on Thursday, February 15; and retired about 10 p.m. on both days. Between 9 and 10 p.m. on Thursday, he was notified by the CSXT that he would be in passenger service the next day. On Friday, February 16, he awoke at 8 a.m. and left for work about 9 a.m.

Assistant Conductor--The 53-year-old assistant conductor went to work for the B&O on September 1, 1965. He remained with that same organization, which ultimately became a part of the CSXT. He worked first as a brakeman and later as a conductor in both yard and road freight service. His last assignment before entering passenger service was as a brakeman at the Jessup Yard.

The assistant conductor completed his most recent operating rules training class on June 18, 1995. His service record showed two instances of disciplinary action. He received a 10-day overhead suspension on September 27, 1969, for violation of rule 804 (approaching a hazardous materials derailment). The second incident occurred on May 30, 1986, and entailed violation of rules 106 (safe train operation) and 450 (radio usage), which resulted in a 10-day overhead suspension. Both occurred while the assistant conductor was in yard service. Twenty-nine CSXT operational efficiency tests had been performed on the assistant conductor during the previous 12 months; no failures were reported.

The most recent railroad physical for the assistant conductor of MARC train 286 was on September 12, 1994, and showed him medically qualified for his job. His distant vision was 20/70 in each eye but improved to 20/20 with glasses, and his near visual acuity, degree of visual field, color sense, and hearing were all within acceptable ranges. His wife reported he was wearing his glasses when he went to work on February 16. She said that her husband had slept well at night during the week before the accident and that he took a daily capsule of the medication Prilosec for an ulcer.

His wife characterized the relationship of her husband and the engineer of MARC train 286 as friendship. They had worked together previously at the Curtis Bay rail yard. She said that on many previous occasions her husband had described him as one of the best engineers, that

[8]Punishment that is held in abeyance provided the employee has no other infractions.

her husband liked all of his coworkers, and that they worked well together. She reported he had also worked with the conductor previously and considered him a good conductor, although he had not really talked much about the conductor.

For the last 4 months he had worked the same weekday assignment on MARC passenger trains. On Wednesday, February 14, and Thursday, February 15, the assistant conductor awoke about 7:30 a.m. and arrived at work about 10 a.m. During the day, his assignment allowed him free time between trains while in Brunswick, and he generally called his wife between 2:30 and 3:30 p.m. He returned home each night about 10:15 p.m. and retired at 11:30 p.m. On Friday, February 16, he awoke and arrived at work at his usual times, and according to his wife, he called her at 3:20 p.m. She described the conversation as typical and said that he had expressed no particular concerns when they talked.

Amtrak Train 29 Crew Information

The operating crewmembers were employed by Amtrak.

Engineer--The 49-year-old engineer began his railroad employment with the B&O on June 14, 1977. He was originally hired as a brakeman and worked in Pittsburgh, Pennsylvania. He went into engine service on June 8, 1978, when he became a fireman and was promoted to engineer on May 20, 1979. He operated Amtrak passenger trains at times as a B&O employee. On August 20, 1986, he transferred to Amtrak and operated its passenger trains full time.

As a B&O engineer, he was qualified over the territory from Cumberland, Maryland, to Pittsburgh; as an Amtrak engineer, he became qualified over the entire territory from Washington to Pittsburgh in 1986. From 1986 until 1993, he operated over various routes, often as the relief engineer from Washington to Pittsburgh, and that route became his regular assignment in 1993.

The engineer successfully completed his last locomotive engineer's certification examination on February 1, 1996, with no restrictions. He was last examined on the CSXT operating rules on October 3, 1995. His service record shows one instance of discipline for violating CSXT operating rule 292 in Halifax, South Carolina, on August 27, 1992. The incident occurred when his assistant engineer, who was operating the train, violated a STOP signal. He received a 30-day suspension from Amtrak and was barred from operating over the CSXT until March 1993. In the 3 years before the accident, the engineer was subject to 20 efficiency tests and was found to be in compliance in each instance.

By happenstance, the engineer's supervisor conducted an efficiency test of the engineer at 1:04 p.m. on the day before the accident. The supervisor observed the engineer cross over from track 1 to 2 at Georgetown Junction (eastbound) on a MEDIUM CLEAR signal. Such a crossover has a speed limit of 30 mph; and the supervisor determined with a radar gun that the engineer crossed over at 27.9 mph.

The engineer of Amtrak train 29 reported he was in good health and was not ill on the day of the accident. He stated he takes three medications each day: Procardia (30 mg) and one aspirin, since a heart attack in 1990, and Mevacor, a cholesterol reduction medication. He passed his last railroad physical on November 1, 1995. His vision and hearing capabilities were found to be within acceptable range without any restrictions. He wore reading glasses but was not required to wear them while operating the train, and he was not wearing them at the time of the accident. He was wearing railroad-supplied clear safety glasses.

Assistant Engineer--The 38-year-old assistant engineer of Amtrak train 29 was hired by the B&O as part of a track gang in June 1977. In August 1977 he began working as a conductor and remained as a conductor with the B&O until August 1986. He transferred to Amtrak in August 1986 and continued to work as a conductor until 1989 when he went into engine service as a fireman. He was promoted to engineer on May 27, 1992, and his most recent certification was February 9, 1996, which had a vision restriction requiring corrective lenses. He was qualified on the CSXT railroad operating rules, had been qualified over the territory for 4 years, and had worked with the engineer previously. His last CSXT operating rules exam was October 3, 1995, and he had no recorded instances of discipline.

The assistant engineer of Amtrak train 29 had his most recent physical examination on April 25, 1995, and was found medically qualified for his job. He reported that he was in good health, had no long term illnesses, was not sick on the day of the accident, took no medication, and was wearing his prescription glasses at the time of the accident.

Train Information

MARC Train 286--The train consisted of passenger coach cab control car 7752, passenger coaches 7709 and 7720, and diesel electric locomotive (GP39-H2) unit 73. These cars were designated by MARC as MARC II type cars.[9] (See figure 5a.) Neoprene diaphragms were attached to both ends of the cars, which provided a weather-resistant barrier between two coupled cars. All cars were equipped with a safety bar on both ends of the cars. The safety bar latched in both the horizontal and the stored vertical position.

MARC train 286 was configured to operate in the push mode with locomotive unit 73 at the rear of the train. Passenger coach cab control car 7752 was very similar in arrangement to the other passenger coaches in train 286 except that the leading "F" end had an operating cab with controls in the front right corner of the car. (See figure 5b.) This enabled the engineer to operate from the front of the train in the push mode as the locomotive unit pushed from the rear of the train. This was the configuration at the time of the accident.

Required Federal Railroad Administration (FRA) scheduled maintenance of MARC passenger coaches and cab control cars is performed under contract by Amtrak personnel at their Washington Ivy City maintenance facility. Required FRA scheduled maintenance of the MARC locomotives is performed under contract by the CSXT mechanical personnel at the Riverside yard near Baltimore. CSXT and Amtrak personnel may also perform daily inspection, servicing, and running repair of MARC equipment depending on where the equipment is stored or turned around.[10] The CSXT also performs inspection, servicing, and running repair at its Brunswick facility.

The night of February 15, 1996, at the CSXT Riverside yard, locomotive unit 73 received a daily inspection. It received a locomotive air brake test as well as a train air brake test with the three passenger coaches as MARC train 243 the next morning. The unit and the cars were then designated as MARC train 271, and Amtrak performed another train air brake test in Washington before the train departed for Brunswick. The inspection records showed no anomalies. That train departed Brunswick designated as MARC train 286 and was the consist in the collision.

The CSXT inspection records for cab control car 7752 showed that the speed indicator was accurate at 70 mph and that no exceptions were taken on the air brake inspection tests. The two predeparture inspection sheets on the day of the accident both indicated that the radio of cab control car 7752 was “good,” and no previous radio malfunction had been reported. The radio was destroyed in the collision.

---

[9]Manufactured by Nippon Sharyo Seizo Kaisha Ltd., of Toyokawa, Japan, and delivered under State of Maryland contract SRA 2108-003 and subsequent change orders.

[10]The three MARC cars involved in this accident had been continuously together since October 3, 1995.

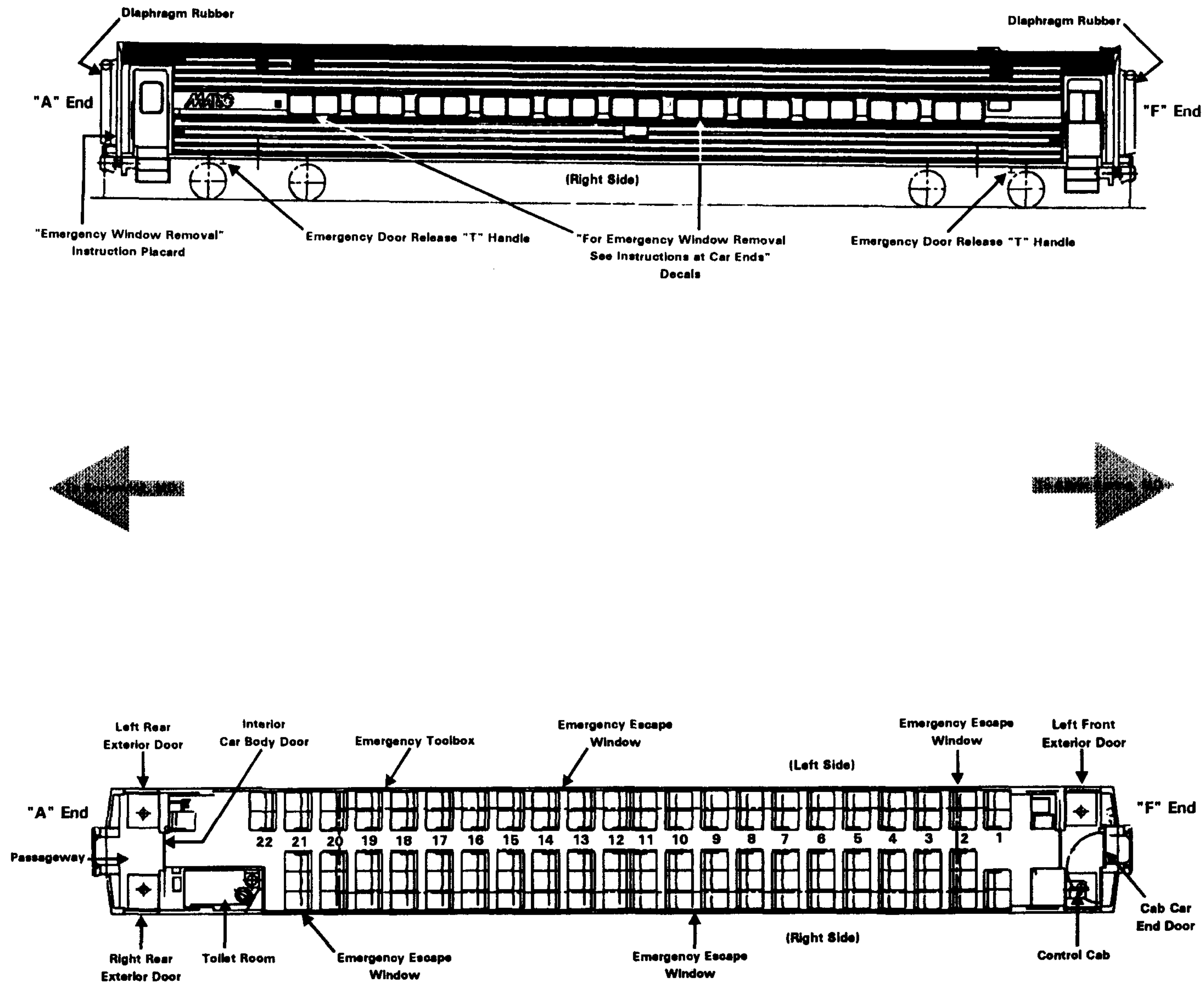


Figure 5--a. Typical MARC II passenger coach cab control car.
b. Interior configuration of MARC passenger coach cab control car 7752.

Amtrak Train 29--The train consisted of a two-unit (F40PH-255 and P40-811) locomotive followed by six material handling cars, a baggage car, a transition-sleeper (from one level to bilevel), two sleeping cars, a dining car, a lounge car, two coaches, and a coach-dormitory car. The radios and antennas from both Amtrak units 255 and 811 were tested at the accident site and then bench tested. All radios and antennas were found in good working order. The throttle on the lead unit was found in the eighth notch position.

Postcollision Train Information

MARC Train 286--The cars and locomotive of the train remained coupled and were situated approximately in a linear orientation, derailed but upright, resting parallel to track 2 on the ballast and the displaced track of the siding. The cars were displaced laterally to the south between 6 and 20 feet from the track 2 centerline. Both the front and rear sanders of locomotive unit 73 were 3/4 full. The sand box on the front left side of cab control car 7752 had been sheared away, and the sand box on the right (engineer's) side had been crushed but still contained sand. Because the running gear and batteries of the coaches were damaged in the derailment, the emergency lighting and public address system were inoperable.

After colliding with Amtrak train 29, cab control car 7752 derailed and came to rest tilted approximately 10 degrees clockwise. (See figure 6.) The leading truck assembly of the car had separated from its mounting and was found upside down and lodged under the car midsection to the right of centerline. The car body plymetal floor above where the truck assembly came to rest was indented about 2 feet in depth. The left-side front anchor bracket assembly of the truck had fractured and was torn from its attachment to the car.

The interior of cab control car 7752 (see figure 7) was gutted by fire, leaving the charred metal shell, internal fittings, and combustion residue. Damaged remnants of insulation remained in the ceiling and side walls. The rubber diaphragm at the rear passageway door was burned near the roof. The rear safety bar was horizontally positioned. A 50-pound portable fire extinguisher, normally secured by a metal strap on the front bulkhead of a vestibule, was missing and later discovered in the debris. The glass cover of the emergency toolbox was shattered, and the tools were missing.

The rear interior door of the car was open and slid within the wall pocket between the vestibule and the lavatory. The fire destroyed the controls for the left- and right-side rear doors and burned the position indicator lenses. The right-side rear door was open 0.5 inch, and its window was missing. The door contacted the front of the car body shell, into which it slides, 12 inches above the vestibule floor. Its interior emergency release handle was in a secured cabinet in the lavatory. (During an inspection of the car on March 14, 1996, at the Middle River, Maryland, MARC facility, the door did not open when this handle was pulled fully down.) The right-side rear "T" handle (exterior emergency door release mechanism) was missing from its cable, which, when pulled downward by pliers, moved the inside emergency release handle downward; however, the door did not open. The left-side rear door was open 1 inch, and its window was damaged by the fire and outwardly displaced at the top. The door contacted the front of the car body shell, into which it slides, 8 inches above the vestibule floor. Its interior emergency release handle was damaged by the fire and could not be pulled down or operate the door. The cover to its cabinet was missing. The left-side rear T-handle was also missing from its cable, which, when pulled downward by pliers, did not move, and the door did not open.

The second car in the consist, passenger coach 7720, derailed and tilted approximately 30 degrees clockwise with its front end lodged against the rear end of cab control car 7752. The left-side front corner of the coach, which included the bulkhead, the vestibule door, and a

Figure 6--Photograph of postcollision passenger coach cab control car 7752 at accident site.

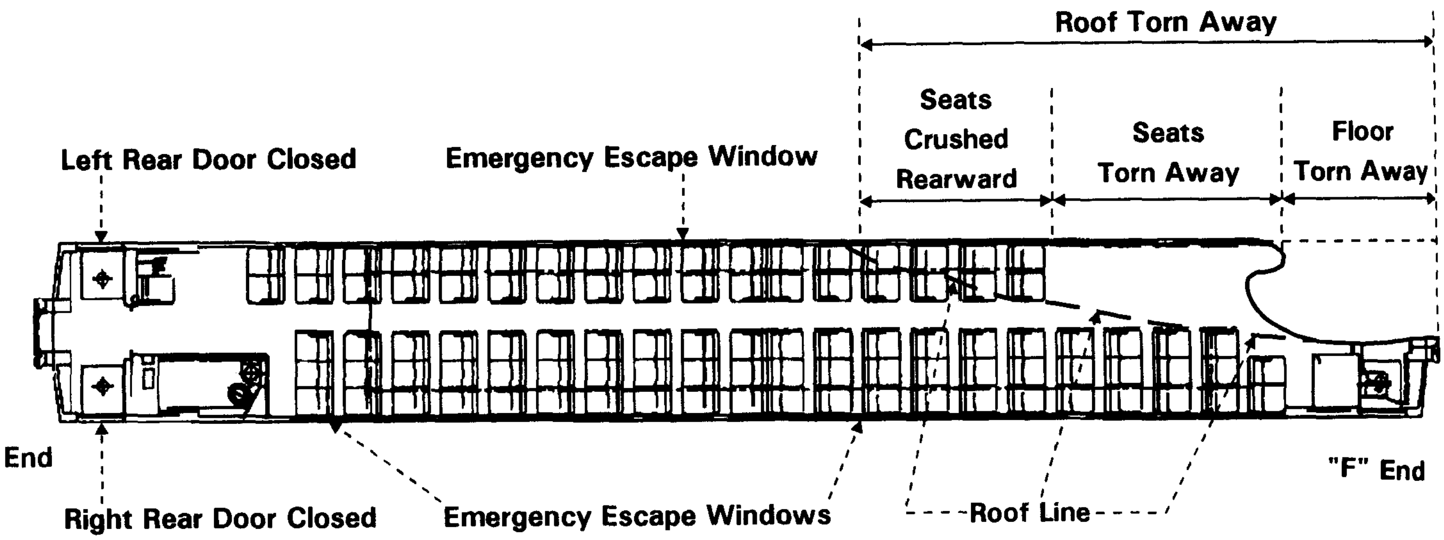


Figure 7--Schematic of postcollision interior passenger coach cab control car 7752.

4.5-foot-long section of sidewall, was pressed inward resulting in a breach of the car body end and corner structure. Fire damage was limited to the front diaphragm, which contacted the adjacent cab control car. The left-side front door was destroyed, and the T-handle was imbedded in the damage. The right-side front door was closed and could not be opened using the T-handle. The front interior door of the coach was displaced rearward and closed; the rear interior door remained intact. The left- and right-side rear doors, respectively, were operable and closed. Its emergency toolbox was empty, its first aid kit was intact, and its fire extinguisher was found in the debris.

The last car in the consist, passenger coach 7709, derailed and tilted approximately 30 degrees clockwise. Its corner was depressed near the frame of the left-side rear door, which was closed. The front end of the passenger coach 7709 was lodged against the rear end of the passenger coach 7720. The truck assembly on the rear end, which was lodged against locomotive unit 73 and Amtrak locomotive unit 811, was damaged. Passenger coach 7709 had no fire damage. No emergency window exit decals were found on or near the windows. On February 29, 1996, with MARC officials present, a Safety Board investigator took several minutes, applying physical exertion, to remove the left-side front emergency exit window of passenger coach 7709. Then on March 14, a Safety Board investigator attempted unsuccessfully to remove the right-side rear emergency exit window, which was later removed by another investigator after about 3 minutes of physical exertion. (A lubricant used to install these particular emergency windows was later found to have hardened over time.)

Amtrak Train 29--The locomotive units, the first, and the fourth through eighth cars were all derailed (either one or both axles) but remained upright. With the exception of the leading unit (ATK 255) and the fifth and sixth (material handling) cars, the equipment was found to be coupled and approximately in a linear orientation. The equipment was displaced laterally to both sides of track 2 and the crossover or resting on track 1 and its displaced ballast.

Lead unit ATK 255 derailed and received damage to the hood, fuel tank, and running gear. (See figure 8.) The left side of the unit superstructure received fire damage behind the control compartment, which remained intact. The lavatory was destroyed. The right-side windshield was shattered, and the left-side windshield was not present. The side windows were shattered. Unit ATK 811 derailed and received substantial damage to its superstructure and running gear.

Of the six material handling cars, the first through sixth in the consist positioning, only the second car remained on the rail. The baggage car, the seventh car in the consist, and the front trucks of the eighth car, a transition/dormitory car, derailed. The passenger-occupied 9^{th} through 15^{th} cars remained on the track and were not damaged. All Amtrak cars in the consist remained upright and parallel to the track, except for the fifth and sixth cars. No damage was noted to passenger compartments.

All emergency lighting had been illuminated immediately after the collision according to the conductor. The emergency lights were illuminated in all cars, except in the 15th car, when Safety Board investigators arrived on scene about 1 hour after the collision. The public address system remained operable after the collision and was used by the conductor for emergency broadcasts. All emergency tools and equipment remained in place.

Track and Signal Information

Tracks--The collision occurred on the CSXT Baltimore Division, Metropolitan Subdivision, which was double main track territory. The tracks were designated as track 1 and 2, and they were spaced on 12.5-foot centers at the collision point. The point of collision was in a turnout on track 2 about MP 8.49, where the track crossed over to track 1, about 180 feet east of the EAS for track 2. (See figure 9.)

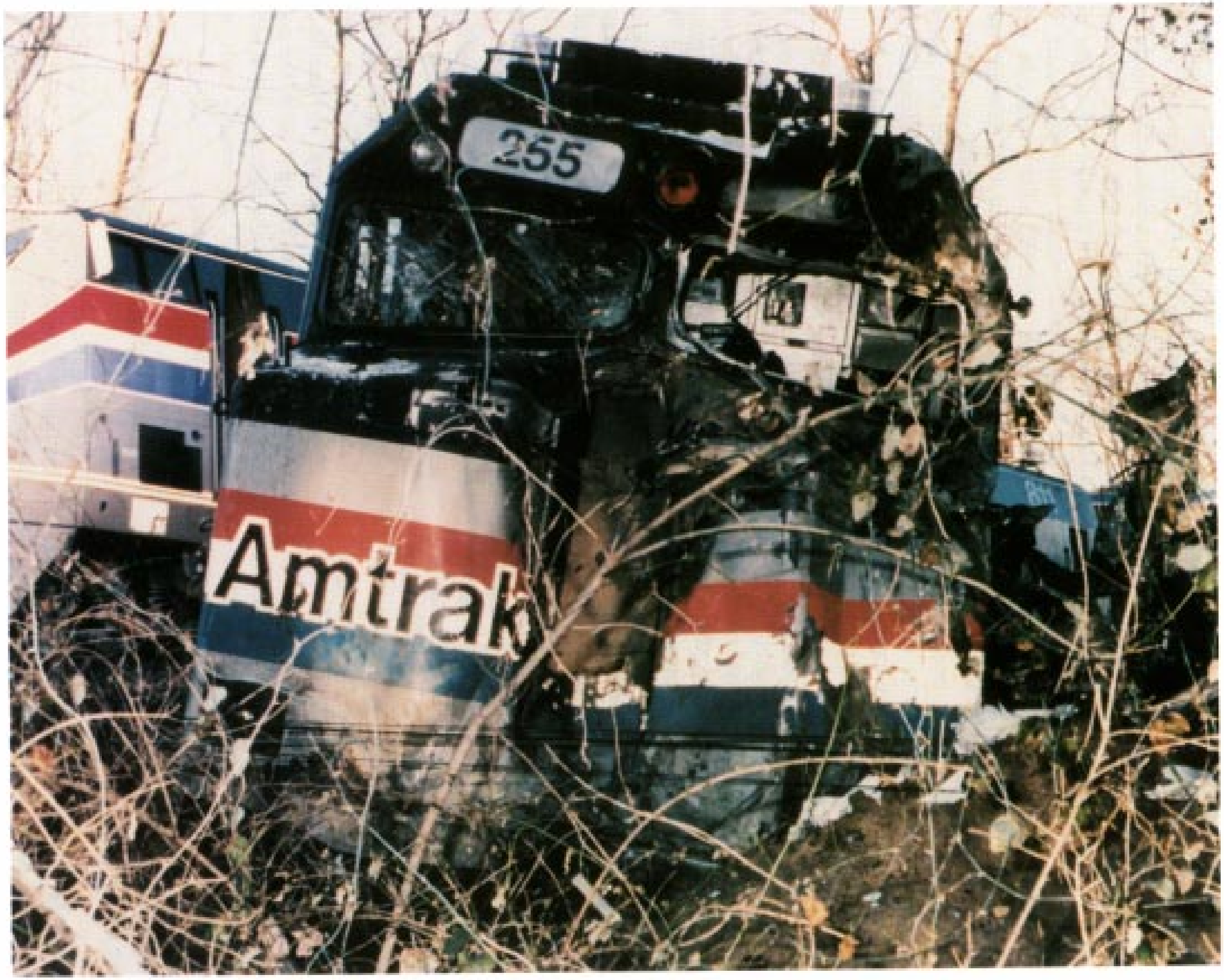


Figure 8--Photograph of postcollision Amtrak locomotive unit ATK 255 at accident site.

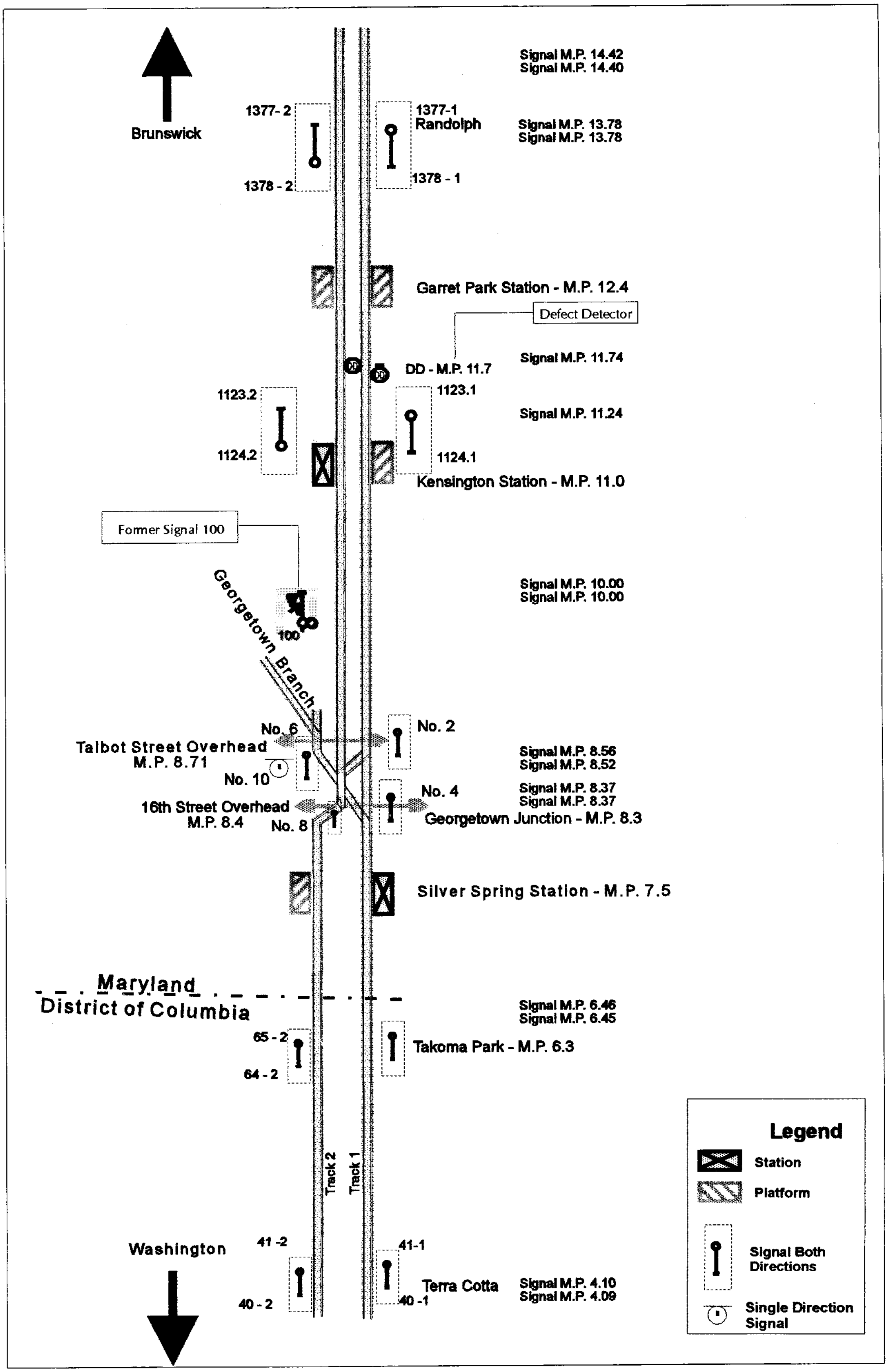


Figure 9--Schematic of tracks and signals at collision site.

The MPs were in decreasing numerical order in the timetable eastward direction. The tracks pass through a residential area. An unpaved railroad maintenance road is adjacent to track 1. The right-of-way closest to the point of collision is elevated above the adjacent topography. A steep slope about 45 feet wide is on the south side, and a far lesser slope about 80 feet wide is on the north side. Both slopes had a dense cover of trees and shrubbery. Open parking lots for large residential buildings are near the bottom of the slopes on both sides of the right-of-way adjacent to the collision site. Highway overpass bridges are about 1,000 and 800 feet, respectively, to the west and the east of the collision site.

Approaching the accident site at MP 8.49 from the west, track 2 between MPs 8.95 and 8.68 curves to the left through a 1° and 36' curve on a 0.43-percent ascending grade eastward. The track alignment and the gradient between MPs 8.68 and 8.27 are, respectively, straight and on a 0.18-percent descending grade in the eastward direction.

The track and turnouts were 140-pound continuous welded rail. Both tracks 1 and 2 and the turnouts making up the interlocking were inspected and maintained by the CSXT to FRA class 4 track standards, which provide specific minimum track geometry requirements for freight and passenger train operations at maximum allowable speeds of 60 and 80 mph, respectively. The before and after accident track geometry measurements for gage, alignment, and cross level and all other track inspection and maintenance records were reviewed and indicated no anomalies. Postaccident inspection found the westernmost crossover switch rails on track 2 and the switch rails on track 1 were lined properly for a crossover movement by Amtrak train 29.

About 8 to 10 "snow pots" (oil burning switch heaters) were in place and lit at all four switches of the Georgetown interlocking crossovers. The snow pots, which were in the spaces between the switch and under the switch point rails, were burning to keep snow from accumulating behind the switch points.

An adjacent track, the former Georgetown branch track, is parallel to and intersects with track 2 east of the collision site. The siding was not involved in the collision but was skewed out of alignment by the derailment and lateral displacement of the MARC equipment.

Signals--Train movements through the accident area, including Georgetown Junction, are controlled by a traffic control signal (TCS) system[11] on the two main tracks that is arranged for train movement in both directions with color position light signals[12] and the General Railway Signal model 5H electric switch machines controlled from the operations center in Jacksonville, Florida. The AU dispatcher controls the power-operated switches at Georgetown Junction for crossover movements between tracks 1 and 2 remotely from Jacksonville by leased telephone lines. East and west of Georgetown Junction the system consists of a TCS on two main tracks arranged for train movement in both directions with color position light signals and electronic track circuits.

The EAS at Georgetown Junction controls eastbound train movements on track 2, and it as well as the eastbound signal 1124-2 at Kensington are mast-mounted color position light signals. (See figure 10.) Their method of operation is by timetable, direct traffic control (DTC) block system,[13] and signal indication of a TCS.

A defect detector is at MP 11.7, about 0.5 mile west of signal 1124-2 at Kensington, and after the accident, it provided a paper tape printout for train movements on track 2. (See table 4.) The clock on the defect detector, measuring

---

[11]Train movements are authorized by block signals whose indications supersede the superiority of trains for both opposing and following train movements on the same track.

[12]Fixed signals that display aspects by the color and position of two or more lights.

[13]Governed by the verbal authority of the train dispatcher, or a series of consecutive DTC blocks activated by train movement on the track circuit.

in hours and minutes, is not synchronized with either the event recorder at Georgetown Junction or the system log in Jacksonville. The defect detector is approximately 16 minutes ahead of the Georgetown Junction event recorder and 14 minutes ahead of the system log in Jacksonville. The detector noted no defects on the three passing trains.

The defect detector broadcasts an arrival and a trailing message, respectively, as a train approaches and shortly after the last car passes. The arrival message is preceded by a 1/4 second tone to alert the engineer, which is followed by an approximately 5-second message that identifies the defect detector MP location and track number for an engineer to determine whether the message applies to him. If no defects are detected (none were for either train in this accident), the approximately 10-second trailing message repeats the arrival message and then adds "no defects," one of four brief safety messages, and a concluding "end of transmission."

The Georgetown Junction interlocking is equipped with a signal event recorder to record specific events and signal relay changes corresponding to the dispatcher's requests, train movements, signal indications, and interlocking conditions. Following the accident the signal event recorder was secured and obtained information indicating that the last time the EAS was cleared for a train movement from track 1 to 1 was at 3:14 p.m. for the eastbound MARC train 284. About 4:05 p.m. the EAS recorded a STOP signal and displayed this signal about 1 hour 33 minutes until the accident at 5:39 p.m.

Figure 10--Signal 1124-2. The "D" was added after the accident.

Table 4.--*MP 11.7 defect detector printout for track 2 train movements*

Train (not recorded)	Date	Time	Direction	Axles	Cars	Speed (mph)	Length (ft)
MARC 284-16	2/16	16:19	East	40	10	61	744
MARC 286-16	2/16	17:50	East	16	4	49	279
CSXT Q401-16	2/16	18:23	East	22	5	15	280

Operations Information

Train movements on the CSXT Baltimore Division, Metropolitan Subdivision, are governed by CSXT operating rules in the Operating Procedures Manual, effective January 1, 1995. Instructions for the movement of trains or equipment and related essential information are in Baltimore Division Timetable No. 5, issued on January 1, 1996. Superintendent's bulletins containing written special instructions about the movement and safety of trains and employees are issued periodically. The Metropolitan Subdivision is called the Brunswick Line for the MARC commuter train operations between Brunswick and Washington, approximately 50 miles. Eastbound MARC trains on the Brunswick Line are normally operated in the push mode and westbound MARC trains in the pull mode.

Train movements through the accident area are controlled by the CSXT AU train dispatcher from the operations center in Jacksonville. The AU train dispatcher controls the movement of approximately 80 trains daily over three lines: Brunswick (Washington to Brunswick, which includes the Georgetown Junction crossover); Camden (Washington to Baltimore); and Penn (Baltimore to Brunswick). (See figure 11.) About 28 unscheduled CSXT freight trains and 2 scheduled Amtrak passenger trains as well as the 18 weekday-scheduled MARC commuter trains on the Brunswick Line operate daily through the Georgetown Junction interlocking.

The Safety Board investigation of this accident involved the activities of seven trains: Amtrak train 29, CSXT freight trains K951 and Q401, and MARC trains 279, 281, 284, and 286. About 4:05 p.m. MARC train 284 was the last eastbound train to operate on track 2 through the crossover switch at Georgetown Junction with the switches lined in the "normal" or through position. MARC train 279 was the last westbound train to operate before the accident through the crossover switch at Georgetown Junction, crossing from track 2 to 1 about 5:15 p.m. The CSXT train K951 was operating westbound toward Georgetown Junction on track 1 and had stopped east of the Georgetown Junction (near the highway overpass bridge) about 5:28 p.m. Amtrak train 29 was operating westbound on track 2 proceeding to make the same crossover as MARC train 279 had made and had been operating behind MARC train 279 before being struck by MARC train 286. The CSXT train Q401 and MARC train 281 had been operating, respectively, behind MARC train 286 and Amtrak train 29 also before the collision.

CSXT Train Operations--Trains[14] through the accident area operate under the authority of block signal indications of a TCS system. Authority for movement is governed by the CSXT operating rules 265 through 271 for the TCS system rules. Passenger-specific operating rules are contained in the CSXT operating rules 620 through 635. The Baltimore Division Timetable No. 5 specifies the maximum authorized speed for the Metropolitan Subdivision as 79 mph for passenger and 55 mph for freight trains. Trains can operate in either direction on either track by signal

[14]The MARC trains began push/pull operations in 1985 with the delivery of the MARC II cab control cars.

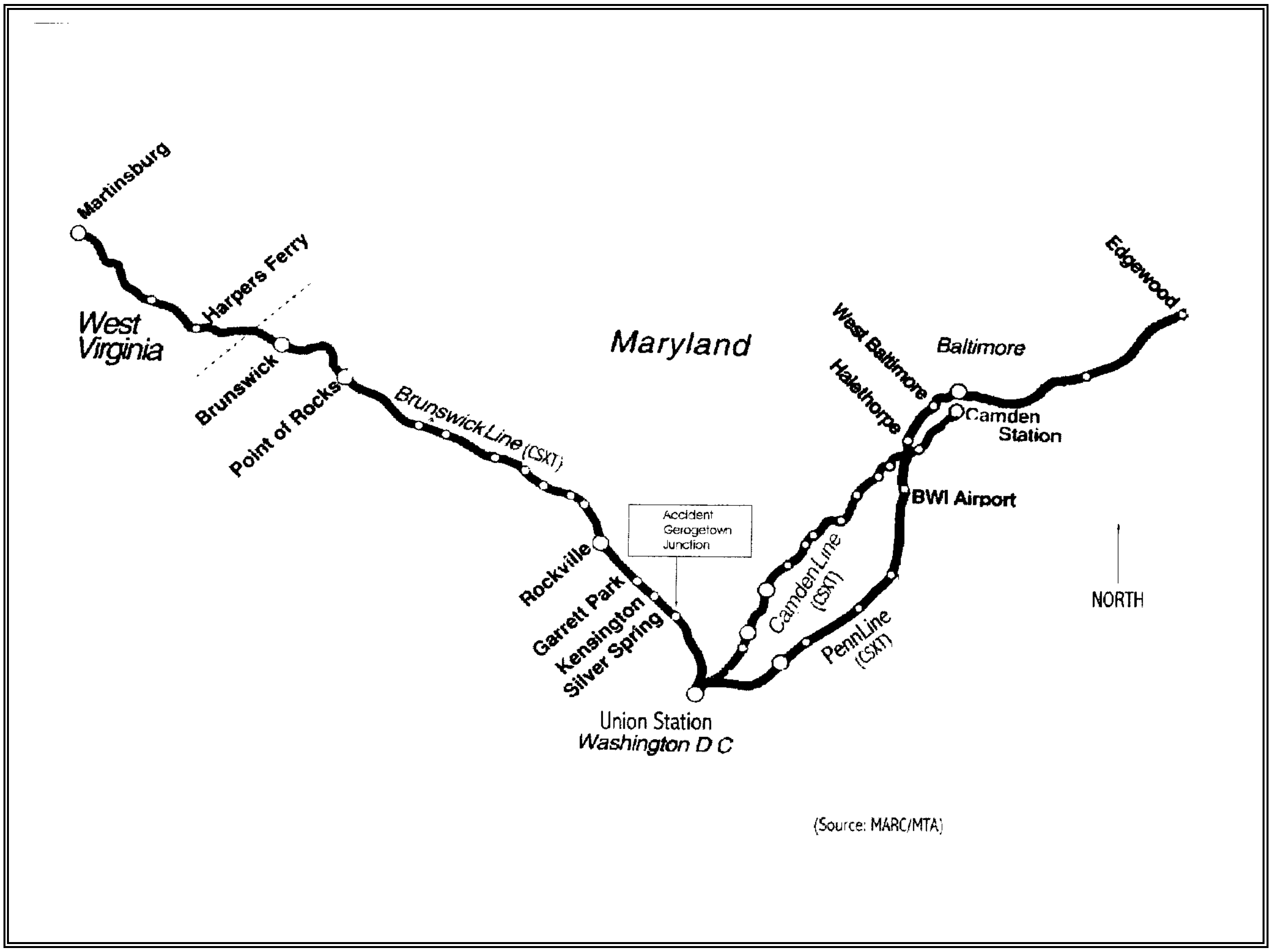


Figure 11--Map of MARC operations for Brunswick, Camden, and Penn Lines.

indication. Between MP 11.0 at Kensington and MP 8.3 at Georgetown Junction, the maximum authorized passenger train speed is 70 mph, except for a timetable speed restriction between MPs 10.6 and 9.5 for a reduction to 55 mph for passenger trains.

The Safety Board reviewed event recordings maintained by the CSXT in three formats: computerized train sheets (FRA records of train movements),[15] signal event logs, and train dispatcher voice communication recordings (including telephone). Train-to-train radio communications are indicated on the dispatcher's voice recording only if the dispatcher is using the radio channel. All event records, with the exception of the computerized train sheets, were voluntarily maintained by CSXT. The Safety Board

[15]Dispatcher records of train movements are maintained by the CSXT in compliance with 49 CFR Part 228 and are required to identify the timetable, the train and engine, the traincrew with duty time, the dispatcher with duty time, the station and office, the location and date, the weather conditions in 6-hour intervals, the distances between stations, the direction of train movement, the time when the train passes each reporting station, the train arrival and departure times at each reporting station, and unusual events affecting train movement.

reviewed the train sheets for the previous 90 days and found that the sheets significantly lacked the recording of unusual occurrences, such as this accident, and weather information, which are elements the FRA regulations require to be maintained.

Operational Efficiency Testing--The CSXT maintains an operational test and observation program in compliance with 49 CFR Part 217 to determine the extent of compliance with its operating rules, timetables, and timetable special instructions. The stated objectives of the program are to eliminate human error accidents and to improve employee compliance with and knowledge of the operating rules and special instructions.

CSXT operating officers, following procedures and instructions contained in the CSXT Efficiency Test Manual dated April 1, 1993, test CSXT and Amtrak crews who operate over CSXT property. Of the 43,566 efficiency tests performed on the Baltimore Division during the calendar 1995, 1,334 test failures were recorded. The Metropolitan Subdivision had 2,357 of those efficiency tests and recorded 95 test failures. The majority of the failures involved radio (37) and safety rule (31) tests.

To comply with 49 CFR Part 240, the CSXT maintains a Qualification and Certification Program of Locomotive Engineers. For 1995 the CSXT revoked 66 engineer certifications, which ranged from 30-day suspensions to permanent revocations. Thirty-two, 14, and 6 suspensions involved track authority, signal, and disarming a safety device violations, respectively.

The MTA/MARC neither has operating rules for its commuter trains nor performs operational efficiency tests on traincrews because its trains are operated by CSXT employees in accordance with the CSXT operating rules or Amtrak employees in accordance with the Amtrak operating rules. Amtrak conducts operational efficiency tests on Amtrak traincrews operating on the CSXT for observance of the CSXT operating rules as well as the Amtrak operating rules.

