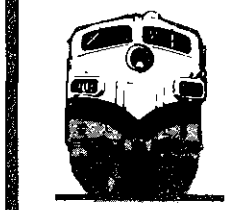
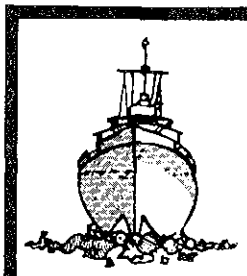
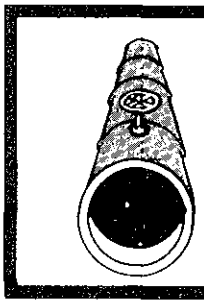
PB87-916302

NATIONAL TRANSPORTATION SAFETY BOARD







RAILROAD ACCIDENT REPORT

REAR END COLLISION BETWEEN BOSTON AND MAIN CORPORATION COMMUTER TRAIN NO. 5324 AND CONSOLIDATED RAIL CORPORATION TRAIN TV-14 BRIGHTON, MASSACHUSETTS MAY 7, 1986

NTSB/RAR-87/02

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB/RAR-87/02	2. Government Accession No. PB87-916302	3. Recipient's Catalog No.
4. Title and Subtitle Rear End Collision between Boston and Main Corporation Commuter Train No. 5324 and Consolidated Rail Corporation Train TV-14 Brighton, Massachusetts, May 7, 1986		5. Report Date April 28, 1987 6. Performing Organization Code
7. Author(s) Railroad accident report,		8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 4456A 11. Contract or Grant No.
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		13. Type of Report and Period Covered Railroad Accident Report May 7, 1986 14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

About 8:36 a.m. on May 7, 1986, Boston and Maine Corporation commuter train No. 5324 struck the rear of Conrail train TV-14 standing on Consolidated Rail Corporation's (Conrail) No. 2 main track, at Brighton, Massachusetts. The locomotive and head cars of train TV-14 had entered Conrail's Beacon Park Yard at Brighton; the last 10 cars of the train were not in the yard, but were extending through an interlocking plant and about 6 of the cars were standing on the No. 2 main track in a 2° 8' curve to the right. Of the 550 passengers and 5 crewmembers on the commuter train, 149 passengers and 4 crewmembers were injured. The crewmembers of train TV-14 were not injured. The combined equipment damage was estimated to be $102,210.

The National Tranportation Safety Board determines that the probable cause of this accident was the failure of the engineer of train No. 5324 to properly interpret and comply, due to inattention or distraction, with the speed restriction mandated by the stop and proceed aspect of a wayside signal located to the rear of train TV-14.

17. Key Words	18. Distribution Statement
rear-end collision, speed recorders, event recorders, interior design, maintenance	This document is available to the public through the National Technical Information Service Springfield, Virginia, 22161

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	34	

NTSB Form 1765.2 (Rev. 9/74)

CONTENTS

EXECUTIVE SUMMARY

About 8:36 a.m. on May 7, 1986, Boston and Maine Corporation commuter train No. 5324 struck the rear of Conrail train TV-14 standing on Consolidated Rail Corporation's (Conrail) No. 2 main track, at Brighton, Massachusetts. The locomotive and head cars of train TV-14 had entered Conrail's Beacon Park Yard at Brighton; the last 10 cars of the train were not in the yard, but were extending through an interlocking plant and about 6 of the cars were standing on the No. 2 main track in a 2° 8' curve to the right.

Of the 550 passengers and 5 crewmembers on the commuter train, 149 passengers and 4 crewmembers were injured. The crewmembers of train TV-14 were not injured. The combined equipment damage was estimated to be $102,210.

The primary issues evolving from the investigation of this accident are:

a. speed recorders and event recorders;
b. maintenance of operating accessories;
c. passenger car interior design.

The National Tranportation Safety Board determines that the probable cause of this accident was the failure of the engineer of train No. 5324 to properly interpret and comply, due to inattention or distraction, with the speed restriction mandated by the stop and proceed aspect of a wayside signal located to the rear of train TV-14.

Safety recommendations were made as a result of this accident to the Massachusetts Bay Transportation Authority (MBTA) concerning passenger car interiors and maintenance of speed recorders on MBTA equipment.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: April 28, 1987

REAR END COLLISION BETWEEN BOSTON AND MAINE CORPORATION COMMUTER TRAIN NO. 5324 AND CONSOLIDATED RAIL CORPORATION TRAIN TV-14 BRIGHTON, MASSACHUSETTS, MAY 7, 1986

INVESTIGATION

Events Preceding the Accident

On May 5, 1986, the Division Superintendent of the New England Division, Northeastern Region, Consolidated Rail Corporation (Conrail), issued Bulletin Order No. 1-8 effective at 8:00 a.m. Wednesday, May 7, 1986. Bulletin Order No. 1-8 removed the single main track extending between Control Points (CP) 3 and 4 1/ from service between the hours of 8:00 a.m. on Wednesday, May 7 and 5:30 p.m. on Thursday, May 8, 1986. During this time trains would have to have been operated over yard track No. 1 between CP-3 and CP-4.

On May 6, 1986, Conrail train TV-14 2/ left Selkirk, New York, at 11:25 p.m. Train TV-14 consisted of locomotive units 6582, 6572, and 6555 and 88 cars with a load of 6,080 tons. The crew consisted of an engineer, conductor, and brakeman. An engineer who would operate the train TV-14 to Springfield, Massachusetts, overheard the engineer who operated train TV-14 into Selkirk, state that he had experienced about three emergency brake applications during his run because of a "kicker" 3/ in the train. The engineer, however, did not experience any emergency brake applications on train TV-14 between Selkirk and Springfield where the crew set off 16 cars.