MARC Train Radio Communication--Shortly before the accident, MARC trains 286 and 279 passed each other just west of the Kensington station, and a radio transmission took place between the engineers of the two trains. The engineer of MARC train 279 provided information about that interchange, which is contained in the following synopsis:

The MARC train 279 conductor called his engineer by radio when they were in Silver Spring to determine whether he had heard from MARC train 286 yet. The engineer had not. The conductor wanted the engineer to notify train 286 that a passenger had boarded train 279 by mistake. The passenger wanted to go to Baltimore, not Brunswick. Since MARC train 286 had not yet passed Silver Spring, the conductor said that train 286 could return the passenger to Washington from the Silver Spring station to catch the proper train to Baltimore. The train 279 engineer did not transmit that information to train 286 at that time because the train was still too far away to contact. He said that the two trains usually passed each other around Kensington. Around Georgetown Junction, the MARC train 279 conductor called his engineer and again asked whether he had heard from MARC train 286, and again, the engineer had not. The conductor reported that another passenger had also boarded the wrong train. He said that if they had not passed train 286 by the time they arrived at Kensington station, he would let the passenger off at that station for train 286 to pick up and return to Washington.

Shortly thereafter, the MARC train 286 engineer contacted the MARC train 279 engineer and warned him about children in the Garret Park area who were throwing snowballs near the track. The train 279 engineer said that at first he had not quite heard the other engineer and had to ask him to repeat his message. The train 279 engineer asked the children’s location, and the train 286 engineer responded that the children were near the east end of the station platform. The train 279 engineer at that time began watching for the children or something on his track. The train 279 engineer next told the train

286 engineer about the passengers at Kensington and at Silver Spring waiting for train 286; the train 286 engineer had replied that that was all right. The train 279 engineer, however, had not told the train 286 engineer on which side of the tracks the passengers had gotten off.

The MARC train 279 engineer stated that the radio communications took place near the defect detector at MP 11.7 between Kensington (MP 11.0) and Garrett Park (MP 12.4). He thought that the two trains had passed each other near MP 11.7 and that the rear of his train had possibly cleared the defect detector by four or five car lengths before the head end of his train reached the head end of MARC train 286. Between the radio communications of the two engineers, the defect detector was transmitting messages to the trains over the same radio frequency. The train 279 engineer said that because of the defect detector broadcast, which is still conveyed when engineers speak, he and the train 286 engineer were not hearing each other's every word. Nevertheless, he believed that they managed to get across their messages. The communications began before the trains met and continued as they passed each other. At the end of the communications, the train 279 engineer told the train 286 engineer that everything was all right behind him, which meant that no snowball-throwing children were behind his train. The engineer of MARC train 279 said he again heard the engineer of MARC train 286 use the radio to call out what he thought was the signal aspect at Kensington; however, he could not understand what signal aspect was called because the defect detector radio was broadcasting its message at the same time.

MARC Train 286 Passenger Load Data--MARC provided the January and February 1996 passenger load information for MARC train 286. Inclement weather during January forced the cancellation of 6 days of the train 286 scheduled service. It operated 15 days and had a total ridership count for the month of 72 passengers. The highest single-day (Friday, January 26) total was 21 passengers. Train 286 had operated 11 days through Thursday, February 15, and had a total ridership count of 79 passengers. The highest single-day (Friday, February 9) total was 25 passengers.

CSXT and MARC Operating Agreement--An operating agreement was first effected between the B&O, now the CSXT operations, and the Maryland State Railroad Administration, now the MTA/MARC. Their last contracted agreement, dated November 1, 1985, was renewable for five additional 5-year periods. The October 1990 operating agreement,[16] in effect at the time of the accident, has been under negotiation since 1995 for its second 5-year term. The contract provides that the CSXT service will be "safe and efficient" and that the CSXT will maintain equipment to comply with all applicable safety regulations of regulatory bodies and manufacturers' standards. The MTA owns the railroad equipment used for the MARC service. The MTA/MARC has the right to review and audit equipment shop orders and maintenance. The operating contract has no provision regarding the delineation of responsibility for passenger handling. The CSXT director of passenger services explained in an August 1996 letter to the Safety Board that the contract obligates the:

> CSXT to handle MARC's commuter trains in a manner consistent with safe operating rules and practices, to operate them on schedule subject to operating conditions and overriding safety considerations, and to operate them in a cost efficient manner.

[16]The 1990 operating contract provides for limited liability of the CSXT in the event of an accident in passenger service and affords that the MTA indemnify the CSXT for the first $150 million of exposure per accident. The CSXT is not indemnified for any damages payable to its employees from an accident; however, the compensation terms of the contract include a 20-percent additive to incurred labor costs intended to reimburse the CSXT for the risk of insuring its own employees.

He continued that the CSXT, as a freight railroad, does not have special expertise in the handling of passengers and "is responsible for matters associated with train handling and MARC is responsible for matters relating to the passengers themselves." The CSXT indicated that its crews were not specifically trained in emergency procedures for passenger handling and that MARC, at its choice, did not supply on-board train personnel. However, MARC informed Safety Board investigators that it believed that for MARC to provide its own on-board personnel would have been a "contradiction to CSXT's labor agreements."

(See Appendix E, Organization Charts of the CSXT and the MDOT/MTA/MARC.)

Meteorological Information

A strong low-pressure system, which was off the central Atlantic coast on the morning of February 16, moved northeast during the day. Accumulated snow, reduced visibility due to the snow and fog, and strong winds were associated with the storm system.

The National Weather Service issued the following short term forecast at 5:30 p.m. for Montgomery County:

> Winter storm warning continues…. Snow will continue this evening accumulating 1 to 3 inches before tapering to flurries by 7 p.m…. Temperatures will drop into the lower 20s by 11 p.m. Winds will be north 15 to 25 miles per hour and gusty. There will be blowing and drifting of snow as wind chills below zero.

Pathological and Medical Information

MARC Train 286--On February 17, 1996, autopsies were performed in Baltimore on the three MARC operating crewmembers and the eight MARC passengers who were fatally injured in the collision. The Maryland medical examiner recorded the postmortem examination reports.

The engineer, who was found on the exterior left side of cab control car 7752, received fatal multiple injuries and generalized body burns. The conductor, who was recovered from the aisle floor at row 10, sustained fatal multiple injuries. The assistant conductor, who was discovered lying over a right side seat of row 9, received fatal smoke and soot inhalation and generalized body burns. The eight passenger fatalities were also in cab control car 7752: two sustained fatal smoke and soot inhalation injuries, three received fatal smoke and soot inhalation injuries plus general body burns, one sustained fatal generalized body burns, another received fatal soot inhalation injuries and generalized body burns, and the final victim sustained fatal multiple injuries with generalized body burns. (See figure 12 for the postaccident placement of fatalities, which was based on information obtained from the MARC train survivors, the MCPD, and the Maryland medical examiner report.)

Amtrak Train 29--The engineer had remained in the locomotive control compartment and received blunt torso injuries and multiple contusions. The assistant engineer, who jumped from the locomotive unit before the collision, sustained pulmonary contusions and multiple facial lacerations. The mechanical rider, who was in the control compartment of the second locomotive unit, received blunt torso injuries and a closed head injury. He said that he had been thrown against the back wall of the locomotive. He and the two operating crewmembers were admitted to a local hospital. The conductor in the midsection of the train sustained a facial abrasion and stated that he had struck a table. The assistant conductor in the last car also received a facial abrasion but from striking a seat. Two on-board service crewmembers sustained minor injuries. All four employees were treated at and released from local hospitals. Eight Amtrak passengers received bruises and abrasions and were taken to area hospitals, treated in the emergency rooms, and released.

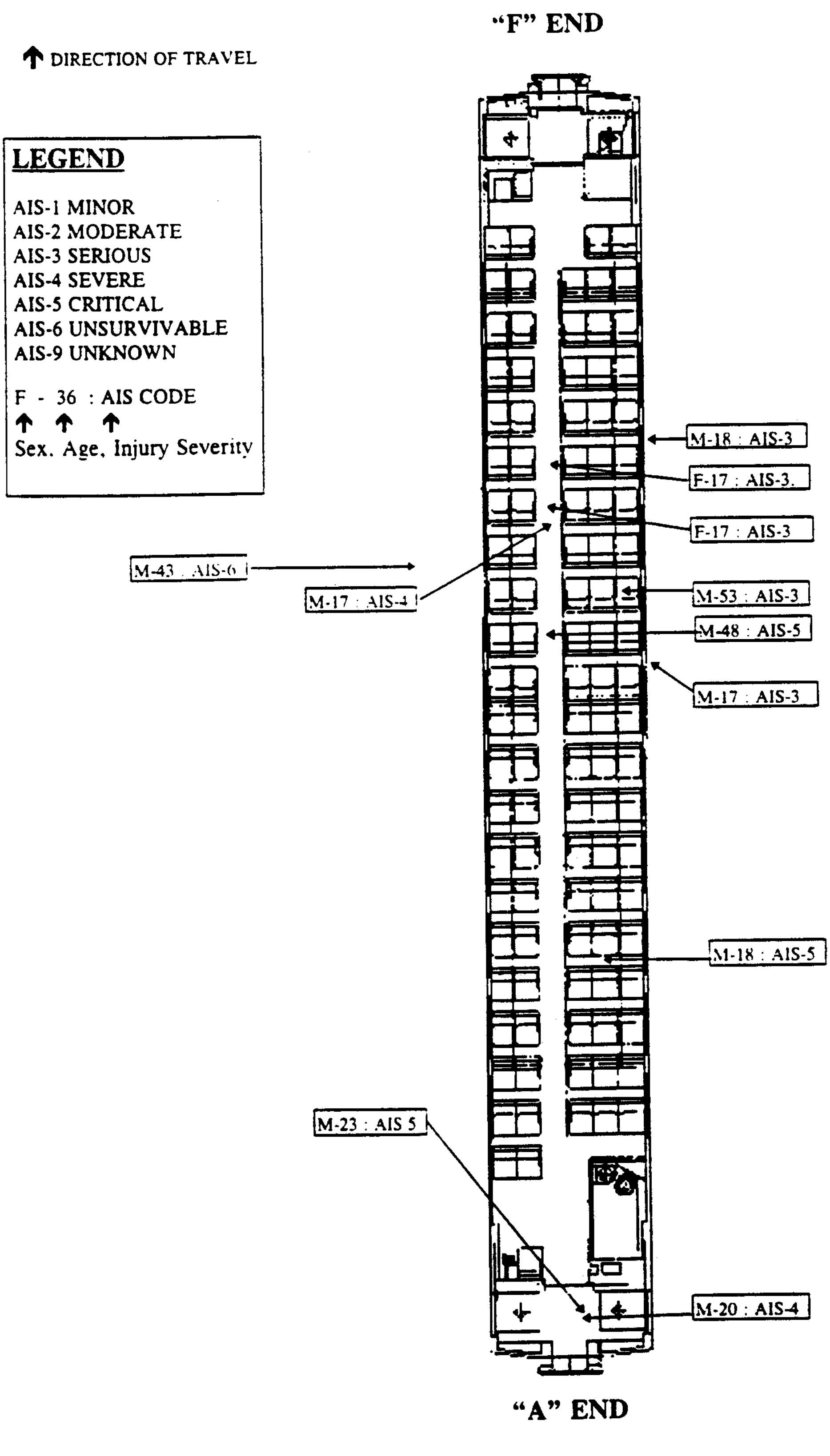


Figure 12--Placement of fatalities in MARC passenger coach cab control car 7752.

Toxicological Information

The postaccident specimens, which were acquired from the three deceased crewmembers of MARC train 286, consisted of blood for all three and tissue and other body fluids, as obtainable under the circumstances. Postaccident blood and urine specimens were also acquired from the Amtrak engineer, assistant engineer, conductor and assistant conductor. The federally approved laboratory, Northwest Toxicology, Inc., in Salt Lake City, Utah, conducted the tests for marijuana, cocaine, phencylidine (PCP), opiates (morphine and codeine), and amphetamines (amphetamine and methamphetamine) and for alcohol in accordance with the FRA postaccident testing program. No drugs or alcohol were identified in either traincrew's specimens.

The Maryland medical examiner during the autopsy process conducted a more comprehensive drug screening than the FRA-required testing. Neither other drugs nor alcohol were found for the engineer and assistant conductor. However, acetaminophen, orphenadrine, and antipyrine were detected in the conductor's bile and antipyrine also in his blood. The nonprescription-analgesic acetaminophen relieves pain and reduces fever. Orphenadrine is a prescription muscle relaxant. The prescription-analgesic-anesthetic antipyrine, applied within the ear, relieves the pain and swelling of some ear infections and additionally removes ear wax.

At the request of the Safety Board, further testing on the available specimens was conducted by the Center for Human Toxicology in Salt Lake City. The test results confirmed the FRA and medical examiner's test results.

No postaccident toxicological testing specimens were obtained from the CSXT train dispatcher who was on duty at the time of the accident. FRA regulations require specimens be provided by the dispatcher following an accident and their testing to occur only should the dispatcher be "directly and contemporaneously involved in the circumstances of the accident/incident." To determine whether the dispatcher should be tested, the CSXT division manager of operations reviewed the signal log for the involved railroad line and the audio tapes of the dispatcher's conversations before the accident, interviewed the dispatcher, and conferred with the CSXT director of operating practices. The two CSXT officials noted that the audio tapes indicated the dispatcher had not conversed with either traincrew or anyone else in the area during the relevant timeframe before the accident. They also determined that the dispatcher had lined the involved signal apparatus well in advance of the accident and its position had remained unchanged. As a result of these observations, the CSXT officials found the dispatcher not "directly and contemporaneously involved" in the accident and, thus, excluded the dispatcher from postaccident testing.

Emergency Response

Montgomery County Fire and Rescue Services-- About 5:41 p.m. the MCFRS 911 dispatcher received at least 12 telephone calls from citizens who reported the train collision and fire. At 5:42 p.m. the MCFRS dispatcher notified fire and rescue personnel through a computer activated dispatch system. Also at 5:42 p.m., the Montgomery County 911 emergency operator received a cellular phone call from the conductor on Amtrak train 29.

At 5:46 p.m., the first firefighter arriving on scene reported a fully engulfed passenger car which he was unable to enter or open the doors. By 6:15 p.m., an emergency medical services (EMS) command was established as well as the fire sectors situated for the management of the level two incident.[17]

---

[17]This level of command is appropriate for use on serious, involved, or extended incidents in which five or more units are used. It is established at the direction of the IC and requires a formal command post and the use of command communications and incident position designations.

The IC said that at 6:30 p.m. his communication center advised him that another train was approaching the accident site from the direction of Kensington. The IC staff activated radio tones and air horns to warn emergency responders to evacuate the scene, and it was cleared for about 10 minutes until the IC determined that the approaching CSXT train Q401 was not a hazard to the emergency responders.

The last victim was removed from the wreckage by 3:50 a.m. on February 17 and emergency operations were suspended. During the rescue operations, five on-scene triage sites were available for the injured victims, who were later transported to five area hospitals for treatment.

Under Montgomery County Emergency Operations Center (EOC) direction, two nearby schools were used to provide victims with shelter, crisis counseling, and staging for transportation. County, emergency management, and volunteer agencies' officials and members staffed the EOC; however, MARC, Amtrak, and the CSXT were not represented at the EOC. State, county, and volunteer organizations supplied services at both the accident site and shelters.

Montgomery County Disaster Plan-- Montgomery County has a disaster plan[18] to ensure maximum preparedness for response to and recovery from any disaster that occurred within the county. The on-scene IC decided not to fully implement the disaster plan for this accident based on the information developed during the initial response. The disaster command system (DCS), a part of the plan that provides for multiagency response and integrates the incident command system used in the field, was activated. The DCS established a standardized operational system with unified command, comprehensive resource management and interagency coordination, and cooperation from the EOC. The Fire and Rescue Disaster Plan annex O was also activated. The plan outlines how an incident will be managed in the field and how the IC will coordinate with the disaster manager in the EOC. Additionally, the Greater Metropolitan Washington Area Police and Fire/Rescue Services Mutual Aid Operational Plan[19] was implemented between Montgomery, Prince George's, and Howard Counties in Maryland, Fairfax County in Virginia, and Washington, DC.

Montgomery County simulated a Washington Metropolitan Area Transit Authority (WMATA) train derailment in Rockville in February 1995 during which at least 24 people were transported to hospitals and shelters were established with county agencies' participation. A hazardous materials incident was also included in the derailment exercise. In October 1995 another WMATA train derailment was simulated with casualties during a 30-inch snowfall. MCFRS units responded on January 6, 1996, to an actual WMATA train derailment during a snowstorm, which involved one fatality, at the Shady Grove station in Gaithersburg, Maryland.[20] The MCFRS had not participated in any disaster drills that involved MARC, Amtrak, or the CSXT and in any disaster training or familiarization training with any freight or passenger railroad that provides service in Montgomery County.

Amtrak, MARC, and CSXT--Amtrak reported to Safety Board investigators that about 6:15 p.m. one of its officers made four attempts within 10 minutes to provide the passenger list and other information to the MCFRS personnel at the

[18]Approved by the Governor in 1988 and certified by the county executive and the county chief administrative officer in November 1995.

[19]Part of the Metropolitan Washington Council of Governments plan and last revised in September 1990.

[20]Railroad Accident Report--*Collision of Washington Metropolitan Area Transit Authority Train T-111 with Standing Train at Shady Grove Passenger Station, Gaithersburg, Maryland, January 6, 1996* (NTSB/RAR-96/04).

command center in the adjacent parking lot. He was finally told that the information was not needed and he should wait. Later he asked MCFRS personnel at this command center to which hospital the traincrew had been taken, and they told him that they did not know. Amtrak did not locate the traincrew in the hospital until 10:30 p.m.

The assistant superintendent of the CSXT Baltimore Division told the Safety Board that on two occasions at the MCFRS command post and on one occasion at the accident site, he identified himself and asked to assist. He was told that his assistance was not needed but to stand by, in case he would be needed. Another CSXT official was later asked to participate in a media interview with the MCFRS public relations officer.

Neither MARC nor the CSXT either had an action plan for accidents or emergencies, in coordination with each other or Amtrak, or had performed, in conjunction with each other or Amtrak, any emergency disaster drills or exercises that involved the CSXT operation of MARC passenger train equipment. In addition, neither MARC nor CSXT personnel had attended any classroom instructions or hands-on exercises that included the use of emergency fire and rescue equipment or procedures.

According to the MARC Interim System Safety Plan of April 5, 1995, MARC had made its passenger equipment available in 1995 to the Brunswick Volunteer Fire Department and to the Maryland Fire and Rescue Institute for emergency response training. On April 18, 1995, the Amtrak manager of emergency preparedness had conducted 4 hours of classroom training and 2 hours of hands-on training at a MARC facility to members of the Baltimore County Fire Department and the Cowenton [Maryland] Volunteer Fire Department. On October 18, 1995, the Maryland Fire and Rescue Institute provided a 3-hour class,[21] which included classroom discussion, a photographic slide presentation, and a tour of MARC passenger equipment at the Brunswick CSXT railroad yard, for several fire and rescue departments of Frederick County, Maryland. MARC reported that it participated in this training by providing the equipment.

Survival Aspects

MARC Train 286 Occupant Evacuation--Two passengers had occupied the second car, passenger coach 7720, and exited it through an emergency window. One of these passengers was injured and needed assistance. The other passenger lost his eye glasses after being thrown from his seat on the left side of the car in the fourth or fifth row. He said that he had been waiting to buy a ticket from the conductor when he heard an explosion, the lights went out, and no emergency lights came on. As he was starting for the rear exit because displaced seats obstructed the exit at the forward end of the car, the injured passenger pointed out the right-side emergency window near the center of the car. He reported that he pulled the rubber molding around the emergency window and "then pulled on the window handle and nothing happened." He decided to then put one foot on the seat and to place his other foot on the wall beside the window. He said:

> Just so I can get better leverage and I pull and then it starts coming unstuck, and the top comes unstuck. So I grab the top of the actual window with my hands and pry the rest of it off and then put that down.

He stated that removing the emergency window took about 3 minutes and that helping the injured passenger to exit and his own exit required about 7 minutes more.

---

[21]Part of the 45-hour Rescue Specialist Training course that has been offered throughout the State to full-time and volunteer emergency responders since 1991.

Ten of the 18 passengers on board cab control car 7752 survived the accident. The passengers were unsuccessful in opening the left and right rear exterior doors after the accident. The ten surviving passengers had exited the train through an opening created by the misalignment of the passageway between cab control car 7752 and passenger coach 7720. The longitudinal misalignment of both cars was about 15 degrees. Cab control car 7752 came to rest upright and had rotated vertically clockwise about 10 degrees; passenger coach 7720 had also rotated vertically clockwise, but about 30 degrees.

Nine surviving passengers were U.S. Department of Labor Job Corps students, and they stated they had known nothing about the operation of the emergency doors or windows. Some stated that they did not see any emergency placards explaining the use of emergency exits and that no crewmember had given any emergency announcements before the accident. One student remarked that he had seen the emergency placards but had paid no attention to them. The survivors noted that about half of the students were asleep before the collision. One stated that he had been seated in the rear section of cab control car 7752 when the conductor ran from the front of the car shouting, “Brace yourself! Get on the floor!” The student dropped to the floor and held onto the seat on which he had been sitting. He said that windows had shattered during the collision, that the car was on fire afterwards, and that he could feel the heat from the fire on his back. He reported that he crawled to the rear of the car and tried unsuccessfully to open both side doors. He saw light through an opening between the cars and climbed through the space.

One student, who was sitting next to an emergency window on the last seat in the right-rear section of control cab car 7752, described the smoke as extending from about 2 feet above the floor to the car ceiling. This student said that he did not have time to open the window and that he believed he could escape faster by using the door through which he had entered the car.

Another student stated that the conductor with another person came from the front of the car shouting, "everybody run to the back" and the conductor had reached the midpoint of the car when the collision occurred. The student reported that after the collision, he was thrown between the seats, the lights went out, smoke came into the car, and that other students were screaming and running to the rear of the car. He saw students unsuccessfully attempting to open the rear side doors, and he explained that because of the fire, no one attempted to open the emergency windows. He slid to the floor because he could not see or breathe with the smoke. He observed that while he was on the floor, one person exited “off the train through a hole or crack in the train.” He followed another person through that opening and ran down a hill to a large residential building. He estimated that he escaped within 5 minutes.

One student, who had been standing and talking to another student, stated that he had seen two crewmembers running rearward through the car from the control compartment and had heard them shouting, what he understood to be, “aboard, aboard.” He noted that the two crewmembers appeared to be expressing shock and disbelief that another train was approaching on the same track. He said that he saw the conductor jump behind one of the seats and that he himself crouched behind and held onto the last seat on the left side of the car in anticipation of the collision. He recounted that he proceeded immediately after the crash to the rear door exits, that he felt the heat from the fire on his back, and that smoke quickly filled the car. He reported that he looked “high and low” for “handles or gadgets or something to open the doors” but smoke obscured his vision and that he could find nothing to open the doors. He added that he pounded with this hands on the door windows but the glass would not break. Other students were running toward him, coughing from the smoke, and yelling for someone to open the doors. He also heard banging and kicking noises that suggested other passengers were attempting to open or break windows.

Firefighter Evacuation Action--The first firefighters to reach cab control car 7752 observed the car fully engulfed by fire and found no survivors. The firefighters said that they attempted to open the right-rear door of the car with an ax, a halligan tool, and a 10,000 psi hand-pumped hydraulic tool. The door had opened about the width (0.5 foot) of the ax head, could not be opened any farther, and closed when the tools were removed. One firefighter reported that he had observed two victims within 0.5 foot of the right-rear vestibule door of cab control car 7752. He stated that he then endeavored to find another entrance into the car because the door could not be opened.

Subsequently, the firefighters broke the first right-side window on passenger coach 7720 and entered that car through the broken window. They exited passenger coach 7720 through the damaged left-front door and crawled down to the ballast on the north side of the train. Two firefighters crawled up on the couplers and entered cab control car 7752 through the diaphragm opening that had been used as an escape route by the surviving passengers from the car. After the two entered the cab control car 7752, a third firefighter passed a hand line through a small opening between the two cars. (Because of the angle at which the cars came to rest, no person could pass through the vestibules from one car to the other car.) The firefighters in cab control car 7752 proceeded to suppress the fire and search for victims.

The firefighters stated that they had not observed either any exterior instructions detailing how to open the emergency windows or the location of the emergency door release handles on the car exterior.

Tests and Research

Locomotive Event Recorders--MARC unit 73 was equipped with a Pulse MTR magnetic tape event recorder and Amtrak units ATK 255 and 811 were equipped with Pulse Train Trax® solid state event recorders. The Pulse solid state event recorders on Amtrak units ATK 255 and 811, respectively, used a FAK PAK® removable recording media and a nonremovable memory module with battery-backed SRAM memory.

The event recorders were removed from MARC unit 73 and the Amtrak lead unit ATK 255 under Safety Board supervision between 9 and 10:30 p.m. on February 16, 1996. The event recorder from the Amtrak second unit ATK 811 was not removed but was downloaded the next morning. The readouts of the three event recorders were successfully performed between 1 and 10 a.m. on February 17. A subsequent review of the raw electrical wave forms from the MARC unit 73 event recorder data was performed on March 26 and 27, 1996, using Safety Board laboratory hardware and WAVES software, which was required to establish more accurate timing of events than possible with the manufacturer readout software.

MARC Train 286 and Amtrak Train 29 Movement--At 4:45 p.m., shortly after its eastbound departure from Brunswick on track 2, MARC train 286 was stopped behind the eastbound CSXT freight train Q401, which had been disabled beyond Point of Rocks, Maryland. The MARC train 286 engineer radioed the AU dispatcher, who directed him to make a reverse (westbound) move on track 2 to Point of Rocks and to cross over there onto track 1. MARC train 286 departed Point of Rocks eastbound on track 1 at 4:55 p.m., traveled eastward for 12 miles around the disabled train, and returned at 5:11 p.m. to track 2 at MP 30. The event recorder data indicated that the train stopped at the Rockville station, accelerated to 74 mph, maintained for about 1 minute a speed of between 72 and 74 mph, and 3 minutes 15 seconds and 2.9 miles from that station initiated dynamic braking near the signal at MP 13.78. The train then decelerated under dynamic braking for 1 minute 33 seconds and 1.33 miles until attaining a speed of 20 mph near the Garret Park station (MP 12.4) and subsequently accelerated for 1 minute 13 seconds and 0.8 mile until reaching 53 mph near the defect detector at MP 11.7. Westbound MARC train 279, operating on track 1, passed eastbound MARC train 286, still operating on track 2 at 53 mph, near a dragging equipment detector 0.7 mile west of the Kensington station. The train 279 engineer then advised the train 286 engineer that passengers were to be picked up at the Kensington and Silver Spring stations.

MARC train 286 at this time decelerated at idle throttle for 26 seconds and 0.36 mile, then its engineer initiated dynamic braking at a speed of 46 mph, and 6 seconds later the train passed signal 1124-2 at 44 mph. It stopped 42 seconds and 0.2 mile later at the Kensington station and remained there about 50 seconds. The event recorder data indicated that it had traveled about 2.18 miles after leaving the station when an emergency brake application was made at 66 mph. Dynamic and independent braking began about 6 seconds and 540 feet after the emergency brake application, and the traction motor current for dynamic braking increased to 375 amps. The train was traveling approximately 49 mph when, about 6 seconds and 460 feet later (1,000 feet after the emergency brake application), the reverser on MARC unit 73 was moved from reverse to forward. The traction motor current decreased to 0 amps when the direction of travel changed, and the axle generator drive wheel of MARC unit 73 stopped rotating about 13 seconds and 500 feet later (1,500 feet after emergency brake application). Rapid deceleration at a speed of about 38 mph, consistent with impact with Amtrak train 29, occurred during this time.

Amtrak train 29 departed Union Station 1 hour 20 minutes late (about 5:25 p.m.) because of electrical problems with Amtrak unit ATK 811. The train was routed westbound on track 2 behind MARC train 279, which had departed 9 minutes earlier. The engineer of Amtrak train 29 stated that at MP 6.5 he received an APPROACH MEDIUM signal indication, which limited the train speed to 30 mph approaching the next signal, and he began reducing the train speed in the Silver Spring area. He noted that he neither had radio communications nor overheard any transmissions during that time. The engineer said that he received a MEDIUM CLEAR indication from westbound absolute signal (WAS)-2 for Amtrak train 29 and looked again at the signal to confirm the indication and, also, that CSXT train K951 was stopped at WAS-1 on track 1 east of the Georgetown Junction.

According to the event recorder data from Amtrak units 255 and 811, Amtrak train 29 had traveled about 7.7 miles since its last stop and had been moving for about 1 minute between 27 and 32 mph when data variations, consistent with impact, occurred at 32 mph. Eight seconds before the data ended, the throttle had been moved from position three to four; about 5 seconds and 250 feet before the data ended, a 10 psi automatic brake pressure reduction had been made. The engineer stated that when he saw MARC train 286 moving toward his train, he decided that a collision was imminent and, thus, to remain at his operating position and to accelerate the train in an attempt to prevent a head-on collision. However, the postaccident investigation found no recorded change in speed.

Sight Distance--Tests were conducted on February 19, 1996, between 5 and 6 p.m. to determine the optimum sight distance to the wayside signals as they would have been observed by the MARC train 286 crew at Kensington and Georgetown Junction. A similarly configured MARC train was used in the push mode on eastbound track 2. The weather conditions could not be replicated; however, the MARC train 279, CSXT train K951, and Amtrak train 29 engineers had reported no difficulties seeing signal indications during the intermittent snow showers on February 16. The eastbound signal 1124-2 at Kensington, 885 feet west of the station, was displaying an APPROACH signal aspect (see table 1). The optimum sight distance to this signal was 4,299 feet. EAS-2, the next signal, was 13,786 feet east of eastbound signal 1124-2, and a STOP signal aspect (see table 1) was visible at 1,737 feet.

Signals--After being notified of the accident, the Safety Board had requested that all signal instrument houses be sealed. A preliminary investigation, which entailed a visual inspection of all signals, began about 8:15 p.m. at the Georgetown Junction control station and continued until all involved signal cases were unsealed, including the signal cases east and west of Georgetown Junction and Kensington. The investigation documented the position of vital relays and tested for grounds or combinations of grounds at the energy bus. No grounds as well as no evidence of tampering were found at any signal instrument house.

Other tests performed to determine that circuits were effective and functioning properly included battery voltage readings; route, time, and switch indication locking; time release relays; and cable meggering.[22] All test results indicated compliance with FRA regulations. Voltages of 9.8 and 10 volts d.c. were recorded at eastbound signal 1124-2, respectively, for the top marker lamp and the APPROACH indication (see table 1). No signal lamps were burned-out.

Operational tests pertaining to the involved routes were conducted, and switch and track circuit relays were manipulated because of the track structure absence. A route was established at Georgetown Junction for a westbound move from track 2 to 1 with switches 1 reverse and 3 and 5 normal. WAS-2 was cleared and a MEDIUM CLEAR indication was observed (see table 1), and EAS-2 at Georgetown Junction displayed a STOP indication (see table 1). As the two simulated trains proceeded toward each other, EAS-2 was repeatedly requested for a PROCEED indication and never displayed other than a STOP indication. The Kensington eastbound signal 1124-2 never displayed other than an APPROACH indication.

During the time-locking tests, the time element relay on tracks 1 and 2 was, respectively, 8 minutes 9 seconds and 8 minutes 13 seconds. The November 3, 1994, CSXT test records showed that tracks 1 and 2 were 8 minutes 10 seconds and 8 minutes 5 seconds, respectively. The Georgetown Junction signal event recorder data and the Jacksonville system log were compared. The event recorder data indicated that MARC train 286 passed eastbound signal 1124-2 about 5:34 p.m. and that the collision occurred about 5:39 p.m. (total elapsed time of 4 minutes 44 seconds). The system log recorded that the train passed the signal about 5:36 p.m. and that the collision occurred about 5:41 p.m. (total elapsed time of 4 minutes 46 seconds). The collision occurrence was based on the Georgetown industrial track switch being "out of correspondence" (not in proper position).

After the on-site investigation, a meeting was held at the CSXT headquarters in Baltimore to document complaints about the signal system operation. (See appendix F.) The Safety Board proposed at this meeting that further testing be performed at Georgetown Junction and specifically requested the presence of the involved parties for the investigation. After the damaged track and turnouts were replaced, additional testing for route and time locking were performed on May 28, 1996. During these tests, EAS-2 displayed only a STOP indication, and eastbound signal 1124-2 remained at an APPROACH indication until the track circuit east of the signal was shunted and then displayed a STOP and PROCEED indication.

Stopping Distance--The Safety Board conducted these tests on November 23, 1996, using train equipment similar to MARC train 286, to determine whether differences were in the stopping distances between the push and pull modes of train operation and from moving the reverser from the reverse to forward position during emergency braking. The tests were performed on relatively flat straight tracks on the Amtrak northeast corridor near Bowie, Maryland. The weather was clear with the temperature at 40 ^{o}F.

[22]Testing for the electrical resistance of wire and cable insulation.

Five tests were done each in the push and the pull modes with speeds ranging from 59 to 66 mph. The stopping distances extended from about 1,200 feet at 59 mph with dynamic and emergency braking to about 1,900 feet at 66 mph with only emergency braking. The test results indicated no significant differences in stopping distance between the push and the pull modes of operation; however, use of the reverser did eliminate dynamic braking and, thus, increase stopping distance. MARC train 286 at 66 mph (recorded speed before emergency brake application), according to the test data, would have required approximately 1,650 feet of stopping distance after an emergency brake application with dynamic braking until stopped compared with approximately 1,900 feet of stopping distance after an emergency brake application using the reverser with no dynamic braking after 49 mph. The test data also demonstrated that retaining dynamic braking until impact, MARC train 286 would have collided with Amtrak train 29 at 34 mph (recorded collision speed of 38 mph), resulting in an additional 0.3 second of elapsed time and in Amtrak train 29 advancing about 14 feet farther into the crossover before impact.

Passenger Train Air Brakes--Some locomotives, such as those operated on Amtrak, automatically combine dynamic and pneumatic braking, which is called blended braking, for greater efficiency and less mechanical wear. MARC locomotives, such as the one involved in the accident, are designed to apply the dynamic brakes automatically during emergency braking, and the dynamic brakes supplement the pneumatic braking. The dynamic brakes continue to apply in emergency until a wheel slip occurs, or the reverser is moved, at which time the dynamic braking discontinues and the braking is fully pneumatic. Moving the reverser during emergency braking resets the electrical contacts, which interrupts the dynamic braking circuits, drops the electrical load, and eliminates the dynamic braking; thus, moving the reverser during emergency braking causes a loss of the additional braking effort that the supplemental dynamic braking provided.

The CSXT engineer training in place at the time of the accident had advised that reverser use on a locomotive in motion was inappropriate unless “the brakes fail when a locomotive is being moved at low speed without any cars attached” and other operational use would “increase braking distance due to wheel slide.” The training material did not indicate that using the reverser would eliminate dynamic braking. The CSXT training and mechanical officials stated that they were unfamiliar with the automatic dynamic braking feature that occurred during emergency braking on the MARC locomotives.

Cab Control Car 7752 Doors--The tests and disassembly of the rear interior door performed by the Safety Board on May 2, 1996, revealed that the debris within the door wall pocket and floor track had prevented the door from closing. The right-side rear door interior emergency handle and T-handle were pulled downward and were functional. The right-side rear door was manually opened and slid into its car body pocket. The left-side rear door contacted a loose sheet metal panel in its car body pocket when the door was manually opened and, therefore, could be opened only about 12 inches.

The left-side door opening mechanism was removed and tested in the Washington, DC, Safety Board laboratory. Test results showed no mechanical damage but all electrical components had thermal damage. Sealant melting and then hardening on the pinion and ball bearing, as a result of the fire, caused the resistance to rotation of the motor shaft and to movement of the pinion bearing and the fused toggle spring and self-aligning spherical bearing, which contributed to the inoperable emergency handle on the left-side rear door.

MARC Passenger Coach Car Interior Materials-- The Maryland Department of Transportation (MDOT) purchase contract for 11 passenger cars, including cab control car 7752, contained the following smoke and flammability specifications:

> All materials used in the interior of the car (that is, all materials inboard of the structural shell and including, but not limited to, liners, floor panels, thermal and acoustic insulation, seats and cushions, floor covering materials, wainscots, carpeting, glazing materials, and light fixture lenses) shall have the highest degree of fire resistance and lowest smoke emission consistent with the other qualities required. As a minimum, all materials used in the interior of the car shall meet the requirements of the U.S. Department of Transportation's [DOT] "Proposed Guidelines for Flammability and Smoke Emission Specifications."[23]

To determine the compliance of the MARC car interior materials with the flammability and smoke requirements, tests were conducted on materials from an exemplar MARC passenger car by the University of Maryland Department of Fire Protection Engineering at College Park, Maryland. (See appendix G.) These tests were governed by the FRA recommendations for testing the flammability and smoke emission characteristics for commuter and intercity rail vehicle materials.

The tested materials, consisting of the major combustible items in the car, included the upholstered portion, but not the rigid plastic siderail and back components, of the seats (see figure 13); the ceiling lining, which was similar, if not identical, to the other wall lining and partition materials; and the window mask material. The pad cushion materials of the seat passed the smoke criterion but failed the flammability criterion. The fabric upholstery seat covering passed the flammability test but failed the smoke test in the flaming mode. The vinyl seat coverings passed the flammability test but failed the smoke test in the nonflaming mode. The ceiling panel passed both the smoke and flammability criteria; however, the window mask material failed both criteria. Floor materials were not included in the tests because the cab control car 7752 floor was not destroyed by the fire.

Fuel Oil Presence--On March 18, 1996, fire debris samples were collected from MARC cab control car 7752 and second car 7720 to document the presence of diesel fuel. The chromatographic results from three samples from cab control car 7752 revealed weathered diesel fuel mixed with heavier unknown petroleum hydrocarbon.

Postaccident Actions

National Transportation Safety Board--On March 12, 1996, during its investigation of this accident, the Safety Board issued the following four urgent safety recommendations (see appendix H) to improve the safety of the rail commuting public:

--to the Maryland Mass Transit Administration:

> Install removable windows or kick panels for emergency exits in interior and exterior passageway doors. (R-96-4)
>
> Install an easily accessible interior emergency quick-release mechanism adjacent to all exterior doors. (R-96-5)
>
> Install retro-reflective signage on car interiors and exteriors at emergency exits that contains easily understood instructions and clearly marks all emergency exits (doors and windows). (R-96-6)

[23]Developed by the DOT in 1979 and used by the transit industry in general on a voluntary basis, these guidelines were superseded by the "Recommended Fire Safety Practices for Rail Transit Materials Selection," published in 1984 by the Urban Mass Transportation Administration, now the Federal Transit Administration. The recommended practices formed the basis for the FRA recommendations for testing the flammability and smoke emissions characteristics of commuter and intercity rail vehicle materials, published in January 1989.

Figure 13--Photograph of typical seats in MARC passenger cars.

--and to the Federal Railroad Administration:

> Inspect all commuter rail equipment to determine whether it has: (1) easily accessible interior emergency quick-release mechanisms adjacent to exterior passageway doors; (2) removable windows or kick panels in interior and exterior passageway doors; and, (3) prominently displayed retro-reflective signage marking all interior and exterior emergency exits. If any commuter equipment lacks one or more of these features, take appropriate emergency measures to ensure corrective action until these measures are incorporated into minimum passenger car safety standards. (R-96-7)

Federal Railroad Administration--The FRA stated that because this and the recent train accident in Secaucus, New Jersey,[24] had caused serious concerns about certain aspects of the safety of passengers and railroad employees, it issued on February 20, 1996, emergency order (EO) 20 to all railroads. (See appendix I.) The MARC operations were covered by EO 20, which required the CSXT to modify operating rules covering delays in block and crew communications and MARC to address the operation and inspection of and the instructions on emergency exits as well as to provide interim system safety plans.

---

[24]Railroad Accident Report--*Near head-on Collision and Derailment of Two New Jersey Commuter Trains near Secaucus, New Jersey, on February 9, 1996* (NTSB/RAR-97/01).

Maryland Transportation Administration and Maryland Rail Commuter--Either the AU dispatcher or the chief dispatcher at the CSXT operations center in Jacksonville relays nonemergency information to MARC and Amtrak through a passenger coordinator desk, which provides this information to the MARC operations center[25] at Baltimore Washington International (BWI) airport, Maryland. To manage emergency situations that require immediate attention, the dispatcher and the MARC operations center use a direct line.

When the CSXT dispatcher became aware of the collision between MARC train 286 and Amtrak train 29, the CSXT manager of operations support (MOS) in Jacksonville tried telephoning the MARC BWI operations center about 5:45 p.m., but the phone line was busy. While trying to reach the MARC operations center, the MOS did inform the CSXT passenger services director in Jacksonville and both CSXT managers of passenger operations in Baltimore. The MOS stated that he was unable to get through by telephone to the MARC operations center until 6 p.m., at which time he was informed that “they knew” about the collision and were very busy. Some MARC officials who had the Amtrak alphanumeric pagers were made aware of a MARC train involvement in the accident only by reading messages meant for the Amtrak personnel. Since the accident, the CSXT and MARC have established direct communication procedures to be followed in the event of an emergency situation and have available a dedicated phone line for emergency notification. In addition, the CSXT has access to the MARC officers’ alphanumeric pagers.

CSX Transportation Inc.--In response to the FRA EO 20, the CSXT installed D markers (see figure 9) for use in passenger train operations to remind train operators of the requirements in the revised CSXT operating rule 269 (TCS system), which states:

> When a train has passed a signal permitting it to proceed (other than a Restricting, a Stop and Proceed at Restricted Speed, or Grade aspect) and is stopped in the block, the train must proceed prepared to stop at the next signal. This must be done until it can be seen that the next signal permits the train to proceed.
>
> Exceptions:
>
> A. This rule does not apply to passenger trains, making station stops, this includes push-pull, or MU [multiple-unit] passenger trains:
>
> 1. Equipped with automatic train control/cab signal apparatus
>
> or
>
> 2. Operating immediately preceding an intermediate signal, however, rule 98-G does apply.
>
> Passenger trains in push-pull, or MU service not equipped with automatic train control/cab signal apparatus, or operating immediately preceding an absolute signal be governed by exception (B) below.
>
> B. If a passenger train in push-pull, or MU service has passed a block signal that permitted it to proceed, (other than an approach, a restricting, a stop and proceed at restricted speed or grade aspect), and
>
> 1. Is stopped in the block
>
> or

[25] Its consoles mirror the CSXT AU dispatcher display screens and monitor the AU dispatcher radio communications on channels only in use by the dispatcher. From this information, the commuter train passengers are advised by a station public address system of train arrivals and delays and passenger boarding directions.

2. The train speed is reduced below 10 mph.

The train must proceed prepared to stop at the next signal not exceeding 40 mph. The train must not exceed the indication permitted by the previous signal. This must be done until,

a. The next signal is clearly visible,
b. That signal displays a proceed indication, and
c. The track to that signal is clear.

National Railroad Passenger Corporation--In October 1996 as the first of 20 planned installations, Amtrak made the OREIS[26] software available to the Montgomery County fire department and rescue communications center to assist first responders to train accidents. The software provides schematics of Amtrak cars and locomotives with layout information about the seating configuration, the emergency exit doors and windows, and the electric and fuel sources.

Cooperative Organization Activities--Also since the accident, MARC, in cooperation with the CSXT and Amtrak, has developed and distributed video training material for emergency responders. The MTA safety department, in conjunction with MARC, the CSXT, Amtrak, and the Maryland Fire and Rescue Institute, has effected a training course for emergency responders and scheduled several training dates. MARC and the MCFRS have initiated a training program to become familiar with emergency equipment on the MARC passenger trains.

[26]Operation Respond Emergency Information System, developed by the Operation Respond Institute, Inc., of Washington, DC.

Other Information

Maryland Mass Transit Administration--As the modal administration of the MDOT, the MTA operates the MARC train service as well as the light rail, subway, and bus services for approximately 370,000 passengers each day. The MARC train service averages 20,000 passenger trips daily compared with 50,000 and 20,000 passenger trips daily, respectively, for the subway and light rail operations.

Regularly scheduled daily (Monday through Friday) MARC commuter rail service is provided on the Camden and Penn Lines between Baltimore and Washington and on the Brunswick Line between Martinsburg, West Virginia, and Washington. The CSXT and Amtrak, under contract, operate daily 40 and 39 trains, respectively. The MARC weekday schedule for the Brunswick and Camden Lines was last revised on December 11, 1995. (See appendix J.) Nine scheduled MARC passenger trains are provided daily in each direction on the Brunswick Line. Two morning MARC trains originate and three evening MARC trains terminate in Martinsburg, and Brunswick is an intermediate stop for these trains. The remaining MARC trains originate or terminate in Brunswick.

In addition to a chief transportation officer, the MARC operating staff consists of three trainmasters, who address the station operations, such as the condition of the platforms and walkways, and ten staff personnel, who act as ticket agents, operations clerks, and customer service representatives. The MARC trainmasters also respond to passenger complaints and resolve passenger operational issues with the CSXT; they have no responsibility for or authority over train handling.

The CSXT and Amtrak supply and supervise the traincrews, control the train movement dispatching, and provide the equipment maintenance, depending on whose property is being used. The CSXT, under its contractual agreement, allocates two managers of passenger operations, who supervise the CSXT traincrews. MARC pays the cost of these positions. The on-duty CSXT conductors and assistant conductors are required to wear MARC uniforms, which MARC supplies, to assist passengers in identifying the traincrew. The CSXT engineers are not required to wear the MARC uniforms because they do not have direct contact with the passengers.

The CSXT, sometimes in coordination with MARC, issues *Passenger Service Bulletins* to cover unique circumstances that occur during the operation of MARC trains. These bulletins include passenger safety alerts, schedule change notices, and general guidance. The CSXT and MARC were developing a passenger conductor's guidance manual that incorporated the *Passenger Service Bulletins*, which MARC had been reviewing at the time of the accident and is still reviewing now.

MARC Train Accidents--During the previous 5 years, the CSXT reported two train accidents that involved MARC trains operating on the CSXT. Both accidents involved nonrail equipment fouling the track on the Camden Line between Washington and Baltimore. In one accident, MARC train 244 collided with a backhoe that was fouling the track near Hanover, Maryland, in December 1992. Neither a derailment nor injuries were reported, and the equipment damages were $15,000. The second MARC accident occurred when an empty MARC train, being moved in the push mode to Washington by a CSXT crew, collided with a concrete pouring boom fouling the track near College Park, Maryland, in November 1993. The cab control car derailed and the engineer and two private-contractor personnel sustained injuries; the damages were estimated at $475,000.

Maryland Department of Labor and Industry-- The Maryland Department of Labor and Industry (MDLI) is accountable for occupational safety and health in the State of Maryland. It is responsible for boiler, amusement ride, and elevator as well as railroad safety. The MDLI has an agreement with the FRA to conduct inspections, and three MDLI railroad safety inspectors work, under the FRA state participation program, in the track, operating practices, and motive power equipment disciplines by reporting through the FRA and its reporting system. The MDLI is unable to perform independent inspections, must conform to the FRA inspection regulations, and must channel all activities through the FRA; consequently, the MDLI is not permitted to have an independent inspection program.

The MDLI has jurisdiction over some areas where the FRA would not be involved, such as private yards where it inspects the tracks, but it has no jurisdiction over rapid rail systems, which include the two metro systems and the light rail system in Baltimore. However, it does inspect some of the track in the light rail system because freight operations are on some of that track. It has little direct relationship with the MTA regarding railroad issues, but it does all MARC inspection activity (operations, mechanical, and track) that would be done with the operating carriers such as Amtrak and CSXT. According to the MDLI, its inspection reports are sent directly from Amtrak or the CSXT to MARC, and it does not work directly with MARC, unless specific issues arise that put them in contact from the inspector level to the operating level.

The MDLI has no signal inspector and had no responsibility for oversight of the design and installation of the CSXT signal system modifications on the Brunswick Line, and it stated that it believed the FRA had the oversight responsibility. As recently as 1989, the MDLI had about eight inspectors; currently they have only three, even though the number of passenger and commuter trains has increased. The MDLI informed the Safety Board that it is considered the monitor of carriers in the State and not the safety system for the State. The MDLI was aware of the FRA EO 20 but had not participated in the development of that order and had not seen it. Also the MDLI had not participated in the development of the MARC interim system safety plan submission to the FRA.

Brunswick Line Signal Modifications--About 1985, MARC requested the CSXT to allow more commuter trains on both the Camden and Brunswick Lines. (MARC wanted to add 22 trains on a daily basis between 5 and 10 a.m. and between 4 and 9 p.m. in addition to the January 1, 1990, schedule.) The CSXT provided cost estimates in 1986 after which an agreement was signed. The development of a joint project to increase the service capacity of the corridor from Baltimore to Washington to Brunswick was begun in August 1988. The project was designed to permit signaled, dispatcher-controlled movement between main tracks in either direction. In April 1990, the Board of Public Works awarded a project contract of $13.085 million to the CSXT. The areas covered were the 40 miles from Camden Station to Union Station and the 50 miles from Brunswick Station to Union Station. The Federal Transit Administration (FTA),[27] formerly the Urban Mass Transit Administration (UMTA), the CSXT, and the MDOT were to pay, respectively, 75, 12.5, and 12.5 percent. The MTA and the CSXT would divide any cost overruns of the modifications by 87.5 and 12.5 percent, respectively.

The signal modification project was designed in 12 phases, and plans were subsequently issued in October 1991. Construction began south of Baltimore and proceeded towards Brunswick. Track changes during construction necessitated changes in signal design, which were approved by MDOT. New crossovers were proposed for several locations which included MP 19.7 at Derwood, Maryland. The crossover installation at Derwood added a new control point (CP), which required respacing the signals between Georgetown Junction and Derwood. As a result, additional safe braking distance for mixed freight and passenger operation was achieved by reducing from four to three the number of intermediate signals between Georgetown Junction and Derwood.

[27]Established in 1968, under the Urban Mass Transportation Act of 1964, to administer Federal grants to urban mass transit projects for new acquisition, construction, and operations and for the improvement of existing facilities and equipment.

The project was completed in July 1993 at a final total cost of $17.085 million. The MTA paid the cost overrun of $3.9 million plus $0.10 million for the final inspection. The Federal and State interest in the fixed assets of the signal system will be 87.5 percent for the 15-year life of the improvements. At the end of this 15 years, July 2006, the CSXT assumes full ownership.

Federal-Grant-Requested Signal Project--In accordance with the FTA act under which Federal assistance is allocated, the FTA provides grants through section programs of discretionary and formula funds. Discretionary funds are allocated at the discretion of the FTA administrator, and the formula funds are apportioned by a statutory formula based on population, population density, and various transportation data. The FTA obligated, for example in 1995, approximately $2.6 billion of discretionary funds and about $3.1 billion of formula funds.[28] According to the FTA, local organizations and transit systems submit grant applications to the appropriate FTA regional office. The grantees self-certify that they have the legal, financial, and technical capacity to engage in the project for which they are applying for FTA funding.

In May 1987 the MDOT applied to the FTA for a rail modernization grant of approximately $9.8 million to assist in the financing of a fiscal-year 1987 capital project, generally described as the “installation of centralized traffic control system on MARC/CSXT Lines.” The MDOT State Railroad Administration (now the MTA) was delegated to administer this project. In addition to the Federal funds, the MDOT and the CSXT would each provide about $1.6 million for the project. The grant application included the excerpted project justification:

[28]The MTA indicated that for a $940-million 6-year-period (1996 through 2001) capital program, approximately $667 million of Federal funds were anticipated. MARC would account for $390 million, of which $294 million would be Federal funds, of this $940 million.

> The centralized traffic control (CTC) system on the CSXT lines will modify the method and efficiency of train control and operations, thus providing increased system capacity, and consequently allowing expanded use of the CSXT lines for commuter rail operations. More specifically, the CTC will permit:
>
> the addition of trains in bi-directional service during peak periods: head-ways could be reduced to twenty minutes in each direction. This would provide the capacity to double service levels on the Brunswick Line and triple service on the Washington-Baltimore Line.
>
> the addition of bi-directional service in off peak periods: Midday, evening, weekend, and special event service will be possible, enhancing commuter as well as shopper, tourist, and non-work related trips by providing increased flexibility in scheduling trips.
>
> continued safe, combined movements of freight and passenger trains on the CSXT lines. By minimizing the possibility of conflict between freight and passenger traffic through computerized monitoring and control of movements, the CTC will enhance the safety of MARC and CSXT operations.

When questioned whether it would conduct a safety analysis of the project, given the above statements in the project justification, the FTA indicated that a safety analysis, or at least a preliminary safety analysis, would be done at the local level as the entities develop their transportation improvement programs. Under those auspices FTA employees would not review the grant application because the grantee has certified the technical capacity to undertake the project. For this particular grant, according to the FTA, the budget included $450,000 for engineering, which would be the design of the signal system upgrade, and that would be conducted by the grantee or the grantee contractor, in this case the CSXT. Because this grant application involved an upgrade to the signal system, Safety Board investigators questioned whether the FTA had in-house signal expertise or would look to the FRA for any guidance on the benefits or shortcomings of the MDOT proposed signal project. According to the FTA, it had no in-house signal expertise and no communication with the FRA regarding this project because it was not required to have the FRA involved. The FTA has indicated that subsequent to the Silver Spring accident, the FTA administrator has requested that the FRA become more involved in reviewing operational plans and safety proposals for grantees, including commuter railroads.

The MDOT grant project (exhibit A) description included:

> The improvements envisioned in this program provide the foundation for the next "generation" of train control systems: advanced train control system (ATCS). This system will permit discrete train identification and provide remote override operation of the train itself. The technology for ATCS is progressing with significant commercial applications starting in 5-10 years.

The FTA or the MTA did not follow up the MDOT pursuit of this technology. According to MARC officials, the industry had no consensus on ATCS or commercial applications at the time.

Following the approval of the grant, the CSXT and the MDOT/MTA signed an agreement in March 1990 regarding the installation of the CTC system on CSXT lines. The signal system, according to the agreement, would be designed in compliance with all applicable Federal and State requirements and installed by the CSXT. The MTA would have the right to review and comment on the design and construction plans. However, the CSXT, according to this agreement, would have exclusive control over the design, installation, and operation of the signal system. The agreement stated that "at the end of 15 years, which is calculated from July 1, 1991, or the operational start date, whichever comes first, CSXT will assume full ownership of the fixed assets and UMTA's and SRA's [State Railroad Administration] net salvage credit shall be reduced to zero."

CSXT Signal System Modification Design--The CSXT uses several equal factors in the determination of signal spacing and traffic density. First, if it is necessary to run trains on short headway,[29] the signals will need to be spaced close enough to allow the trains to move safely behind one another. The aspects displayed by the signals must inform the train engineer what actions need to be taken to safely advance the train. Another factor is the train braking distance required to stop or slow a train to the prescribed speed, conforming to the signal indication with respect to the operating rules. The CSXT standard braking distance for freight trains is 11,000 feet for 55-mph operation or greater than 13,000 feet for 60-mph operation.

When signals must be spaced closer than three-aspect breaking will allow, a fourth aspect needs to be employed so that trains would be operating at less than maximum authorized speed should conditions require the train to stop. In a two-block three-aspect signal system, a normal signal progression would be CLEAR, APPROACH, and STOP. As example of a three-block four-aspect signal system, the normal signal progression would be CLEAR, APPROACH-MEDIUM, APPROACH, and STOP. When freight and passenger trains both operate on the same set of tracks, the more restrictive braking data for freight trains is used.

The proposal to install the TCS operation on the Brunswick and Camden Lines was conceived, designed, and constructed to increase the capacity of these subdivisions to accommodate additional traffic proposed by MARC. The operating headway to meet the MARC scheduling request was a 15-minute headway during the most dense scheduling periods and a significantly more-than-15-minute headway in other nonpeak periods. To increase the capacity on the Metropolitan Subdivision, the TCS operation was proposed with crossovers at MPs 19.7 and 29.9 as well as a power turnout to access the Potomac Electric Power Company plant at MP 37.

To accommodate the braking requirements for freight trains, the intermediate signal spacing needed to be no less that 11,000 feet. Automatic signals 99 and 100 at MP 10 were part of a single direction, automatic block signal system in service between CP Rocks at MP 42.8 and CP Georgetown Junction at MP 8.5. The control circuitry for these signals was inconsistent with the controls required for TCS operation because it had been designed for one direction operation. The last automatic wayside signal before the CSXT signal modification project had been signal 100, which had been east of the Kensington station platform. Additionally, signal 100 was less than the 11,000 feet minimum braking requirement from the EAS-2 signals at CP Georgetown Junction. As a result of the signal modifications, signal 100 was replaced by signal 1124-2, which was now the last automatic wayside signal before EAS-2 for Georgetown Junction and was west of the Kensington station platform.

Neither the FRA nor the MDOT/MTA reviewed the CSXT design of the proposed signal system modification before installation. The CSXT did not have to apply to the FRA to review and approve the proposed CSXT signal modifications on the Brunswick Line. The FRA

---

[29]Time separation between two trains traveling in the same direction on the same track, which is measured from the instant the head end of the leading train passes a given reference point until the head of the train immediately following passes the same reference point.

made changes in 1984 to the regulations (49 CFR Part 235). An extensive list of changes was developed that the FRA believed should not require prior approval to implement a signal modification;[30] therefore, the installation of the TCS system to replace an automatic block signal system did not require prior approval. The FRA stated that the reason a railroad would change from an automatic block signal to a TCS system is safety and efficiency. In addition, the FRA regional inspectors were aware of the signal modifications through routine inspections, and the signal installation on the Brunswick Line was FRA-inspected on three separate occasions with no exceptions taken. The FRA performed normal inspections of the signal system modifications after installation for compliance with Federal regulations and the CSXT signal plans.

CSXT Traincrew Roster Consolidation--CSXT had consolidated its seniority rosters on January 30, 1996, which combined six rosters into one. That change lowered the roster position of the three crewmembers of MARC train 286 and was reported to be a topic of conversation on the day of the accident.

The roster change began in late 1993 when the CSXT initiated an effort through the U.S. Interstate Commerce Commission (ICC) to consolidate the train and engine service work forces of the former B&O, Western Maryland, and Richmond, Fredericksburg, and Potomac railroads. The approximately 1,300 employees who were involved worked in the territory bounded by Philadelphia, Pennsylvania; Richmond, Virginia; and Parkersburg, West Virginia. The labor unions objected to the consolidation, and an arbitration hearing was held in March 1995, with a decision rendered 1 month later. Neither the CSXT nor the labor unions were satisfied with the arbitrator's decision, and both subsequently appealed it to the ICC, which decided in favor of the consolidation in December 1995. The labor unions then appealed to the courts, and the U.S. Circuit Court in Washington refused to stay the ICC decision; therefore, the CSXT went forward with its consolidation plans. The labor unions then advised the CSXT of their intention to strike over the issue, after which the CSXT obtained a court-issued restraining order. The consolidation was subsequently implemented on January 30, 1996, although litigation has continued.

Before the consolidation, the MARC train 286 engineer had been the number 11 engineer of 126 engineers on the Baltimore West End Engineer Seniority Roster. After the consolidation, he was the number 50 engineer of 428 engineers. The MARC train 286 conductor and assistant conductor had been on two prior rosters. As trainmen, they were on the Baltimore West End Trainman Seniority Roster, and the conductor and assistant conductor, respectively, had been numbers 34 and 11 of 246 trainmen. After the consolidation, the conductor and assistant conductor, respectively, became numbers 110 and 36 of 695 trainmen. On the Baltimore West End Conductor Seniority Roster, the conductor and assistant conductor, respectively, had been numbers 133 and 99 of 255 conductors. After the consolidation, the conductor and assistant conductor, respectively, became numbers 328 and 273 of 664 conductors.

The regular conductor for MARC train 286 stated that the engineer did not show much emotion about the roster change. However, he said that the engineer was aware of and was concerned about the possibility that as the lowest seniority engineer in passenger service, he could be the first to be bumped from his assignment by a higher seniority engineer. The regular conductor for MARC train 286 characterized the assistant conductor as "very distraught" and vocal over the seniority issue. On the day before the accident, the topic was discussed at a safety meeting in Brunswick, which the assistant conductor, the engineer, and he had

[30]The changes were made to clarify the meaning of a material modification, a discontinuance, a catastrophic occurrence, and track change. These changes were based on information acquired through the experience of investigating applications for signal changes in signal and train control systems.

attended (the accident-day conductor was not at the meeting). The regular conductor said, "It upset him [the assistant conductor] enough that on our run on the [MARC train] 286 going from...Brunswick to Washington that he stood in the cab and talked about it the whole way down the road. So he was really upset about it."

On the day of the accident, the assistant conductor again discussed his concerns with a fellow conductor and a United Transportation Union (UTU) representative. The conversation took place at the Riverside Yard after the assistant conductor reported for work in the morning. The UTU representative reported that the assistant conductor was "very upset" about the meeting that had occurred the day before. The engineer, the assistant conductor, and the conductor also all discussed the seniority change on the day of the accident at the yard office in Brunswick. They spoke to another engineer who said, "nobody seemed to like it." The assistant conductor and the engineer of MARC train 286 also spoke to a fellow conductor about their concerns during their lunch break about 3:30 p.m. MARC train 286 left Brunswick about 1 hour later.

The wife of the assistant conductor was asked about his comments concerning the seniority change, and she said that they had discussed it previously in general terms. She indicated her husband was not too worried about his job and had told her there was nothing he could do about the seniority change anyway and that he just had to go along with it. Still, no one had bumped him from his assignment.

The wife of the conductor was asked about her husband's comments concerning the recent alteration in the seniority structure at work. She said that they had discussed it, although not in the last week. She said he did not know what his seniority position would ultimately be, but he was not worried about it because he was "still working." He also told her that no changes were likely before November because of the litigation between the CSXT and the various labor unions. She added that her husband told her that no change would take place in the conductor or engineer seniority rosters for passenger service at all and that it would remain the same as before.

Locomotive Fuel Tanks--The postaccident inspection of the fuel tank of the MARC unit 73 indicated that it was not breached during the derailment. The fuel tank of the Amtrak lead locomotive unit ATK 255 was almost completely separated from the unit and was found lodged against and partially underneath the left side of the unit, adjacent to its normally mounted location. The left side-plate of the tank was catastrophically ruptured open and showed substantial shredding deformation and impact striations. The circumstances suggest that the fuel tank of the lead Amtrak unit ATK 255 ruptured on impact with the MARC cab control car 7752 and that the diesel fuel therein ignited and engulfed the cab control car. There are no regulatory requirements or industry design specifications for the locomotive fuel tanks involved in this collision; however, the Association of American Railroads (AAR) Recommended Practice (RP)-506, *Performance Requirements for Diesel Electric Locomotive Fuel Tanks*, effective September 1, 1995, is the current industry standard for all locomotives built after that date.

Cellular Service Communication--During the emergency response activity of this accident, the arriving fire and rescue personnel were unable to communicate by cellular phone with off-site accident support personnel because of an apparent saturation of the cellular phone network. The on-scene news media quickly engaged and would not release the existing cell sites in the area. This situation prevented the rescue personnel from making any connections and hampered the rescue efforts according to several rescuers, who stated that this problem had occurred previously during other high-visibility accidents in which the news media were present.

ANALYSIS

General Factors

The witness statements, inspection reports, and locomotive event recorder readouts provided no evidence of equipment failure. The track inspections and measurements before and after the accident indicated no defects or deviations from the FRA track safety standards. The Safety Board investigation revealed that the CSXT AU dispatcher conducted the dispatching activities properly.

Results of the postaccident toxicological tests found that the three MARC train 286 crewmembers and the two Amtrak train 29 locomotive crewmembers were not impaired by alcohol or drugs. The investigation also examined the experience, sleep/wake cycle, and health of the three MARC train 286 crewmembers and two Amtrak train 29 crewmembers to determine whether those factors influenced the accident. Except for the MARC engineer's normal operational experience with MARC train 286, which will be discussed later, these factors had no effect on the accident.

Therefore, the Safety Board concludes that the train equipment and the track functioned as designed and that the AU dispatcher conducted the dispatching activities properly. Neither the three MARC train 286 crewmembers nor the two Amtrak train 29 locomotive crewmembers were impaired by alcohol or drugs. All train crewmembers were in good health, had no evidence of fatigue, and were experienced in and qualified for their duties.

Because of the reports of blowing snowfall in the accident area, the Safety Board reviewed the locomotive event recordings, AU dispatcher voice recordings, and statements from other traincrews for any negative impact that the weather might have had on the visibility of Kensington signal 1124-2. No traincrew operating in the accident area reported being unable to distinguish signal indications. The MARC train 279 engineer stated that he heard the radio transmission from the MARC train 286 engineer acknowledge signal 1124-2, as required by CSXT operating rule 34-A; however, the wayside equipment defect detector had distorted that transmission. The Safety Board concludes that the weather conditions did not impair the ability of the MARC train 286 crewmembers to distinguish the indication of Kensington signal 1124-2.

The Safety Board staff conducted a postaccident signal examination that revealed the signal indications for MARC train 286 before the collision would have been an APPROACH at Kensington signal 1124-2 and a STOP at Georgetown Junction signal EAS-2. Additionally, all postaccident signal tests indicated that the proper codes were being transmitted to Kensington from the electronic track circuit unit at Georgetown Junction. The signal system transmitted codes in a logical progression when tested, and the signals displayed were not in conflict with each other. All tests of signal 1124-2, EAS-2, and WAS-2 indicated that conflicting signals could not be displayed. Therefore, the Safety Board concludes that the signal system functioned as designed.

Accident Narrative Review

The APPROACH indication of signal 1124-2 required the MARC train 286 engineer to slow his train to not more than 30 mph after passing the signal and to be prepared to stop at the Georgetown Junction signal. The collision occurred because the engineer did not operate MARC train 286 in conformity with the signal indication when he stopped at Kensington station and then proceeded towards Georgetown Junction, attaining a speed of about 66 mph. The engineer's actions after departing the Kensington station were appropriate had signal 1124-2 been CLEAR, but his actions were inappropriate for an APPROACH aspect.

The Safety Board determined from the stopped position of the MARC train 286 locomotive and its event recorder information that the engineer placed the train into emergency braking 1,407 feet before the collision at a speed of about 66 mph. The engineer made the emergency brake application about 510 feet after passing the optimum sight distance location, about 1,227 feet from the EAS-2 or 5.27 seconds later. The delay is understandable and reasonable considering the engineer's apparent belief that he was operating under a CLEAR signal indication.

There is no reason to suppose that the MARC train 286 engineer would be looking for the Georgetown Junction signal as soon as it was physically visible. If the engineer thought that his last signal (1124-2) was CLEAR, none of the signals he could have normally expected at Georgetown Junction would have been so restrictive as to demand his immediate action. Hence, he had no reason to try to see the signal as soon as possible. In addition, there was no radio conversation between train engineers and the dispatcher that could have provided the MARC train 286 engineer with a clue on the other trains operating in the area. Disbelief was likely once he or the other crewmembers or both observed the STOP signal at Georgetown Junction. The crew would have then consumed some time trying to reconcile the restrictive STOP indication with an expected CLEAR indication, which had been the norm for them at Georgetown Junction. One of the passengers stated, "I could see the look, like bend over and check to see if something's coming, then they jump back like in shock, then they went forward again just to double check," which would attest to disbelief on the part of the traincrew.

About 407 feet before impact, the reverser of MARC train 286 was moved when the train speed was about 49 mph. The speeds at impact were 38 mph and 32 mph, respectively, for MARC train 286 and Amtrak train 29. After colliding with Amtrak train 29, MARC train 286 came to rest with its cab control car 7752 about 93 feet beyond the point of impact.

The Safety Board identified the following safety issues in its investigation of this accident: the performance and responsibility of the MARC train 286 crewmembers, the oversight of CSXT signal system modifications, the Federal oversight of commuter rail operations, the lack of positive train separation control systems, and the adequacy of passenger car safety standards and emergency preparedness. In addition, the Safety Board considered the use of a reverser during an emergency brake application, the effectiveness of the computer-aided train dispatching recordkeeping, the crashworthiness of locomotive fuel tanks, and the contents of the CSXT and MARC operating agreement.

MARC Train 286 Engineer Performance

The actions of the MARC train engineer prompted two questions that would need to be answered to understand the accident events: Why did he behave as he did? How could a well-respected, experienced engineer forget a signal?

Although it is possible that the engineer did not see signal 1124-2, this does not appear to be likely because the engineer of the passing MARC train 279 overheard a partial radio transmission that he believed was the MARC train 286 engineer acknowledging the signal indication as required by CSXT operating rules. (The MARC train 279 engineer did not hear, however, what signal aspect was acknowledged.) In addition, based on witness statements and the normal operating practice of the assistant conductor to ride this trip segment from Brunswick to Washington in the cab control car, at least one other crewmember was, and perhaps the other two were, in the cab control car during the time that the signal was visible. The CSXT operating rule 34 requires that crewmembers call out the signal as it becomes visible. That at least one other crewmember was present argues against the signal not being seen.

Another possible explanation for the engineer's behavior is that he saw the signal, forgot the aspect after passing it, and realized he did not remember the aspect. However, this is not likely because the engineer could have simply asked the other crewmember or crewmembers in the cab control car about the aspect. If he or they also did not know the aspect, the engineer should have immediately slowed his train to the restricted speed,[31] as required by CSXT general operating rule S, which states, "In case of doubt or uncertainty, the safe course must be taken."

However, it is more likely that the engineer observed and correctly identified the signal and correctly repeated its indication over the radio, but he then forgot its aspect because other information interfered with its retention.[32] The specific information and tasks that demanded the engineer's attention and interfered with his retention of the signal information came from several sources, some routinely encountered and some unique to the trip. These sources included the important mental and physical tasks required to stop the train at Kensington station, the various radio conversations with the engineer of MARC train 279, the defect detector broadcasts and disrupted radio conversations, and the presence of the crewmembers in the cab control car, possibly discussing an important topic.

The physical and mental tasks associated with stopping the train at Kensington station provided the primary source of interference. The attention demanding tasks included reducing the throttle, applying the train brakes, and stopping at the proper platform location at a station where the engineer seldom stopped. He was also probably watching through the snow to ensure that the passenger waiting at the at-grade platform was clear of the path of the train.

Other sources of interference for the MARC train 286 engineer included the various radio conversations held with the MARC train 279 engineer and the defect detector broadcasts that needed to be listened to but at the same time disrupted the radio conversations. The defect detector broadcasts caused both engineers to repeat information back and forth to ultimately attain it, which was a process that required increased attention for a longer period of time than otherwise necessary. The radio conversations that had to be repeated between the two engineers included the information about the children throwing snowballs and their location. As both trains continued, the engineers exchanged more information concerning the passenger at Kensington and the one at Silver Spring to be picked up by MARC train 286, which was important information because neither station is a regular station stop for the train.

As these conversations took place, both trains passed over adjacent defect detectors, which also provided information important to the safe operation of the train. Indeed, "if/then" CSXT operating rules 58A-G, 60, and 60A prescribe what an engineer must do under various circumstances if a defect detector locates a defect. Many of the prescribed actions may involve immediately stopping and inspecting the train and, thus, require the immediate attention of the engineer. With the trains so close to each other, the engineers needed to attend to both messages, first to determine who the message applied to and secondly because of its potential safety implications. The MARC train 279 engineer stated that these conversations occurred about MP 11.7, which is less than 0.5 mile from signal 1124-2. Because the signal could have been visible from about 0.8 mile, these communications had the potential to delay perception of that signal or to interfere with the aspect retention or both.

In addition, the CSXT operating rules require that when two trains pass each other, each engineer is required to conduct a visual inspection of the other train as it passes, which would require the engineer's attention during the passing.

[31]Defined by the CSXT operating rules as "A speed that will permit stopping within one-half the range of vision. It will also permit stopping short of a train, a car, an obstruction, a stop signal, a derail or an improperly lined switch. It must permit looking out for broken rail. It will not exceed 15 MPH."

[32]Psychological literature refers to the process as retroactive interference: new information interfering with the retention of previously learned or sensed information.

When a train passing event and a defect detector broadcast occur concurrently, an engineer benefits by listening to the broadcast associated with the other train to cue him where to look for specific problems. This is a practice of many engineers. The defect detector, however, broadcasts on the same radio frequency used by engineers to talk to each other or the dispatcher or both. Consequently, when the defect detector began to automatically broadcast, radio communication between the two trains was disrupted. This disruption made understanding each other difficult and required repetition and clarification of information as well as additional attention.

The last source of interference may have come from the presence of a crewmember or crewmembers in cab control car 7752 with the engineer and the possible discussion of an important topic. The other crewmembers have essentially no function in the cab control car, but they may have been talking to the engineer. Their presence, however, can be beneficial when they assist the engineer in observing the track and signals and the conversation is limited to essential operational exchanges. Listening to or participating in a conversation with another crewmember would further divide the engineer's attention and interfere with his retention of the signal aspect. A conversation between crewmembers likely did occur in cab control car 7752 on the accident day because of the practice of the assistant conductor to ride this segment of the trip in the cab control car and to talk during the trip. Conversation creates a potential for distraction and interference with the engineer's retention of information, in this case the signal information.

Although the information provided by the signal 1124-2 aspect was critical for directing the engineer's actions after the station stop, it had no relevance to the task immediately at hand, which was stopping at Kensington station. The locomotive event recorder showed that the engineer started reducing speed about 0.5 mile before the signal. The speed reduction is believed to have been in response to the stopping for passengers and not to the APPROACH signal indication because compliance with the signal would not have required the engineer to reduce his speed as soon as he did.

Ample sources of competing information and tasks were present and capable of interfering with the engineer's retention of the signal 1124-2 information. One or more of those sources interfered with his retention of that information, which is believed to have caused the signal indication to be completely forgotten as if it had not existed. Nevertheless, when the engineer left Kensington station, he had to have some guidance, which is normally supplied by the signals, on how to operate over the next block of track. However, because signal 1124-2 was before the station and his stop, the engineer needed to recall the signal aspect after intervening information and tasks. The regular conductor for MARC train 286 could not recall ever having to stop at Georgetown Junction, which would mean that the engineer would not have normally observed any other indication but CLEAR at signal 1124-2. On the accident day, the engineer may have recalled the expected CLEAR indication, rather than what was actually there, and operated MARC train 286 accordingly. The Safety Board therefore concludes that the MARC train 286 engineer apparently forgot the signal aspect, which required him to be prepared to stop at Georgetown Junction, due to interference caused by various events, including performing an unscheduled station stop, that occurred between the presentation of the APPROACH aspect at signal 1124-2 and the STOP signal at Georgetown Junction.

MARC Train 286 Crewmember Responsibility

As MARC train 286 departed the Kensington station, its engineer was required to comply with the signal indication that had been displayed on signal 1124-2. An APPROACH indication required that the engineer limit the train speed to 30 mph or less and be prepared to stop at Georgetown Junction. According to the event recorder data, however, the engineer accelerated the train speed to 59 mph in the next 1.15 miles, gradually reduced the speed, and then accelerated until an emergency brake application was made at 66 mph. The acceleration rate from the station stop was constant for the first 0.8 mile, reaching a speed of about 50 mph in just over 1 minute. The engineer exceeded the 30 mph speed restriction within the first minute of the departure. As a result of this evidence, the Safety Board examined why other crewmembers in the cab control car apparently did not take action as required by the CSXT operating rules.

The responsibilities of the various crew-members in the operating cab control car are quite different. The engineer's role of physically operating the train requires him to be in the locomotive or cab control car of the train. The job responsibilities of conductors in passenger service require them to be primarily in the passenger cars. Consequently, the nature of each job generally separates crewmembers and keeps them in different places on the train. (Neither the CSXT nor MARC prohibits other crew-members being in the operating cab control car.) The CSXT recognizes that crewmembers other than the engineer may have occasion to be in the operating cab control car and has assigned responsibilities to them when they are. The CSXT operating rules 34 and 34C basically require other crewmembers to acknowledge signals and to take action should the engineer fail to operate his train in accordance with a signal indication.

Under the usual passenger train operations, the conductor and assistant conductor would be in the passenger cars performing the assigned duties of collecting tickets, responding to passenger queries, preparing for station stops, and monitoring radio transmissions from the engineer. However, because of the light passenger load during this segment of the trip on MARC train 286, the conductor and assistant conductor divided the work; one of them stayed in the cab control compartment with the engineer while the other performed the requisite duties and then returned to the compartment. The CSXT operating rules expect that when crewmembers are in the operating compartment of the controlling locomotive (in this case, the cab control car) they have the responsibility for calling and acknowledging the wayside signals and for taking the appropriate action should the engineer fail to operate the train according to the signal indication.

The assistant conductor is believed to have been in the cab control car with the engineer for the entire trip from Brunswick to the accident site, based on his normal habit of riding this trip segment in the cab control car and, also, the statements of surviving passengers. Consequently, he would have been in the cab control car when the Kensington signal was visible and when the engineer acknowledged it. Whether the assistant conductor also acknowledged the signal is unknown; however, he did have the opportunity both to see and to hear what it was.

In addition, the conductor is believed to have been in the cab control car during much of the trip, and may have been in the cab control car when the Kensington signal was visible and the engineer acknowledged it. However, the witness testimony is unclear on his exact activities at that time. He could have been walking to or waiting at the doors between cab control car 7752 and car 7720 to board passengers at Kensington station and not have seen the signal; although, he might have heard the engineer acknowledge the signal over his portable radio. Still, the conductor may have neither seen the signal indication nor heard the engineer acknowledge it and, therefore, not have known what the signal indication was. However, had he not heard the signal being called, the conductor was in the cab control compartment with the engineer later according to witnesses and could have then questioned the signal indication that should have been acknowledged.

Accident survivors who had been in the passenger compartment of the cab control car placed all three crewmembers in the cab control car after the Kensington station stop. Clearly, both crew-members were in the cab control compartment with the engineer for most, if not all, of the trip segment after signal 1124-2 from Kensington to Georgetown Junction. Additionally, the survivors did not note any unusual activity from the crewmembers until the accident appeared imminent. MARC train 286 had not been operated in accordance with the APPROACH indication during that segment of the trip. The other crewmembers apparently had not taken action when the engineer did not operate the train according to the last signal indication.

The explanation for their behavior may be found in the normal operating practice. Rule 34, to acknowledge the signals, is a required activity for crewmembers that occurs many times each day. As such, the assistant conductor may have acknowledged the signal when the engineer did, and the conductor may also have done so. Once the signal is called and acknowledged, however, only the engineer has a physical activity to perform. The other crewmembers have only a passive oversight responsibility to do something under rule 34C should the engineer fail in his responsibility. Since adhering to signal indications is fundamental to safe rail operations, such failures are rare. Personnel practices further sanctify signal compliance, as engineers who fail to adhere to signals are usually disciplined or fired. The other crewmembers have the responsibility to be vigilant for a rare event and to take corrective action. Actually taking a corrective action, such as using the emergency brake handle, is even more rare and not likely to occur in a crewmember's entire career. Thus, because the engineer has an active task to perform with every signal and does so routinely, and the other crewmembers have only a passive responsibility that is rarely, if ever, exercised, it is not difficult to conceive that the crewmembers in this accident deferred to the engineer and did not monitor his compliance with the signal indication during the interval from the Kensington station stop to the emergency brake application.

It is possible that one crewmember or both told the engineer that he was not complying with the APPROACH signal. However, they may have deferred to the engineer's recollection of the signal aspect as CLEAR in the absence of an independent source of information, such as cab signals, to advise them otherwise. This is perhaps an unlikely possibility because a prudent engineer would probably accept the most restrictive signal aspect and act accordingly. Nevertheless, no actions were taken by the conductor or assistant conductor to counteract the actions of the engineer as required by rule 34C. This occurred even though the conductor and assistant conductor were competent, experienced personnel, which calls into question whether it is reasonable to rely on the vigilance of a person to compensate for the error of another person in the same circumstances. The Safety Board concludes, therefore, that neither the conductor nor the assistant conductor while in the cab control compartment appeared to have effectively monitored the engineer's operation of MARC train 286 and taken action to ensure the safety of the train. The Safety Board believes that the CSXT should inform all operating train crewmembers of the circumstances of this accident and emphasize the crew responsibility while in the operating compartment for the safe operation of the train.

Traincrew Voice Recording

The 35-year experience using cockpit voice recordings (CVRs) to assist in determining the cause of commercial aviation accidents has shown that evidence about the operating communications among crewmembers is frequently important in accident investigations. Initially installed on aircraft carrying 40 or more passengers, CVRs only recorded the last 30 minutes of cockpit and radio conversation before an accident. In the early 1990's a change was made to establish design standards that increase the recording length from 30 minutes to 2 hours. Although required for all newly manufactured transport aircraft registered in Europe after 1995, a 2-hour CVR is not required for any aircraft operating in the United States. However, the Safety Board is of the opinion that a 2-hour CVR should be required on all newly manufactured commercial aircraft registered in the United States.

Over the years the CVR recordings have been a key tool in documenting the circumstances leading up to an accident and a valuable assistance to the Safety Board in determining the probable cause of aviation accidents. The CVR has been most useful in the type of accident that has not been caused by mechanical failure onboard an aircraft. The CVR recording has shown to be an almost necessary tool in documenting the operational decisions or mistakes of the crew that lead up to the accident. The Safety Board had repeatedly recommended to the Federal Aviation Administration (FAA), using this argument, that the FAA require CVRs on smaller commuter aircraft, and the FAA has now required that CVRs be installed on all multi-engine turbine-powered aircraft having a seating configuration of six or more and for which two pilots are required by certification or operating rules.

The Safety Board understands that appropriate protections of the privacy of such communications have been established in aviation and could also be adopted by the railroad industry. The communications that occurred from the Garret Park station up to the collision at Georgetown Junction would have been extremely valuable to this investigation. In particular, knowing the signal aspect acknowledged by the MARC train 286 engineer at signal 1124-2 would have facilitated investigative activities. Although Safety Board investigators conducted an exhaustive attempt to reconstruct traincrew activities, they could not document the MARC train 286 engineer's acknowledgment of the Kensington signal or the communications, if any, among crewmembers as the train approached Georgetown Junction.

Current locomotive event recorders have great utility but only provide mechanical response data, which cannot answer some questions asked in an accident investigation about the traincrew’s knowledge and actions. The voice recordings maintained by the CSXT operations center included no communications between trains or among MARC train 286 crewmembers. Had a voice recording from MARC train 286 existed, the signal aspect acknowledged and the communications in the last few minutes before the collision would have been available to this investigation. A few years ago the FRA contemplated issuing a rule requiring voice recorders in locomotive compartments but rejected the idea because it did not consider them as a necessary safety measure. The FRA could have included traincrew voice recording requirements in the 1993 regulations for locomotive event recorders as part of the minimum parameters to be recorded. The Safety Board, consequently, concludes that had the FRA required the recording of the train crewmembers’ voice communications, the essential details about the circumstances of this accident could have been provided. Therefore, the Safety Board believes that the FRA should amend 49 CFR Part 229 to require the recording of train crewmembers’ voice communications for exclusive use in accident investigations and with appropriate limitations on the public release of such recordings.

CSXT Signal System Modification Oversight

The CSXT and MARC had operational reasons to modify the Brunswick Line signal system: improve passenger safety and freight train operations by changing the method that CSXT dispatched and monitored trains, upgrade the system capacity to operate more trains with increased peak and midday service, increase the MARC labor and equipment productivity, and reduce the CSXT operating costs. Identifiable improvements, such as total trains, traincrew use, cost savings, and CTC operations, could be quantified and measured; however, the signal system modifications did not address the overall safety of the signal system for traincrew use. The adequacy of the system safety could only have been addressed with a total system review that included a human factors analysis of such issues as human information processing capabilities.

A total system review examining human capabilities and limitations might have resulted in the installation of a redundant system, such as an automatic train control system or automatic cab signals (ACS), which would have produced an audible indication to alert the engineer and a visible reference to identify when the cab signal display changed to a more restrictive aspect. The MTA application for FTA funding for the project indicated that the funding approval for the project would later address advanced train control systems. Yet, when MTA and MARC officials were queried about this subject, they had no current plans.

The Safety Board investigators questioned the removal of signal 100, which, located east of the Kensington station, had been the last signal on track 2 for eastbound trains traveling towards Georgetown Junction. As a result of the modification and respacing of the signals, the last signal on track 2 for trains traveling towards Georgetown Junction was now signal 1124-2, which is west of Kensington station and about 1.25 miles west of the former signal 100 location. The spacing of signals is FRA regulated under 49 CFR Part 236.24, which requires signals to be adequately spaced to provide proper distances for reducing speeds or stopping by use of other than an emergency brake application before reaching the point where reduced speed or stopping is required. The FRA determined during routine signal inspections that the Brunswick Line signal system complied with the regulation for the spacing of roadway signals.