At 4:14 a.m., train TV-14 left Springfield with 72 cars with a trailing weight of 4,965 tons. The engineer and conductor were on the lead locomotive unit and the brakeman was on the third locomotive unit. Train TV-14 did not have a caboose; the rear of the train was protected by an end-of-train (EOT) 4/ marking device.

1/ CP-3 and CP-4 are the third and fourth control points west of Boston's South Station. CP-3 and-4 have switches and signals for controlling train movements and they are remotely controlled by the train dispatcher at Springfield.

2/ The symbol TV stands for trailer van which is a train consisting of one or more railroad flat cars designed to carry one or two highway truck trailers.

3/ A "kicker," sometimes known as a "dynamiter," is a freight car that has a faulty brake valve that will randomly vent the air in the train line and cause the train to stop with an emergency brake application. The train line extends the length of the train and carries the air used for braking.

4/ A device that provides a red marker light at the end of a train not provided with a caboose. Additionally, by radio telemetry, the EOT provides the engineer a digital readout of the train line air pressure at the end of the train, and of any change in air pressure. Some EOT units provide motion detectors.

Train TV-14 arrived at Framingham at 6:36 a.m., and the dispatcher stopped the Boston and Maine Corporation (B&M) commuter train No. 5318. The dispatcher said that he decided not to allow train TV-14 to leave Framingham ahead of train No. 5318, scheduled to leave at 7:30 a.m., because TV-14 had too many cars to enter the Beacon Park Yard and would be unable to clear the main track. The inability of train TV-14 to clear the No. 2 main track would delay commuter train No. 5324, which was scheduled to depart Framingham at 8:00 a.m.

Train TV-14 departed Framingham at 7:43 a.m. and arrived at CP-4 at 8:19 a.m. When train TV-14 approached CP-4, the engineer changed his locomotive radio from road channel 4 to yard channel 2 to contact the yardmaster at Beacon Park Yard for instructions about placing the train in the yard. The dispatcher was not advised of the change in radio channels and was not required to be notified.

The yardmaster at Beacon Park Yard instructed the engineer of train TV-14 to pull the train into the yard on lead track 3 and stop at a designated point where a yard crew would seperate the train between the 24th and 25th cars. The engineer was also instructed to move the head 24 cars into a track designated as trailvan 2. Then the yardmaster told the engineer of train TV-14 that he would arrange for a yard engine to be coupled to the remaining 48 cars and pull them into the yard for distribution to various yard tracks.

The engineer of train TV-14 stated that he acknowledged the yardmaster's instructions and proceeded into Beacon Park Yard. He said that just as the locomotive approached the designated uncoupling point, he operated the automatic brake handle to stop the train. The engineer also stated that the train airbrakes then went into an uninitiated emergency, and the train stopped about one car length short of the designated uncoupling location. The yard crew then uncoupled the train between the 24th and 25th cars, and after the engineer recharged the train line with air on the head portion of the train, he moved the head 24 cars into the track designated as trailvan 2. At that point the locomotive was uncoupled from the cars, and the crew proceeded with the locomotive to the roundhouse.

After the road locomotive and the head 24 cars were detached from the train, the yard engine was moved to the end of the 25th car so it could be coupled to the cars and then pull the remaining cars of train TV-14 into the yard. Before the yard crew could couple the yard engine to the standing cars, they heard an emergency broadcast over the yard radio system that the rear of train TV-14 had been struck by a commuter train.

The Accident

At 6:30 a.m. on May 7, 1986, the engineer of B&M train No. 5324 reported for duty at Boston's South Station. At 6:40 a.m. the conductor and one trainman of train No. 5324 also reported for duty at South Station. The crew's first assignment was to operate the westbound 7:00 a.m. commuter train, No. 5309 from South Station to Framingham.

Before the train's departure, the crew inspected, tested, and determined that the train brakes were operating satisfactorily. The train radio on the locomotive was not tested. Train No. 5309, pulling four passenger coaches, departed South Station on time at 7:00 a.m. with the engineer operating the train from the diesel electric locomotive power unit. After the train left the station, the engineer made the required running brake test which satisfied him as to their operating condition. En route to Framingham, the engineer

checked the locomotive's speedometer for accuracy by correlating speed and time between designated mile posts. He was satisfied that the speedometer was accurate to within the plus or minus 4 mph as required by the Conrail operating rules. The train made several station stops between South Station and Framingham, including Back Bay, where an additional crewmember boarded the train.

Train No. 5309 arrived at Framingham on time at 7:40 a.m. When the train arrived at Framingham, it proceeded into the yard west of the station. The engineer then changed from the operating position on the power unit, located on the west end of the equipment, to an operating position in a control coach 5/ located on the east end of the equipment. While the train was in the yard, the crew made a brake application and release test. On the trip from Framingham into South Station the equipment would be operated as eastbound train No. 5324, and the power unit would push the train. A fifth crewmember joined the crew of train No. 5324 at Framingham.

Train No. 5324 departed Framingham at 8:00 a.m. with the engineer operating the train from the operating position in the right side of the control coach. The engineer did not check the speedometer or the radio in the control coach returning to South Station. The conductor was in the passenger compartment of the control coach, and the three trainmen were positioned in each of the other three coaches.