The CSXT signal system modification, however, did not adequately account for the operating characteristics of passenger trains stopping at the Kensington station, as evidenced by this accident. The removal of signal 100 relocated a source of vital information for passenger train engineers stopping at the Kensington station from a position close to where it would be acted upon to a position farther away. In this case, the physical distance the signal was moved was not the critical element; but rather, the relocation created the potential for other information and tasks to intervene and interfere with the retention of the signal indication, thus permitting it to be forgotten before it was required to be used. Of course, the potential for interference to lead to an operational error did not necessarily exist to the same degree for all trains, and the right set of circumstances had to exist. Nevertheless, the potential for an operational error to occur as a result of the relocated signal could have been foreseen. Had the design of the signal system received input from knowledgeable human factors specialists, the potential pitfall of the relocation could have been addressed and redundancy provided for an engineer forgetting a signal. Such redundancy could have been accomplished through a delayed-in-block rule change, as the FRA did with EO 20 issued following this accident; with a repeater signal; with cab signals; or with a positive train separation (PTS) control system, as the Safety Board has long advocated.

The FRA EO 20 contained specific information for all railroads on every push-pull operation without benefit of cab signal, automatic train stop, or automatic train control and whose speed exceeds 30 mph. The new rule required that all trains stopped or delayed in a block immediately preceding interlockings and controlled points must reduce their speed in accordance with applicable operating rules, but, in no case, may speed exceed 40 mph. In addition, EO 20 added another measure that required appropriate signs be installed at each affected signal and at the departure end of stations. The Safety Board concludes that had the FRA and the FTA required the CSXT to perform a total signal system review of the proposed signal changes that included a human factors analysis within a comprehensive failure modes and effects analyses, this accident may have been prevented.

The information obtained during the Safety Board investigation of this accident, including its public hearing, raised questions about the oversight by Federal agencies of federally funded transit projects and, specifically, the FTA grant application and approval process. Although Federal funding provided most of the funds for the design and installation of the CTC system on the CSXT Brunswick and Camden Line signal modification, the Federal Government apparently did not perform an in-depth analysis or evaluation of this project from a safety standpoint primarily because the applying agency self-certified that it had the technical capacity to undertake the project. Furthermore, the project justification statement indicated that safety would be enhanced by the installation of this upgraded signal system; however, the available evidence indicates that the project was undertaken for economic reasons and that a total system safety review, including a human factors analysis of the upgraded signal system, was not considered at either the State or Federal Government level.

The Safety Board recognizes that the FTA may not have the necessary expertise in all project areas for which transit agencies seek funding. In this particular instance, the FTA indicated that it did not have any in-house signal expertise with which to judge the safety benefits of the proposed signal modifications. However, the FTA could have either requested assistance from other modal administrations that have the technical expertise or required a total system safety analysis by an independent contractor, as a condition for grant approval. Subsequent to the Silver Spring accident, the FTA has requested that the FRA become more involved in reviewing operational plans and safety proposals for grantees, including commuter railroads. Although the FTA request for FRA involvement is commendable, it does not formally address what the FTA specifically expects from the FRA.

The Safety Board concludes that Federal funds granted for the signal modifications on the CSXT Brunswick Line to accommodate an increase in the number of MARC trains did not ensure that the safety of the public was adequately addressed. Therefore, the Safety Board believes that the FRA should require comprehensive failure modes and effects analyses, including a human factors analysis, for all signal system modifications and that the FTA should revise the grant application process to require the same such analyses be provided for all federally funded transit projects that are directly related to the transport of passengers.

Federal Commuter Rail Operations Oversight

The Safety Board requested the FRA to respond to its concerns about commuter railroad operations within FRA regulatory authority, which included a 5-year reportable accident listing for MARC and the Virginia Railway Express (VRE) and a 5-year accident, inspection, and defect history for commuter railroad operations. The FRA responded that 17 commuter rail operations are under its regulatory authority of which six, including VRE, are operated by Amtrak; two, including MARC operations, are operated by Amtrak and CSXT together; seven are operated by the commuter railroad, itself; two are operated by a freight railroad; and one is operated by a contractor. The FRA reported that it does not have a 5-year accident, inspection, defect, or violation record database for individual commuter railroads and that before 1996, any data regarding accidents/incidents was reported as it related to the railroad operating the commuter service. This data could not be readily separated because it was commingled with the freight and intercity rail reporting data. The FRA advised that it is currently working with those railroads to ensure that commuter rail operations data will be reported separately in the future. (See appendix K.)

The Safety Board, consequently, concludes that without a separate collection database specific to commuter rail inspections and accident/incidents, it is difficult for the Federal Railroad Administration to evaluate its own effectiveness of inspections and to identify problematic trends. Records should include reporting on inspections and accident/incidents to determine the effectiveness of its own as well as that of participating state organizations and to identify, and to take corrective action in, those areas inadequate to public safety. Therefore, the Safety Board believes that the FRA should develop and maintain separate identifiable data records for commuter and intercity rail passenger operations.

Positive Train Separation Control Systems

The Safety Board has long advocated a PTS control system and since 1970[33] has issued safety recommendations concerning train collision prevention. (See appendix L.) A PTS control system can prevent trains from colliding by automatically interceding in the operation of a train when an engineer does not comply with the requirements of the signal indication.

Following its investigation of a head-on collision on the Burlington Northern Railroad near Ledger, Montana,[34] the Safety Board issued in July 1993 the following safety recommendation to the FRA:

> In conjunction with the Association of American Railroads and the Railway Progress Institute, establish a firm timetable that includes at a minimum, dates for final development of required advanced train control system hardware, dates for an implementation of a fully developed advanced train control system, and a commitment to a date for having the advanced train control system ready for installation on the general railroad system. (R-93-12)

The Safety Board additionally issued a similar recommendation to the AAR and to the Railway Progress Institute (RPI), respectively, in Safety Recommendations R-93-13 and -15.

The Safety Board classified Safety Recommendation R-93-12 "Open--Acceptable Response" after the FRA took the measure to seek the "final system definition, migration path, and timetable" for a PTS control system by December 1994. The Safety Board also classified Safety Recommendations R-93-13 and -15, respectively, to the AAR and the RPI "Open-Acceptable Response" based on their responses. Because of the AAR and the RPI participation and support in current test projects of the Union Pacific/Burlington Northern Santa Fe Railroad (UP/BNSF) in the Pacific Northwest and of Amtrak tests in Michigan, the Safety Board reclassifies R-93-13 and -15, respectively, as "Closed--Superseded" and "Closed--Acceptable Alternate Action." Neither the AAR nor the RPI is in a position to either establish timetables or to implement a PTS control system for the railroad industry. The FRA and the railroad industry share the responsibility for the development and implementation of a PTS control system. Under its regulatory authority, the FRA can order a railroad to install a PTS control system, and the FRA can issue emergency orders, as it did following this accident, where an unsafe condition or practice causes an emergency situation involving a hazardous death or injury.

The Safety Board, however, believes that the AAR can assist the railroad industry with the development of PTS control systems through a continuing review of nonrailroad technology and assess its adaptability to railroad communication-based control systems. In addition, the Safety Board believes that the AAR can assist the railroad industry with the development of PTS control systems by acting as a clearinghouse for information on the status and results of pilot projects and by disseminating that information to the railroad industry and the Federal and participating State transportation organizations. Finally, the Safety Board believes that the AAR can assist the railroad industry with the installation and operation of PTS control systems by maintaining industry standards to ensure interoperability of equipment and an open architecture for train control systems.

Citing the recent train accidents in Secaucus and Silver Spring, the FRA stated in EO 20 that it had a particular concern for operations that involve lead cars carrying passengers on track

---

[33]Railroad Accident Report--*Head-on Collision between Penn Central Trains N-48 and N-49 at Darien, Connecticut, August 20, 1969* (NTSB/RAR-70/03).

[34]Railroad Accident Report--*Head-on Collision between Burlington Northern Freight Trains 602 and 603 near Ledger, Montana, on August 29, 1991* (NTSB/RAR-93/01).

segments that have neither cab signals nor an automatic train stop or automatic train control. EO 20 required that commuter and intercity passenger railroads modify services operating above 30 mph that lack cab signals or automatic train stop or automatic train control protections and that permit passengers to occupy the lead car, either cab control cars in the forward position push-pull mode or self-propelled locomotives with passenger seating (MU [multiple-unit] locomotives). The FRA also exercised its oversight responsibility for operating rules by concluding that certain current conditions and practices on commuter and intercity passenger railroads posed an imminent and unacceptable threat to public and employee safety. The EO 20 specifically addressed the delayed-in-block rule and the exclusion granted to passenger trains under certain conditions. The FRA recognized that unacceptable threats to public and employee safety exist where protection is not provided by cab signal or automatic train stop or automatic train control systems. The FRA addressed several public safety issues that required immediate attention in EO 20; however, it did not address the other critical risks posed by reliance on crew alertness in complying with operating rules.

The Safety Board has investigated numerous train collisions in which the probable cause or contributing cause was the inattention of the traincrew to wayside signals. In its investigation of the head-on collision of two freight trains near Kelso, Washington,[35] the Safety Board attempted to determine again why one traincrew did not comply with the signal indication of an intermediate signal. The Safety Board reported its concerns about a systemic safety issue: the adequacy of passive wayside signals to reliably capture traincrews' attention when competing sources of attention are present, and it urged the railroad industry to recognize that human vigilance has limits and that wayside signals do not ensure safe train operations. The FRA EO 20, notice no. 2, concluded that "certain current conditions and practices on commuter and intercity passenger railroads pose an imminent and unacceptable threat to public and employee safety. Of greatest concern are push-pull and MU operations lacking the protection provided by cab signal, automatic train stop, or automatic train control systems." After its investigation of the Thedford, Nebraska,[36] accident, the Safety Board stated that had a PTS control system been in place it could have detected that the engineer was not responding appropriately to the signal indications and could have slowed and stopped the train, thus preventing the collision.

The FRA newly required rule for calling signals has basically the same instructions as the existing CSXT operating rule 34. The signal calling that the FRA requires likely occurred in the Silver Spring accident, and at least one crewmember was in the cab control car with the engineer and is believed also to have seen the signal. The accident still happened because such a rule does not adequately compensate for human capabilities and crew interaction, as noted earlier in this report. Therefore, the Safety Board concludes that the FRA reliance on the need for increased vigilance of wayside signals and special actions in operating rules, such as the crew communication rule of EO 20, does not adequately safeguard the public.

The full development of a PTS control system is still underway; however, current technology exists for cab signal, automatic train stop, or automatic train control systems. At the Safety Board public hearing for this accident also, a commuter railroad official from METRA[37] explained an alternate system that METRA has

[35]Railroad Accident Report--*Head-on Collision and Derailment of Burlington Northern Freight Train with Union Pacific Freight Train, Kelso, Washington, on November 11, 1993* (NTSB/RAR-94/02).

[36]Railroad Accident Report--*Collision and Derailment Involving Three Burlington Northern Freight Trains near Thedford, Nebraska on June 8, 1994* (NTSB/RAR-95/03).

[37]Chicago Commuter Rail Service Board, formerly Northeast Illinois Railroad Corporation, operates its own suburban services and controls commuter trains, operated by freight railroads, such as UP/BNSF, in the Chicago area.

designed, in cooperation with the operating carrier and labor unions, to caution the engineer of his last signal indication, which METRA believes may not require FRA approval. The Safety Board concurs with the FRA EO 20, notice no. 1, that:

> Since most train collisions on the railroad result from human factors, the most effective preventive measure is a highly effective train control system. Cab signal systems serve an important safety purpose because they provide a constant display of the governing signal indication. This provides a corrective measure should an engineer fail to note, forget, or misread a restrictive wayside signal indication. Even greater security is provided by a train control system capable of intervening should the engineer fail to observe signals and operating rules for whatever reason….Such systems are referred to as automatic train control or automatic train stop.

Although all MARC locomotives and cab control cars have cab signal equipment, the Brunswick Line was not equipped with a train control system to implement those devices. A train control system, which would have been recognized by the MARC cab control car cab signal equipment, could have provided the engineer with a visual reminder of the 1124-2 signal aspect, required him to acknowledge and comply with the APPROACH signal indication, or enforced the requirements of the signal indication by stopping the train. The Safety Board concludes that had a train control system that could utilize the cab signal equipment on the MARC cab control car been a part of the signal system on the Brunswick Line, this accident may not have occurred. Therefore, the Safety Board believes that the FRA should require, in the interim of a PTS control system being available, the installation of cab signals, automatic train stop, automatic train control, or other similar redundant systems for all trains where commuter and intercity passenger railroads operate. In addition, the Safety Board believes that the FTA should cooperate with the FRA for requiring, in the interim of a positive train separation control system being available, the installation of cab signals, automatic train stop, automatic train control, or other similar redundant systems for all trains where commuter and intercity passenger railroads operate.

The 1987 MDOT grant application to the FTA for the CSXT signal system modification on the Brunswick Line stated that the improvements envisioned in this program provide the foundation for the next "generation" of train control systems: ATCS. However, neither the FTA nor the MTA followed up on the MDOT pursuit of this technology. In the MTA/MARC grant application to the FTA, the future installation of an ATCS, such as cab signals, was part of the justification for awarding the grant for the signal modifications being proposed. At the time of this accident, no advanced train control had been installed.

Since the collision at Georgetown Junction, MARC has undertaken a project, for which the MTA has hired a consultant and provided funding, to develop and evaluate an intermittent cab signaling system (ICSS) that features both civil speed enforcement and positive train stop technology. In addition, the supplier of track circuit equipment is estimating the cost for upgrading the equipment to continuously inductive ACS that will be compatible with the automatic train control equipment currently installed on MARC locomotives and cab control cars. The CSXT is also involved in the project because its wayside signal equipment and locomotives will be directly affected by the installation of any changes proposed to the current signal system.

The Safety Board is encouraged by the efforts of the MTA/MARC project to develop and evaluate an ICSS; however, ICSS should only be an interim solution until a PTS control system can be fully implemented. A PTS control system is a major step for the railroad industry to provide a redundant system where an unacceptable threat to public and employee safety exists. Pending the FRA issuance of regulations that require a PTS control system installation, railroads remain responsible for a PTS control system development and installation. Consequently, the Safety Board believes that the CSXT should develop and install a PTS control system on its track segments that have commuter and intercity passenger trains. The Safety Board also believes that the FTA and the MTA should cooperate with the CSXT in the development and installation of a PTS control system where MARC equipment operates on CSXT tracks.

In the FRA July 1994 report to Congress regarding advanced train control, the FRA planned to begin a 2-year "Corridor Risk Assessment" study in 1995 to identify and evaluate which conventional rail corridors would be prime candidates for advanced train control implementation. The study was to contain a geographic information system (GIS) platform to provide the analysis, which would include PTS control system preventable accidents plotted on the GIS. The initial results of the study are to be presented to the FRA Railroad Safety Advisory Committee in June 1997 for review and further analysis.

An Amtrak project in Michigan is complete, but another in Illinois has not started. The Michigan project tested an incremental train control system on the Amtrak line between Kalamazoo and Green Beach.[38] The Michigan territory is similar to the Brunswick Line, in that both passenger and freight trains operate.

The Silver Spring accident is the latest in a series of collisions that could have been prevented had a PTS control system been in place. A PTS control system could have detected that the MARC train 286 engineer was not responding appropriately to signal indications and then slowed and stopped the train, thus, preventing the collision. The Safety Board concludes that a fully implemented PTS control system would have prevented this accident by recognizing that MARC train 286 was not being operated within allowable parameters, based on other authorized train operations, and would have stopped the train before it could enter into the unauthorized track area. The Safety Board therefore believes that the FRA should require the implementation of PTS control systems for all trains where commuter and intercity passenger railroads operate. The Safety Board also believes that the FTA should cooperate with the FRA for requiring the implementation of positive train separation control systems for all trains where commuter and intercity passenger railroads operate. In addition, the Safety Board reiterates Safety Recommendations R-87-16 and R-93-12 to the FRA. The Safety Board intends to closely monitor the progress made on this important issue and to continue discussing the benefits of a PTS control system in all reports of accidents that such a control system could have prevented.

Passenger Car Safety Standards

During the investigation of this accident, the Safety Board identified problems with emergency egress from the passenger cars that contributed to the number of fatalities. The Safety Board concluded that the emergency egress of passengers was impeded because the passenger cars lacked readily accessible and identifiable quick-release mechanisms for the exterior doors, removable windows or kick panels in the side doors, and adequate emergency instruction signage. The Safety Board further concluded that the absence of comprehensive Federal passenger car safety standards resulted in the inadequate emergency egress conditions. Therefore, the Safety Board issued four urgent safety recommendations on March 12, 1996. One was issued to the FRA; three were issued to the MTA, as follows:

[38] The DOT, Michigan DOT, Amtrak, and Harmon Industries began a project in 1995 to implement a high-speed positive train control system on a 71-mile portion of the Detroit, Michigan, and Chicago, Illinois, corridor. Testing was done on the 20-mile segment between Dowagiac and Niles, Michigan. The system works by allowing grade crossings, signals, and locomotives to communicate with each other using data radio.

> Install removable windows or kick panels for emergency exits in interior and exterior passageway doors. (R-96-4)

> Install an easily accessible interior emergency quick-release mechanism adjacent to all exterior doors. (R-96-5)

> Install retroreflective signage on car interiors and exteriors at emergency exits that contains easily understood instructions and clearly marks all emergency exits (doors and windows). (R-96-6)

The MTA responded in a November 7, 1996, letter that it has: 1) entered into an engineering contract for designing removable windows for emergency exits in car end and side doors, but the work will not be completed until the end of 1997; 2) completed the design of a quick-release mechanism adjacent to all exterior doors with the mechanism installation to be completed in March 1997[39] (see figure 14); and 3) installed luminescent interior as well as enhanced retroreflective exterior signage on all MARC cars as of August 30, 1996. Based on this MTA response, the Safety Board classifies the urgent Safety Recommendations R-96-5 and -6 "Closed--Acceptable Action" and "Closed--Exceeds Recommended Action," respectively. The Safety Board also recognizes the complexity of redesigning and installing removable windows for emergency exits in car end and side doors and the MTA efforts to complete the work as promptly as possible. Because this work cannot be completed within the 1-year timeframe required for an urgent safety recommendation, the Safety Board had reclassified Safety Recommendation R-96-4 to regular safety recommendation status "Open--Acceptable Action."

Additionally, as a result of this accident investigation, the following urgent safety recommendation was issued to the FRA:

> Inspect all commuter rail equipment to determine whether it has: (1) easily accessible interior emergency quick-release mechanisms adjacent to exterior passageway doors; (2) removable windows or kick panels in interior and exterior passageway doors; and, (3) prominently displayed retro-reflective signage marking all interior and exterior emergency exits. If any commuter equipment lacks one or more of these features, take appropriate emergency measures to ensure corrective action until these measures are incorporated into minimum passenger car safety standards. (R-96-7)

After reviewing the FRA response of June 6, 1996, the Safety Board classified Safety Recommendation R-96-7 "Open--Acceptable Action" in March 1997. The FRA had stated in that response that it had inspected 1,250 pieces of railroad equipment on 16 commuter organizations, that any variation in the inspection results was indicative of equipment age and of difference by commuter agencies, and that emergency quick-release mechanisms were typically accessible to passengers; although, many were not adjacent to exterior passageway doors. In addition, the FRA had stated that marking emergency exits inside cars with luminescent rather than retroreflective materials may be better. The FRA, however, has taken no immediate action to make corrections. The Safety Board acknowledges the FRA efforts concerning its urgent safety recommendation and recognizes the complexities of developing practical solutions within the requested 1-year period; therefore, the Safety Board classifies Safety Recommendation R-96-7 "Closed--Superseded" and is substituting it with three separate safety recommendations for longer-term action. Consequently, the Safety Board believes that the FRA should:

---

[39]MARC informed the Safety Board on March 3, 1997, that the installation was complete on February 28, 1997.

Figure 14--Photograph showing quick-release mechanisms on MARC cars.

Require all passenger cars to have easily accessible interior emergency quick-release mechanisms adjacent to exterior passageway doors and take appropriate emergency measures to ensure corrective action until these measures are incorporated into minimum passenger car safety standards.

Require all passenger cars to have either removable windows, kick panels, or other suitable means for emergency exiting through the interior and exterior passageway doors where the door could impede passengers exiting in an emergency and take appropriate emergency measures to ensure corrective action until these measures are incorporated into minimum passenger car safety standards.

Issue interim standards for the use of luminescent or retroreflective material or both to mark all interior and exterior emergency exits in all passenger cars as soon as possible and incorporate into minimum passenger car safety standards.

The Safety Board first began addressing passenger car safety with the FRA after an accident at the Botanical Gardens station in New York, New York, in January 1975.[40] The Safety Board continued its efforts on passenger car crashworthiness following Amtrak accidents in March 1980 near Glacier Park, Montana, and in

[40]Railroad Accident Report--*Collision of Two Penn Central Commuter Trains at Botanical Garden Station, New York, New York, January 2, 1975* (NTSB/RAR-75/08).

June 1982 at Gibson, California. [41] The Safety Board issued the following safety recommendations, respectively, to the FRA:

> Promulgate regulations to establish minimum standards for the interior of commuter cars so that adequate crash injury protection and emergency equipment will be provided passengers. (R-75-38)
>
> Promulgate regulations to establish minimum safety standards for the inspection and maintenance of railroad passenger cars. (R-80-31)
>
> Expedite the development of passenger car safety standards which were mandated by Congress in October 1980 (reiterated January 14, 1983) including in the standards: (A) Criteria for the location and intensity of emergency lights within the cars to ensure adequate visibility for escape from smoke filled cars; (B) Requirements for emergency evacuation plans, for training of personnel for emergencies, and for emergency systems, such as emergency exits and doors, smoke detector systems, etc., specifying the numbers, type, location, and markings; (C) Acceptable levels of flame spread rate, smoke emissions, and toxic fumes for interior materials, and (D) Requirements for the installation of a sprinkler system to which water can be supplied by emergency equipment through externally mounted standard standpipes. (R-83-76)

Safety Recommendation R-75-38 was classified in April 1984 "Closed--Superseded" by Safety Recommendation R-84-46, which was subsequently classified "Closed--No Longer Applicable" in August 1991, when Amtrak informed the Safety Board of research in progress which eliminated the need for FRA studies. Safety Recommendations R-80-31 and R-83-76 were both classified "Closed--Unacceptable Action," based on FRA responses, in January 1986. In June 1996, the FRA finally reacted to the concerns raised by the Safety Board, the General Accounting Office, and others and issued a notice of initiation for rulemaking on rail passenger equipment safety standards to comply with the Federal Railroad Safety Authorization Act of 1994.

Current FRA regulations for passenger car safety standards are inadequate. They do not address passenger car safety standards for self-contained emergency lighting; inspection, removal, and maintenance of emergency windows; exterior emergency door releases; interior flammability and smoke standards; and structural crashworthiness. The Safety Board is encouraged by the current FRA position in developing rulemaking and expects that the passenger car safety standards will not only address the safety of passengers in newly built passenger cars but also in existing passenger cars. The FRA indicated that the group working on the development of passenger car safety standards completed their work in December 1996, and a notice of proposed rulemaking (NPRM) is expected by the end of 1997.

In addition during the investigation of this accident, the Safety Board identified several areas of safety deficiencies that should be addressed by passenger car safety standards for improved passenger safety. The identified areas are the power source of emergency lighting, the difficulty in removing emergency windows, the missing or inaccessible exterior emergency door release handles, the failure of interior materials to meet flammability and smoke standards, and the structural crashworthiness of cab control cars.

Emergency Lighting--The two passengers in coach car 7720 stated that no emergency lighting was available after the accident. One passenger's injuries and the other's loss of eye

[41] Railroad Accident Reports--*Derailment of Amtrak Train No. 7 the Empire Builder on Burlington Northern Track, Glacier Park, Montana, March 14, 1980* (NTSB/RAR-80/06) and *Fire Onboard Amtrak Passenger Train No. 11, Coast Starlight, Gibson, California, June 23, 1982* (NTSB/RAR-83/03).

glasses compounded the reported difficulty in moving in the darkness. Additionally, the tilted position of the car contributed to their disorientation and hindered their mobility. Postaccident inspection of the car revealed that batteries supplying power to the emergency lighting system, located below the floor level, had been damaged in the derailment. After Safety Board investigators alerted MARC to the failure of the emergency lighting system, MARC projected plans to complete by late 1997 the fleetwide installation of battery pack ballasts, designed to provide power should head-end or car battery power be lost, in selected fluorescent lighting fixtures.

The MARC passenger cars are not unique in the location of the battery supplying power to the emergency lighting system being below the car floor, which makes them susceptible in a derailment to damage from contact with the car trucks, the rails, or the ground. The installation of battery pack ballasts or other self-contained independent power sources in the car interior would provide reliable power to emergency lighting in derailments when the batteries under the car are most likely to be damaged. The Safety Board concludes that a need exists for Federal standards requiring passenger cars be equipped with reliable emergency lighting fixtures with a self-contained independent power source when the main power supply has been disrupted to ensure passengers can egress safely. Therefore, the Safety Board believes that the FRA should require all passenger cars to contain reliable emergency lighting fixtures that are each fitted with a self-contained independent power source and incorporate the requirements into minimum passenger car safety standards.

Emergency Windows--One passenger in coach car 7720 stated that he exerted much effort to open an emergency window in that car. Postaccident inspection of the car emergency windows revealed that much effort was also necessary to open two other emergency windows in the same car because the window lubricant had hardened. The Safety Board determined that no periodic preventive maintenance had been performed on the emergency windows of the MARC passenger equipment and that none had been required.

The FRA EO 20 requires all passenger railroads to inspect emergency window exits for proper operation, marking, and instructions as part of routine equipment maintenance. The FRA informed the Safety Board in October 1996 that changes to the regulatory text of the draft NPRM on Passenger Train Emergency Preparedness were being made because the inspection cycle requirements of EO 20 were vague. The February 24, 1997, FRA-issued NPRM proposes that a railroad test a representative sample of emergency window exits on its cars a least once every 180 days to verify proper operation and that it repair a defective unit before returning the car to service. As a result of the Safety Board urgent recommendations and the FRA EO 20, MARC has performed functional tests on all existing emergency exit windows and initiated a program to install additional emergency exit windows in all their passenger equipment. The Safety Board, however, is concerned that the FRA EO 20, pertaining to the inspection cycle, does not require a prescribed test cycle and that until the proposed rulemaking becomes effective, emergency windows on other passenger rail carriers may not be adequately inspected. The Safety Board concludes that prescribed inspection and maintenance test cycles are needed to ensure reliable operation of emergency windows in all long-distance and commuter rail passenger cars. Therefore, the Safety Board believes, pending the issuance of the final rule on passenger car safety standards, that the FRA should promptly provide a prescribed inspection and maintenance test cycle to ensure the proper operation of all emergency exit windows as well as provide that the 180-day inspection and maintenance test cycle is prescribed in the final rule.

Exterior Emergency Door Release-- The MARC II passenger cars have provisions for a T-handle, which is used to disconnect the interior release mechanism allowing the exterior side doors to be opened from the outside, at each of the four exterior doors. During postaccident inspection of cab control car 7752, investigators found that the exterior emergency door release T-handles were missing. In addition, when MARC last performed general servicing of cab control car 7752, the T-handles were noted as missing. MARC mechanical officers explained that because of the difficulty in receiving replacements from the original equipment supplier, they needed time to manufacture and install substitute T-handles, but MARC did not restrict the car from being placed back into passenger service.

The postaccident inspection of the passenger coach 7720, immediately behind cab control car 7752, revealed that the exterior emergency door release T-handles on the right side were buried in ballast when the car derailed and were, therefore, inaccessible to emergency responders. The T-handles were designed to be below the floor line of the car and about 3 inches inboard. The original design plans for the MARC II passenger cars showed the emergency door release T-handles above the bottom of the car body and in a glass-covered recessed pocket adjacent to each vestibule door. However, the T-handles had not been installed there because of an approved design change during car building. Emergency responders may have been able to quickly locate the T-handles and gain access to passenger coach interior had the handles been located where planned.

The Safety Board concludes that the exterior emergency door release T-handles for the MARC cars were not either in place or accessible to firefighters because no requirements for their maintenance or accessibility exist. Therefore, the Safety Board believes that the FRA should require that all exterior emergency door release mechanisms on passenger cars be functional before a passenger car is placed in revenue service, that the emergency door release mechanism be placed in a readily accessible position and marked for easy identification in emergencies and derailments, and that these requirements be incorporated into minimum passenger car safety standards.

Interior Materials--The analysis of fire debris indicated that diesel fuel from the breached fuel tank of Amtrak unit 255 sprayed into the breached opening of the MARC 286 cab control car. Positive residues were found on some passenger seats and on a sheetmetal panel near the opening. The analysis revealed that the diesel fuel played a significant role in the early fire growth within the car, and within 3 to 5 minutes after the collision based on witness testimony, flashover developed in the cab control car with the fire accelerating over the breached area because of that sprayed diesel fuel. Had diesel fuel not sprayed into the cab control car, the fire likely would not have spread as quickly as it did. For the passengers to quickly exit the car became even more critical because of the rapid growth of fire. Except for those passengers who died from blunt trauma injuries, others may have survived the accident, albeit with thermal injuries, had proper and immediate egress from the car been available. The Safety Board concludes that the catastrophic rupture of the Amtrak unit 255 fuel tank in the collision with the MARC cab control car 7752 released fuel, which sprayed into the interior of the cab control car, and resulted in the fire and at least 8 of the 11 fatalities.

The Safety Board recognizes that the materials taken from an exemplar MARC car may not have been identical to the materials that were installed on cab control car 7752 and that other factors, such as wear, can affect the performance of the car materials; nevertheless, the materials taken from the exemplar car were significantly similar to the materials in the accident car. Some of the interior materials from the exemplar MARC car failed current flammability and smoke emissions testing criteria, and the materials in the cab control car 7752 also most likely would have failed. Had the materials met current performance criteria, however, the outcome would not have been any different because of the presence of diesel fuel as an ignition source. The fire would have spread quickly whether the interior materials of the MARC passenger cars had met current performance criteria regarding flammability and smoke emissions characteristics; still, the Safety Board is concerned that the interior materials in the MARC passenger cars did not meet existing performance criteria for flammability and smoke emissions characteristics.

Performance criteria is based on guidelines developed by the FRA and the FTA, and the passenger commuter rail industry could reference them with or without modification when ordering new equipment. The Safety Board concludes that because other commuter passenger cars may also have interior materials that may not meet specified performance criteria for flammability and smoke emission characteristics, the safety of passengers in those cars could be at risk. Therefore, the Safety Board believes that the FRA should require that a comprehensive inspection of all commuter passenger cars be performed to independently verify that the interior materials in these cars meet the expected performance requirements for flammability and smoke emissions characteristics.

The current FRA information on the flammability and smoke emissions characteristics and the testing of commuter and intercity rail vehicle materials is based on guidelines that have not changed significantly in the past 30 years. Consequently, the Safety Board concludes that the Federal guidelines on the flammability and smoke emissions characteristics and the testing of interior materials do not provide for the integrated use of passenger car interior materials and, as a result, are not useful in predicting the safety of the interior environment of a passenger car in a fire. Therefore, the Safety Board believes that the DOT should review the testing protocols within the various modal administrations regarding the flammability and the smoke emissions characteristics of interior materials and coordinate the development and implementation of standards for material performance and testing with the FRA and the FTA.

Cab Control Car Structural Crashworthiness--The left side of cab control car 7752 was ripped open in the collision from its front to midsection. (See figure 15.) The cab control car was equipped, as required by FRA standards, with structural components serving as collision posts at each end doorway; however, the magnitude of the impact and collision forces were more than the collision posts could resist. The Safety Board first addressed structural crashworthiness of passenger cab control cars after its investigation of the August 1981 head-on collision between a Boston & Maine Corporation freight train and a Massachusetts Bay Transportation Authority commuter train in Beverly, Massachusetts,[42] urging the FRA to:

> Expedite implementation of Safety Board recommendations to study structural protection for occupants of control cars and locomotive operating compartments. (R-82-34)

Safety Recommendation R-82-34 was classified "Closed-Acceptable" based on the FRA response that it had completed the study, *Analysis of Locomotive Cabs*.

The Safety Board investigation of the January 1993 collision between two MU-locomotive passenger trains in Gary, Indiana,[43] resulted in a safety recommendation asking the FRA to address the collision protection afforded by the corner post structures of passenger cars:

> In cooperation with the Federal Transit Administration and the American Public Transit Association, study the feasibility of providing car body corner post struc-

---

[42]Railroad Accident Report--*Head-on Collision of Boston & Maine Corporation Extra 1731 East and Massachusetts Bay Transportation Authority Train No. 570, Beverly, Massachusetts, August 11, 1981* (NTSB/RAR-82/01).

[43]Railroad Accident Report--*Collision Between Northern Indiana Commuter Transportation District Eastbound Train 7 and Westbound Train 12 near Gary, Indiana, on January 18, 1993* (NTSB/RAR-93/03).

Figure 15--Photograph of MARC passenger coach cab control car 7752 at accident site.

tures on all self-propelled passenger cars and control cab locomotives to afford occupant protection during corner collision. If feasible, amend the locomotive safety standards accordingly. (R-93-24)

Similar Safety Recommendations R-93-25 and -26, respectively, were issued to the FTA and the American Public Transit Association. Since April 1994, Safety Recommendations R-93-24 through -26 have been classified "Open--Acceptable Action."

The car body design of the trains involved in the Gary accident was a lightweight monocoque structure[44] and almost identical to the design of the MARC II cars involved in this accident. The damage to the cars in the Gary collision was not as extensive as to cab control car 7752 in the Silver Spring collision, and no fire was involved. The Silver Spring accident serves to underscore the vulnerability of certain passenger car and cab control car designs in major collisions and the importance of addressing occupant collision protection in car body design.

The FRA, which is principally responsible for oversight of the passenger rail transportation industry, initiated a formal study of the crashworthiness issue in response to the Rail Safety Enforcement and Review Act. That study resulted in the comprehensive *Locomotive Crashworthiness and Cab Working Conditions-Report to Congress* in September 1996, which included an engineering evaluation of cab control cars. The findings identified several crashworthiness safety features, such as implementation of stronger collision posts and full height corner posts, that merited further FRA action in cooperation with private industry.

[44]Metal structure in which the covering absorbs a large part of the stresses to which the body is subjected.

Emergency Preparedness

The CSXT, as well as a local resident, contacted the MCFRS 911 dispatcher about the collision at 5:41 p.m. Within 1 minute, the first fire engine company was notified, and it arrived on scene within 5 minutes of notification. All MCFRS commands had been established by 6:15 p.m. Therefore, the Safety Board concludes that even though the MCFRS personnel responded promptly to the emergency, they could do nothing to save any of the accident victims because passenger coach cab control car 7752 was already completely engulfed in flames when the first firefighter arrived on scene. The investigation identified problems with the MCFRS preparedness for railroad passenger train accidents; the CSXT, the MTA/MARC, and the MCFRS contingency planning; and the interaction between these three agencies.

The MCFRS activated the fire annex section of the Montgomery County Emergency Management Agency (MCEMA) disaster plan; however, the fire annex section did not provide for interchange with the CSXT or MARC, which was evident when interactions were not consistently maintained between the supervisors or dispatchers or both of the MCFRS, the CSXT, and MARC. The MCFRS personnel were not receptive to the CSXT offers for assistance. The fire annex section did not provide for railroad representatives to respond to strategic locations to contribute their expertise and assistance.

The CSXT attempted to assist in evacuating passengers by moving trains closer to the accident site and only complicated the emergency response efforts. Although this attempt was consistent with the CSXT practice for controlling train movements and providing assistance, the MCFRS was not familiar with railroad operations because no procedures had been coordinated between the CSXT and the MCFRS. As a result, the accident scene was evacuated about 6:30 p.m. by emergency responders who feared that another train was entering the accident site.

The MCEMA disaster plan did not contain procedures for responding to railroad passenger train accidents. The Safety Board concludes that the MCEMA disaster plan lacked procedures for responding to railroad passenger train accidents, such as simulating the accident response with coordinated management, which could have emphasized the importance of being familiar with passenger cars and of coordinating activities between the MCFRS, the MTA/MARC, and the CSXT. To be familiar with the means of emergency egress from a passenger train and to coordinate activities with the railroads are extremely essential procedures needed for emergency response. Therefore, the Safety Board believes that the MCEMA should develop comprehensive procedures for responding to railroad passenger train accidents and include these procedures in its disaster plan.

Although MARC knew of the train accident, it was not immediately aware that the collision involved one of its commuter trains. The MARC chief transportation officer said that for 45 minutes after the accident, the MARC operations center had been in a state of confusion. In addition, the CSXT operations center in Jacksonville was unable to contact the MARC operation center by telephone from 5:45 until 6 p.m. because the telephone line was busy and no backup communications was available. Some MARC officials who had the Amtrak alphanumeric pagers were only made aware of the MARC train involvement in the collision by reading the messages that were meant for Amtrak personnel. Since the accident, a dedicated emergency phone line between the MARC operations center and the CSXT operations center has been installed, and the CSXT has been provided with the alphanumeric pager numbers of MARC supervisors.

The confusion between the CSXT and the MCFRS at the accident site and the untimely notifications between the CSXT and MARC of the collision resulted because neither the CSXT nor MARC had a formal emergency management plan available that contained procedures for dispatchers and traincrews to notify emergency responders of train movements near an accident site. When the AU dispatcher authorized the engineer of CSXT train Q401 to move his locomotive closer to assist in evacuating passengers, the MCFRS IC was not advised that the train would be approaching the accident site. The movement of trains toward an accident area should have been addressed by the CSXT and MCRFS dispatchers. The Safety Board concludes that the confusion during the initial emergency response resulted because the CSXT and MARC lacked a formal emergency management plan to follow. The implementation of an emergency management plan that addressed communications and training would have eliminated the confusion between the CSXT and MARC. Therefore, the Safety Board believes that CSXT should develop and implement a formal emergency management plan that contains procedures specific to employee responsibilities and interaction with emergency response agencies and other transportation entities. The Safety Board also believes that the MTA/MARC should develop an emergency plan that will provide a detailed description of emergency response procedures as well as a protocol to coordinate activities with the emergency response organizations and other transportation entities when an accident occurs.

The CSXT traincrews of MARC passenger trains had minimal guidance, compared with the Amtrak manual of on-train instructions for conductors and assistant conductors, to properly perform passenger train functions. Since the CSXT operation in 1985 of the MARC passenger service, the CSXT had not maintained a comprehensive passenger program that would provide guidance to traincrews for passenger train functions. The CSXT produced *Passenger Service Bulletins* as needed, but it offered little guidance on responding to passenger train emergencies. The CSXT passenger traincrews reported that they had not received any emergency training in passenger train operations and in passenger responsibility in emergencies. The Safety Board concludes that the CSXT personnel operating MARC passenger trains are not adequately trained to understand and therefore execute their responsibilities for passengers in emergencies. The CSXT and MARC have been working since 1993 to complete the *Passenger Conductor's Manual*, which was unfinished at the time of the accident. A review of this unfinished manual shows that it is much less comprehensive than the Amtrak manual of on-train instructions for conductors and assistant conductors. The Safety Board believes that the CSXT and MARC should develop and implement, in cooperation, a complete training agenda for all CSXT passenger traincrews that provides experience in the correct use of emergency equipment, in emergency communications procedures, and in passenger evacuation and assistance in an emergency and also includes the distribution of a comprehensive employee guidance manual.

Since the accident MARC has informed the Safety Board that it, in cooperation with Amtrak and the CSXT, has developed video materials for training emergency responders and the Amtrak and CSXT traincrews who operate MARC commuter trains.[45] However, such passive training may not be as effective as training that requires traincrews to actively participate and practice what is being demonstrated. To achieve the protocols and procedures described in any emergency management plan, emergency drills should be performed in conjunction with local emergency management agencies and with the railroad to reinforce training, to test communications, and to determine whether procedural changes are needed. Therefore, the Safety Board believes that the CSXT and the MTA/MARC, in cooperation with the emergency management agencies of Baltimore County, of the city of Baltimore, of the Metropolitan Washington Council of Governments, and of Jefferson and Berkeley Counties in West Virginia, should conduct periodic disaster drills to assess their emergency management plans, to reinforce and evaluate their emergency training, and to test the communications with the organizations.

The Safety Board has found in other accident investigations[46] that emergency responders can be hampered in their search and rescue, as well as extrication, efforts because of the lack of emergency plans, inaccessible terrain along railroad property, accounting for number of passengers, difficult extrication caused by rescue tools inadequate for the construction of and materials in passenger equipment, coordination and communication with railroads and emergency responders, and infrequent disaster drills for emergency responders. With the exception of the nationwide Amtrak service, only certain localities have commuter passenger railroad service. Many rural emergency response agencies may never have had the opportunity to respond to a rail disaster involving fire. With the advent of high-speed passenger rail service, increased development of commuter railroad systems, and widespread rail transportation of hazardous materials, however, the likelihood of more communities being involved in a railroad emergency of this type has increased. The Safety Board therefore concludes that the lack of appropriate training for emergency responders in the areas of emergency planning, coordination and communications, rescue methods, inaccessible terrain along railroad property, familiarity with railroad equipment, and disaster drills may become a recurrent problem for other

---

[45]Before the accident, Amtrak was providing training for MARC traincrews on the Penn Line and hands-on as well as audio-visual training for emergency responders in areas near the Penn Line.

[46]Railroad Accident Reports--*Rear-end Collision of Amtrak Passenger Train 94, the Colonial, and Consolidated Rail Corp. Freight Train ENS-121 on the Northeast Corridor, Chase, Maryland, January 4, 1987* (NTSB/RAR-88/01); *Head-on Collision of National Railroad Passenger Corporation (Amtrak) Passenger Trains Nos. 151 and 168, Astoria, Queens, New York, New York, July 23, 1984* (NTSB/RAR-85/09); *Derailment and Subsequent Collision of Amtrak Train 82 with Rail Cars on Dupont Siding of CSX Transportation Inc. at Lugoff, South Carolina, on July 31, 1991* (NTSB/RAR-93/02); and *Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge near Mobile, Alabama, on September 22, 1993* (NTSB/RAR-94/01).

emergency response organizations unless a national effort is made to address emergency response training for railroad accidents. Consequently, the Safety Board believes that the Federal Emergency Management Agency should include in its training at the U.S. Fire Administration National Fire Academy a curriculum that addresses the needs of State and local emergency management agencies to respond to a major railroad accident and that familiarizes emergency response organizations with railroad equipment and appropriate rescue methods for railroad accidents.