At Wellesley, Massachusetts, a railway and bus inspector for the Massachusetts Department of Public Utilities (DPU) boarded the train and entered the operating compartment of the control coach to ride with the engineer. The inspector was authorized by the Commonwealth of Massachusetts to ride in the operating compartment of the locomotive to perform his official duties, which were to check operating practices and safety procedures. The engineer said that this inspector rode on train No. 5324 regularly. Passengers interviewed by Safety Board investigators after the accident, who had been next to the operating compartment, stated the engineer and the inspector were conversing throughout the trip east from Wellesley. The engineer and the inspector, however, stated that they did not converse.

The engineer said that he had no difficulty stopping the train at the scheduled stops en route from Framingham to Newtonville, Massachusetts, the last scheduled stop before the accident. The engineer and conductor said that train No. 5324 departed Newtonville, MP 8.1 at 8:31 a.m. The conductor said that there were about 45 passengers standing in the first coach in the train. Each of the three trainmen reported that the number of standing passengers was 40 to 45 in the second coach, 35 to 40 in the third coach, and 40 to 45 in the fourth coach. A four-car train similar to train No. 5324 can seat 385 passengers. According to the Massachusetts Bay Transportation Authority (MBTA) the number of passengers on train No. 5324 on May 7 was about 550.

The engineer said that as train No. 5324 approached automatic signal 8.2E, 6/ the signal displayed an advance approach aspect. Since signal 8.2E is located 0.1 mile west of the Newtonville station, the station stop was made immediately after the train passed signal 8.2E. The advance approach aspect required the engineer to limit the speed of the train to 40 miles per hour (mph) within the signal block governed by signal 8.2E. He said

5/ A passenger coach that has operating controls installed so that the operating functions of the locomotive can be controlled from the control coach. The control coach is used in a push-pull operation which precludes having to turn the equipment at the end of a run.
6/ Automatic signals are numbered to closely correspond to the milepost number.

that the next automatic signal, 7.2E, was displaying an approach aspect, which required him to reduce speed to medium speed or 30 mph within the signal block governed by signal 7.2E. Then as the train approached the next automatic signal, 6.2E, the engineer stated that the signal was displaying a stop and proceed aspect which required him to stop the train.

According to Conrail's operating rules, after the engineer had stopped the train, he could then proceed at a speed not to exceed 15 mph within the signal block governed by signal 6.2E. In addition, the engineer was required to control the speed of the train at all times in order to stop the train within one-half his range of vision.

When the engineer stopped the train at signal 6.2E, he released the brakes and throttled the train ahead. He said that he reduced the throttle to zero when he reached the crest of a slight upgrade extending eastward from signal 6.2E, and then allowed the train to coast. The engineer stated that because the train was then descending a slight grade, he intermittently applied and released the brake to regulate the speed of the train. Then, as the train was going through a curve near MP 5, he said the conductor opened the operating compartment door and began to enter. About that time, the engineer stated that he saw the rear car of a train standing on the main track ahead of his train, and that he then called a warning and placed the train brake into the emergency position. The engineer followed the conductor and inspector out of the operating compartment and into the passenger compartment and braced himself for the impact.

The conductor said that when train No. 5324 was stopped at signal 6.2E, he was engaged in a cash-fare transaction with a passenger, and therefore, did not go forward to determine the reason for the unscheduled stop as required by operating rule 102a (see appendix D). The conductor stated that he completed his fare collections within 3 or 4 minutes after the stop, walked to the front of the coach, opened the sliding door separating the operating compartment, and started to enter. Just as the conductor stepped into the operating compartment, he heard the engineer make a startled remark about a train ahead. The conductor stated that he looked up and forward and saw the rear car of train TV-14 about 50 or 60 feet ahead.

The conductor realized there was going to be a collision, turned, ran back into the car, and warned the passengers to brace themselves. The railway and bus inspector closely followed him out of the operating compartment; the engineer was immediately behind the inspector. The engineer also said he warned the passengers of the impending crash. About 8:36 a.m., before the three men could move more than three or four seats deep into the passenger compartment, train No. 5324 struck the rear car of train TV-14 which was standing in a 2° 8' curve to the right.

Upon impact the standing passengers and crewmembers were thrown to the floor. After the collision the engineer got up from the floor as quickly as possible, reentered the operating compartment, and immediately radioed the train dispatcher to advise him of the accident and to request emergency assistance. A tape monitor on the dispatcher's radio communications recorded this call at 8:37: 42 a.m. Simultaneously, a Conrail supervisor, who was nearby at CP-4, radioed the yardmaster in Beacon Park Yard to advise him of the accident and to request emergency assistance.

The trainman assigned to the rear car checked on the condition of the passengers in that car and then went forward to see if the engineer was injured. When he determined that the engineer was not injured, he gathered flagging equipment and proceeded westward on the No. 2 track where he flagged for about 1 1/2 hours.

Neither train was derailed. The accident occurred near MP 5 about 5,655 feet east of automatic block signal 6.2E. (See figure 1.) After the accident the automatic brake handle was found in the emergency position and the throttle was in the off position.

The engineer of train No. 5324 later said that he complied with all of the speed restrictions imposed by the wayside signal aspects, including the stop and the slow speed required by the aspect of signal 6.2E (see figure 2). The engineer also stated that at one time his train may have attained a speed of about 20 mph because of a slight down grade east of signal 6.2E, but otherwise he maintained the speed of the train at less than 15 mph.