In December 1993, the FRA published its report *Recommended Emergency Preparedness Guidelines for Passenger Trains,*[47] in which it stated that it

> has recognized the need for intercity and commuter passenger train system operators to engage in careful advance planning to respond effectively to emergencies. This advance planning should address emergency response procedures, training of system operating and other emergency response organization personnel, and provision and use of emergency equipment.

The report also noted that "This document is advisory in nature. The recommended guidelines contained herein do not have the force and effect of law or regulation."

On February 24, 1997, the FRA published the NPRM *Passenger Train Emergency Preparedness*, which proposes requiring minimum Federal safety standards for the preparation, adoption, and implementation of emergency preparedness plans by railroads connected with the operation of passenger trains, including freight railroads hosting the operations of rail passenger service. The proposed rule also requires each affected railroad to instruct its employees on the provisions of the plan. The Safety Board encourages the FRA to move forward in the rulemaking process for the development of comprehensive emergency management plans that affect the safety and well being of passengers, railroad employees, and the community in an emergency.

Reverser Use During Emergency Braking

The Safety Board stopping distance tests indicated that had the MARC train 286 engineer not used the reverser, thereby retaining dynamic braking until impact, MARC train 286 would have impacted Amtrak train 29 at a speed of about 34 mph as opposed to the actual impact speed of about 38 mph. The additional deceleration of MARC train 286 would have resulted in an additional 0.3 seconds of elapsed time before impact, which in turn would have resulted in Amtrak train 29 moving approximately 14 feet farther into the crossover before impact. Thus, with MARC train 286 operating at the speed of 66 mph and going into emergency braking 1,407 feet before impact, a collision was inevitable regardless of the reverser use by the MARC train 286 engineer.

Despite the CSXT instructions that the reverser only has limited utility and its intentions that the reverser be used only under specific conditions, the use of the reverser having a retarding effect is implied in the instructions. The MARC train 286 engineer may have drawn from that implication and used the reverser about 1,000 feet into his emergency braking sequence out of desperation when he realized emergency braking would not prevent the impending collision. Nevertheless, because the reverser use eliminated the additional braking provided by the locomotive dynamic brakes, the Safety Board concludes that the MARC train 286 engineer's use of the reverser during the emergency brake application resulted in a marginally increased stopping distance for MARC train 286.

[47]Prepared for the FRA by the DOT, Research and Special Programs Administration, John A. Volpe National Transportation Systems Center, Final Report No. DOT/FRA/ORD-93/24 November 1993.

Therefore, the Safety Board believes that the CSXT should inform its engineers, and the AAR, the American Short Line Railroad Association, the Brotherhood of Locomotive Engineers, the UTU, the International Brotherhood of Teamsters, and the American Public Transit Association should inform its membership, of the circumstances of this accident and caution them not to use the reverser during emergency brake applications for those trains on which the use of reverser will eliminate the dynamic braking, thus increasing stopping distance.

Computer-Aided Recordkeeping

Federal regulations under 49 CFR Part 228.17 require that each carrier keep records of train movements that are made under the direction and control of a dispatcher who uses a telephone, radio, or any other electrical or mechanical device to dispatch, report, transmit, receive, or deliver orders pertaining to train movements. These records are to contain such important information as the identification of the timetable in effect; the train location and the date; the dispatcher identification and duty time; the weather conditions at 6-hour intervals; the identification of the trains and the traincrews and their duty times; the station names and the office designations; the distances between stations; the direction of train travel and the times of arrival, departing, and passing all reporting stations; and any unusual events affecting the movement of trains and the identity of affected trains. Before the computerization of dispatching offices, these records were recorded manually and retained on file for review by railroad operating officers, Federal regulators, and accident investigators.

The CSXT operates its CTC system with a computed-aided dispatching (CAD) system, as do many major railroads in the country. The CAD generates "computerized train sheets" (a computer file that can print out the requested information), which was designed by the CSXT for the recordkeeping of each train (about 3,000 per month). The Safety Board examined train sheets covering about 90 days, with particular attention given to the accident trains, and found that the train sheets were incomplete in so far as recording the information delineated under 49 CFR Part 228.17. For example, the computer-generated train sheet for MARC train 286 did not show the train activity after its departure from Point of Rocks, when it was required to make a reverse movement to crossover and go around a disabled freight train; the weather that day; and the accident occurrence. The Safety Board investigation revealed that the train sheets being maintained by CSXT lacked the information required by FRA regulation and, therefore, were of little value in determining unusual events the day of the accident. The Safety Board concludes that the FRA has not addressed the use of CAD system records to provide information for the identification and evaluation of potential safety-related trends for corrective action. The FRA must consider, when alternative methods of recordkeeping are employed, that the current minimum data requirements are critical to good event recording and that alternative should be comparable or better. Consequently, the Safety Board believes that the FRA should update 49 CFR Part 228.17, Train Dispatcher's Record of Train Movements, to include the same parameters for electronic recordkeeping of the dispatcher's record of train movements.

Locomotive Fuel Tank Crashworthiness

In 1992 the Safety Board conducted comprehensive Safety Study (NTSB/SS-92/04), Locomotive Fuel Tank Integrity, which addressed, among other issues, the potential in railroad accidents for diesel fuel fires to fatally injure the trapped crewmembers. The report primarily covered the risk in freight locomotive operations, although a passenger train collision case study was cited. However, the risk of collision damage is effectively the same for both types of operations because fuel tanks for freight locomotives are configured essentially the same as passenger locomotives, such as the one involved in this accident. Specific safety issues discussed in the study were the adequacy of current fuel tank design, factors that affect fuel tank design, and the sufficiency of research to improve fuel tank integrity or fuel containment. The study findings concluded that the evaluation of the extent of locomotive fuel tank damage and spills on an annual basis is difficult because of the limited data available. Furthermore, although the railroad industry has explored changes in fuel tank design, no evidence was found that the industry has performed a systematic engineering analysis to determine the feasibility of providing better crash protection for fuel tank systems.

As a result of this safety study, the Safety Board issued Safety Recommendation R-92-10 to the FRA:

> Conduct, in conjunction with the Association of American Railroads, the General Electric Company, and the Electro-Motive Division of General Motors, research to determine if the locomotive fuel tank can be improved to withstand forces encountered in the more severe locomotive derailment accidents or if fuel containment can be improved to reduce the rate of fuel leakage and fuel ignition. Consideration should be given to crash or simulated testing and evaluation of recent and proposed design modifications to the locomotive fuel tank, including increasing the structural strength of end and side wall plates, raising the tank higher above the rail, and using internal tank bladders and foam inserts.

The Safety Board also issued the similar Safety Recommendations R-92-14, -16, and -17, respectively, to the AAR, the General Electric Company (GE), and the Electro-Motive Division of General Motors (EMD). The Safety Board classified Safety Recommendations R-92-10, -16, and -17 to the FRA, GE, and the EMD, respectively, "Open--Acceptable Response" after noting the industry efforts to address the issue. However, the crash or simulation testing and evaluation of recent and proposed design modifications has not yet been addressed. Therefore, the Safety Board reiterates to the FRA, GE, and the EMD, respectively, Safety Recommendations R-92-10, -16, and -17. In addition the Safety Board has classified Safety Recommendation R-92-14 "Closed--Acceptable Action" to the AAR after it reported the adoption of RP-506 for all locomotive units built after September 1, 1995. RP-506 addressed structural and puncture resistance properties of the fuel tank to reduce the risk of spillage under derailment or minor collision conditions.

Also as a result of the safety study, the Safety Board issued Safety Recommendation R-92-11 to the FRA:

> Establish, if warranted, minimum performance standards for locomotive fuel tanks based on the research called for in Safety Recommendation R-92-10.

Because the Safety Board believed that AAR RP-506 was an adequate direction to take and, at the time, realized no need for Federal regulations, Safety Recommendation R-92-11 was classified "Closed--No Longer Applicable."

The locomotive in the Silver Spring accident, Amtrak unit ATK 255, was built in 1977 and was under the FRA standard in 49 CFR Part 229.71, stipulating the minimum clearance from the top of the rail. The current FRA regulations do not address the design, size, locations, or performance of locomotive fuel tanks, and do not require a regularly scheduled or periodic inspection of fuel tanks to ensure no safety hazards are present. In this collision, substantial compressive forces bearing on the lead truck of Amtrak unit ATK 255 caused it to be displaced into the front plate of the fuel tank, located immediately behind the lead truck. The front of the fuel tank compressed inward substantially damaging the fuel tank. The left side of the fuel tank subsequently was ruptured catastrophically by the raking action of the body bolster of the MARC cab control car 7752 as both trains continued to move forward. The fuel tank provided little impact resistance to the compressive forces of the lead truck and the shearing action of the projecting body bolster of cab control car 7752. The released fuel sprayed into the exposed interior of cab control car 7752, and with multiple sources of ignition, the fuel quickly ignited and engulfed the car.

The Safety Board has previously expressed its concern to the FRA about locomotives built before the effective date of September 1, 1995, noting that many of these locomotives will remain in service for several years, and this accident only reinforces that concern about this issue. The Safety Board will continue to address the crashworthiness issue in future accident investigations and to monitor the FRA progress for improving locomotive fuel tank crashworthiness.

CSXT and MARC Operating Agreement

The FTA grant process and FRA/MDLI operations oversight suggest areas of needed improvement for the involved government agencies; however, the CSXT is inevitably the most important agent in safe, or unsafe, operations. In this regard, the indemnification arrangement for CSXT/MARC service is a significant, but not likely uncommon, issue: the actual operator of the service in question was well-insulated against damages that might arise from both its employees and the passengers on the line. Risk of liability from injury to its employees was compensated by a substantial surcharge to the CSXT billings for labor expense, and the State of Maryland assumed the risk, through self-insurance and the purchase of commercial coverage, for the first $150 million of passenger-related liabilities.

The exposure to liability may induce cautious behavior; however, in the absence of this exposure, it is not so obvious that one will be readily able to identify the precautions that were forsworn when the financial risks were eliminated, particularly in a regime, like railroading, where so much of the activity is required and inspected under regulatory authority. Nevertheless, the manner in which the protection of MARC passengers was approached, and subsequently explained, almost assuredly reflects a disconnect between activity and responsibility. The CSXT manager for these commuter services indicated that at the request of MARC, the CSXT crews wore MARC uniforms in the passenger cars. The CSXT crews were not trained by MARC or by the CSXT in emergency procedures. Indeed, no specific carrier-initiated safety assessment of the emergency passenger equipment or its operation had been undertaken, and no emergency preparedness plan had been developed. In postaccident questioning, CSXT personnel allowed that passenger safety, as opposed to train handling safety, was an issue for MARC. The CSXT was, of course, aware that MARC had done little in this regard and had no on-train personnel. But when asked whether the matter had ever been discussed between the two principals, the CSXT indicated that MARC had never broached the subject. It appears that the CSXT had not raised the issue as well. The Safety Board concludes that the CSXT/MARC system lacked comprehensive safety oversight to ensure the safety of the commuting public. The Safety Board is concerned by this apparent hands-off approach and is convinced that it cannot be divorced from the environment of diminished liability in which it arose. Therefore, the Safety Board believes that the Governor and the General Assembly of the State of Maryland should instruct and empower an appropriate State agency to provide continual, effective, and independent safety oversight of all aspects of the MARC operations.

FINDINGS

Conclusions

1. The train equipment and the track functioned as designed and the AU dispatcher conducted the dispatching activities properly. Neither the three MARC train 286 crewmembers nor the two Amtrak train 29 locomotive crewmembers were impaired by alcohol or drugs. All train crewmembers were in good health, had no evidence of fatigue, and were experienced in and qualified for their duties.

2. The weather conditions did not impair the ability of the MARC train 286 crewmembers to distinguish the indication of Kensington signal 1124-2.

3. The signal system functioned as designed.

4. The MARC train 286 engineer apparently forgot the signal aspect, which required him to be prepared to stop at Georgetown Junction, due to interference caused by various events, including performing an unscheduled station stop, that occurred between the presentation of the APPROACH aspect at signal 1124-2 and the STOP signal at Georgetown Junction.

5. Neither the conductor nor the assistant conductor while in the cab control compartment appeared to have effectively monitored the engineer's operation of MARC train 286 and taken action to ensure the safety of the train.

6. Had the Federal Railroad Administration required the recording of the train crewmembers' voice communications, the essential details about the circumstances of this accident could have been provided.

7. Had the Federal Railroad Administration and the Federal Transit Administration required the CSX Transportation Inc. to perform a total signal system review of the proposed signal changes that included a human factors analysis within a comprehensive failure modes and effects analyses, this accident may have been prevented.

8. Federal funds granted for the signal modifications on the CSXT Brunswick Line to accommodate an increase in the number of Maryland Rail Commuter trains did not ensure that the safety of the public was adequately addressed.

9. Without a separate collection database specific to commuter rail inspections and accident/incidents, it is difficult for the Federal Railroad Administration to evaluate its own effectiveness of inspections and to identify problematic trends.

10. The Federal Railroad Administration reliance on the need for increased vigilance of wayside signals and special actions in operating rules, such as the crew communication rule of emergency order 20, does not adequately safeguard the public.

11. Had a train control system that could utilize the cab signal equipment on the Maryland Rail Commuter cab control car been a part of the signal system on the Brunswick Line, this accident may not have occurred.

12. A fully implemented positive train separation control system would have prevented this accident by recognizing that MARC train 286 was not being operated within allowable parameters, based on other authorized train operations, and would have stopped the train before it could enter into the unauthorized track area.

13. The emergency egress of passengers was impeded because the passenger cars lacked readily accessible and identifiable quick-release mechanisms for the exterior doors, removable windows or kick panels in the side doors, and adequate emergency instruction signage.

14. The absence of comprehensive Federal passenger car safety standards resulted in the inadequate emergency egress conditions.

15. A need exists for Federal standards requiring passenger cars be equipped with reliable emergency lighting fixtures with a self-contained independent power source when the main power supply has been disrupted to ensure passengers can safely egress.

16. Prescribed inspection and maintenance test cycles are needed to ensure reliable operation of emergency windows in all long-distance and commuter rail passenger cars.

17. The exterior emergency door release T-handles for the MARC cars were not either in place or accessible to firefighters because no requirements for their maintenance or accessibility exist.

18. The catastrophic rupture of the Amtrak unit 255 fuel tank in the collision with the MARC cab control car 7752 released fuel, which sprayed into the interior of the cab control car, and resulted in the fire and at least 8 of the 11 fatalities.

19. Because other commuter passenger cars may also have interior materials that may not meet specified performance criteria for flammability and smoke emission characteristics, the safety of passengers in those cars could be at risk.

20. The Federal guidelines on the flammability and smoke emissions characteristics and the testing of interior materials do not provide for the integrated use of passenger car interior materials and, as a result, are not useful in predicting the safety of the interior environment of a passenger car in a fire.

21. Even though the Montgomery County Fire and Rescue Services personnel responded promptly to the emergency, they could do nothing to save any of the accident victims because passenger coach cab control car 7752 was already completely engulfed in flames when the first firefighter arrived on scene.

22. The Montgomery County Emergency Management Agency disaster plan lacked procedures for responding to railroad passenger train accidents, such as simulating the accident response with coordinated management, which could have emphasized the importance of being familiar with passenger cars and of coordinating activities between the Montgomery County Fire and Rescue Services, the Maryland Rail Commuter, and the CSX Transportation Inc.

23. The confusion during the initial emergency response resulted because the CSX Transportation Inc. and Maryland Rail Commuter lacked a formal emergency management plan to follow.

24. The CSX Transportation Inc. personnel operating Maryland Rail Commuter passenger trains are not adequately trained to understand and, therefore, execute their responsibilities for passengers in emergencies.

25. The lack of appropriate training for emergency responders in the areas of emergency planning, coordination and communications, rescue methods, inaccessible terrain along railroad property, familiarity with railroad equipment, and disaster drills may become a recurrent problem for other emergency response organizations unless a national effort is made to address emergency response training for railroad accidents.

26. The MARC train 286 engineer’s use of the reverser during the emergency brake application resulted in a marginally increased stopping distance for MARC train 286.

27. The Federal Railroad Administration has not addressed the use of computer-aided dispatching system records to provide information for the identification and evaluation of potential safety-related trends for corrective action.

28. The CSX Transportation Inc./Maryland Rail Commuter system lacked comprehensive safety oversight to ensure the safety of the commuting public.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the apparent failure of the engineer and the traincrew because of multiple distractions to operate MARC train 286 according to signal indications and the failure of the Federal Railroad Administration, the Federal Transit Administration, the Maryland Mass Transit Administration, and the CSX Transportation Inc. to ensure that a comprehensive human factors analysis for the Brunswick Line signal modifications was conducted to identify potential sources of human error and to provide a redundant safety system that could compensate for human error.

Contributing to the accident was the lack of comprehensive safety oversight on the CSX Transportation Inc./Maryland Rail Commuter system to ensure the safety of the commuting public. Contributing to the severity of the accident and the loss of life was the lack of appropriate regulations to ensure adequate emergency egress features on the railroad passenger cars.

RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board makes the following recommendations:

--to the Federal Railroad Administration:

Amend 49 Code of Federal Regulations Part 229 to require the recording of train crewmembers' voice communications for exclusive use in accident investigations and with appropriate limitations on the public release of such recordings. (R-97-9)

Require comprehensive failure modes and effects analyses, including a human factors analysis, for all signal system modifications. (R-97-10)

Develop and maintain separate identifiable data records for commuter and intercity rail passenger operations. (R-97-11)

Require, in the interim of a positive train separation control system being available, the installation of cab signals, automatic train stop, automatic train control, or other similar redundant systems for all trains where commuter and intercity passenger railroads operate. (R-97-12)

Require the implementation of positive train separation control systems for all trains where commuter and intercity passenger railroads operate. (R-97-13)

Require all passenger cars to have easily accessible interior emergency quick-release mechanisms adjacent to exterior passageway doors and take appropriate emergency measures to ensure corrective action until these measures are incorporated into minimum passenger car safety standards. (R-97-14)

Require all passenger cars to have either removable windows, kick panels, or other suitable means for emergency exiting through the interior and exterior passageway doors where the door could impede passengers exiting in an emergency and take appropriate emergency measures to ensure corrective action until these measures are incorporated into minimum passenger car safety standards. (R-97-15)

Issue interim standards for the use of luminescent or retroreflective material or both to mark all interior and exterior emergency exits in all passenger cars as soon as possible and incorporate the interim standards into minimum passenger car safety standards. (R-97-16)

Require all passenger cars to contain reliable emergency lighting fixtures that are each fitted with a self-contained independent power source and incorporate the requirements into minimum passenger car safety standards. (R-97-17)

Provide promptly a prescribed inspection and maintenance test cycle to ensure the proper operation of all emergency exit windows as well as provide that the 180-day inspection and maintenance test cycle is prescribed in the final rule. (R-97-18)

Require that all exterior emergency door release mechanisms on passenger cars be functional before a passenger car is placed in revenue service, that the emergency door release mechanism be placed in a readily accessible position and marked for easy identification in emergencies and derailments, and that these requirements be incorporated into minimum passenger car safety standards. (R-97-19)

Require that a comprehensive inspection of all commuter passenger cars be performed to independently verify that the interior materials in these cars meet the expected performance requirements for flammability and smoke emissions characteristics. (R-97-20)

Update 49 Code of Federal Regulations Part 228.17, Train Dispatcher's Record of Train Movements, to include the same parameters for electronic recordkeeping of the dispatcher's record of train movements. (R-97-21)

--to the Federal Transit Administration:

Revise the grant application process to require a comprehensive failure modes and effects analyses, including a human factors analysis, be provided for all federally funded transit projects that are directly related to the transport of passengers. (R-97-22)

Cooperate with the Federal Railroad Administration for requiring, in the interim of a positive train separation control system being available, the installation of cab signals, automatic train stop, automatic train control, or other similar redundant systems for all trains where commuter and intercity passenger railroads operate. (R-97-23)

Cooperate with the Federal Railroad Administration for requiring the implementation of positive train separation control systems for all trains where commuter and intercity passenger railroads operate. (R-97-24)

Cooperate with CSX Transportation Inc. in the development and installation of a positive train separation control system where Maryland Rail Commuter equipment operates on CSX Transportation Inc. tracks. (R-97-25)

--to the CSX Transportation Inc.:

Develop and install a positive train separation control system on track segments that have commuter and intercity passenger trains. (R-97-26)

Develop and implement a formal emergency management plan that contains procedures specific to employee responsibilities and interaction with emergency response agencies and other transportation entities. (R-97-27)

Develop and implement, in cooperation with Maryland Mass Transit Administration/Maryland Rail Commuter, a complete training agenda for all CSX Transportation Inc. passenger traincrews that provides experience in the correct use of emergency equipment, in emergency communications procedures, and in passenger evacuation and assistance in an emergency and also includes the distribution of a comprehensive employee guidance manual. (R-97-28)

Conduct, in cooperation with Maryland Mass Transit Administration/Maryland Rail Commuter, the Baltimore County Emergency Management Agency, the City of Baltimore Emergency Management Agency, the Metropolitan Washington Council of Governments, the Jefferson County Commissioners, and the Berkeley County Commissioners, periodic disaster drills to assess their emergency management plans, to reinforce and evaluate their emergency training, and to test the communication with the organizations. (R-97-29)

Inform all operating train crewmembers of the circumstances of this accident and emphasize the crew responsibility while in the operating compartment for the safe operation of the train. (R-97-30)

Inform your engineers of the circumstances of this accident and caution them not to use the reverser during emergency brake applications for those trains on which the use of the reverser will eliminate the dynamic braking, thus increasing stopping distance. (R-97-31)

--to the Maryland Mass Transit Administration:

Cooperate with CSX Transportation Inc. in the development and installation of a positive train separation control system where Maryland Rail Commuter equipment operates on CSX Transportation Inc. tracks. (R-97-32)

Develop an emergency plan that will provide a detailed description of emergency response procedures as well as a protocol to coordinate activities with the emergency response organizations and other transportation entities when an accident occurs. (R-97-33)

Develop and implement, in cooperation with CSX Transportation Inc., a complete training agenda for all CSX Transportation Inc. passenger traincrews that provides experience in the correct use of emergency equipment, in emergency communications procedures, and in passenger evacuation and assistance in an emergency and also includes the distribution of a comprehensive employee guidance manual. (R-97-34)

Conduct, in cooperation with the CSX Transportation Inc., the Baltimore County Emergency Management Agency, the City of Baltimore Emergency Management Agency, the Metropolitan Washington Council of Governments, the Jefferson County Commissioners, and the Berkeley County Commissioners, periodic disaster drills to assess their emergency management plans, to reinforce and evaluate their emergency training, and to test the communication with the organizations. (R-97-35)

--to the U.S. Department of Transportation:

Review the testing protocols within the various modal administrations regarding the flammability and the smoke emissions characteristics of interior materials and coordinate the development and implementation of standards for material performance and testing with the Federal Railroad Administration and the Federal Transit Administration. (R-97-36)

--to the Federal Emergency Management Agency:

Include in your training at the U.S. Fire Administration National Fire Academy a curriculum that addresses the needs of State and local emergency management agencies to respond to a major railroad accident and that familiarizes emergency response organizations with railroad equipment and appropriate rescue methods for railroad accidents. (R-97-37)

--to the Governor and the General Assembly of the State of Maryland:

Instruct and empower an appropriate State agency to provide continual, effective, and independent safety oversight of all aspects of the Maryland Rail Commuter operations. (R-97-38)

--to the Association of American Railroads:

Assist the railroad industry with the development of positive train separation control systems through a continuing review of nonrailroad technology and assess its adaptability to railroad communication-based control systems. (R-97-39)

Assist the railroad industry with the development of positive train separation control systems by acting as a clearinghouse for information on the status and results of pilot projects and by disseminating that information to the railroad industry and the Federal and participating State transportation organizations. (R-97-40)

Assist the railroad industry with the installation and operation of positive train separation control systems by maintaining industry standards to ensure open architecture and an interoperability of equipment for train control systems. (R-97-41)

Inform your membership of the circumstances of this accident and caution them not to use the reverser during emergency brake applications for those trains on which the use of the reverser will eliminate the dynamic braking, thus increasing stopping distance. (R-97-42)

--to the Montgomery County Emergency Management Agency:

Develop comprehensive procedures for responding to railroad passenger train accidents and include these procedures in your disaster plan. (R-97-43)

--to the Baltimore County Emergency Management Agency, the Baltimore City Emergency Management Agency, the Metropolitan Washington Council of Governments, the Jefferson County Commissioners, and the Berkeley County Commissioners:

Conduct, in cooperation with the CSX Transportation Inc. and the Maryland Mass Transit Administration/Maryland Rail Commuter, periodic disaster drills to assess their emergency management plans, to reinforce and evaluate their emergency training, and to test the communication with the organizations. (R-97-44)

--to the American Short Line Railroad Association, the Brotherhood of Locomotive Engineers, the United Transportation Union, the International Brotherhood of Teamsters, and the American Public Transit Association:

Inform your membership of the circumstances of this accident and caution them not to use the reverser during emergency brake applications for those trains on which the use of the reverser will eliminate the dynamic braking, thus increasing stopping distance. (R-97-45)

Also, as a result of its investigation, the National Transportation Safety Board reiterates the following recommendations:

--to the Federal Railroad Administration:

> Promulgate Federal standards to require the installation and operation of a train control system on main line tracks that will provide for positive separation of all trains. (R-87-16)
>
> Conduct, in conjunction with the Association of American Railroads, the General Electric Company, and the Electro-Motive Division of General Motors, research to determine if the locomotive fuel tank can be improved to withstand forces encountered in the more severe locomotive derailment accidents or if fuel containment can be improved to reduce the rate of fuel leakage and fuel ignition. Consideration should be given to crash or simulated testing and evaluation of recent and proposed design modifications to the locomotive fuel tank, including increasing the structural strength of end and side wall plates, raising the tank higher above the rail, and using internal tank bladders and foam inserts. (R-92-10)
>
> In conjunction with the Association of American Railroads and the Railway Progress Institute, establish a firm timetable that includes at a minimum, dates for final development of required advanced train control system hardware, dates for an implementation of a fully developed advanced train control system, and a commitment to a date for having the advanced train control system ready for installation on the general railroad system. (R-93-12)

--to the General Electric Company:

> Conduct, in conjunction with the Federal Railroad Administration, the Association of American Railroads, and the Electro-Motive Division of General Motors, research to determine if the locomotive fuel tank can be improved to withstand forces encountered in the more severe locomotive derailment accidents or if fuel containment can be improved to reduce the rate of fuel leakage and fuel ignition. Consideration should be given to crash or simulated testing and evaluation of recent and proposed design modifications to the locomotive fuel tank, including increasing the structural strength of end and side wall plates, raising the tank higher above the rail, and using internal tank bladders and foam inserts. (R-92-16)

--to the Electro-Motive Division of General Motors:

> Conduct, in conjunction with the Federal Railroad Administration, the Association of American Railroads, and the General Electric Company, the research to determine if the locomotive fuel tank can be improved to withstand forces encountered in the more severe locomotive derailment accidents or if fuel containment can be improved to reduce the rate of fuel leakage and fuel ignition. Consideration should be given to crash or simulated testing and evaluation of recent and proposed design modifications to the locomotive fuel tank, including increasing the structural strength of end and side wall plates, raising the tank higher above the rail, and using internal tank bladders and foam inserts. (R-92-17)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES E. HALL
Chairman

ROBERT T. FRANCIS II
Vice Chairman

JOHN A. HAMMERSCHMIDT
Member

JOHN J. GOGLIA
Member

GEORGE W. BLACK, JR
Member

July 3, 1997

APPENDIX A

INVESTIGATION AND HEARING

The Safety Board was notified of the collision at 6 p.m. on February 16, 1996, and dispatched a major railroad accident investigation team. Investigative groups studied the operations, track, signals, mechanical, survival factors, and human performance aspects of the accident.

The CSX Transportation Inc., the National Railroad Passenger Corporation, the Maryland Mass Transit Administration, the Federal Railroad Administration, the Brotherhood of Locomotive Engineers, the United Transportation Union, and the Montgomery County Department of Fire and Rescue Services assisted in the Safety Board investigation.

As part of its investigation, the Safety Board held a 3-day public hearing in Rockville, Maryland, between June 26 and 28, 1996, at which 27 witnesses testified. Parties to the hearing included the CSX Transportation Inc., the National Railroad Passenger Corporation, the Maryland Mass Transit Administration, the Federal Railroad Administration, the Brotherhood of Locomotive Engineers, the United Transportation Union, and the Montgomery County Department of Fire and Rescue Services.

APPENDIX B

CHRONOLOGY OF SIGNAL SEQUENCE

The times recorded at Georgetown Junction differ about 2 minutes from the Jacksonville system log. The discrepancy results from the delay that occurs in the order the information is received from field locations and the actual setting of the clock. The following information was recorded at Georgetown Junction:

1. Train No. K951-16: "Rock Runner" - a westbound ballast train.
2. Train No. P279-16: Westbound MARC passenger train ahead of Amtrak passenger train.
3. Train No. P284-16: Eastbound MARC passenger train ahead of MARC passenger train.
4. Train No. P029-16: Westbound Amtrak passenger train involved in accident.
5. Train No. P286-16: Eastbound MARC passenger train involved in accident.

P is the CSXT designation for a passenger train.

Signal Identification corresponding to report:
Signal No. 2 Eastbound Absolute Signal track 1 (EAS-1)
Signal No. 4 Westbound Absolute Signal track 1 (WAS-1)
Signal No. 6 Eastbound Absolute Signal track 2 (EAS-2)
Signal No. 8 Westbound Absolute Signal track 2 (WAS-2)

Present Conditions at 1500:
Switch No. 1 - Normal
Switch No. 3 - Normal
Switch No. 5 - Normal
Signal No. 4 Clear
Signal No. 2 at Stop
Signal No. 8 at Stop
Signal No. 6 at Stop
Track 1 Interlocking Track Circuit Energized
Track 2 Interlocking Track Circuit Energized
Track Circuit West of Interlocking - Track No. 1 Energized
Track Circuit West of Interlocking - Track No. 2 Energized
Track Circuit East of Interlocking - Track No. 1 Energized
Track Circuit East of Interlocking - Track No. 2 Energized
Track Circuit West of Interlocking - From Georgetown Branch Energized

APPENDIX B

Time	Train	Track	Direction	Event
15:14:04	P284-16	2	East	Signal 6 **Clear**

Last time signal No. 6 is cleared at Georgetown Junction on track No. 2 for an eastbound move.

Time	Train	Track	Direction	Event
15:21:38	E107-16	1	West	Occupies track cast of Georgetown
15:26:04	E107-16	1	West	Occupies Georgetown interlocking switches 1N, 3N, 5N
15:26:04	E107-16	1	West	Signal 4 at **Stop**
15:26:32	E107-16	1	West	Occupies track west of Georgetown
15:27:38	E107-16	1	West	Unoccupied track east of Georgetown
15:28:16	E107-16	1	West	Unoccupied Georgetown interlocking switches 1N, 3N, 5N
15:32:18	E107-16	1	West	Unoccupied track west of Georgetown
16:02:10	P284-16	2	**East**	Occupies track west of Georgetown
16:05:39	P284-16	2	**East**	Occupies Georgetown interlocking switches 1N, 3N, 5N
16:05:39	P284-16	2	**East**	Signal 6 at stop

Signal No. 6 remains at stop up to and beyond the time of the accident, about 1 hour and 33 minutes.

Time	Train	Track	Direction	Event
16:05:50	P284-16	2	**East**	Unoccupied track west of Georgetown
16:05:55	P284-16	2	**East**	Occupies track east of Georgetown
16:06:14	P284-16	2	**East**	Unoccupied Georgetown interlocking
16:08:06	P284-16	2	**East**	Unoccupied track cast of Georgetown
16:32:51		l&2		Switch 1 out of correspondence
16:33:08		l&2		Switch 1 reverse
16:33:23	P275-16	2	West	Signal 8 **Clear**
16:40:37	P275-16	2	West	Occupies track cast of Georgetown
16:05:39	P275-16	2	West	Occupies Georgetown interlocking switches 1R, 3N, 5N
16:46:45	P275-16	2	West	Signal 8 at **Stop**
16:47:05	P275-16	2	West	Unoccupied track east of Georgetown
16:47:079	P275-16	1	West	occupies Georgetown interlocking switches 1R 3N, 5N
16:47:15	P275-16	1	West	Occupies track west of Georgetown
16:47:37	P275-16	2	West	Unoccupied Georgetown interlocking switches lR, 3N, 5N
16:47:45	P275-16	1	West	Unoccupied Georgetown interlocking switches 1R, 3N, 5N
16:50:20		l&2		switch 1 out of correspondence
16:50:36		l&2		Switch 1 normal
16:54:10	P277-16	1	West	Unoccupied track west of Georgetown
17:03:48		l&2		Switch 1 out of correspondence
17:04:04		l&2		Switch 1 Reverse
17:04:04	P277-16	2	West	Signal 8 at **Clear**

17:09:51	P277-16	2	West	Occupies track cast of Georgetown
17:14:45	P277-16	2	West	Occupies Georgetown interlocking switches 1R, 3N, 5N
17:14:45	P277-16	2	West	Signal 8 at Stop
17:15:03	P277-16	1	West	Occupies Georgetown interlocking
17:15:03	P277-16	2	West	Unoccupied track cast of Georgetown
17:15:11	P277-I 6	1	West	Occupies track west of Georgetown
17:15:38	P277-16	2	West	Unoccupied Georgetown interlocking switches 1R, 3N, 5N
17:15:42	P277-16	1	West	Unoccupied Georgetown interlocking switches 1R, 3N, 5N
17:16:49	P279-16	2	West	Signal 8 at Clear
17:18:31	P279-I 6	2	West	Unoccupied track west of Georgetown
17:21:16	P279-16	2	West	Occupies track east of Georgetown
17:25:25	P279-16	2	West	Occupies Georgetown interlocking switches 1R, 3N, 5N
17:25:25	P279-16	2	West	Signal 8 at Stop
17:25:41	P279-16	2	West	Unoccupied track east of Georgetown
17:25:50	P279-16	1	West	Occupies Georgetown interlocking switches 1R, 3N, 5N
17:25:59	P279-16	1	West	Occupies track west of Georgetown
17:26:18	P279-16	2	west	Unoccupied Georgetown interlocking switches 1R, 3N, 5N
17:26:22	P279-16	1	West	Unoccupied Georgetown interlocking switches 1R, 3N, 5N
17:26:59	P029-16	2	West	Signal 8 at Clear
17:28:07	K951-16	1	West	Occupies track east of Georgetown
17:31:38	P279-16	2	West	Unoccupied track west of Georgetown
17:33:57	P286-16	2	East	Occupies track west of Georgetown
17:35:46	P029-16	2	West	Occupies track East of Georgetown
17:38:22	P029-16	2	West	Occupies Georgetown interlocking switches 1R, 3N, 5N
17:38:22	P029-16	2	West	Signal 8 at Stop
1738:41	P029-16	2	West	Switch 3 out of correspondence
	P286-16	2	East	
17:38:42	P029-16	2	West	switch 5 out of correspondence
	P286-16	2	East	
17:38:45	P029-16	2	East	
17:38:47	P029-16	2	West	Switch 5 Normal
	P286-16	2	East	
17:38:48	P029-16	2	West	switch 5 out of correspondence
	P286-16	2	East	

*****Switches out of correspondence due to derailment*****

APPENDIX C

CHRONOLOGY OF ACCIDENT

Times indicated with (j) are from the Jacksonville signal log and are about 2 minutes ahead of time shown. All other times are from the Jacksonville AU dispatcher tape, published time tables, or the reporting agency.

Time	Event
10:10 a.m.	CSXT/MARC engineer reports to work in Baltimore.
11:00 a.m.	CSXT/MARC crew began first trip (train 251) from Camden station to Washington.
12:59 p.m.	MARC train 251 arrives in Washington 49 minutes behind schedule.
1:24 p.m.	CSXT/MARC crew began second trip (train 273) from Washington to Brunswick 24 minutes late.
1:34 p.m.(j)	MARC train 273 travels westbound (WB) through Georgetown Jct. from track 2 to 1.
2:50 p.m.	Amtrak train 29 crew reports to work.
2:53 p.m.	MARC train 273 arrives in Brunswick 33 minutes late.
4:05 p.m.	Scheduled departure time for Amtrak train 29 from Union Station.
4:05 p.m.(j)	MARC train 284 travels eastbound (EB) through Georgetown Junction from track 2 to 2.
4:27 p.m.	Scheduled departure time for Amtrak train 29 from Rockville station.
4:30 p.m.	CSXT/MARC crew began third trip (train 286) from Brunswick to Washington.
4:33 p.m.(j)	AU Jacksonville dispatcher makes request and crossovers at Georgetown Junction are lined for WB movements from track 2 to 1.
4:47 p.m.(j)	MARC train 275 travels WB through Georgetown Juntion from track 2 to 1.
5:15 p.m.(j)	MARC train 277 travels WB through Georgetown Junction from track 2 to 1.
5:18 p.m.	Scheduled time for MARC train 286 to depart (flag stop) from Rockville station.
5:25 p.m.	Amtrak train 29 departs Union Station 1 hour 20 minutes late.
5:27 p.m.	MARC train 279 travels WB through Georgetown Junction from track 2 to 1.
5:28 p.m.(j)	MARC train 286 recorded by Rockville intermediate wayside signal on track 2.
5:30 p.m.(j)	CSXT train K951, WB, stops for Georgetown Junction STOP signal on track 1.
5:30(j) to 5:34 p.m.(j) (approx.)	Engineers of MARC train 279 and MARC train 286 communicate over radio near equipment defect detector at MP 11.7. Engineer of MARC train 279 hears engineer of MARC train 286 acknowledge the wayside signal before Kensington but did not hear what signal showed.
5:32 p.m.(j)	MARC train 279 WB by Kensington signal on track 1.
5:34 p.m.(j)	MARC train 286 EB by Kensington signal on track 2. MARC train 286 stops (approx. 50 seconds) at Kensington station (flag stop) and departs.
5:36 p.m.(j)	Amtrak train 29 passes Takoma Park signal on track 2.

APPENDIX C

Time	Event
5:38:41 p.m.	**Accident occurred: Train 286 (MARC) collided with train 29 Amtrak**
5:41 p.m.	First communication with CSXT AU dispatcher from CSXT traincrew K951. reporting accident. Reports fire and derailment of Amtrak train 29.
5:44 p.m.	CSXT AU dispatcher notifies MCFRS, which is already aware of accident.
5:45 p.m.	CSXT AU dispatcher attempts to call MARC operations center, but line is busy.
5:46 p.m.	First MCFRS emergency responders on scene.
5:47 p.m.	CSXT train Q401 passes Rockville signal EB on track 2.
5:48 p.m.	CSXT AU dispatcher notifies WMATA operations center.
5:51 p.m.	Second call from CSXT train K951 to inform AU dispatcher of fire and evacuation, emergency personnel on scene.
5:53 p.m.	Amtrak train 29 conductor contacts AU dispatcher that Amtrak train 29 had had a MEDIUM CLEAR signal indication and about Amtrak crew condition.
6:00 p.m.	CSXT AU dispatcher contacted MARC operations center, which was already aware of accident.
6:02 p.m.	AU dispatcher contacts CSXT manager of passenger operations in Baltimore, who already knew about accident.
6:08 p.m.	CSXT train 401 (following MARC train 286) with a CSXT road foreman on board contacts AU dispatcher requesting permission to cut away and close up behind MARC train 286. AU dispatcher authorizes CSXT train 401 to go ahead and to be prepared to atop, looking out for emergency personnel.
6:14 p.m.	MARC train 281 (following Amtrak train 29) contacts AU dispatcher asking permission to come up behind Amtrak train 29 and assist in passenger evacuation AU dispatcher gives OK.
6:15 p.m	MCFRS command sectors established for level two incident.
6:20 p.m.	CSXT train Q401 stops near bridge.
6:30 p.m.	MCFRS IC receives message from his communications center about train approaching accident scene from Kensington and orders evacuation of site.
6:56 p.m.	MARC train 281 (following Amtrak train 29) instructed to move west of Silver Sprint station to allow MARC train 285 into station to unload passengers.

APPENDIX D

EXCERPTS FROM CSXT OPERATING RULES

Rule 27

A signal imperfectly displayed must be regarded as the most restrictive indication that can be conveyed by that signal.

Exceptions:
1. When the arms of a semaphore signal can be seen, they will govern.
2. When one colored light is displayed in the cluster of lights of a color position light signal, it will mean the same as two lights in the cluster; or
3. when one or more lower units of a color light signal aspect is dark, the aspect will be observed as though the lights that should be displayed were displaying red. This does not apply to Rule C-290(a).

A signal imperfectly displayed must be reported promptly to the dispatcher.

Rule 34 (IN PART)

Crew members must maintain a lookout for signals or conditions along the track that affect the movement of their train. Crew members located in the operating cab of an engine must clearly communicated the following information to each other:

1. Concerning signals:

a) The name of each block and interlocking signal governing the movement of their train;
b) The number of the track to which the signal applies if in multiple track territory;

Rule 34-A

A crew member located in the operating cab of a radio-equipped engine must announce by radio ***the following conditions that affect the movement of the train:***
1. The name and location of each block and interlocking signal.
2. The train entry into each DTC Block when entering the block.
3. In multiple track territory, a crew member must announce the number of the track.

On radio-equipped freight trains, each of these announcements must be acknowledged by a crew member if located on the rear of the train, ***or by any crew member who may be in a trailing unit of the traim.***

APPENDIX D

Rule 34-C

Should the engineer fail to control the train in accordance with a signal indication or a restriction imposed upon his train, other members of the crew must:
1. Caution the engineer and, if necessary,
2. Take action to ensure the safety of the train, (including stopping the movement).

Rule 98-G

When a train is stopped or its speed is reduced to 15 mph or less after passing a signal governing either the approach to a railroad crossing at grade, or the beginning of TCS territory, the train must approach the next signal prepared to stop. It must do so until it can be seen that the indication of the signal permits the train to proceed.
Exception: This does not apply where special instructions specify and govern the approach to locations with time-out features.

Rule C-292

Block, interlocking, and other fixed signal aspects and indications. **STOP AND PROCEED;** stop then proceed at restricted speed.

Rule 103-G

When humping operations are being conducted in a hump yard equipped with remotely controlled switches, train or engine service employee may be required to couple an air hose or adjust a coupling device. When this requires the employee to place himself between rolling equipment located on a bowl track, the following protection must be provided against cars being released from the hump into the track involved.

1. The employee controlling any remotely controlled switch that provides access from the apex of the bump to the track on which the rolling equipment is located must be notified.
2. Upon such notification, the operator of such remotely controlled switch must line the switch against movement to the affected bowl track. The operator must apply, or must have applied a locking or blocking device to the control for that switch, and
3. The operator must then notify the employee that the required protection has been provided. The operator will remove the locking or blocking device only after he has been notified by the employee that the protection is no longer required on that track.

Rule 104-C

Employees lining switches must ascertain that: 1. The route is lined for the movement. 2. The switch points fit properly. And 3. The switch lever is secured.

A main track switch must not be lined for a diverging movement of an approaching train until the employee attending the switch is assured by the affected train that the movement is to use the turnout or crossover.

Employees must ascertain that the switches that they are to use are in proper position. When such switches are being changed ahead of an approaching movement, they must know that the movement is under control to prevent operating over or through an improperly lined switch.

When kicking cars, a switch must not be lined for a following car going to another track, until it is known that the preceding car will clear the route.

Rule 105

Trains may use tracks, other than main tracks, signaled tracks or sidings, without permission. (see rule 46.)

Rule 106 (from Chessie System Operating Rules, effective September 1, 1985.)

Both the conductor and engineer are responsible for the safe and efficient operation of their train and the observance of the rides. Train crew members must comply with the instructions of the conductor. When there is no conductor, or the conductor is not available to directly supervise, crew members will comply with the instructions of the engineer. The train dispatcher must be advised as promptly as practicable, by the engineer or conductor, of any condition that will delay the train or prevent it from making the usual speed. The conductor and engineer must see that members of their crew are familiar with their duties and instruct them when necessary in the observance of the rules and safe performance of their work.

Rule 450 (from Chessie System Operating Rules, effective September 1, 1985.)

Radio communications must not be used instead of hand signals when conditions exist for continuous direct visual contact between the engineer and the signal of the employee(s) directing the movement. Radio communication and hand signals, except stop signals, must not be used simultaneously by a crew to direct train or engine movements. When changing from one mode of signaling to another, all crew members involved must be notified and acknowledge their under-standing before the change is made.

Rule 804 (from Chessie System Operating Rules, effective September 1, 1985.)

When trying to determine the extent of damage in a derailment involving a hazardous material or a car leaking a hazardous material, the employees should always approach the incident from up-wind in order to avoid any fumes. If fumes arc detected, the employees should withdraw to a safe distance until qualified people have arrived and determined the extent of the danger.

APPENDIX D

Rules 58A-G, 60 and 60A.
Defect Detectors and Audible Defect Detectors on the former Chessie System.

DEFECT DETECTORS

58. The locations of defect detectors are designated in special instructions.

58-A. *A brake application must not be made when* passing a defect detector, except when necessary to comply with operating rules or in an emergency.

58-B. Inspections made by *defect detectors do not* relieve employees from performing required visual inspections.

58-C. Train documentation must not be used in locating defects.

58-D. Information concerning the defect and the results of the inspection must be recorded and given promptly to the train dispatcher.

58-E. Evidence that a defect detector is not working properly must be promptly reported to the train dispatcher.

58-F. The following are conditions which may occur when a train encounters a defect detector:

Table 8. Defect Detectors

If	Then
(a) A defect is not found at the location identified by a defect detector and the specific side was identified.	An inspection must be performed of 20 axles before and after the reported defect, on the side identified.
(b) A defect is not found at the location identified by a defect detector and the specific side was not identified.	Be governed the same as (a), but on both sides of the train.
(c) A "HOT BOX" is found.	The temperature testing stick must be used on roller bearing journals inspected.
(d) A "HOT BOX" is indicated at a journal previously tagged with a "HOT BOX" tag.	The *equipment* must be set out even if there is no evidence of overheating.
(e) A train stops or moves slower than 5 MPH over a defect detector that indicates a defect which is not found at location indicated.	A complete walking inspection of the train must be performed before proceeding.
(f) A train stops or moves slower than 5 MPH over two consecutive defect detectors and no defects are indicated by either defect detector.	Train must stop after passing the second defect detector, then be governed the same as (e).
(g) A train is not inspected by a defect detector at two consecutive locations.	Be governed the same as (e).

58-G. This rule applies to passenger equipment only.

Table 9. Defect Detectors

If	Then
(a) You receive a hot box indication from an audible defect detector	*The train must be stopped. The crew must examine the defect detected.*
(b) No defect is found at the location identified	*The crew must examine the remaning journals on that car and the journals on 2 cars ahead of and behind the suspected car.*
(c) No defect is found after inspecting train as prescribed in (b)	*The train may proceed at authorized speed.*
(d) The same journal actuates two or more defect detectors on the same trip, and no defect is found	*The crew will;* *1. Operate not exceeding 30 MPH for the next five miles.* *2. After completion of the 5 miles in item 1, stop and examine all journals on the car that actuated the defect detector and the journals on the 2 cars ahead of and behind it.* *3. If no defect is found, the train may operate at authorized speed to the next authorized passenger equipment repair point where the car must be set out.* *4. This suspected car must be examined every 100 miles until the set out location is reached.*

Trains equipped with on-board detector systems will be governed by instructions for those systems in addition to this rule.

Rule 58-F (a), (b), (c) and (d) does not apply to passenger equipment.

AUDIBLE DEFECT DETECTORS

Rules 60 through 60-A apply exclusively on the former Chessie System.

60. A visual on-board inspection of the moving train must be made immediately after passing a defect detector that is not functioning or one that has been temporarily removed from service. The defect detector is considered not functioning if upon arrival at the defect detector, a site-identification message is not received, or if the site identification message includes "HOT BOX DETECTOR MALFUNCTION".

60-A. After the rear of a train passes a functioning defect detector the crew will be governed as follows;

Table 11 Defect Detectors

If	Then
(a) The voice message indicates no defects.	The train may proceed.
(b) The voice message indicates defects.	The train must be stopped and an inspection must be made of the identified defects.
(c) No voice message is received or the voice message is not understood.	The train must be stopped and the entire train must be inspected for hot journals and dragging equipment.
(d) The voice message indicates "HOT BOX DETECTOR MALFUNCTION."	Be governed the same as (c).
(e) The voice message indicates no defects and a malfunction advisory other than "HOT BOX DETECTOR MALFUNCTION."	The train may proceed and the train dispatcher must be advised.

APPENDIX D

Rules 265 through 271.
Traffic Control Signal System Rules

Rule 270 (from CSXT - no operating rule on record since 1931.)

TRAFFIC CONTROL SIGNAL SYSTEM RULES

265. On those portions of the railroad and on the tracks designated in special instructions, trains will be governed by block signals. Block Signal indications will authorize the trains' movement. Such system will constitute a Traffic Control Signal System and rules governing Traffic Control Signal System will apply.

Where TCS rules are in effect, General Signal Rules 228 through 241 and Interlocking Rules 257(d) and 257(e) are also in effect.

266. Trains must not enter a signaled track or a controlled siding except by controlled signal indication or by permission of the train dispatcher. Train dispatcher's permission must be obtained by the conductor or the engineer.

When a train clears on a track that is not provided with a signal to govern the movement from that track, the conductor or the engineer must report clear to the train dispatcher.

267. Hand-operated switches are sometimes not equipped with an electric lock or signal. A train must not clear the main track at such a switch, unless the authorized speed on the main track over the switch is 20 miles per hour or less. A train must not clear a signaled siding at a hand-operated switch that is not equipped with an electric lock or signal unless the authorized speed on the signaled siding is 30 miles per hour or less.

A train, using a track on which it is not permitted to clear, must leave part of the train on the connecting signaled track or leave the switch open until the work is completed.

268. Trains must not make a reverse movement within TCS limits, except as follows:

1. By authority of the control station; or
2. As prescribed by Rules 89 (m), 271 or 274.

When the conductor or the engineer secures authority from the control station to make a reverse movement, the train may move to the first signal at Controlled Speed. It will then be governed by signal indication.

269. When a train has passed a signal permitting it to proceed (other than a Restricting, a ***Stop and Proceed at Restricted Speed, or Grade aspect)*** and is stopped in the block, the train must proceed prepared to stop at the next signal. This must be done until it can be seen that the next signal permits the train to proceed.

Exception: This rule does not apply to passenger trains making station stops, however, Rule 98-G does apply.

271. A train may occupy a specific track segment and move in both directions when authorized by the train dispatcher.

The train must be clear of the track segment before the time limit expires. The train dispatcher must be so advised. A train that has been reported clear must not occupy the track segment again without securing a new authority.

The authority to work does not relieve the crew of complying with block signal indications.

When more than one train is authorized to work in the same track segment, each authority must include the requirement for both trains to protect against each other. Each engineer must be so advised. Movements must be made at a speed that will permit stopping within one-half the range of vision, regardless of signal aspects displayed, not exceeding the indications conveyed by such signals.

272. When a train is stopped by a signal with an illuminated "S" (Rule 294), further movement may be made as follows:

1. A crew member must open the switch. After the switch has been opened, the indication of the signal should change to permit movement. The switch must be restored to normal position after the movement has cleared the switch. If the signal fails to change to permit movement after the switch has been opened, the switch must be restored to normal position and the train dispatcher must be notified; and
2. If a derail is connected with the movement, a crew member must obtain permission from the train dispatcher before the derail is removed

274. Where designated by special instructions that this rule is in effect, a train may move in either direction without flag protection. Movements must be made at a speed that will permit compliance with the signal aspects.

When more than one train is permitted to occupy the same track segment, each train must be given permissions to occupy the track segment. Each permission must include the requirement for these trains to protect against each other. Each engineer must be so advised. Movements must be made at a speed that will permit stopping within one-half the range of vision, regardless of signal aspects displayed. Also, such speed must not exceed the indications conveyed by such signals.

APPENDIX D

Rules 620 through 635.
Passenger Service

PASSENGER SERVICE

620. Conductors and trainmen in Amtrak service must be conversant with and must comply with the Manual Of Instructions for Conductors and Trainmen in Amtrak Service. This manual will supersede any of these rules (620 through 634) that may be inconsistent with its provisions.

621. Helper conductors report to regular conductors.

622. Unless otherwise provide, conductors must not give the signal to leave stations until they have received notice from the inspectors that their work is finished. They must not give the signal to leave while passengers are getting on or off trains. To the extent possible, they must prevent passengers from getting on or off while the train is moving. When a station stop is made, if possible, they will allow passengers to get off the train before other passengers board. While the train is at a station, the conductor or a trainman will remain on the station platform at the car steps.

623. After a passenger train leaves a station, crew members should notice whether or not persons are hanging on the sides of cars, unable to enter, because of closed vestibules. If so, crew members must go immediately to the passengers' assistance. They must take whatever steps are necessary for their safety.

624. Conductors must pass through the train frequently to attend to the comfort of the passengers. They must ensure that employees are performing their duties.

625. Unless otherwise provide, portable railroad radios will be kept in the "ON" position, with the selector switch set for the proper channel. Volume will be adjusted to the lowest possible level that will receive communications. To the extent possible, radios will not be used in the presence of passengers.

626. Employees must not:

1. Occupy seats with passengers, or
2. Hold unnecessary conversation with passengers.

627. Crew members must assist passengers with their luggage, to the extent practicable. Special attention should be given to:

1. Women,
2. Children, and
3. Aged and infirm persons.

Aisles in cars must be kept clear of baggage and other articles. Passengers must not be permitted to take dangerous articles, such as explosives or flammables into cars. Overhead baggage racks must be inspected frequently to ensure that articles are stowed safely. Passengers must not be permitted to use seats in coaches to deposit their baggage, when such seats are required for passengers. When necessary, the conductor or trainman will request the owner, in a polite manner, to remove baggage or packages from seats or aisles. Should the owner refuse to do so, the conductor or trainman will remove the articles in a careful manner, placing them in the overhead racks or on the floor, within easy reach of the owner.

628. When passengers become ill on a train, the conductor should ask them whether they desire medical attention. The conductor will be governed by the passenger's answer, unless it is obvious that the passenger is not responsible. If this is the case, medical attention should be requested by the conductor. When practicable to do so, the conductor must communicate ahead for medical personnel to meet the train and attend the passenger.

629. If a passenger refuses to pay the fare, the conductor will obtain the passengers name and address. He will discharge the passenger at the first scheduled stop. Care must be taken to ensure that the passenger is not discharged at:

1. An inaccessible stop, or
2. A location where other tra- portation is not available.

The conductor must make a written report of the incident to the trainmaster.

629-A. The conductor must protect passengers from rudeness, threatened violence and abusive or obscene language. Any person acting in a disorderly manner may be removed from the train at the next scheduled stop, in accordance with provisions in rule 629. If the fare has been collected from such person, the conductor should:

1. Return the ticket, properly endorsed, for the balance of the trip, or
2. Return the regular fare for the incomplete portion of the trip.

Each conductor will use discretion. Conductors must not use unnecessary force that could subject the Company to litigation.

The conductor may call upon other employees or the police for assistance in removing persons from the train. He should obtain the names and addresses of several witnesses to the occurrence. He must make a full, written report of all the circumstances to the trainmaster.

APPENDIX D

629-B. Should a conductor permit a person to remain on his train, contrary to rules 629 629-A, the conductor must prepare a full, written report of the incident promptly to the trainmaster.

630. When approaching a station at which the train is to stop, a crew member must:

1. Pass through each coach occupied by passengers, and
2. Twice distinctly announce the name of the station.

Should a stop be made before the announced station is reached, the vestibule doors must not be opened, without leaving a member of the crew in charge.

The conductor must prepare a report to the ***division superintendent*** when a passenger is carried beyond his destination.

631. The conductor must notify the engineer promptly if:

1. The train is handled roughly, or
2. The braking is not satisfactory,

If an improvement is not made, the conductor must make a report to the trainmaster.

632. When passenger service is delayed or detoured, passengers should be informed as to how long they will be delayed. When the time that service is expected to be restored has been ascertained, this information should be relayed to the passengers.

633. Lost articles found on trains or at passenge stations must be tagged, showing the.

1. Date found,
2. Location,
3. Train number, and
4. Name of the finder.

The articles must be turned over to the baggage agent at the final terminal, or at the station where found. The baggage agent's receipt must be obtained for such articles.

634. When handling mail, employees must:

1. Give proper attention to the custody and delivery of United States and train mail,
2. Report any irregularities promptly to the trainmaster,
3. Handle the mail carefully, and
4. Keep a proper record of the mail handled on the form,

634-A. When mail or other articles are delivered from a moving train:

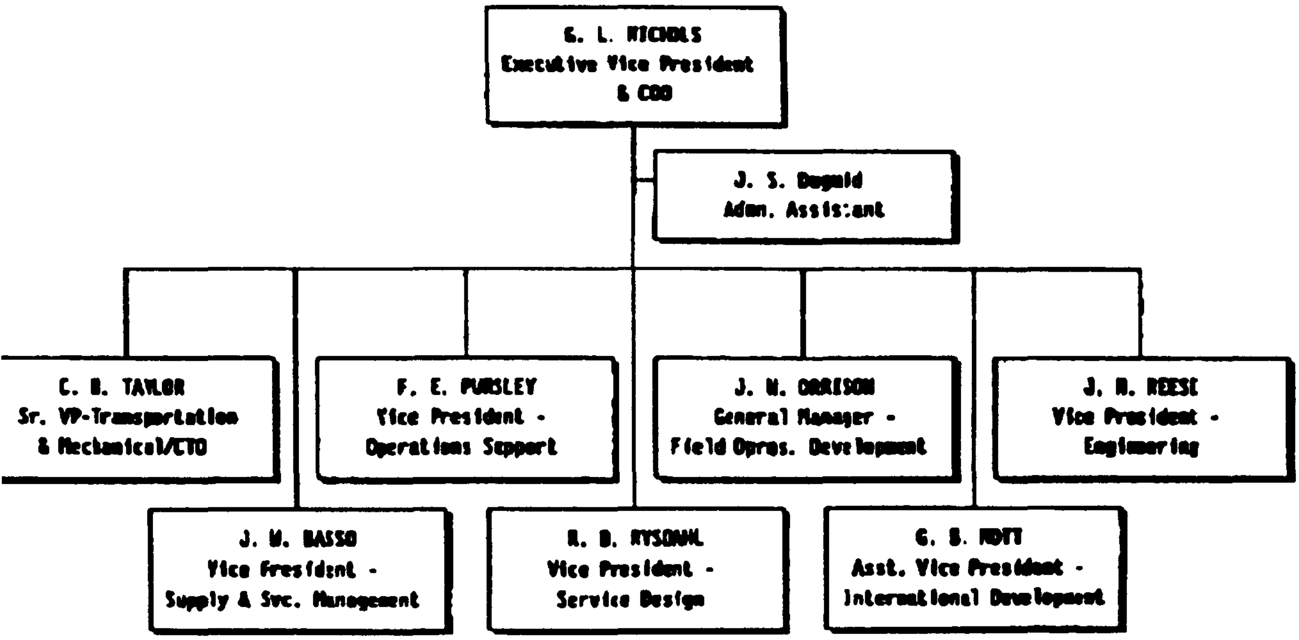
1. The package must be thrown off at the designated place, and
2. It must be done with care to ensure that the package clears the train and does not strike persons or objects.

635. Station times for scheduled passenger trains apply at locations where passengers are received or discharged. Not more than two times are given for a train at any station. When one time is given, it is the leaving time, unless otherwise indicated; when two times are given, they are the arriving and the leaving times.A scheduled passenger train must not leave a station before its station time.

APPENDIX E

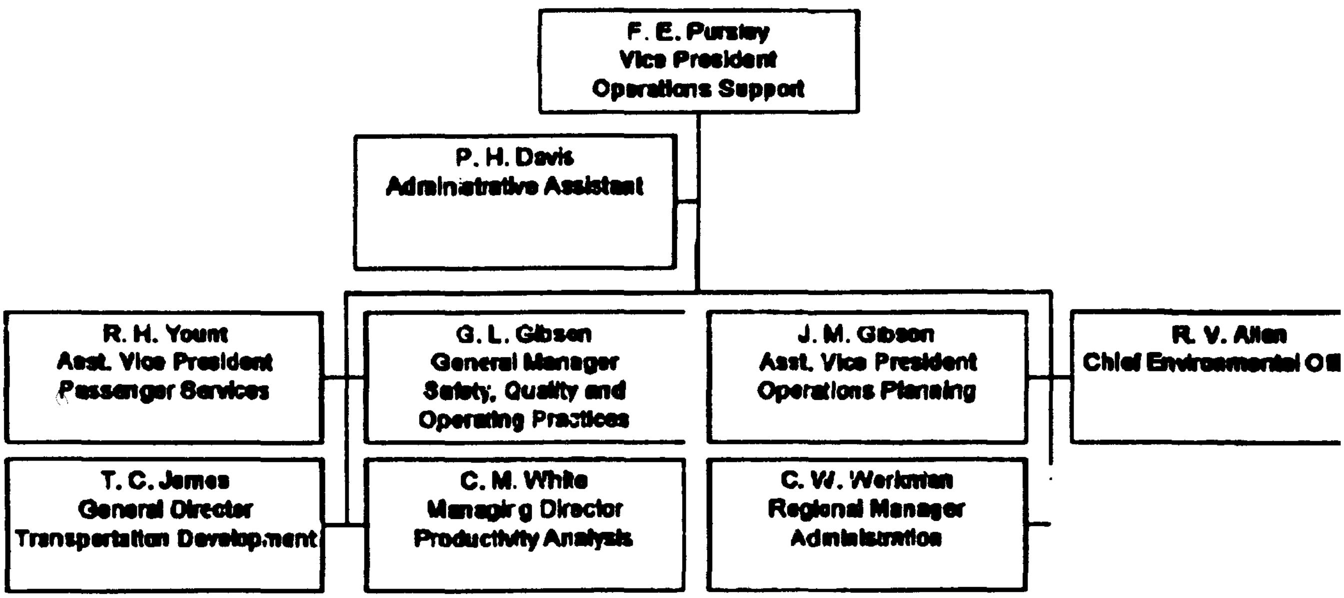
ORGANIZATION CHARTS OF CSXT AND MDOT/MTA/MARC

CSX TRANSPORTATION
Operating Department



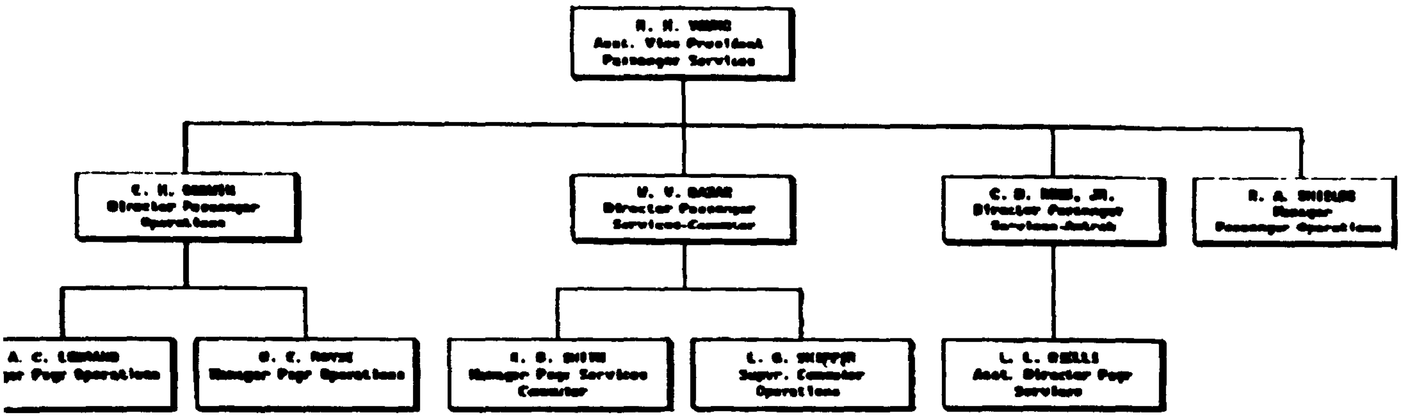
APPENDIX E

CSX Transportation
Operating Department
Operations Support



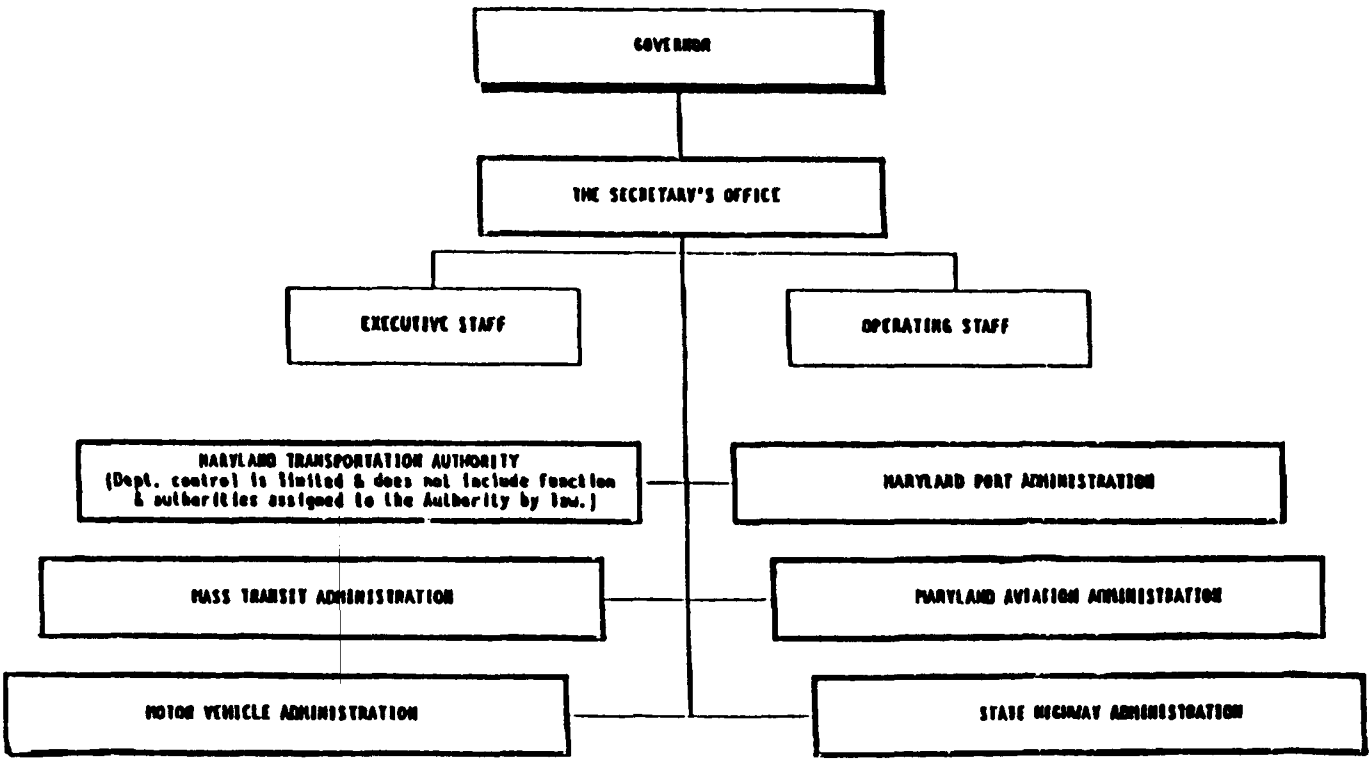
APPENDIX E

OPERATIONS SUPPORT
Passenger Services

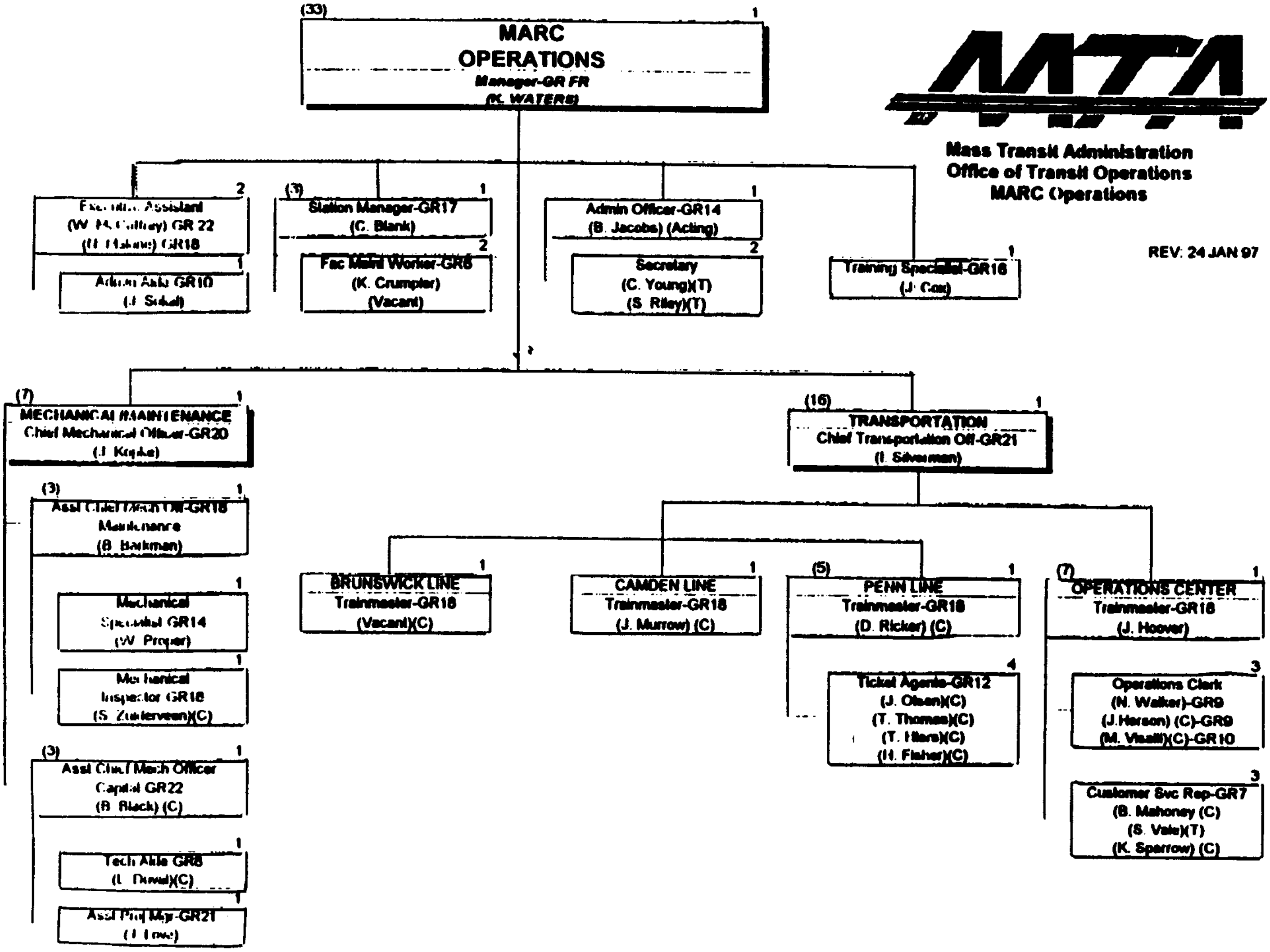


APPENDIX E

MARYLAND
DEPARTMENT OF TRANSPORTATION

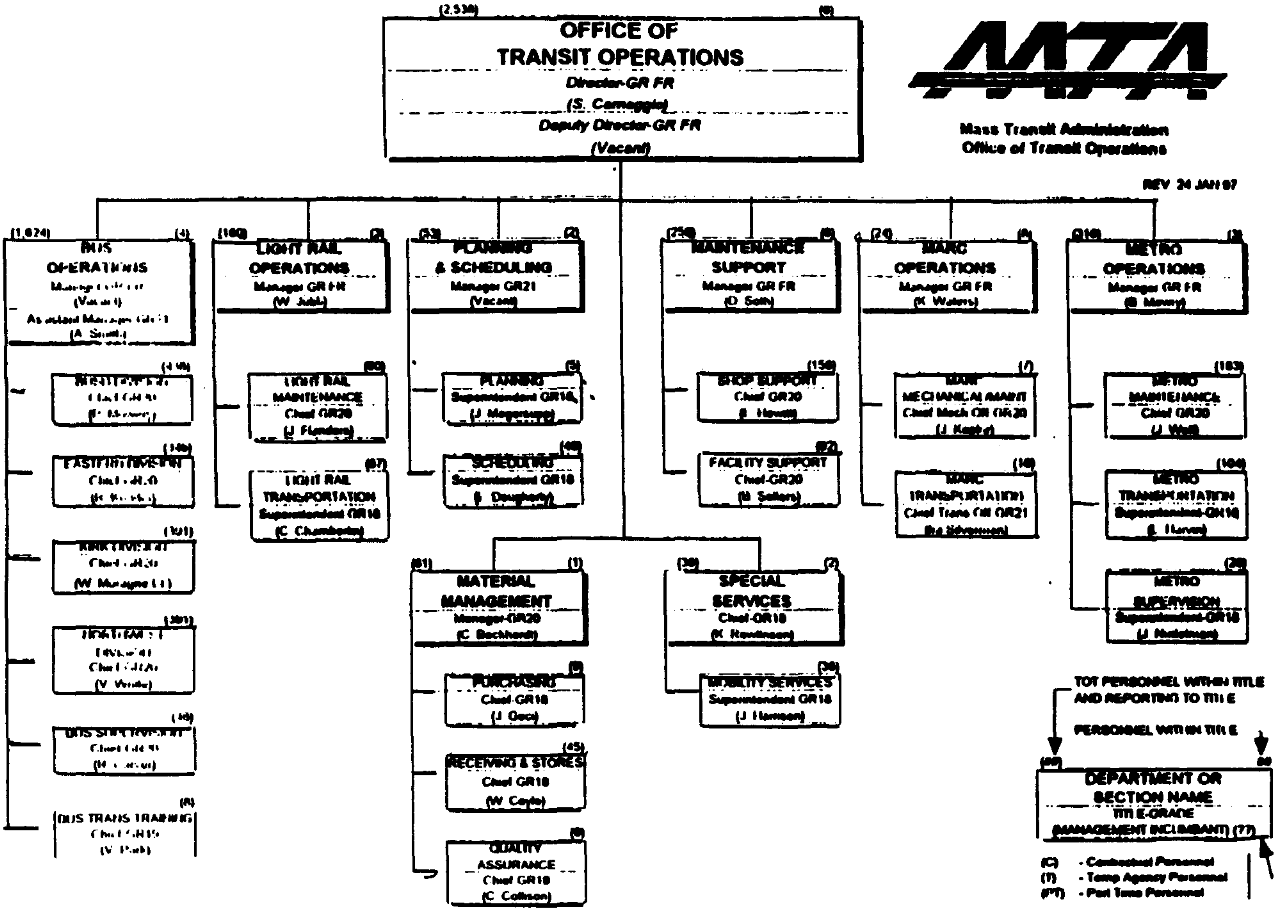


APPENDIX E



(33) 1
MARC OPERATIONS
Manager-GR FR
(K. WATERS)
Mass Transit Administration
Office of Transit Operations
MARC Operations
REV: 24 JAN 97
2
Executive Assistant
(W. McCaffrey) GR 22
GR18
1
Admin Aide GR10
(3) 1
Station Manager-GR17
(C. Blank)
2
Fac Maint Worker-GR8
(K. Crumpler)
(Vacant)
1
Admin Officer-GR14
(B. Jacobs) (Acting)
2
Secretary
(C. Young)(T)
(S. Riley)(T)
1
Training Specialist-GR16
(7) 1
MECHANICAL MAINTENANCE
Chief Mechanical Officer-GR20
(3) 1
Maintenance
1
Mechanical
Specialist GR14
(W. Proper)
1
Mechanical
Inspector GR18
(3) 1
Asst Chief Mech Officer
Capital GR22
(B. Black) (C)
1
Tech Aide GR8
1
Asst Proj Mgr-GR21
(16) 1
TRANSPORTATION
Chief Transportation Off-GR21
(I. Silverman)
1
BRUNSWICK LINE
Trainmaster-GR18
(Vacant)(C)
1
CAMDEN LINE
Trainmaster-GR18
(J. Murrow) (C)
(5) 1
PENN LINE
Trainmaster-GR18
(D. Ricker) (C)
4
Ticket Agents-GR12
(J. Olsen)(C)
(T. Thomas)(C)
(H. Fisher)(C)
(7) 1
OPERATIONS CENTER
Trainmaster-GR18
(J. Hoover)
3
Operations Clerk
(N. Walker)-GR9
(J.Herson) (C)-GR9
(M. Visalli)(C)-GR10
3
Customer Svc Rep-GR7
(B. Mahoney (C)
(S. Vale)(T)
(K. Sparrow) (C)

APPENDIX E



OFFICE OF TRANSIT OPERATIONS
Director-GR FR
(S. Cameggio)
Deputy Director-GR FR
(Vacant)
Mass Transit Administration
Office of Transit Operations
REV 24 JAN 97
BUS OPERATIONS
LIGHT RAIL OPERATIONS
PLANNING & SCHEDULING
MAINTENANCE SUPPORT
MARC OPERATIONS
METRO OPERATIONS
LIGHT RAIL MAINTENANCE
LIGHT RAIL TRANSPORTATION
PLANNING
SCHEDULING
SHOP SUPPORT
FACILITY SUPPORT
MECHANICAL MAINT
MARC TRANSPORTATION
METRO MAINTENANCE
METRO TRANSPORTATION
METRO SUPERVISION
MATERIAL MANAGEMENT
SPECIAL SERVICES
PURCHASING
RECEIVING & STORES
QUALITY ASSURANCE
MOBILITY SERVICES
BUS TRANS TRAINING
TOT PERSONNEL WITHIN TITLE AND REPORTING TO TITLE
PERSONNEL WITHIN TITLE
DEPARTMENT OR SECTION NAME
TITLE-GRADE
(MANAGEMENT INCUMBANT)
(C) - Contractual Personnel
(T) - Temp Agency Personnel
(PT) - Part Time Personnel

APPENDIX F

SIGNAL INCIDENTS, COMPLAINTS, AND FALSE PROCEED INDICATIONS

A review of CSXT signal incident reports for the period between August 1995 and February 1996 indicated approximately 134 signal and 21 highway/rail grade crossing incidents between Washington and Brunswick on the Metropolitan Subdivision. The majority of the signal incidents were weather-related (snow/lightning/rain), A.C. power interference by Amtrak at "F" Tower, commercial power outages, and burned-out signal lamps. All reported incidents were in the fail safe mode.

During the public hearing, the FRA indicated that it had one signal complaint filed in 1994 and none in 1995 on the CSXT. To follow up on reported traincrew complaints about the operation of the signal system, the Safety Board provided a survey form to the Brotherhood of Locomotive Engineers (BLE) and the UTU requesting a description of any unusual signal occurrences. A total of 95 complaints were received from both organizations dating from February 1993; 3 of the 95 reports were at Kensington.

One of the complaints for March 13, 1996, involved multiple complaints. Three trains reported the eastbound signal at Kensington "pumping" from CLEAR to STOP and PROCEED. The FRA had repros of the same condition. According to the FRA and the CSXT, the failure was caused by one of the lamps in the green aspect being burned-out, and the filament in the other green aspect was broken and intermittently touching. The signal system is designed that when both filaments in the yellow or green aspect burn out, the signal will go to STOP and illuminate the red aspect. This will prevent a train from passing a CLEAR signal to a dark signal. The signal should have displayed a CLEAR signal, but because of the condition of the signal lamps, intermittently displayed a STOP and PROCEED signal. The signal was considered to have failed in a fail-safe mode as designed. The FRA continues to investigate other BLE and UTU complaints on the Brunswick and Camden Lines. To date, no signals have failed in a more favorable state, which would cause a false proceed signal indications[1] on these lines.

In 1994, the CSXT had 13 false proceed signal indications. In 1995, the CSXT reported seven confirmed false proceed signal indications, and one reported to May 1996. For 1995 and 1996 these were attributed to vandalism (4), defective pole line (2), wiring short (l), and sunlight reflection (1).

By May 15, 1996, at a meeting held at CSXT headquarters in Baltimore, the FRA had received over 30 complaints, which were under investigation. All complaints were reports of signal malfunctions which resulted in a more restrictive aspect than should have been displayed. The majority of the complaints were stated by one labor union as a lack of understanding on how the signal system operates. Suggestions were made that during the employees annual operating rules test, an overview of the signal system be presented. The FRA is in the process of finalizing its report and is to have a follow-up meeting with the parties.

---

[1] **A more favorable aspect than intended or other condition hazardous to the movement of a train.**

APPENDIX G

FIRE TESTING RESULTS OF MARC CAR INTERIOR MATERIALS

Table 1. Test Results for Cushion Materials

Material	Test	Parameter	1	2	3	Average	1979 criterion
Cushions:	ASTM D 3675 (flammability)	I_s					[2]25
3b. Seat			9.6	6.6	6.5	8	
4c. Pad			4.6	5.3	5.9	5	
4b. Pad cover			1498	1105	833	1145	
3b. or 4c.	ASTM 662 (smoke)	$D_s(1.5)$[1]	54	54	50	53	[2]100[2]
		$D_s(4.0)$[1]	105	122	117	115	[2]200[2]
4b.		$D_s(1.5)$[1]	43	50	51	48	[2]100[2]
		$D_s(4.0)$[1]	92	109	109	103	[2]200[2]

1. The maximum value under flaming or non-flaming is given.
2. The 1979 Guidelines excepted cushions, we list the 1982 criteria for reference.

APPENDIX G

Table 2. Results for Upholstery Coverings

Material	Test	Parameter	1	2	3	Average	1979 criterion
Upholstery covering	FAR 28.853 (flammability)						
3a. Fabric		Flame time	1	4	2	2.3	≤10 s
		Burn length	1.75	2	1.5	1.8	≤6 in.
		Flaming drips	0	0	0	0	0 s
4a. Vinyl		Flame time	1	0	0	0.33	≤10 s
		Burn length	2.2	2.6	1.9	2.2	≤6 in.
		Flaming drips	0	0	0	0	0 s
	ASTM E 662 (smoke)	$D_s(4.0)$[1]					≤100
3a. Fabric			254	245	205	235	
4a. Vinyl			359	351	321	344	

1. The maximum value under flaming or non-flaming is given.

Table 3. Results for Wall and Ceiling Linings

Material	Test	Parameter	1	2	3	Average	1979 criterion
Walls/Ceilings:	ASTM E 162 (flammability)	I_s					[2]35
1. Ceiling panel			5.8	2.5	63.5	24	
2. Window mask			51	57	79	62	
	ASTM E 662 (smoke)						
1. Ceiling panel		D_s (1 .5)[1]	23	1	30	18	[2]100
		D_s (4.0)[1]	79	51	109	80	[2]200
2. Window mask		D_s(l.5)[1]	92	73	105	90	[2]100
		D_s (4.0)[1]	234	278	373	295	[2]200

1. The maximum value under flaming or non-flaming is given. For large continuous sheets used in applications, such as the passenger rail car, the edge effects should be different and, likely, less. The edge effect is very likely responsible for the I_s value of 63.5 for the ceiling material. This is very likely attributed to the way that the cut sample responded in its metal frame holder of the apparatus.

APPENDIX H

ISSUANCE OF URGENT SAFETY RECOMMENDATIONS

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: **March 12, 1996**

In Reply Refer To: R-96-4 through -6

Mr. John A. Agro, Jr.
Administrator
Mass Transit Administration
William Donald Schafer Tower
6 Saint Paul Street
Baltimore, Maryland 21202-1614

About 5:38 p.m. on February 16, 1996, eastbound Maryland Rail Commuter (MARC) train 286 collided with westbound National Railroad Passenger Corporation (Amtrak) train 29, the Capitol Limited, at milepost 8.55 on CSX main track near Silver Spring, Maryland. The MARC train was operating in the push mode in revenue service between Brunswick, Maryland, and Washington, D. C.; it consisted of a locomotive and three commuter cars. The Amtrak train, operating in revenue service between Washington, D. C., and Chicago, Illinois, consisted of 2 locomotives and 15 cars.

The left front quadrant of the MARC cab car (the leading passenger car) separated and was destroyed as a result of the collision. The fuel tank of the Amtrak lead locomotive ruptured on impact and the diesel fuel ignited. Fire engulfed the rear superstructure of the locomotive. Fuel spilled onto the MARC cab car, ignited, and destroyed the car.

One hundred sixty-four passengers, 13 on-board service personnel, 4 operating crew, and 1 mechanical rider were aboard the Amtrak train. The engineer, assistant engineer, and conductor received minor-to-moderate injuries.