The engineer of train No. 5324 said that his vision was not impaired by atmospheric conditions; he was not distracted or confused by any highway signs or vehicular traffic on the adjacent Massachusetts Turnpike; he was not distracted by the railway and bus inspector's presence in the compartment or the conductor entering the compartment; and the speed of the train was between 3 mph and 4 mph at the time of impact. Further, the engineer stated that, he was expecting restrictive speed signal aspects in the vicinity of CP-4 because of Bulletin Order No. 1-8 (see appendix C).

The engineer of train No. 5324 stated to Safety Board investigators in a deposition that he did not remember seeing train TV-14 en route to or from Framingham. However, in an earlier interview, he stated that he saw train TV-14 somewhere east of Framingham. In the deposition proceeding he also stated that he did not remember hearing any radio communications directly with the dispatcher concerning train TV-14. However, at 7:31:53 a.m., the dispatcher's radio tape monitor recorded a call from the dispatcher to train No. 5309 indicating that train TV-14 would be going through Framingham on No. 2 track. There was no response recorded. Train TV-14 normally arrived at Beacon Park Yard before the daily commuter runs began.

Injuries to Persons

Injuries	Passengers	Crewmembers	Total
Fatal	0	0	0
Injured	149	4	153
None	401	1	402
Total	550*	5	555

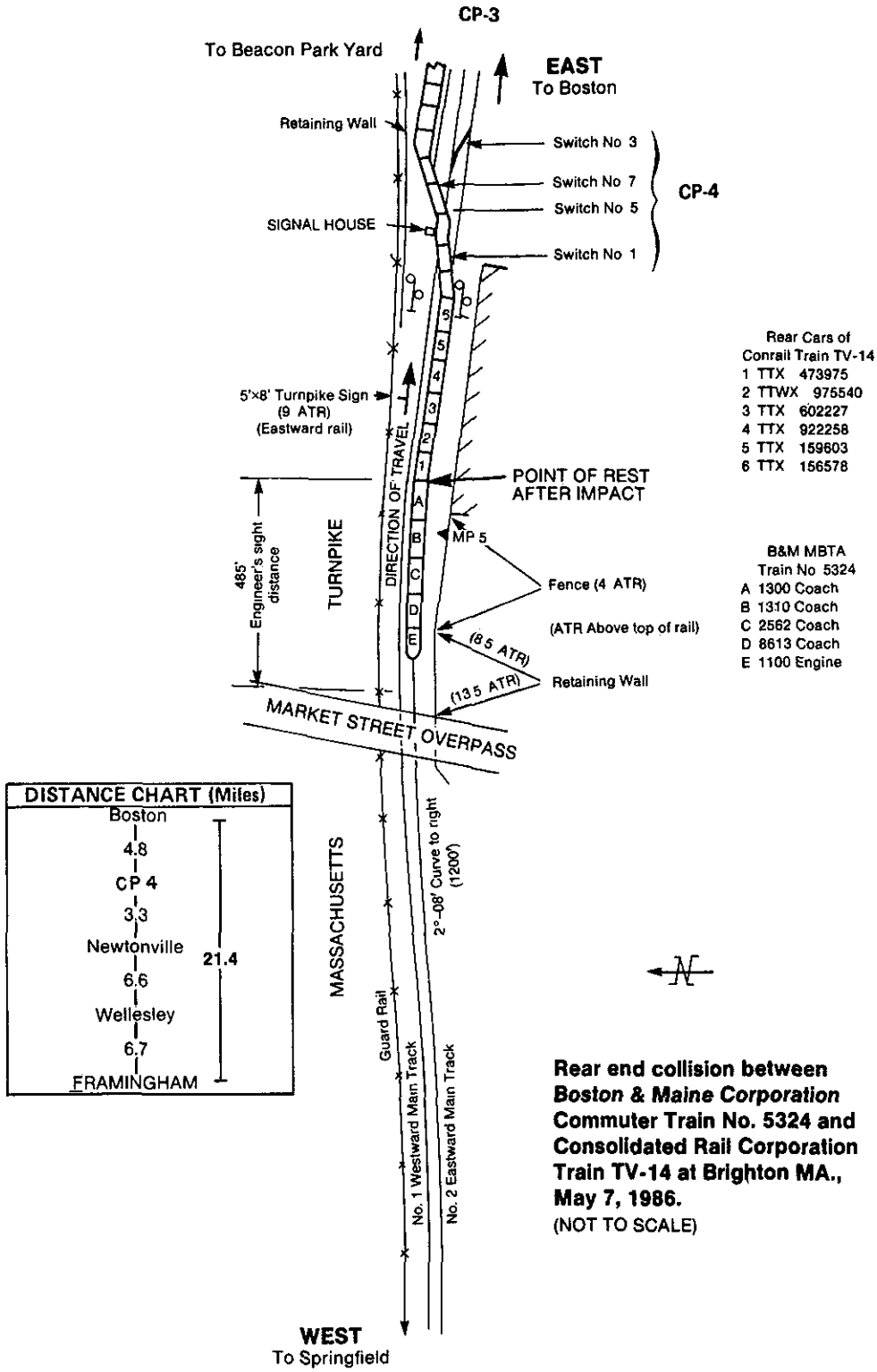
*Estimated number of passenger based on data from B&M.

Damage

The damage to train TV-14 was not extensive. The rear car had a broken locking plate on the "B" end 7/ stanchion 8/ of car TTX 473975. In addition, the impact caused the end of the trailer van to open and spill some of its contents on to the car deck and right of way. Some lading was spilled from other trailer vans, but the damage to other rail cars in train TV-14 was negligible. The EOT marking device was destroyed.

7/ Rail cars are identified by an "A" end and a "B" end. The "B" end is the end where the handbrake is located.

8/ The mechanical stand on the rail flat car to which the trailer van's king pin (center plate) is secured.



Rear end collision between *Boston & Maine Corporation* Commuter Train No. 5324 and Consolidated Rail Corporation Train TV-14 at Brighton MA., May 7, 1986.
(NOT TO SCALE)

Figure 1.--Accident site.

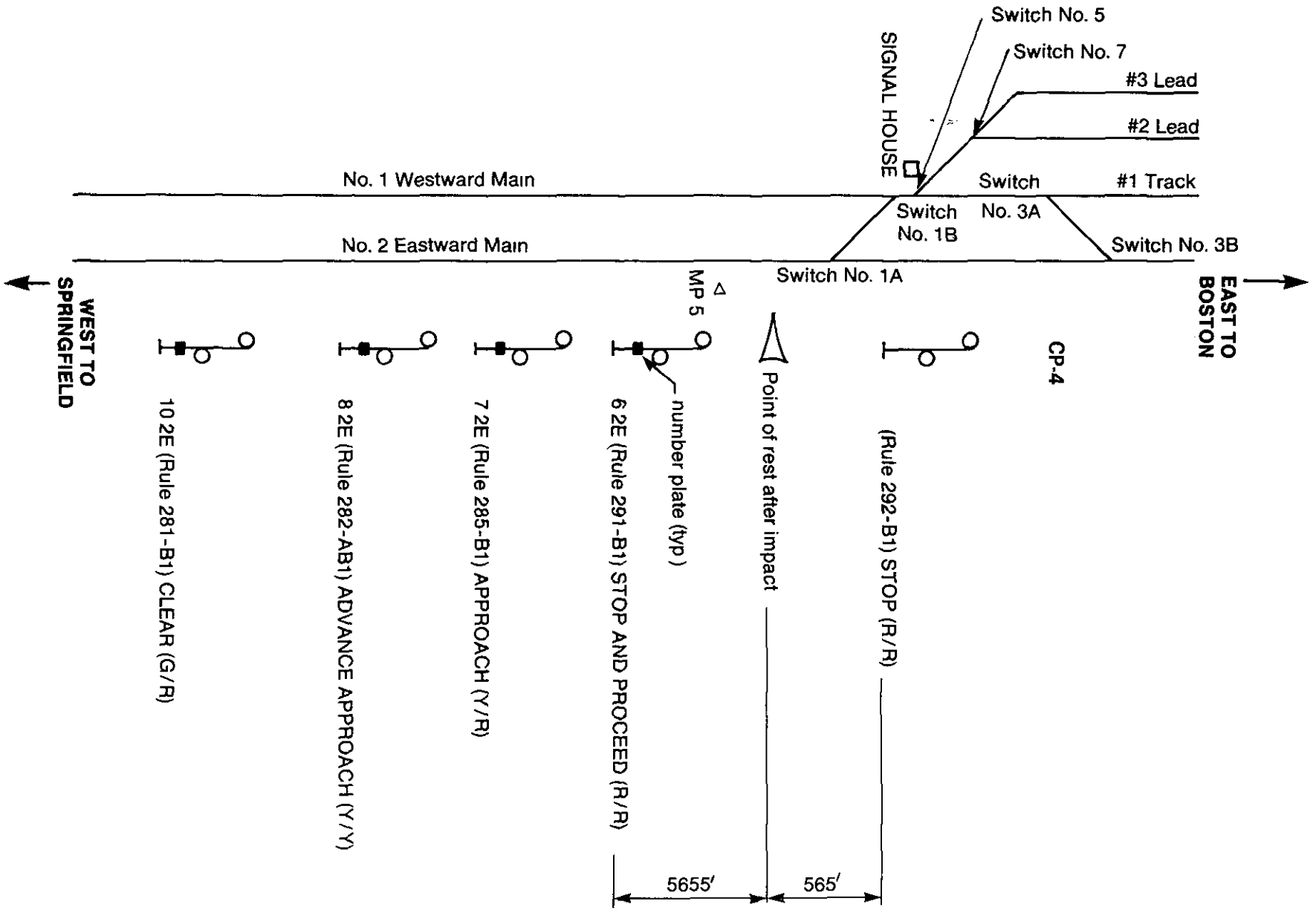


Figure 2.--Signal system indications observed following the accident.

The passenger coaches of train No. 5324 sustained extensive damage. The lead control coach was damaged at the front truck and at welds to the car body. The draft gear pocket was expanded and the center sill was cracked. There were cracks between the center sill and floor and between the floor and floor beams. The end doors on the forward end of the coach and the step platforms were jammed because of a slight frame warp. The second coach had bolster damage at weld points on both sides at the trailing end, and a bolster anchor was broken on the forward end. In addition, lateral truck wear pads for the left and right sides of the No. 1 truck (on the "B" end of the car) were missing at the weld to the car body, and the drawbar on the trailing end was slightly bent. The third coach had a bent drawbar on the "B" end and the drawbar on the "B" end of the fourth car was broken behind the coupler head.

Conrail and the B&M each provided damage assessments for their equipment. The estimated damage to lading and equipment is provided in the following table.