Three operating crewmembers and 20 passengers were on board the MARC train. Two crewmembers and 7 passengers died of smoke inhalation, and 1 crewmember and 1 passenger died as a result of impact injuries; 11 of the 12 survivors were injured.

Safety Board investigators interviewed six U.S. Department of Labor Job Corps students who were passengers in the MARC cab car and two individuals who were passengers in the second MARC car.

The students stated that after the impact, the car quickly filled with smoke, making it very difficult to see. One student, who said he was sitting in the last seat on the right rear of the first car next to an emergency window, described the smoke as extending from the ceiling of the car to 2 feet above the floor. The student also stated that he did not have time to open the window and that he believed it would be faster to exit using the door through which he had entered. Another student said that he had to crawl to the rear of the car on his hands and knees because of the smoke. Two other students, seated near the rear of the first car, proceeded through the rear end interior door and made several unsuccessful attempts to open the left and right exterior side doors. They stated that no instructions were provided concerning the operation of the door handle in an emergency.

These two students made their way into the vestibule of the second car and escaped through an opening in the damaged left front corner of the second car. All surviving students, as well as a 26-year-old passenger who was also seated in the cab car, followed.

The upper half of the side exterior doors on the MARC Sumitomo cars are fitted with freed polycarbonate windows. When opened, the single-panel exterior side doors slide into a pocket in the car body sidewall. Construction of the interior end doors, which have upper-half freed windows, is similar to that of the exterior doors. These doors also slide into a wail pocket when opened; they are not equipped with emergency release mechanisms. The four exterior side doors are electrically operated and may be opened manually in an emergency by pulling an emergency handle located in one of four secured cabinets (two at each end of the passenger compartment). Each cabinet door is secured by two fasteners, which require a screwdriver or coin to open. Instructions for opening the cabinet doors are on the door's exterior. Instructions for operating the emergency handles to release the exterior doors are inside the cabinet.

The Safety Board is concerned that emergency quick-release mechanisms for the exterior doors are located in a secured cabinet some distance from the door they control. Emergency controls for each door should be readily accessible and identifiable. Therefore, the Safety Board believes that well-marked emergency quick-release mechanisms for exterior doors on MARC cars should be relocated so that they are immediately adjacent to the door they control and readily accessible for emergency escape purposes.

Examination of the first and second cars revealed that the left and right rear exterior side doors of the former, as well as the front interior end door and the right front exterior door of the latter, were jammed. None of the doors had removable windows or pop-out emergency escape panels (kick panels) for use in an emergency. The left front exterior door of the second car was destroyed. Thus, if the opening in the damaged car body of the second car had not provided an escape route for the surviving passengers of the cab control car, the loss of life in this accident could have been far greater.

Several students stated that they were unaware of the locations of the emergency exits, and none knew how to operate them. The Safety Board found that the interior emergency window decals were not prominently displayed and that one car had no interior emergency window decals. The Safety Board noted that the exterior emergency decals were often faded or obliterated and that the information on them, when legible, directed emergency responders to another sign at the end of the car for instructions on how to open emergency exits, which is a time-consuming process. The Safety Board believes that all emergency exits should be clearly identified and provided at the exit with easily understood operating instructions. These instructions should be prominently located on the car interior for use by passengers and on the exterior for use by emergency responders.

Therefore, the National Transportation Safety Board recommends that the Mass Transit Administration of the Maryland Department of Transportation

> Install removable windows or kick panels for emergency exits in interior and exterior passageway doors. (Class I, Urgent Action) (R-96-4)
>
> Install an easily accessible interior emergency quick-release mechanism adjacent to all exterior doors. (Class I, Urgent Action) (R-96-5)
>
> Install retroreflective signage on car interiors and exteriors at emergency exits that contains easily understood instructions and clearly marks all emergency exits (doors and windows). (Class I, Urgent Action) (R-96-6)

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" (Public Law 93-633). The Safety Board's investigation of the MARC accident is continuing. The Safety Board is interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations R-96-4 through -6 in your reply. If you need additional information, you may call (202) 382-6840.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Jim Hall
Chairman

APPENDIX H

National Transportation Safety Board

Washington, D. C. 20594

Safety Recommendation

Date **March 12, 1996**

In Reply Refer To: R-96-7

Honorable Jolene M. Molitoris
Administrator
Federal Railroad Administration
Washington, D.C. 20590

About 5:38 p.m. on February 16, 1996, eastbound Maryland Rail Commuter (MARC) train 286 collided with westbound National Railroad Passenger Corporation (Amtrak) train 29, the Capitol Limited, at milepost 8.55 on CSX main track near Silver Spring, Maryland. The MARC train was operating in the push mode in revenue service between Brunswick, Maryland, and Washington, D. C.; it consisted of a locomotive and three commuter cars. The Amtrak train, operating in revenue service between Washington, D. C., and Chicago, Illinois, consisted of 2 locomotives and 15 cars.

The left front quadrant of the MARC cab car (the leading passenger car) separated and was destroyed as a result of the collision. The fuel tank of the Amtrak lead locomotive ruptured on impact and the diesel fuel ignited. Fire engulfed the rear superstructure of the locomotive. Fuel spilled onto the MARC cab car, ignited, and destroyed the car.

One hundred sixty-four passengers, 13 on-board service personnel, 4 operating crew, and 1 mechanical rider were aboard the Amtrak train. The engineer, assistant engineer, and conductor received minor-to-moderate injuries.

Three operating crewmembers and 20 passengers were on board the MARC train. Two crewmembers and 7 passengers died of smoke inhalation, and 1 crewmember and 1 passenger died as a result of impact injuries; 11 of the 12 survivors were injured.

Safety Board investigators interviewed six U.S. Department of Labor Job Corps students who were passengers in the MARC cab car and two individuals who were passengers in the second MARC car.

The students stated that after the impact, the car quickly filled with smoke, making it very difficult to see. One student, who said he was sitting in the last seat on the right rear of the first car next to an emergency window, described the smoke as extending from the ceiling of the car to 2 feet above the floor. The student also stated that he did not have time to open the window and that he believed it would be faster to exit using the door through which he had entered. Another student said that he had to crawl to the rear of the car on his hands and knees because of the smoke. Two other students, seated near the rear of the first car, proceeded through the rear end interior door and made several unsuccessful attempts to open the left and right exterior side doors. They stated that no instructions were provided concerning the operation of the door handle in an emergency.

These two students made their way into the vestibule of the second car and escaped through an opening in the damaged left front comer of the second car. All surviving students, as well as a 26-year-old passenger who was also seated in the cab car, followed.

The upper half of the side exterior doors on the MARC Sumitomo cars are fitted with fixed polycarbonate windows. When opened, the single-panel exterior side doors slide into a pocket in the car body sidewall. Construction of the interior end doors, which have upper-half freed windows, is similar to that of the exterior doors. These doors also slide into a wall pocket when opened; they are not equipped with emergency release mechanisms. The four exterior side doors are electrically operated and may be opened manually in an emergency by pulling an emergency handle located in one of four secured cabinets (two at each end of the passenger compartment). Each cabinet door is secured by two fasteners, which require a screwdriver or coin to open. Instructions for opening the cabinet doors are on the door's exterior. Instructions for operating the emergency handles to release the exterior doors are inside the cabinet.

The Safety Board is concerned that emergency quick-release mechanisms for the exterior doors are located in a secured cabinet some distance from the door they control. Emergency controls for each door should be readily accessible and identifiable. Therefore, the Safety Board believes that well-marked emergency quick-release mechanisms for exterior doors on MARC cars should be relocated so that they are immediately adjacent to the door they control and readily accessible for emergency escape purposes.

Examination of the first and second cars revealed that the left and right rear exterior side doors of the former, as well as the front interior end door and the right front exterior door of the latter, were jammed. None of the doors had removable windows or pop-out emergency escape panels (kick panels) for use in an emergency. The left front exterior door of the second car was destroyed. Thus, if the opening in the damaged car body of the second car had not provided an escape route for the surviving passengers of the cab control car, the loss of life in this accident could have been far greater.

Several students stated that they were unaware of the locations of the emergency exits, and none knew how to operate them. The Safety Board found that the interior emergency window decals were not prominently displayed and that one car had no interior emergency window decals. The Safety Board noted that the exterior emergency decals were often faded or obliterated and that the information on them, when legible, directed emergency responders to another sign at the end of the car for instructions on how to open emergency exits, which is a time-consuming process. The Safety Board believes that all emergency exits should be clearly identified and provided at the exit with easily understood operating instructions. These instructions should be prominently located on the car interior for use by passengers and on the exterior for use by emergency responders.

The Safety Board's investigation of the MARC accident is continuing. However, the Board is concerned that the unsafe conditions identified on MARC's Sumitomo cars may exist on other commuter lines subject to Federal Railroad Administration (FRA) oversight. No comprehensive passenger car safety standards are currently in place. Consequently, the Safety Board believes that FRA safety inspection personnel should determine whether the unsafe conditions identified on MARC's Sumitomo cars exist on other lines. The Safety Board further believes that the FRA should issue emergency orders to correct such unsafe conditions, as necessary, and incorporate the emergency measures into minimum passenger car safety Standards.

Therefore, the National Transportation Safety Board recommends that the Federal Railroad Administration:

> Inspect all commuter rail equipment to determine whether it has: (1) easily accessible interior emergency quick-release mechanisms adjacent to exterior passageway doors; (2) removable windows or kick panels in interior and exterior passageway doors; and (3) prominently displayed retroreflective signage marking all interior and exterior emergency exits. If any commuter equipment lacks one or more of these features, take appropriate emergency measures to ensure corrective action until these measures are incorporated into minimum passenger car safety standards. (Class 1, Urgent Action) (R-96-7)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Jim Hall
Chairman

APPENDIX I

FEDERAL RAILROAD ADMINISTRATION EMERGENCY ORDER NO. 20

Emergency Order No. 20

[4910-06]

DEPARTMENT OF TRANSPORTATION
Federal Railroad Administration

[FRA Emergency Order No. 20,
Notice No. 1]

Commuter and Intercity Passenger Railroads,
Including Public Authorities Providing Passenger
Service, and Affected Freight Railroads

Emergency Order Requiring Enhanced Operating Rules
and Plans for Ensuring the Safety of Passengers
Occupying the Leading Car of a Train

Introduction

The Federal Railroad Administration (FRA) of the United States Department of Transportation (DOT) has determined that the safety of passengers and railroad employees compels issuance of this Emergency Order. Based on the historical record, rail passenger transportation in the United States is an extremely safe mode of transportation. However, recent train accidents in New Jersey and Maryland, which have claimed a total of fourteen lives, have caused DOT, FRA, and the Federal Transit Administration (FTA) (also part of DOT) to have very serious concerns about the safety of certain aspects of rail passenger transportation. The National Transportation Safety Board (NTSB) has the lead in investigating both accidents. FRA is assisting in both investigations. Although NTSB will not reach final conclusions as to probable cause of either accident for some time, NTSB's preliminary conclusions and what FRA has learned from the investigations (set forth in detail, below) compel that certain steps be taken now to reduce the risks to passengers and crew that apparently exist under certain operating conditions.

Of particular concern are those operations that involve carrying passengers in the lead car of a train over segments of track that do not have either cab signal systems (which provide the engineer with an on-board display of signal indications alongside the tracks) or automatic train stop or automatic train control systems (which automatically cause the train to stop or reduce speed where an engineer fails to respond appropriately to a trackside signal). Both of the recent accidents involved such operations. While thousands of such operations occur daily without incident, the occurrence of two fatal accidents in one week has caused DOT, FRA, and FTA to examine closely the need for immediate enhancements in the safety of such operations. Also of great concern, based on the Maryland accident, is passenger and crew egress after an accident.

APPENDIX I

In summary, this order requires that commuter and intercity passenger railroads, including public authorities providing passenger service through contracts with other railroads, and any other entities (e.g., freight railroads with affected passenger service on their lines) whose actions are necessary to effectuate this order, take certain immediate steps with regard to any of their operations above 30 miles per hour that do not entail cab signal, automatic train stop, or automatic train control protections and that permit passengers to occupy the leading car (i.e., using either cab cars as the forward car in the push-pull mode or self-propelled locomotives with passenger seating (MU locomotives)). As set forth in detail below, those railroads are required to: (1) adopt and comply with an operating rule requiring that, when a passenger train stops for any reason, including a station stop, or its speed is reduced below 10 m.p.h., the train shall proceed under any speed limitations set forth in applicable railroad operating rules, and in addition, must be prepared to stop before passing the next signal; the train must maintain the prescribed speed until the next wayside signal is clearly visible and that signal displays a proceed indication, and the track to that signal is clear; (2) adopt and comply with an operating rule requiring that a crew member located in the operating cab of a controlling locomotive, cab car, or MU car, shall have a means to orally communicate and will communicate to another crew member the indication and location of each wayside signal affecting the movement of the train as soon as the signal becomes visible, for all signals which require either that the train be prepared to stop at the next wayside signal or that the train be prepared to pass the next wayside signal at restricted speed; (3) take certain measures to instruct and test employees on the aforementioned operating rules; and (4) submit to FRA an interim system safety plan for enhancing the safety of such operations that includes (I) a description of circumstances in which the leading car is permitted to be occupied by passengers; (ii) a review of operating rules relevant to such operations; (iii) plans for any short-term technology enhancements that would enhance train control; (iv) a review of crew management practices to see what steps can be taken to improve crew alertness; (v) a review of the hazards posed to passengers in the forward car by vehicles using highway-rail grade crossings; and (vi) a review of practices, in addition to marking exits, used by the railroad to inform passengers of the location and operation of emergency exits, specifying any plans for enhancing such information. In addition, each of these commuter and intercity passenger railroads, regardless of the speeds or equipment they use, is required to ensure that each emergency window on every passenger car is clearly marked on the outside and inside and that a representative sample has been inspected to make sure they are operable.

FRA may amend this order at any time to require other actions to ensure safety. For example, depending on what FRA learns from the railroads' interim safety plans and other sources after issuance of this order, it may decide that safety requires it to prohibit one or more railroads from carrying passengers in the lead car in the absence of a cab signal, automatic train stop, or automatic train control system.

__Authority__

Authority to enforce Federal railroad safety laws has been delegated by the Secretary of Transportation to the Federal Railroad Administrator. 49 CFR 1.49. Railroads are subject to FRA's safety jurisdiction under the Federal railroad safety laws. 49 U.S.C. 20101, 20103. FRA is authorized to issue emergency orders where an unsafe condition or practice "causes an emergency situation involving a hazard of death or personal injury." 49 U.S.C. 20104. These orders may immediately impose "restrictions and prohibitions . . . that may be necessary to abate the situation." *(Ibid.)*

Background

New Jersey Transit accident, Secaucus, N.J. On February 9, 1996, at about 8:40 a.m., a near-head-on collision occurred between New Jersey Transit trains 1254 and 1107 at mile post 2.8, on the borderline of Secaucus and Jersey City, New Jersey. Speed at the point of collision was approximately 7 m.p.h. for train 1254 and 53 m.p.h. for train 1107. Of the 325 passengers on both trains, one received fatal injuries and 162 reported minor injuries. The passenger fatality and most of the nonfatal injuries to passengers occurred on train 1254, which was operating with the cab control car forward and the locomotive pushing. In addition, the engineer was fatally injured. The cab control car incurred substantial damage as a result of near-frontal impact with the heavier locomotive of train 1107, operating in the "pull" mode. The locomotive engineer on train 1107 was fatally injured as a result of "cornering" of the locomotive cab that bypassed the collision posts in the short hood. Railroad property damage was estimated at more than $3.5 million. Although the trains involved were equipped with cab signal and automatic train control (ATC) apparatus, the wayside portion of the signal system on the lines in question did not provide cab signals. The method of operation was by wayside signal indication.

Based on preliminary information derived from the joint investigation of the NTSB, FRA and other parties, the accident appears to have resulted from failure of train 1254 to observe signal indications requiring that the train be stopped short of the junction where the accident occurred. Agencies are investigating whether lack of alertness on the part of the locomotive engineer, who was working the second portion a night "split shift," may have contributed to the failure to observe signal indications. Since the accident, New Jersey Transit has eliminated use of the night split shift, which had previously been a longstanding practice on the railroad.

MARC accident, Silver Spring, Md. On February 16, 1996, at approximately 5:40 p.m., a near-head-on collision occurred between Maryland Rail Commuter Authority (MARC) train P28616 and National Railroad Passenger Corporation (Amtrak) Train PO2916 on the CSX Transportation line at Silver Spring, Maryland (milepost 8.3). The Amtrak train consisted of two locomotives in the lead and 15 cars. The MARC train consisted of a cab control car in the lead followed by two passenger coaches and a locomotive pushing the consist.

The accident resulted in 11 fatalities, consisting of 3 crew members and 8 passengers who were located in the MARC cab car. Non-fatal injuries were sustained by at least 13 additional passengers of the MARC train. As this order was prepared, one passenger remained in critical condition.

Early investigative findings by staff of the NTSB and FRA indicate that the MARC train, proceeding eastbound towards Washington Union Station on Track No. 2, passed an intermediate signal conveying an approach indication (proceed prepared to stop at next signal), made a scheduled station stop immediately past the signal, accelerated to approximately 63 miles per hour (maximum timetable speed 70 miles per hour), and then

APPENDIX I

applied the train's emergency brakes upon rounding a curve and establishing sight distance for the home signal governing a crossover between the two main tracks, which is believed to have displayed a stop signal. The MARC train proceeded past the signal and struck the midpoint of the lead locomotive of the Amtrak train, which was diverging from Track No. 2 to Track No. 1 through the crossover. The initial impact sheared off the left collision post of the MARC cab car, together with a substantial portion of the front, side and roof structure on the left side approximately one-third of the way back along the length of the car. The impact also ruptured the left diesel fuel tank of the Amtrak lead locomotive, discharging an undetermined amount of diesel fuel into the MARC cab car. The MARC train continued substantially in line, apparently raking the second locomotive and coming to rest substantially parallel with the Amtrak train. Diesel fuel present in the cab car ignited.

Both of these accidents involved casualties in so-called "push/pull" operations with the consist being pushed by a locomotive at the rear. Control of such operations is conducted from the front of a cab control car, or "cab car," where an engineer compartment is located. Control cables run the length of the train, as do electrical lines providing power for heat, lights and other purposes throughout the train.

Cab cars provide passenger seating, as well as providing a location from which the train is operated. Cab cars are built with the same minimum longitudinal strength as locomotives and with substantial collision posts at each end to prevent incursion of other vehicles into the occupied volume. However, cab cars are lighter than powered vehicles, and no combination of structural measures can wholly prevent harm to persons in collisions involving substantial forces. Occupants of cab cars may incur a significantly higher risk of serious injury when compared with occupants of a locomotive-hauled consist, if the cab car collides with a heavier rail vehicle or any highway or rail vehicle transporting hazardous materials. Similar risks may obtain in the case of electric multiple-unit (EMU) service and diesel multiple-unit (DMU) service, because those vehicles have a structure similar to that of a cab car.

FRA recognizes that cab cars have provided hundreds of millions of miles of safe transportation since they were introduced in the late 1950s. EMU and DMU service has been provided with a high degree of safety since the early decades of this century. However, the recent accidents noted above compel FRA to review the safety of these operations to determine whether means can be found to further reduce the risk of serious injury in the subject service.

Prior accidents further illustrate the potential risk. For instance, on August 1, 1981, at Beverly, Massachusetts, a commuter train engineer was killed and 28 passengers were injured when a commuter train in the push mode collided head-on with a freight train due to dispatcher error. On January 2, 1982, at Southhampton, Pennsylvania, a single rail diesel car commuter train collided with a gas truck at a highway-rail crossing due to malfunction of the automated warning device at the crossing (loss of shunt). On November 12, 1987, at Boston, Massachusetts, a train in the push mode struck the locomotive at the back of a train proceeding in the same direction on the same track, resulting in injuries to 3 crew members and 220 passengers, due in part to a wayside signal malfunction. At Gary, Indiana, on January 18, 1993, two EMU consists struck in a cornering collision at the approach to a gauntlet bridge, resulting in 7 fatalities and 95 persons injured, due to failure of one of the engineers to observe signal indications.

Related FRA Rulemaking Actions

FRA is engaged in a broad range of actions designed to further enhance the safety of passenger operations. In September of 1994, the Secretary of Transportation announced that FRA would develop passenger equipment safety standards in two phases: initial regulations dealing with the most critical issues in three years, and final regulations dealing with all related subjects in five years. In November 1994, Congress passed the Federal Railroad Safety Authorization Act of 1994, section 215 of which requires the Secretary to issue regulations under the timetable the Secretary had previously announced, as measured from the enactment of the statute. FRA has begun a rulemaking concerning comprehensive passenger equipment safety standards. A Passenger Equipment Working Group, including representatives of passenger operators, employee representatives, rail passenger organizations, and States, assisted by railway suppliers, began work last summer on proposed rules. An Advance Notice of Proposed Rulemaking describing the issues under consideration by the working group will be published this spring, followed by one or more notices of proposed rulemaking on issues such as the following:

- Inspection, testing and maintenance of passenger equipment;
- Crashworthiness of passenger equipment, including cab car and passenger coach structural strength;
- Emergency features integral to the train (e.g., emergency lighting, operation of doors, access points in the event equipment is on its side);
- Standards for high-speed equipment; and
- Passenger car interiors.

The working group will also prepare a second Notice of Proposed Rulemaking (NPRM) for passenger power brakes (which may be combined with other subject matter). FRA anticipates publication of an NPRM on passenger equipment safety measures in 1996, followed by a final rule in 1997, as required by law. Issues requiring further research and technology development may be included in a subsequent NPRM.

Under the same statutory authority, FRA has also established an Emergency Preparedness Working Group for rail passenger service that is broadly representative of interested parties. This effort builds on a process of research and consultation initiated in 1993. The working group is presently preparing an NPRM addressing issues such as on-board emergency equipment, availability of first aid, liaison with emergency responders, communication capability, and advance planning. Publication of the NPRM is anticipated in early summer.

The measures taken in this emergency order address matters of immediate concern as identified in the investigation of recent accidents. These measures will be integrated into the process of dialogue and discussion already underway with respect to passenger equipment safety and emergency preparedness. However, FRA believes that public safety requires the actions called for by this order now rather than waiting for the rulemaking process to run its course.

The Need for Action

APPENDIX I

Although definitive conclusions have not been reached, preliminary indications are that both the Secaucus and Silver Spring accidents could have been prevented had wayside signal indications been followed, and the death tolls might have been reduced significantly had occupied cab cars not been the lead cars. Additionally, the Silver Spring accident indicates a need to ensure that emergency windows are clearly marked and operable. FRA believes that certain immediate measures are necessary to prevent a recurrence of these problems.

There is no evidence that push/pull or EMU operations are in any way over represented in passenger train accidents. All rail passenger operations, like other forms of transportation, involve some risk of injury due to collision with other vehicles or fixed structures. In certain accident scenarios (e.g., where the passenger consist in question is impacted from the rear), push-pull operations with the cab car forward actually offer greater protection. However, in collisions involving the front of the passenger train, cab car forward and MU operations do present an increased risk of severe personal injury or death when compared with locomotive-hauled service. This risk is of particular concern where operations are conducted at relatively higher speeds, where there is a mix of various types of trains, and where there are numerous highway-rail crossings over which large motor vehicles are operated.

As the accidents of past two weeks illustrate, this potential for accidents of greater severity warrants a review of measures taken to prevent such accidents. Since most train collisions on the railroad result from human factors, the most effective preventive measure is a highly effective train control system. Cab signal systems serve an important safety purpose because they provide a constant display of the governing signal indication. This provides a corrective measure should an engineer fail to note, forget, or misread a restrictive wayside signal indication. Even greater security is provided by a train control system capable of intervening should the engineer fail to observe signals and operating rules for whatever reason (e.g., lack of alertness due to fatigue, sudden incapacitation, loss of situational awareness due to unusual events). Such systems are referred to as automatic train control or automatic train stop systems. New technologies currently under development and demonstration that can prevent collisions and overspeed derailments are known as "positive train separation" (PTS), "positive train control" (PTC), or advanced train control (ATCS) systems.

1. Necessary Rule Changes

With regard to cab car forward and MU operations over territory lacking at least cab signals, the immediate need is to ensure that signal indications are followed. FRA believes that certain operating rules, already in place on many railroads, will assist engineers in remembering and adhering to signal indications. One rule will require that signal indications for an approach or less favorable than an approach be called out by the engineer as they are seen. A designated crewmember elsewhere in the train will acknowledge the communication and, in the absence of an appropriate response to a restrictive indication that has been communicated, take action to ensure the appropriate response. This will serve as a simple device to help the engineer remember to abide by signal indications and will add safety redundancy by involving other crew members in responsibility for safety with regard to compliance with signals.

The second rule will require that, if a passenger train enters a block on a signal indication and the train stops for any reason, including a station stop, or its speed is reduced below 10 m.p.h., the train shall proceed under speed limitations set forth in existing applicable operating rules, and in addition, must be prepared to stop before passing the next signal; the train must maintain the prescribed speed until the next wayside signal is clearly visible and that signal displays a proceed indication, and the track to that signal is clear. (For purposes of this order, a "block" is a length of track of defined limits the use of which is governed by wayside signal indications.) This will prevent situations where a signal displays an aspect less favorable than "clear" prior to a station stop but the engineer, after stopping and resuming movement, forgets that he or she should be operating at a reduced speed. This very well may be what happened in the Silver Spring accident. Under this rule, if the next signal is clear, timetable speed may be resumed. However, if the next signal requires a stop, the engineer will have the train under control and be prepared to stop short of the signal. This rule will presumably result in a certain amount of slowing of operations between station stops and the next forward signal, but FRA believes such relatively minimal delay is warranted to ensure safety.

2. Interim Safety Plans

FRA believes there is a broader need to have railroads carefully evaluate their passenger operations with a view toward enhancing the safety of those operations, with particular attention given to the safety of operations where passengers are in the lead car and to ways that train control systems might be upgraded. FRA has concluded that the safety of such operations can be enhanced by having each railroad develop an interim system safety plan addressing these subjects. This will both focus the attention of those railroads on avoiding occurrences similar to the recent accidents and provide FRA with detailed information allowing it to determine what further action may be necessary.

Therefore, this order will require railroads operating scheduled intercity or commuter rail service to conduct an analysis of their operations and file with FRA an interim safety plan indicating the manner in which risk of a collision involving a cab car is addressed. Railroads are encouraged to implement identified opportunities for risk reduction immediately. Upon review of these plans and the subject operations, FRA will determine whether further action is warranted.

Plans will be reviewed with the following factors in mind:

- Railroads operating trains with the benefit of cab signals incur reduced risk. Augmentation of cab signals with ATC or PTC further reduces risk.
- Lower speed operations (e.g., not to exceed 30 miles per hour) involve less risk because of lower potential collision forces.
- The presence of automated warning devices, particularly flashing lights with gates, reduces risk of highway-rail crossing accidents involving heavy vehicles, particularly if crossing surfaces and approaches do not create a "hump" capable of hanging up a long, low truck or trailer.

Moreover, each interim safety plan will address these specific issues:

Passenger occupancy of cab/MU cars in lead. Each interim safety plan must include a review of the use of leading cab cars and MU cars for transportation of passengers. In the Silver Spring accident, most train occupants were located in the cab car, even though two very lightly loaded passenger coaches were available for occupancy. Some operating authorities limit access to cab cars when seating capacity is not required. This order asks other authorities to review this potential for risk reduction. For instance, an operator whose service gathers small numbers of passengers on branch lines, with heavier loadings at stops on a cab-signal-equipped main line, might direct passengers to trailing coaches until the train arrives on the main line.

Operating rules. As noted above, this order requires early amendment of operating rules to make passenger operations subject to the "delayed in block" provisions of most existing rule books and to require engineer-to-train crew communication of certain signals. These steps will enhance safety by adding a layer of redundancy in safety procedures where presently none exists. In addition to these steps, the order requires passenger railroads to review other operating rules applicable to their particular methods of operation to determine if enhancements in safety can be achieved consistent with provision of efficient rail passenger service.

Adverse operating conditions. Crew performance and other aspects of operational safety can be affected by unusual conditions such as heavy snow, fog, high water, and other unusual conditions. This order requires a review of existing procedures to determine if reasonable enhancements in safety can be made by compensating for the challenges these conditions pose to system performance.

Short-term technology enhancements. Where the railroad and all trains are not already cab signal/ATC-equipped, positive train control systems will offer the most secure means of preventing train collisions. However, PTC systems remain under development and will be deployed over a period of several years. The order requires review of possible technology enhancements that can be achieved over a short time period. For instance, FRA believes that virtually all passenger operations include the use of an alerting device that will stop the train should the engineer become incapacitated. However, certain freight operations on the same railroad may be conducted without such a device. Depending upon the number of units involved, equipping remaining trains with alerting devices (a readily available item) could close a gap in accident prevention at relatively low cost.

Crew management. Following the accident of February 9, New Jersey Transit found that it was able to eliminate night split shifts without adversely affecting operations. Night split shifts present special problems because of the effect of biological rhythms and fatigue on human performance. This order requires other passenger operators using cab car/MU forward trains to review their management of operating crews to determine if opportunities exist for risk reduction similar to the action taken by New Jersey Transit. FRA emphasizes that the issue of on- and off-duty periods is governed by the hours of service law, as codified at 49 U.S.C. 21102-21108, 21303-21304. The order requires passenger operators to consider safety improvements that may be undertaken voluntarily in a manner that is consistent with statutory law. FRA is also authorized to approve pilot projects involving variances from the periods specified by the statute upon petition by the railroad and designated representatives of the employees involved.

Highway-rail crossings. Cab-forward and MU operations pose a somewhat heightened risk of severe injury for passengers should an accident occur, in comparison to locomotive-hauled passenger coaches. Operators should give consideration to closer interface with private crossing holders that use the crossings for truck access, give greater attention to liaison with law enforcement authorities, and explore other means that may reduce risk at both public and private crossings. Accelerated application of locomotive alerting lights (already authorized by regulation and required by statute) may offer another opportunity for risk reduction. This order requires that each railroad's interim safety plan address these grade crossing issues in the context of cab-forward and MU operations. FRA is very concerned about the safety of such operations in absence of a plan to address grade crossing hazards.

Information on emergency exits. The Silver Spring accident has raised serious concerns about whether the MARC passengers had sufficient information about the location and operation of emergency exits to enable them to find and use those exits in a crisis. FRA believes it would be very useful for all commuter and intercity passenger railroads to review their practices, in addition to marking the exits, for providing this information.

3. Emergency Exits

Finally, there is a need to ensure that emergency exits are clearly marked and in operable condition on all passenger lines, regardless of the equipment used or train control system. FRA's regulations generally require that all passenger cars be equipped with at least four emergency opening windows, which must be designed to permit rapid and easy removal during a crisis situation. The investigation of the Silver Spring accident has raised some concerns that at least some of the occupants of the MARC train attempted unsuccessfully to exit through the windows. Whether those same people eventually were among those who exited safely, or whether those persons were attempting to open windows that were not emergency windows is not known at this time. However, there is sufficient reason for concern to require that measures be taken to ensure that such windows are readily identifiable and operable when they are needed. Accordingly, the order requires that any emergency windows that are not already legibly marked as such on the inside and outside be so marked, and that a representative sample of all such windows be examined to ensure operability. (FRA Safety Glazing Standards, 49 CFR Part 223, require that each passenger car have a minimum of four emergency window exits "designed to permit rapid and easy removal during a crisis situation.")

Finding and Order

FRA concludes that certain current conditions and practices on commuter and intercity passenger railroads pose an imminent and unacceptable threat to public and employee safety. Of greatest concern are push-pull and MU operations lacking the protection provided by cab signal, automatic train stop, or automatic train control systems. I find that the unsafe conditions discussed above create an emergency situation involving a hazard of death or injury to persons. Accordingly, pursuant to the authority of 49 U.S.C. 20104, delegated to me by the Secretary of Transportation (49 CFR 1.49), it is hereby ordered that each commuter and intercity passenger railroad, and any other entity (e.g., freight railroads over whose lines affected passenger operations are conducted) whose actions are necessary to effectuate the directives in this order, take the following actions:

Emergency Order No. 20 Page 10 of 14

(1) Delayed in block rule. Note: This rule applies to all push-pull and MU operations unless cab signal, automatic train stop, or automatic train control is in operation, speeds do not exceed 30 m.p.h., or within yard or terminal limits as specified for this purpose by the railroad.

- (A) Within 10 days of this order, have in effect, publish in its code of operating rules, and comply with a rule that requires: If a passenger train enters a block on a signal indication and the train stops for any reason, including a station stop, or its speed is reduced below 10 m.p.h., the train shall proceed under speed limitations set forth in existing applicable railroad operating rules, and in addition, must be prepared to stop before passing the next signal. The train must maintain the prescribed speed until the next wayside signal is clearly visible and that signal displays a proceed indication, and the track to that signal is clear. A copy of the rule will be provided to the FRA Office of Safety Assurance and Compliance in care of James T. Schultz, Staff Director, Operating Practices.
- (B) Within 30 days of the issuance of the railroad's rule, a railroad operating supervisor shall personally contact each engineer and conductor in passenger service and inform them in a face-to-face meeting of the requirements of that rule. Such briefing shall be documented and such documentation shall be available for FRA review upon request, including date, time, location, crew members contacted, and supervisor making the contact.
- (C) Within 60 days of the issuance of the railroad's rule, each engineer/conductor in such passenger service shall receive an unannounced operational ("efficiency") test on the rule which requires a full stop at the signal ahead; and, within 90 days of rule publication, an on-board operational monitoring ride shall be conducted by an operating supervisor of the railroad to ensure a complete understanding of rule provisions. Such tests and operational monitoring checks shall be documented and such documentation shall be available for FRA review upon request, including date, time, location, crew members involved, and supervisor making the test/monitoring ride.
- (D) The railroad's program of operational tests and inspections under 49 CFR Part 217 shall be revised as necessary to include this rule, and shall specifically include a minimum of two such tests per year for each passenger engineer.

(2) Crew communications rule. Note: This rule applies to all push-pull and MU operations unless cab signal, automatic train stop, or automatic train control is in operation, speeds do not exceed 30 m.p.h., or within yard or terminal limits as specified for this purpose by the railroad.

- (A) Within 10 days of this order, have in effect, publish in its operating rules, and comply with a rule that requires: A crew member located in the operating cab of a controlling locomotive, cab car, or MU car, shall have means to communicate orally and shall communicate the indication and location of each wayside signal affecting the movement of the train as soon as the signal becomes visible, for all signals which require either (1) that the train be prepared to stop at the next wayside signal, or (2) that the train be prepared to pass the next wayside signal at restricted speed. In multiple track territory, the crew member shall include the affected track number. A copy of the rule shall be provided to the FRA Office of Safety Assurance and Compliance in care of James T. Schultz, Staff Director, Operating Practices.

18 Jun 1996 04:09 PM

- (B) A designated crew member located on a trailing unit or car shall immediately acknowledge the transmission, and confirm the information to the crew member(s) on the controlling locomotive by repeating the message. If the designated crew member fails to acknowledge the communication, the engineer must ascertain at the next scheduled stop why the message is not being confirmed. If necessary due to radio equipment failure, alternative means shall be established by the operating crew (e.g., via intercom, cellular telephone, etc.) to accomplish the procedure.
- (C) If the engineer fails to control the train movement in accordance with either a wayside signal indication or other restrictions imposed upon the train, the designated crew member in a trailing unit or car shall at once communicate with and caution the engineer regarding the restriction, and, if necessary, take appropriate action to ensure the safety of the train, including stopping the movement if appropriate.
- (D) Within 30 days of the issuance of the railroad's rule, a railroad operating supervisor shall personally contact each engineer and conductor in passenger service and inform them in a face-to-face meeting of the requirements of this rule. Such briefing shall be documented and such documentation shall be available for FRA review upon request, including date, time, location, crew members contacted, and supervisor making the contact.
- (E) Within 60 days of the issuance of the railroad's rule, each engineer/conductor in such passenger service shall receive an unannounced operational "efficiency" test on the rule; and, within 90 days of rule publication, an on-board operational monitoring ride shall be conducted by an operating supervisor of the railroad to ensure a complete understanding of rule provisions. Such tests and operational monitoring checks shall be documented and such documentation shall be available for FRA review upon request, including date, time, location, crew members involved, and supervisor making the test/monitoring ride.
- (F) The railroad's program of operational tests and inspections under 49 CFR Part 217 shall be revised as necessary to include this rule, and shall specifically include a minimum of two such tests per year for each passenger engineer.

(3) Emergency egress: marking and inspecting exits.

- **(A) Within 60 days of this order, ensure that each emergency exit location is marked both inside the car for passenger and crew information and, with regard to emergency window exits, on the exterior of the car as well for emergency responders. Markings for egress from inside the car shall be accompanied by clear and legible instructions for operation of the exit. Such markings must be clearly visible and legible at egress locations. This paragraph does not require action where reasonably conspicuous and fully legible markings and instructions already exist.**
- **(B) Immediately begin, and within 60 days of this order complete, a program to test a representative sample of emergency window exits on cars in its fleets to verify proper operation. Defective units will be repaired before the car is returned to service. Additionally, when a defective exit is discovered, all exits on that specific series/type of car will be tested and every defective exit replaced. Railroads must report to FRA when such action is necessary, and shall include a timetable for window inspection and replacement on the car series to remedy the problem in the most expedient manner.**
- (C) Records of the date, car number, and verification of proper exit operation shall be

APPENDIX I

maintained and available for FRA review upon request. Each railroad shall also verify emergency exit operation as part of routine vehicle maintenance cycles.

(4) Interim system safety plans.

Each authority operating or contracting for the operation of push-pull, EMU or DMU service (including Amtrak) shall, not later than 45 days from this order, submit to FRA an interim system safety plan for the purpose of enhancing the safety of such operations. In developing such plans, the authority shall provide opportunity for the riding public and designated representatives of railroad employees to comment on proposed actions that may affect the quality of service, including passenger safety.

The plan shall address the following hazards associated with passenger occupancy of lead units:

- Train-to-train collisions.
- Derailments giving rise to the hazard of impact with fixed structures.
- Collisions with heavy vehicles at highway-rail crossings.

The plan shall take into consideration the overall safety of all passengers and crew members and shall, at a minimum, address the following opportunities for risk reduction:

(A) Use of cab car/MU car. The authority shall specify the circumstances under which occupancy of a cab or MU car in the lead position is permitted, by route and train assignment. The authority shall propose or report appropriate modifications in such practices, taking into consideration service needs (e.g., equipment capacity passenger loadings) and safety issues (e.g., train densities, method of operation, availability of cab signals and automatic control, issues related to standing passengers, grade crossing exposure, and other relevant factors).

. *(B) Operating rules*. The authority shall review railroad operating rules and practices pertinent to the hazards listed above to determine if further enhancements in safety are warranted and advise FRA as to what action is necessary to enhance the level of safety. Changes in existing rules shall be specified. In conducting this review, the operating authority shall analyze the measures imposed in sections 1 and 2 of this order and may propose alternative approaches that ensure the same enhancements in safety associated with those measures.

(C) Adverse conditions. In conducting the review of railroad operating rules and practices, consideration shall be given to adverse or unusual operating conditions such as weather (e.g., fog, heavy rain or snow, flooding, etc.).

(D) Short-term technology enhancements. The authority shall consider short-term enhancements in technology that may improve the safety of train operations, such as use of alerting devices, equipping of additional locomotives with cab signal/ATC apparatus (where in effect on the territory), or other available enhancements to enhance engineer performance or provide warning of operation in excess of authority provided by the wayside signal system. In addition, the authority shall consider whether the installation of additional signals on any particular line would appreciably reduce the risk of train collisions.

(E) Crew management. The authority shall review crew management practices in light of contemporary literature regarding shift work and cumulative fatigue to determine if the alertness and performance of employees can be promoted by changes in those practices. Special attention shall be given to the issue of night split shifts.

(F) Highway-rail grade crossings. The authority shall review risks to passengers associated with occupancy of cab or MU cars in the lead while passing over highway-rail crossings, particularly crossings utilized by heavy vehicles and vehicles transporting hazardous materials, and shall address measures that can reduce these risks..

(G) Emergency exit notification. The authority shall review methods it uses, in addition to marking emergency exits, to inform passengers of the location and operation of those exits, such as flyers dropped on seats, announcements to passengers, explanations on the face of passenger tickets, etc. The authority shall specify any plans it has to increase passenger awareness of the location and operation of emergency exits.

Upon receipt of plans responsive to the above-reference requirements, the Administrator, in consultation with the FTA Administrator, will determine whether other mandatory action appears necessary to address hazards associated with the subject rail passenger service.

Relief

Petitions for special approval to take actions not in accordance with this order may be submitted to the Associate Administrator for Safety, who shall be authorized to dispose of those requests without the necessity of amending this order.

Pena

Any violation of this order shall subject the person committing the violation to a civil penalty of up to $20,000. 49 U.S.C. 21301. FRA may, through the Attorney General, also seek injunctive relief to enforce this order. 49 U.S.C. 20112.

Effective Date and Notice to Affected Persons

This order shall take effect at 12:01 a.m on February 21, 1996. This notice will be published in the *Federal Register* as soon as possible. Prior to publication, copies of this notice will be delivered by overnight mail or facsimile to the affected passenger railroads, public authorities, and railroad labor organizations.

Review

Opportunity for formal review of this Emergency Order will be provided in accordance with 49 U.S.C. 20104(b) and section 554 of Title 5 of the United States Code. Administrative procedures governing such review are found at 49 CFR Part 211. See 49 CFR 211.47, 211.71, 211.73, 211.75, and 211.77.

Issued in Washington, D.C. on FEB 20, 1996

Jolene M. Molitoris

18 Jun 1996 04:09 PM

Jolene M. Molitoris

Administrator

18 Jun 1996 04:09 PM

APPENDIX I

[4910-06]

DEPARTMENT OF TRANSPORTATION
Federal Railroad Administration

[FRA Emergency Order No. 20,
Notice No. 2]

Commuter and Intercity Passenger Railroads, Including Public Authorities Providing Passenger Service, and Affected Freight Railroads

Clarification of Emergency Order Requiring Enhanced Operating Rules and Plans for Ensuring the Safety of Passengers Occupying the Leading Car of a Train with Appropriate Amendments

---

<u>Introduction</u>

On February 20, 1996, the Federal Railroad Administration (FRA) issued Emergency Order No. 20 (Notice No. 1). The order required prompt action to immediately enhance passenger train operating rules and emergency egress and to develop a more comprehensive interim system safety plan addressing cab car forward and multiple unit (MU) operations that do not have either cab signal, automatic train stop, or automatic train control systems. Subsequent to issuance of the order, FRA and the Federal Transit Administration (FTA) recognized that the original order's safety measures, while establishing requirements to abate the safety risks at issue, would benefit from refinements increasing their effectiveness. Three aspects of the original order are being refined in this notice. FRA is: (1) more sharply focusing and strengthening the provisions relating to the delay in block rule; (2) tailoring the signal calling provisions to reflect more diverse operating situations; and (3) providing more detailed guidance on the emergency egress sampling provision. FRA is also clarifying measures that apply to defective cab signal, automatic train stop (ATS) and automatic train control (ATC).