Train	Equipment (Dollars)	Lading (Dollars)	Labor (Dollars)	Total (Dollars)
Conrail	8,500	20,000	3,710	32,210
B&M	70,000	-	-	70,000
Total	$78,500	$20,000	$3,710	$102,210

The track damage was minimal; no material costs were assessed, however, costs for track and signal personnel were assessed as $3,710.04. There was no damage to the signal system.

Method of Operation

The 21.4-mile Boston to Framingham line is part of the New England Division of the Northeastern Region of Conrail. The B&M had trackage rights over the Framingham line and operated a commuter service under contract with the MBTA between South Station and Framingham. In addition to the Conrail freight trains, the National Railroad Passenger Corporation (Amtrak) also operated passenger trains over this line.

Trains are operated over the Framingham line by a Traffic Control System (TCS), controlled by the Conrail train dispatcher at Springfield and by an automatic block color light signal system, timetable, train orders, and bulletin orders. The timetable direction is east to Boston and west to Framingham. The westward track is designated as track No. 1 and the eastward track as track No. 2. The maximum authorized speed is 50 mph. Between CP-3 and CP-4, No. 2 track is used for bi-directional running because No. 1 track is classified as a yard running track. The train dispatcher has to obtain permission from the yardmaster at Beacon Park Yard before he can use track No. 1 between CP-3 and CP-4.

Conrail, Amtrak, and MBTA trains operating over the Framingham line are equipped with radio transceivers, operable on road channel 4 and yard channel 2. A crewmember on the locomotive can communicate with the train dispatcher in Springfield or with another train on channel 4. Conrail operates trains between Springfield and Beacon Park Yard without cabooses. Instead of the caboose, an EOT marking device is used and, there is no crewmember at the end of these trains.

The engineer and the conductor of a B&M commuter train must be qualified on B&M, Conrail, and Amtrak operating rules before they can operate over the Framingham line. Conrail operating rules apply between Framingham and Cove Interlocking at MP 1.1, and Amtrak rules apply between Cove Interlocking and South Station. Trainmen, whose

primary function is to collect fares and assist passengers, must be qualified on the B&M and Amtrak operating rules before being allowed to operate over B&M and Amtrak lines. They can operate temporarily over the Conrail line without being qualified on the Conrail operating rules; however, they must schedule a rules examination at the earliest possible date and have 90 days to pass the examination.

On January 1, 1987, the B&M's contract with the MBTA expired, and as a result of competetive bidding, Amtrak began to provide commuter service for the MBTA.

Operating Rules

All crewmembers operating on the Boston to Framinghan line are required to be qualified on the Conrail operating rules including the following:

Conrail operating Rule 291 states: 9/

> Stop; then proceed at Restricted Speed until the entire train has passed a signal displaying a more favorable aspect.

Restricted speed is defined as:

> A speed which will permit stopping within one-half the range of vision, which will result in stopping short of train, obstruction or switch improperly lined, looking out for broken rail and not exceeding 15 miles per hour.

Conrail operating Rule 102a states:

> When a train is delayed, the conductor and engineer, or other member of crew when instructed by conductor or engineer, must, as soon as the safety of their train will permit, ascertain the cause, and, as soon as practical, communicate with the train dispatcher or operator.

Conrail operating Rule 711 states:

> Train and engine crewmembers must not request, and train dispatchers or operators must not advise by radio the name aspect or indication of any fixed signal. However, when a train is approaching a location where conditions require that the crew know whether the train is to be held, crews may be instructed to stop at an appropriate location.

After the accident, other Conrail operating rules were cited by the B&M (see appendix D).

Crewmember Information

The crewmembers of train TV-14 were qualified on the operating rules and for their respective positions as required by Conrail. They had reported for duty at Selkirk at 9:55 p.m. on May 6, 1986, after having had a minimum of 8 hours rest as required by the Code of Federal Regulations 49 Part 228.19 (Subpart B).

9/ Consolidated Rail Corporation—Rules of the Transportation Department, Revision No. 3, effective January 1, 1986.

The engineer and conductor of train No. 5324 were qualified on the operating rules of the B&M, Conrail, and Amtrak. The three trainmen were not qualified on the Conrail operating rules because they had only been working their assignment for a few weeks; however, they were qualified on the operating rules of the B&M and Amtrak. All crewmen of train No. 5324 were qualified for their respective positions in accordance with B&M requirements. They each had bid for and were assigned the position which they were working. Each of the crewmembers of train No. 5324 said they were in compliance with the off-duty rest period required by the CFR and that they were adequately rested on May 7. (See appendix B.)

Track Information

The Conrail right-of-way through the accident site is bounded on the north side by the Massachusetts Turnpike, and on the south side by a stone and concrete retaining wall varying in height from 4 feet to 13 1/2 feet above the top of the rails of the eastward track. An overhead bridge crosses the railroad about 955 feet west of the accident site.

The gradient of the No. 2 eastward track is 0.27 percent ascending eastward from signal 6.2E for approximately 2,700 feet, where it changes to a 0.45 percent descending grade for approximately 2,100 feet. Beyond that point the gradient is 0.03 percent ascending to the accident site.

The No. 2 track is tangent for approximately 3,460 feet east of signal 6.2E, then it begins to enter a 1° 15' left curve for approximately 510 feet. At the curve exit it becomes tangent for about 690 feet before entering a 1,200-foot, 2° 8' right curve. The collision occurred about 995 feet into the 2° 8' curve (see figure 3).

Train Information

The equipment of B&M commuter train No. 5324 belonged to the MBTA, but it was operated and maintained under contract by the B&M. Train No. 5324 consisted of a type F-10 diesel electric locomotive, No. 1100, and four passenger coaches (numbered from front to rear 1300, 1310, 2562, and 8613). Coaches No. 1300 and 1310 were control coaches.

The four coaches were built by the Pullman-Standard Company; coaches 1300 and 1310 were built in 1968, and coaches 2562 and 8613 were built in 1948. The underframes of all coaches were built of a high tensile strength low-alloy steel. Cars 1300 and 1310 had side sills, side posts, window posts, sash rests, window headers, and side plates of aluminum extrusions covered with an outside skin of horizontally brushed aluminum. The two older cars were constructed mostly of low-alloy steel with some aluminum details. The exterior of the cars was covered with stainless steel. All of the coaches were equipped with tightlock couplers. Electric power was obtained from the head end power generating unit on the locomotive and supplemented by storage batteries.

Coaches 2562 and 8613 had a type D-22 brake system. Coaches 1300 and 1310 and the locomotive had a type 26 brake system. Some of the B&M engineers who operate the commuter trains stated to Safety Board investigators that when the two brake systems are used in the same train consist, brake effectiveness is degraded and braking becomes slower. Those engineers also stated that in their opinion, those trains require earlier brake applications to stop at predetermined locations.

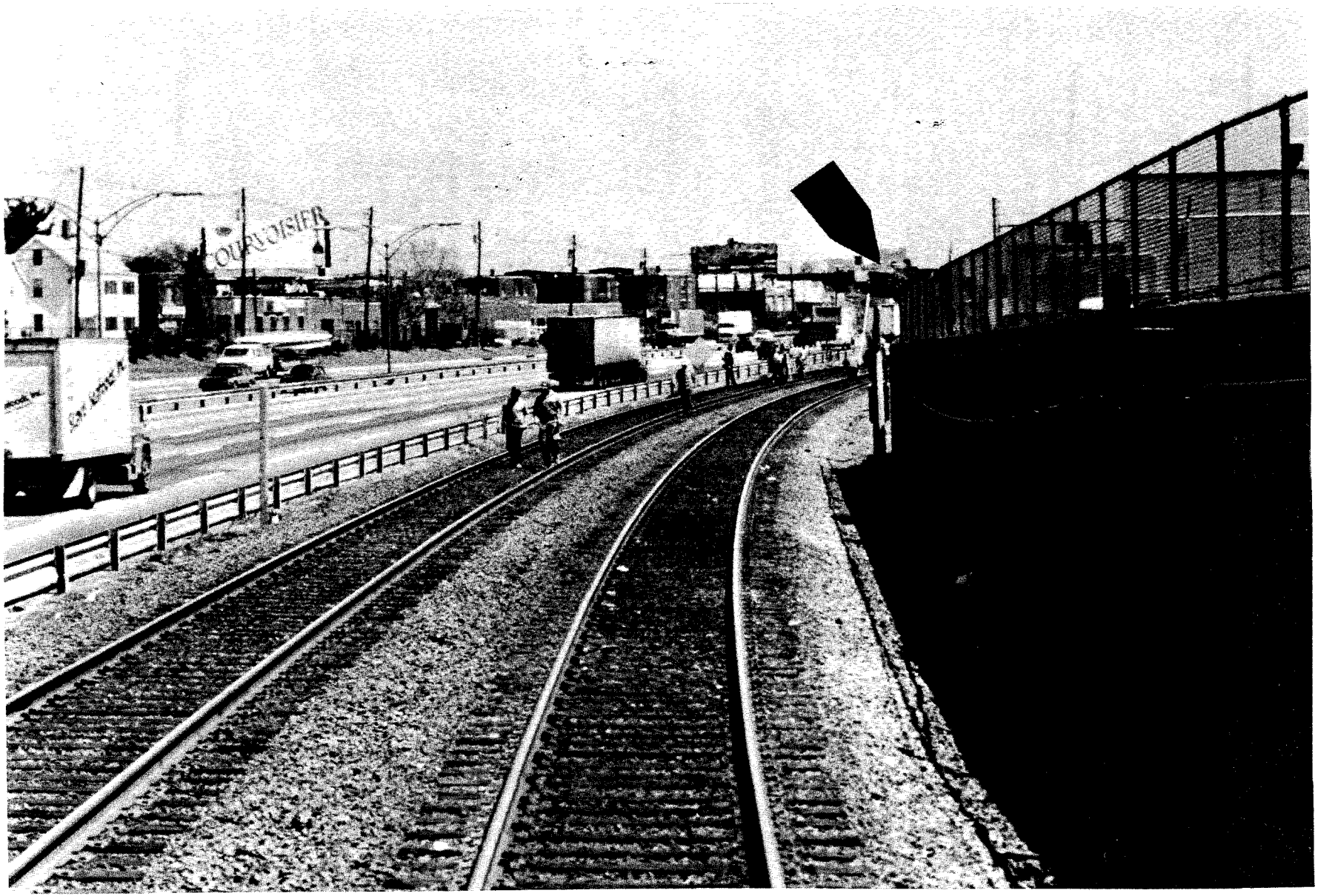


Figure 3.--Arrow indicates site of large plywood board placed at the location of the last car after impact with train TV-14.