Emergency Order No. 20 generally applies to commuter and intercity passenger railroads using push-pull and MU operations where cab signal, ATS, or ATC is not in operation and trains are operating in excess of 30 miles per hour. Although enroute failures are rare events, if cab signals, ATS or ATC fail, the relevant safety measures of this order apply. The only exception would be when cab signal, ATS or ATC fail on track that is not governed by wayside signals. In those instances, adherence to existing federal standards and applicable operating rules provide a comparable level of safety. It is important to note, however, that railroads are not expected to conduct efficiency testing when cab signal, ATS, or ATC is the normal method of operation and there is an occasional failure. Therefore, railroads are not expected to interfere with normal operation of the cab signal, ATS, or ATC systems for such efficiency testing. All changes and the clarification addressed above reflect discussions that FRA and FTA held with the commuter and intercity railroads subsequent to issuance of the order.

(1) Delayed in Block

The original order required application of the delay-in-block provisions regardless of the train's location on the railroad although, in the relevant accidents that formed the basis for the order, the trains involved were operating in a block immediately preceding an interlocking or controlled point. Additionally, the original order provided no maximum speed for delayed-in-block movements other than that provided in relevant railroad rules. The FRA's refined approach will limit the order's applicability to blocks immediately preceding interlockings and controlled points and require that the train reduce speed in accordance with applicable operating rules, but in no case may speed exceed 40 miles per hour. FRA established the maximum speed of 40 miles per hour in accordance with the reduced speed imposed under its regulations addressing failure of cab signal, ATS, or ATC devices (see 49 CFR 236.567, 236.811). This will more clearly focus the rule on the situations intended to be addressed by the original order and ensure that the maximum reduced speed permitted where the rule applies is standardized and is based on a known st~ ndard. In other words, the maximum speed where the rule applies will be 40 miles ', ur hour or less, depending upon the railroad's rules. FRA is also strengthening the delay-in-block rule by adding a measure requiring that appropriate signs be installed at each affected signal and at the departure end of stations. This will prevent confusion as to where the rule applies.

(2) Signal Calling

The modification to the signal calling provision reflects the reality that designated crew members will be positioned in varying locations when receiving the verbal communication identifying the signal indication. Although the initial version of the order specified a particular location on the train (i.e. in a trailing unit or car), the underlying safety concern can be satisfied by having the crew member receive and acknowledge the communication regardless of the responder's physical location on the train.

(3) Emergency Egress

The original order required but did not set parameters for testing a representative sample of emergency exits. The alteration to the emergency egress provisions requires that sampling of emergency window exits be conducted in conformity with either of two alternate methods commonly recognized for such efforts. This modification provides a degree of uniformity industry wide. These methods require sampling meeting a 95 percent confidence level that all emergency window exits operate properly (i.e., the methods do not accept a defect rate of 5 percent). Although the original order would have required testing all exits on a specific series or type of car if one such car had a defective window exit, the amended order permits the use of these commonly accepted sampling techniques to determine how many additional windows in test. In general, these principles require that the greater the percentage of windows initially found defective, the greater the percentage of windows that will have to be tested.

In addition, FRA has modified the emergency egress portion of the order to clarify that the exterior marking requirement applies to those windows that may be employed for access by emergency responders, which may be windows other than, or in addition to, those designed for emergency egress for passengers. In addition, FRA has modified the interim system safety plan portion of the order to require discussion of the railroad's programs and plans for liaison with and training of emergency responders with respect to emergency access to passengers. The original order required discussion only of methods used to inform passengers of the location and method of emergency exits.

Finding and Order

FRA concludes that certain current conditions and practices on commuter and intercity passenger railroads pose an imminent and unacceptable threat to public and employee safety. Of greatest concern are push-pull and MU operations lacking the protection provided by cab signal, automatic train stop, or automatic train control systems. Based on the matters discussed in Notice No. 1 of this order, I found that the unsafe conditions discussed there create an emergency situation involving a hazard of death or injury to persons. While I continue to find an emergency situation to exist, I have concluded that certain modifications to the order are necessary. For the convenience of those subject to this order. I have set forth here all of its terms, as amended. Accordingly, pursuant to the authority o · U.S.C. § 20104, delegated to me by the Secretary of Transportation (49 CFR § 1.49), it is hereby ordered that each commuter and intercity passenger railroad, and any other entity (e.g., freight railroads over whose lines affected passenger operations are conducted) whose actions are necessary to effectuate the directives in this order, take the following actions:

(1) **Delayed-in-block rule.** Note: This rule applies to all push-pull and MU operations unless cab signal, automatic train stop, or automatic train control is in operation, speeds do not exceed 30 m.p.h., or within yard or terminal limits as specified for this purpose by the railroad.

(A) On March 4, 1996, at 12:01 a.m., have in effect, publish in its code of operating rules, and comply with a rule that requires: If a passenger train operating in the block immediately preceding an interlocking or controlled point stops for any reason, or its speed is reduced below 10 m.p.h., the train shall proceed under the reduced speed set forth in applicable operating rules governing such circumstances and be prepared to stop before passing the next signal. In no event shall this reduced speed exceed 40 m.p.h., although lower speeds are permissible. The train must maintain the prescribed reduced speed until the next wayside signal is clearly visible and that signal displays a proceed indication. A copy of the rule will be provided to the FRA Office of Safety Assurance and Compliance in care of James T. Schultz, Staff Director, Operating Practices.

(B) Within 30 days of issuance of the railroad's rule, a railroad operating supervisor shall personally contact each engineer and conductor in passenger service and inform them in a face-to-face meeting of the requirements of that rule. Such briefing shall be documented and such documentation shall be available for FRA review upon request, including date, time, location, crew members contacted, and supervisor making the contact.

(C) Within 60 days of issuance of the railroad's rule, each engineer/conductor in such passenger service shall receive an unannounced operational ("efficiency") test on the rule which requires a full stop at the signal ahead; and, within 90 days of rule publication, an on-board operational monitoring ride shall be conducted by an operating supervisor of the railroad to ensure a complete understanding of rule provisions. Such tests and operational monitoring checks shall be documented and such documentation shall be available for FRA review upon request, including date, time, location, crew members involved, and supervisor making the test/monitoring ride.

(D) The railroad's program of operational tests and inspections under 49 CFR Part 217 shall be revised as necessary to include this rule, and shall specifically include a minimum of two such tests per year for each passenger engineer.

(E) Within 30 days of issuance of the railroad's rule, an appropriate qualifying appurtenance shall be affixed to each signal governing the approach to an interlocking or controlled point signal to serve as a visual reminder to the engineer. Appropriate signage shall be displayed at the departure end of passenger stations located in the block immediately preceding interlockings or controlled points.

(2) Crew communications rule. Note: This rule applies to all push-pull and MU operatio. unless cab signal, automatic train stop, or automatic train control is in operation, speeds do not exceed 30 m.p.h., or within yard or terminal limits as specified for this purpose by the railroad.

(A) On March 4, 1996, at 12:01 a.m., have in effect, publish in its operating rules, and comply with a rule that requires: A crew member located in the operating cab of a controlling locomotive, cab car, or MU car, shall have means to communicate orally and shall communicate the indication and location of each wayside signal affecting the movement of the train as soon as the signal becomes visible, for all signals which require either (1) that the train be prepared to stop at the next wayside signal, or (2) that the train be prepared to pass the next wayside signal at restricted speed. In multiple track territory, the crew member shall include the affected track number. A copy of the rule shall be provided to the FRA Office of Safety Assurance and Compliance in care of James T. Schultz, Staff Director, Operating Practices.

(B) A designated crew member shall immediately acknowledge the transmission, and confirm the information to the crew member(s) on the controlling locomotive by repeating the message. If the designated crew member fails to acknowledge the communication, the engineer must ascertain at the next scheduled stop why the message is not being confirmed. If necessary due to radio equipment failure, alternative means shall be established by the operating crew (e.g., via intercom, cellular telephone, etc.) to accomplish the procedure.

(C) If the engineer fails to control the train movement in accordance with either a wayside signal indication or other restrictions imposed upon the train, the designated crew member shall at once communicate with and caution the engineer regarding the restriction, and, if necessary, take appropriate action to ensure the safety of the train, including stopping the movement if appropriate.

(D) Within 30 days of the issuance of the railroad's rule, a railroad operating supervisor shall personally contact each engineer and conductor in passenger service and inform them in a face-to-face meeting of the requirements of this rule. Such briefing shall be documented and such documentation shall be available for FRA review upon request, including date, time, location, crew members contacted, and supervisor making the contact.

(E) Within 60 days of the issuance of the railroad's rule, each engineer/conductor in such passenger service shall receive an unannounced operational "efficiency" test on the rule; and, within 90 days of rule publication, an on-board operational monitoring ride shall be conducted by an operating supervisor of the railroad to ensure a complete understanding of rule provisions. Such tests and operational monitoring checks shall be documented and such documentation shall be available for FRA review upon request, including date, time, location, crew members involved, and supervisor making the test/monitoring ride.

(F) The railroad's program of operational tests and inspections under 49 CFR Part 217 shall be revised as necessary to include this rule, and shall specifically include a minimum of two such tests per year for each passenger engineer.

(3) Emergency egress: marking and inspecting exits.

(A) No later than April 20, 1996, ensure that each emergency exit location is marked inside the car for passenger and crew information. Markings for egress from inside the car shall be accompanied by clear and legible instructions for operation of the exit. Also, clear markings shall also be provided on the exterior of each car indicating which windows may be employed for access by emergency responders. All such markings must be clearly visible and legible at egress locations. This paragraph does not require action where reasonably conspicuous and fully legible markings and instructions already exist.

(B) Immediately begin, and by April 20 complete, a program to test a representative sample of emergency window exits on cars in its fleets to verify proper operation. Sampling must be conducted to meet a 95% confidence level and in accordance with Military Standard MIL-STD-105(D) Sampling for Attributes or American National Standards Institute ANSI-ASQC Z1.4-1993 Sampling Procedures for Inspections by Attributes. Defective units will be repaired before the car is returned to service. Railroads must report to FRA when such action is necessary, and shall include a timetable for window inspection and replacement on the car series to remedy the problem in the most expeditious manner.

(C) Records of the date, car number, and verification of proper exit operation shall be maintained and available for FRA review upon request. Each railroad shall also verify emergency exit operation as part of routine vehicle maintenance cycles.

(4) Interim system safety plans.

Each authority operating or contracting for the operation of push-pull, EMU or DMU service (including Amtrak) shall, not later than April 5, 1996, submit to FRA an interim system safety plan for the purpose of enhancing the safety of such operations. In developing such plans, the authority shall provide opportunity for the riding public and designated representatives of railroad employees to comment on proposed actions that may affect the quality of service, including passenger safety.

The plan shall address the following hazards associated with passenger occupancy of lead units:

Train-to-train collisions.

Derailments giving rise to the hazard of impact with fixed structures.

Collisions with heavy vehicles at highway-rail crossings.

The plan shall take into consideration the overall safety of all passengers and crew members and shall, at a minimum, address the following opportunities for risk reduction:

(A) *Use of cab car/MU car*. The authority shall specify the circumstances under which occupancy of a cab or MU car in the lead position is permitted, by route and train assignment. The authority shall propose or report appropriate modifications in such practices, taking into consideration service needs (*e.g.*, equipment capacity, passenger loadings) and safety issues (*e.g.*, train densities, method of operation, availability of cab signals and automatic control, issues related to standing passengers, grade crossing exposure, and other relevant factors).

. *(B)* *Operating rules*. The authority shall review railroad operating rules and practices pertinent to the hazards listed above to determine if further enhancements in safety are warranted and advise FRA as to what action is necessary to enhance the level of safety. Changes in existing rules shall be specified. In conducting this review, the operating authority shall analyze the measures imposed in sections 1 and 2 of this order and may propose alternative approaches that ensure the same enhancements in safety associated with those measures.

(C) *Adverse conditions*. In conducting the review of railroad operating rules and practices, consideration shall be given to adverse or unusual operating conditions such as weather (*e.g.*, fog, heavy rain or snow, flooding, etc.).

(D) *Short-term technology enhancements*. The authority shall consider short-term enhancements in technology that may improve the safety of train operations, such as use of alerting devices, equipping of additional locomotives with cab signal/ATC apparatus (where in effect on the territory), or other available enhancements to enhance engineer performance or provide warning of operation in excess of authority provided by the wayside signal system. In addition, the authority shall consider whether the installation of additional signals on any particular line would appreciably reduce the risk of train collisions.

(E) *Crew management*. The authority shall review crew management practices in light of

contemporary literature regarding shift work and cumulative fatigue to determine if the alertness and performance of employees can be promoted by changes in those practices. Special attention shall be given to the issue of night split shifts.

(F) Highway-rail grade crossings. The authority shall review risks to passengers associated with occupancy of cab or MU cars in the lead while passing over highway-rail crossings, particularly crossings utilized by heavy vehicles and vehicles transporting hazardous materials, and shall address measures that can reduce these risks..

(G) Emergency exit notification. The authority shall review methods it uses, in addition to marking emergency exits, to inform passengers of the location and operation of those exits, such as flyers dropped on seats, announcements to passengers, explanations on the face of passenger tickets, etc. The authority shall specify any plans it has to increase passenger awareness of the location and operation of emergency exits. The authority shall also discuss its plans for liaison with and training of emergency responders with respect to emergency access to passenger cars.

Upon receipt of plans responsive to the above-reference requirements, the Administrator, in consultation with the FTA Administrator, will determine whether other mandatory action appears necessary to address hazards associated with the subject rail passenger service.

Relief

Petitions for special approval to take actions not in accordance with this order may be submitted to the Associate Administrator for Safety, who shall be authorized to dispose of those requests without the necessity of amending this order. A copy of this petition should be submitted to the Docket Clerk, Office of Chief Counsel, Federal Railroad Administration, 400 Seventh Street, S.W., Washington, D.C. 20590.

Penalties

Any violation of this order shall subject the person committing the violation to a civil penalty of up to $20,000. 49 U.S.C. §§ 21301. FRA may, through the Attorney General, also seek injunctive relief to enforce this order. 49 U.S.C. § 20112.

Effective Date and Notice to Affected Persons

The amendments to this order shall take effect at 12:01 a.m. on March 4, 1996. The original order would have required the railroad to have its revised operating rules on delay in block and crew communications to be in place by March 2. The additional two days granted here is intended to ensure that it is feasible to revise, issue, and implement the revised rules by Monday, March 4. Other deadlines (i.e., for compliance with the emergency egress and interim system safety plan requirements) are not changed, but actual dates have been inserted to avoid confusion about how to count the days allotted for certain tasks. This notice will be published in the *Federal Register* as soon as possible. Prior to publication, copies of this notice will be delivered by overnight mail or facsimile to the affected passenger railroads, public authorities, and railroad labor organizations.

Review

Opportunity for formal review of this Emergency Order will be provided in accordance with 49 U.S.C. § 20104(b) and section 554 of Title 5 of the United States Code. Administrative procedures governing such review are found at 49 CFR Part 211. See 49 CFR §§ 211.47, 211.71, 211.73, 211.75, and 211.77.

Issued in Washington, D.C. on February 29, 1996 Jolene M. Molitoris Administrator

APPENDIX J

MARC TRAIN SERVICE SCHEDULE FOR BRUNSWICK AND CAMDEN LINES

MARC TRAIN SERVICE
BRUNSWICK & CAMDEN LINES
MONDAY through FRIDAY EFFECTIVE DECEMBER 11, 1995

WESTBOUND SCHEDULE

TRAIN NUMBER	AR/DP	241	243	245 H	271	247	249 H	251	273 H	275 H	253 H	277 P	279	255	281 CP/H	257/283	285	259 H	261/287
CITY / AM - PM		AM	AM	AM	AM	AM	AM	AM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
CAMDEN LINE																			
BALT. CAMDEN STATION	DP	5:30	5:55	6:30	-	7:05	8:05	11:00	-	-	3:45	-	-	4:15	-	4:55	-	5:55	6:40
ST. DENIS	DP	5:42	-	6:42	-	7:17	8:17	f11:12	-	-	f3:56	-	-	-	-	-	-	f6:05	-
ELKRIDGE	DP	-	-	6:45	-	7:20	-	f11:14	-	-	-	-	-	-	-	-	-	-	-
JESSUP	DP	5:51	-	6:53	-	7:28	8:28	11:22	-	-	4:05	-	-	-	-	5:15	-	6:14	7:02
SAVAGE	DP	5:55	6:10	6:57	-	7:32	8:30	11:26	-	-	4:09	-	-	4:38	-	5:19	-	6:19	7:06
LAUREL RACETRACK	DP	5:58	-	7:02	-	7:36	8:34	11:29	-	-	4:12	-	-	-	-	5:23	-	6:23	7:10
LAUREL	DP	6:02	6:23	7:06	-	7:38	8:36	11:31	-	-	4:14	-	-	4:43	-	5:25	-	6:25	7:12
MUIRKIRK	DP	6:07	6:28	7:11	-	7:44	8:41	11:35	-	-	4:19	-	-	4:48	-	5:30	-	6:30	7:17
GREENBELT	DP	6:14	-	7:18	-	7:52	8:48	11:43	-	-	4:26	-	-	-	-	5:37	-	6:37	7:24
COLLEGE PARK	DP	6:19	-	7:23	-	7:57	8:53	f11:48	-	-	f4:31	-	-	-	-	f5:42	-	f6:42	f7:29
RIVERDALE	DP	6:22	-	7:26	-	8:01	8:56	f11:51	-	-	4:34	-	-	-	-	5:45	-	f6:45	f7:32
WASHINGTON	AR	6:35	6:50	7:40	-	8:15	9:10	12:10	-	-	4:48	-	-	5:10	-	6:00	-	7:00	7:50
																THRU			THRU
BRUNSWICK LINE																			
WASHINGTON	DP	-	-	-	8:32	-	-	-	1:00	4:25	-	4:55	5:10	-	5:30	6:13	6:55	-	8:00
SILVER SPRING	DP	-	-	-	8:45	-	-	-	1:13	4:38	-	5:09	5:24	-	5:44	6:28	7:08	-	8:13
KENSINGTON	DP	-	-	-	8:51	-	-	-	f1:18	4:44	-	-	5:30	-	5:49	6:34	7:13	-	f8:18
GARRETT PARK	DP	-	-	-	-	-	-	-	f1:21	-	-	-	5:34	-	5:53	6:38	7:17	-	f8:21
ROCKVILLE	DP	-	-	-	8:58	-	-	-	1:27	4:53	-	5:21	5:39	-	5:59	6:43	7:23	-	8:25
WASHINGTON GROVE	DP	-	-	-	-	-	-	-	f1:32	-	-	-	5:44	-	-	6:48	7:28	-	f8:30
GAITHERSBURG	DP	-	-	-	9:05	-	-	-	1:35	5:01	-	-	5:47	-	6:06	6:51	7:32	-	8:33
METROPOLITAN GROVE	DP	-	-	-	9:09	-	-	-	f1:39	5:05	-	-	5:51	-	6:10	6:55	7:36	-	f8:36
GERMANTOWN	DP	-	-	-	9:13	-	-	-	1:43	5:10	-	-	5:57	-	6:16	7:01	7:41	-	8:40
BOYDS	DP	-	-	-	-	-	-	-	d1:46	-	-	-	d6:02	-	-	d7:05	d7:44	-	d8:44
BARNESVILLE	DP	-	-	-	-	-	-	-	d1:52	L5:19	-	-	L6:08	-	L6:24	d7:11	d7:48	-	d8:49
DICKERSON	DP	-	-	-	-	-	-	-	d1:55	-	-	-	d6:11	-	-	d7:15	d7:51	-	d8:52
POINT OF ROCKS	DP	-	-	-	L9:28	-	-	-	L2:04	L5:36	-	-	L6:19	-	6:37	L7:22	d7:57	-	L9:01
BRUNSWICK, MD.	DP	-	-	-	9:42	-	-	-	2:20	5:47	-	L6:01	L6:34	-	L6:49	7:37	L8:10	-	9:17
HARPERS FERRY, W.V.	DP	-	-	-	-	-	-	-	-	-	-	L6:11	-	-	L6:59	-	L8:20	-	-
DUFFIELDS	DP	-	-	-	-	-	-	-	-	-	-	L6:23	-	-	L7:11	-	L8:33	-	-
MARTINSBURG, W.V.	AR	-	-	-	-	-	-	-	-	-	-	6:40	-	-	7:29	-	8:50	-	-

FOR ADDITIONAL INFORMATION ON MARC SCHEDULES, FARES AND OTHER SERVICES CALL 1-800-325-RAIL.

f Flag stop at this station: trains will pick up passengers standing on platform, and visible to engineer. Trains will discharge passengers at this station if passengers have notified conductor upon boarding.

d Discharge only stop at this station: Train will stop to discharge passengers only. Passengers must notify conductor upon boarding. Train may leave ahead of scheduled departure time when passengers have been discharged.

L Train receives and discharges passengers at this station. Train may leave this station up to five minutes in advance of scheduled departure time.

H Holiday Service – Trains designated with an H at the top of the column will operate on Martin Luther King, President's, Columbus, Veterans Day and the Friday following Thanksgiving. There is no MARC train service on New Year's, Memorial, Independence, Labor, Thanksgiving and Christmas days.

CP Cafe Parlor service available on this train. Individual, rotating, reclining seats are available by reservation, and at extra charge. Light food and beverage service available to all passengers. Call 1-410-[illegible]-7420 for reservations.

P Parlor service is available on this train. Individual, rotating, reclining seats are available by reservation and at extra charge. Snack and beverage service available to all passengers. Call 1-410-[illegible]-7420 for reservations.

WESTBOUND SCHEDULE

APPENDIX J

MARC TRAIN SERVICE
BRUNSWICK & CAMDEN LINES
MONDAY through FRIDAY EFFECTIVE DECEMBER 11, 19[illegible]

EASTBOUND SCHEDULE

	TRAIN NUMBER	ARR/DP	270	240	272/242	274 CP/H	276 P	244	278	280 H	246 H	282 H	248 H	284	250	252 H	254	286	256	258 H	260
	CITY / AM - PM		AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	PM	PM	PM	PM	PM	PM	PM	PM
BRUNSWICK LINE	MARTINSBURG, W.V.	DP	-	-	-	5:30	-	-	-	6:35	-	-	-	-	-	-	-	-	-	-	-
	DUFFIELDS	DP	-	-	-	5:40	-	-	-	6:51	-	-	-	-	-	-	-	-	-	-	-
	HARPERS FERRY, W.V.	DP	-	-	-	5:56	-	-	-	7:01	-	-	-	-	-	-	-	-	-	-	-
	BRUNSWICK, MD.	DP	5:15	-	5:40	6:07	6:25	-	6:40	7:12	-	8:00	-	3:00	-	-	-	4:30	-	-	-
	POINT OF ROCKS	DP	[illegible]	-	5:51	6:10	6:36	-	6:51	7:23	-	8:11	-	3:10	-	-	-	4:41	-	-	-
	DICKERSON	DP	5:31	-	5:58	-	-	-	6:58	-	-	8:19	-	-	-	-	-	4:48	-	-	-
	BARNESVILLE	DP	5:37	-	6:01	6:25	6:45	-	7:03	-	-	8:24	-	-	-	-	-	4:54	-	-	-
	BOYDS	DP	5:41	-	-	-	-	-	7:08	-	-	8:29	-	-	-	-	-	4:58	-	-	-
	GERMANTOWN	DP	5:46	-	6:08	6:38	6:54	-	7:13	7:40	-	8:33	-	3:24	-	-	-	5:03	-	-	-
	METROPOLITAN GROVE	DP	5:51	-	6:13	6:43	6:58	-	7:19	7:45	-	8:37	-	3:28	-	-	-	5:07	-	-	-
	GAITHERSBURG	DP	5:57	-	6:19	6:48	7:03	-	7:25	7:50	-	8:41	-	3:31	-	-	-	5:11	-	-	-
	WASHINGTON GROVE	DP	5:59	-	6:21	-	-	-	7:28	-	-	8:43	-	-	-	-	-	5:13	-	-	-
	ROCKVILLE	DP	6:06	-	6:27	6:55	7:12	-	7:34	7:57	-	8:48	-	3:38	-	-	-	5:18	-	-	-
	GARRETT PARK	DP	6:12	-	-	-	7:16	-	7:40	-	-	8:54	-	-	-	-	-	5:24	-	-	-
	KENSINGTON	DP	6:16	-	6:36	-	7:21	-	7:44	-	-	8:57	-	3:46	-	-	-	5:27	-	-	-
	SILVER SPRING	DP	6:21	-	6:42	7:06	7:27	-	7:50	8:08	-	9:03	-	3:53	-	-	-	5:33	-	-	-
	WASHINGTON	AR	6:34	-	7:00	7:25	7:43	-	8:10	8:25	-	9:20	-	4:10	-	-	-	5:50	-	-	-
					THRU																
CAMDEN LINE	WASHINGTON	DP	-	6:47	7:15	-	-	7:55	-	-	8:35	-	11:35	-	4:35	5:12	5:37	-	6:06	7:09	8:00
	RIVERDALE	DP	-	6:57	7:25	-	-	-	-	-	8:45	-	11:45	-	4:45	5:22	-	-	6:16	7:19	8:10
	COLLEGE PARK	DP	-	7:00	7:28	-	-	-	-	-	8:48	-	f11:48	-	4:48	5:25	-	-	6:19	f7:21	f8:13
	GREENBELT	DP	-	7:02	7:30	-	-	-	-	-	8:50	-	11:52	-	4:51	5:28	-	-	6:24	7:25	8:16
	MUIRKIRK	DP	-	7:09	7:37	-	-	8:14	-	-	8:57	-	11:59	-	4:58	5:35	5:56	-	6:31	7:33	8:23
	LAUREL	DP	-	7:14	7:42	-	-	8:19	-	-	9:02	-	12:04	-	5:03	5:40	6:01	-	6:36	7:38	8:28
	LAUREL RACETRACK	DP	-	f7:16	f7:44	-	-	-	-	-	f9:04	-	12:06	-	5:06	5:43	-	-	6:38	7:40	f8:30
	SAVAGE	DP	-	7:19	7:48	-	-	8:24	-	-	9:08	-	12:09	-	5:12	5:49	6:06	-	6:44	7:45	8:33
	JESSUP	DP	-	7:23	7:52	-	-	-	-	-	9:12	-	12:13	-	5:17	5:53	-	-	6:48	7:49	8:37
	ELKRIDGE	DP	-	-	-	-	-	-	-	-	-	-	f12:23	-	-	6:01	-	-	6:56	f7:57	f8:45
	ST. DENIS	DP	-	f7:33	-	-	-	-	-	-	f9:27	-	f12:25	-	5:25	6:04	-	-	6:59	f8:00	f8:48
	BALT. CAMDEN STATION	AR	-	7:49	8:22	-	-	8:50	-	-	9:38	-	12:44	-	5:43	6:23	6:32	-	7:17	8:15	9:13

FOR ADDITIONAL INFORMATION ON MARC SCHEDULES, FARES AND OTHER SERVICES CALL 1-800-325-RAIL.

f Flag stop at this station: trains will pick up passengers standing on platform, and visible to engineer. Trains will discharge passengers at this station if passengers have notified conductor upon boarding.

d Discharge only stop at this station: Train will stop to discharge passengers only. Passengers must notify conductor upon boarding. Train may leave ahead of scheduled departure time when passengers have been discharged.

L Train receives and discharges passengers at this station. Train may leave this station up to five minutes in advance of scheduled departure time.

H Holiday Service – Trains designated with an H at the top of the column will operate on Martin Luther King, President's, Columbus, Veterans Day and the Friday following Thanksgiving. On these days only trains 274 and 280 will also stop at Kensington at 7:00 am and 8:02 am. There is no MARC train service on New Year's, Memorial, Independence, Labor, Thanksgiving and Christmas days.

CP Cafe Parlor service available on this train. Individual, reclining seats are available by reservation, and at extra charge. Light food and beverage service available to all passengers. Call 1-410-859-7420 for reservations.

P Parlor service is available on this train. Individual, reclining seats are available by reservation and at extra charge. Snack and beverage service available to all passengers. Call 1-410-859-7420 for reservations.

EASTBOUND SCHEDULE

APPENDIX K

FRA CORRESPONDENCE ON REGULATORY AUTHORITY OF COMMUTER RAILROAD OPERATIONS

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Surface Transportation Safety
Washington, D. C. 20594

May 23, 1996

Honorable Jolene M. Molitoris
Administrator
Federal Railroad Administration
400 Scvcnth Street S.W.
Washington, D.C. 20590

Dear Ms. Molitoris:

The collision and derailment of the MARC commuter train with Amtrak train 29 at Silver Spring on February 16, 1996 has focused attention on commuter railroad options. The Safety Board needs to obtain accident and inspection statistics for commuter operations regulated by the Federal Railroad Administration (FRA) along with the inspection and compliance history for these operations. This information will assist the Safety Board in its investigation of the recent accident at Silver Spring by identifying the operator(s) of commuter operations and the accident history of the those organizations and the commuter rail industry.

The Safety Board requests the following information:

- Listing of commuter railroad operations within FRA's regulatory authority.
- **Listing of FRA reportable accidents within the last five years reported by MARC and Virginia Railway Express (VRE) to the FRA.**
- A five year accident history and rate per million train miles for commuter operations for those commuter railroad operations under FRA's regulatory authority.
- **A five year inspection, defect, and violation history, by year and type (track, equipment, etc.) for commuter railroad operations. This listing would include detailed data for MARC and Virginia Railway Express (VRE).**

Thank you for FRA's cooperation in this investigation.

Respectfully,

Ed Dobranetski **P.E.**
Investigator-in-Charge
Chief Major Investigations
Railroad Division

APPENDIX K

U.S. Department of Transportation
Federal Railroad Administration

Office of the Administrator

400 Seventh St., S.W.
Washington, D.C. 20590

JUN 25 1996

Ed Dobranetski, P.E.
Investigator-in-Charge
Chief, Major Investigations
Railroad Division
Office of Surface Transportation Safety
National Transportation Safety Board
Washington, D.C. 20594

Dear Mr. Dobranetski:

Thank you for your letter requesting historical and statistical information for commuter railroad operations regulated by the Federal Railroad Administration (FRA).

FRA's regulatory authority extends to the following commuter railroad operations:

<u>Commuter Service Operated By Amtrak for</u> -
Connecticut Department of Transportation
Massachusetts Bay Transportation Authority (MBTA)
Peninsula Corridor Joint Powers Board (CalTrain)
San Diego Northern Railway
Southern California Regional Rail Authority (METROLINK)
Virginia Railway Express (VRE)

<u>Commuter Service Operated by Amtrak and CSX for</u> -
Maryland Mass Transit Administration (MARC)

<u>Commuter Service Operated by the Commuter Railroad itself</u> -
Long Island Rail Road (LIRR)
Metro-North Railroad
Northern Indiana Commuter Transportation District (NICTD)
Northeast Illinois Regional Commuter Rail Corp. (METRA)
New Jersey Transit Rail Operations, Inc.
Port Authority Trans-Hudson Corporation (PATH)
Southeastern Pennsylvania Transportation Authority (SEPTA)

2

Commuter Service Operated by a Freight Railroad -
Union Pacific Railroad (formerly CNW)
Burlington Northern Railroad

Commuter Service Operated by Herzog Transit Services Inc. for -
Tri-County Commuter Rail Authority (Trial-Rail)

We do not have five-year accident, inspection, defect, or violation data for individual commuter railroads, including MARC and VRE. Prior to 1996, data regarding accidents and incidents involving commuter trains was reported by the carrier operating the train service. In many cases, the operating railroad was Amtrak or a freight railroad. Some commuter railroad accident/incident data reported to FRA was commingled with freight and intercity data.

FRA has the information you requested for nine individual commuter railroads. I have enclosed annual train-mile, reportable accidents, and accident rate information for those railroads. In July 1995, FRA requested that those commuter railroads which were not reporting accident/incident information in separate form to FRA begin doing so beginning in January 1996. We are currently working with those railroads to ensure that data is reported correctly.

I appreciate your interest in this matter and hope this information is useful.

Sincerely,

Jolene M. Molitoris

Jolene M. Molitoris
Administrator

Enclosure

APPENDIX K

06/25/96 17:31 ☎202 366 7009 FRA → NTSB CHAIR HALL 00

Summarized Frequency Rates for SELECT Railroad System
RAIL-HIGHWAY CROSSING ACCIDENTS HAVE NOT BEEN COUNTED
CASUALTY STATISTICS INCLUDE ALL ACCIDENTS/INCIDENTS

Year=91

ilroad	Total Miles	Total EOD Hours	Total EOD Casualties	CASUALTY RATES	Total All Accidents	ACCIDENT RATES
ng Island Rail Road	8,184,190	13,012,673	997	15.3235	15	1.8328
tro North Commuter Railroad Company	7,159,111	10,927,437	635	11.6221	22	3.0730
rthern Indiana Commuter Transportation District	787,394	558,523	42	15.0397	3	3.810
rtheast Illinois Regional Commuter Rail Corp. (METRA)	3,037,860	4,228,647	123	5.8175	2	0.658
w Jersey Transit Rail Operations	6,648,126	7,826,852	240	6.1327	40	6.016
rt Authority Trans Hudson	1,563,273	2,723,476	209	15.3480	4	2.558
utheastern Pennsylvania Transportation Authority	4,926,725	3,611,008	197	10.9111	10	2.030
i-County Commuter Rail Authority	428,388	169,283	13	15.3589	.	.

Year=92

ilroad	Total Miles	Total EOD Hours	Total EOD Casualties	CASUALTY RATES	Total All Accidents	ACCIDEN RATES
ng Island Rail Road	8,207,787	11,780,728	831	14.1078	14	1.705
tro North Commuter Railroad Company	7,290,733	10,748,262	581	10.8111	20	2.743
rthern Indiana Commuter Transportation District	822,008	584,696	33	11.2879	2	2.433
rtheast Illinois Regional Commuter Rail Corp. (METRA)	3,153,257	4,290,557	90	4.1953	2	0.634
w Jersey Transit Rail Operations	7,168,670	7,592,676	244	6.4801	25	3.487
rt Authority Trans Hudson	1,557,679	2,778,204	207	14.9017	6	3.851
utheastern Pennsylvania Transportation Authority	6,361,905	3,404,248	164	9.6350	10	2.292
i-County Commuter Rail Authority	505,044	196,761	6	6.0988	.	.

APPENDIX K

Year=93

oad	Total Miles	Total ECD Hours	Total ECD Casualties	CASUALTY RATES	Total All Accidents	ACCIDENT RATES
Island Rail Road	8,182,739	12,156,566	686	11.2861	22	2.6886
North Commuter Railroad Company	7,369,991	10,716,196	563	10.5075	29	3.9349
ern Indiana Commuter Transportation District	829,348	602,159	67	22.2533	2	2.6115
east Illinois Regional Commuter Rail Corp. (METRA)	3,176,344	4,533,038	95	4.1916	.	.
ersey Transit Rail Operations	7,432,997	7,342,887	220	5.9922	31	4.1706
Authority Trans Hudson	1,625,175	2,617,188	222	16.9648	4	2.4613
ern California Regional Rail Authority	446,215	196,469	.	.	5	11.2054
eastern Pennsylvania Transportation Authority	4,436,432	3,347,887	207	12.3660	10	2.2540
unty Commuter Rail Authority	620,985	211,855	9	8.4964	.	.

Year=94

oad	Total Miles	Total ECD Hours	Total ECD Casualties	CASUALTY RATES	Total All Accidents	ACCIDENT RATES
Island Rail Road	8,141,369	12,296,303	693	11.2733	35	4.2990
North Commuter Railroad Company	7,374,073	10,765,789	574	10.6634	33	4.4751
ern Indiana Commuter Transportation District	826,515	618,533	54	17.4607	4	4.8513
east Illinois Regional Commuter Rail Corp. (METRA)	3,233,488	4,720,979	116	4.9142	2	0.6185
ersey Transit Rail Operations	7,442,993	7,345,156	239	6.5077	14	1.8810
Authority Trans Hudson	1,676,057	2,148,459	138	12.8464	2	1.1933
ern California Regional Rail Authority	913,518	285,242	.	.	2	2.1893
eastern Pennsylvania Transportation Authority	4,964,483	3,313,114	243	14.6690	4	0.8057
unty Commuter Rail Authority	629,363	237,226	8	6.7446	.	.

Year=95

oad	Total Miles	Total ECD Hours	Total ECD Casualties	CASUALTY RATES	Total All Accidents	ACCIDENT RATES
Island Rail Road	8,188,318	11,537,943	584	10.1231	30	3.6638
North Commuter Railroad Company	7,834,671	10,729,538	525	9.7861	23	2.9357
ern Indiana Commuter Transportation District	832,292	624,227	51	16.3402	1	1.2015
east Illinois Regional Commuter Rail Corp. (METRA)	3,598,995	4,784,937	123	5.1411	6	1.6671
ersey Transit Rail Operations	7,546,969	7,317,126	86	2.3506	6	0.7950
Authority Trans Hudson	1,977,626	2,070,978	131	12.6510	5	2.5283
ern California Regional Rail Authority	1,054,843	352,590	6	3.4034	3	2.8440
eastern Pennsylvania Transportation Authority	5,050,245	3,496,187	231	13.2144	4	0.7920
unty Commuter Rail Authority	622,607	234,849	10	8.5154	.	.

APPENDIX L

NATIONAL TRANSPORTATION SAFETY BOARD AND POSITIVE TRAIN CONTROL

Railroads rely on train crews to comply with operating rules to prevent collisions. The operating rules explain the meaning of each signal, the proper response to a particular signal aspect, the procedure for conveying track warrants, the individual duties of the train crew members, and other vital information needed to safely operate trains. The operating rules provide all necessary guidelines to prevent collisions providing crews understand and obey them.

An increasing majority of the train accidents investigated by the Safety Board have been the result of human error. The best efforts by the railroads to train and test train crews for compliance with operating rules has not guaranteed that individuals will take the correct action or that accidents will not happen. Highly trained individuals still have accidents. A PTS control system provides the back-up to the engineer that ensures a train is properly operated.

After its investigation of a May 1986 rear-end collision at Brighton, Massachusetts,[2] the Safety Board issued the following Safety Recommendation to the FRA:

R-87-16

Promulgate Federal standards to require the installation and operation of a train control system on main line tracks that will provide for positive separation of all trains.

In June of 1993 the FRA responded that the 1992 "Rail Safety Enforcement and Review Act" requires them to conduct a comprehensive review and safety inquiry into ATC. They reported that several major railroads are beginning installation of the ATC communications platform or are actively considering installation. In addition the FRA stated that they were to explore possible trial applications on one or more corridors selected for funding under the President's high speed rail ground transportation initiative. The recommendation is still classified "Open--Acceptable Response." PTS control systems are still on the Safety Board's list of most wanted transportation safety improvements.

Following the accident involving the head-on collision between two trains in Kelso, Washington on November 11, 1993, the Safety Board reiterated Safety Recommendations R-87-16 and R-93-12 to the FRA and issued the following safety recommendations to the FRA:

R-94-13

As part of your monitoring and oversight activities on the Burlington Northern and the Union Pacific Railroad's train control demonstration project, identify and evaluate all potential safety and business benefits of the train control system currently proposed for the northwest region of the United States. Consider the value of these benefits in your overall assessment of the system.

R-94-14

[2] Railroad Accident Report--*Rear End Collision Between Boston and Maine Corporation Commuter Train No. 5324 and Consolidated Rail Corporation Train TV-14, Brighton, Massachusetts, May 7, 1986 (NTSB/RAR-87/02).*

> In conjunction with the AAR, identify and evaluate all of the potential benefits of positive train separation and include them in any cost benefit analysis conducted on positive train separation control systems.

Based on the FRA's response and the awarding of a financial grant to the Washington State DOT to develop high-speed train control technology, through the use of computer modeling, as an assessment tool of the benefits of PTS, both recommendations were classified as "Open-Acceptable Response" in November of 1995.

From the same Kelso, Washington accident the Safety Board issued the following Safety Recommendation to the AAR:

> R-94-16
>
> In conjunction with the FRA, identify and evaluate all of the potential benefits of positive train separation and include them in any cost benefit analysis conducted on positive train separation control systems.

The AAR responded in August of 1995 that its membership continue to believe that PTS must be justified on the basis of safety benefits only. However, the Safety Board recognized the cooperative efforts that were taking place on the UP/BNSF PTS pilot project and will revisit the recommendation once the results of the project are released. The recommendation is classified as "Open-Acceptable Response."

APPENDIX M

ACRONYMS AND ABBREVIATIONS

AAR Association of American Railroads
ACS automatic cab signals
Amtrak National Railroad Passenger Corporation
ATCS advanced train control system
B & O Baltimore and Ohio Railroad
CAD computer-aided dispatching
CFR Code of Federal Regulations
CP control point
CSXT CS X Transportation Inc.
CTC centralized traffic control
CVR cockpit voice recorder
DCS disaster command system
DTC direct traffic control
DOT U.S. Department of Transportation
EAS eastbound absolute signal
EMS emergency medical services
EO emergency order
EOC emergency operations center
FAA Federal Aviation Administration
FRA Federal Railroad Administration
FTA Federal Transit Administration
GIS geographic information system
IC incident commander
ICC U.S. Interstate Commerce Commission
ICSS intermittent cab signaling system
MARC Maryland Rail Commuter
MCEMA Montgomery County Emergency Management Agency
MCFRS Montgomery County Fire and Rescue Services
MCPD Montgomery County Police Department
MDLI Maryland Department of Labor and Industry
MDOT Maryland Department of Transportation
MOS manager of operations support
MP milepost
MTA Mass Transit Administration (Maryland)
MU multiple unit
NPRM notice of propose d
PTS positive train separation
RP recommended practice
RPI Railway Progress Institute
TCS traffic control signal
UMTA Urban Mass Transit Administration
UTU United Transportation Union
VRE Virginia Railway Express
WAS westbound absolute signal
WMATA Washington Metropolitan Area Transit Authority