Meteorological Information

On May 7, 1986, at 8:52 a.m. the weather at Logan International Airport, about 8 miles east-northeast of the accident site, was reported to be: visibility 1/8 mile; light drizzle and fog with a temperature of 46° F, and wind 70° at 9 knots. Drizzle, but no fog was reported at the accident site.

Medical and Toxicological Information

Of the estimated 550 passengers on train No. 5324, 140 were treated at local hospitals and released. Nine passengers were admitted to area hospitals. The most seriously injured passengers were located in the first (No. 1300) and the last (No. 8613) coaches. The investigation revealed that those passengers facing rearward received fewer and less serious injuries.

Information obtained from passengers as a result of personal interviews and questionnaires indicated that a number of the passengers sustained their injuries when they struck the seatback in front of them, particularly the metal seatbacks in the first two coaches (Nos. 1300 and 1310). The exposed metal seatback frames in the last coaches (Nos. 2562 and 8613) also caused facial injuries. Passengers sustained bruises and abrasions when they struck the seat edges and other passengers. In addition, passengers received a few minor head injuries when briefcases and umbrellas fell from the overhead luggage racks. Injuries included lacerations and multiple contusions to the face and extremities, fractured ribs and noses, and broken or lost teeth. The crewmembers suffered similar injuries.

The conductor and engineer of train No. 5324 each submitted blood and urine samples for toxicological tests in compliance with 49 CFR Part 219, Control of Alcohol and Drug Use Railroad Operations, effective November 1, 1985. The test results were negative for alcohol and drugs of abuse.

Survival Factors

All passenger coaches except coach No. 8613 were equipped with fire extinguishers. Coaches Nos. 1300 and 1310 were also provided with wrecking tools (a saw and a crowbar). Coaches Nos. 1300 and 1310 had emergency window exits at the 1st and 8th windows on the right side of the coach (facing forward) and the 4th and 11th windows on the left side. Each emergency window exit was identified and provided with a red handle marked with the inscription "EMERGENCY EXIT--PULL HANDLE-REMOVE RUBBER." The interior of the coaches could be accessed through sliding doors in the vestibules at each end. The door in the operating compartment of the control coaches, however, was for emergency/crew exit only.

Coaches Nos. 1300 and 1310 had 24 double-width seats and 3 single seats with arm rests on each end. A full seat base for each seat was mounted to the floor and the side wall of the car. The seats were equipped with metal tubular grab bars on the upper inner corners of the reversible seatbacks, but there were no overhead bars or handholds for standing passengers to use.

Coach No. 2562 had a metal and glass partition to provide a smoking compartment near one end of the coach. The seats in the nonsmoking compartment were double-width seats with armrests at each end. They were constructed of chromium plated tubular steel frames with cloth upholstered seat cushions and backs. The smoking compartment had six

freestanding metal chairs on each side secured to each other with bolts through the rear legs. An overhead aluminum luggage rack extended the length of the car on both sides. The end doors were the sliding type, leading to the vestibule which had dutch-type doors with trap doors over the steps.

Coach No. 8613 was arranged similar to coach No. 2562. However, the 12 free standing chairs in the smoking compartment had been replaced with four rows of double seats. Neither coach was provided with emergency exit windows, and there were no overhead bars or handholds for standing passengers to use.

The operating compartment of control coach No. 1300 did not crush on impact. Damage to the interior of the coaches of train No. 5324 included displaced seatbacks and seat cushions. Some seat frames were bent slightly; some had the seatbacks separated from the cushion frame; and some were detached from the floor mounting. Other seat frames were pulled loose from the wall mounting. Some seat attachment points were rusted and corrosion-weakened floors pulled loose. One or two windows were cracked, and three of the emergency exit windows were apparently removed during the evacuation, however, no one left the train through the emergency exit windows.

Only the passengers in coach No. 1300 were warned of the impending collision. Most passengers left the train without assistance, but emergency personnel helped several passengers out of the train.

Emergency Response

At 8:42 a.m. the Boston Fire Department received a telephone call from a private citizen concerning the train accident. About 1 minute later, firebox No. 5294, located at North Beacon and Market Streets, transmitted a signal to the Boston Fire Department.

At 8:48 a.m. the operations center at the Boston Police Headquarters received a telephone call from the MBTA police dispatcher requesting assistance at the rear of 40 Guest Street, Brighton, because of a commuter train accident. Three police vehicles and a deputy police superintendent responded initially. A command post was established on the Beacon Park Yard at the rear of 40 Guest Street. At 8:52 a.m. the Boston Police Department notified the Boston Emergency Medical Service Department (EMSD). The first EMSD unit arrived on the scene 4 minutes later.

By 9:20 a.m. the initial triage of the injured passengers and crewmembers had been completed, and the first ambulance left the scene en route to a hospital. By 10:00 a.m. the last injured person had been removed from the accident site. A total of 141 injured persons were removed from the site by 23 ambulances and 3 buses. Local telephone service was established with hospitals to maintain communications because of malfunctioning radio equipment on the responding emergency vehicles. (See appendix E.)

Disaster Preparedness

The City of Boston does not have a disaster plan. Officials of the Massachusetts Office of Emergency Preparedness, the Boston Fire Department and the Boston EMSD have established a commission to devise a comprehensive disaster management plan which is scheduled to be completed in mid-summer 1987.

Disaster drills are performed every 6 months by EMSD personnel. The EMSD administrating director told Safety Board investigators that the rescue operation proceeded more efficiently than a drill. He cited the faulty radio equipment on the ambulances as the only problem.

Tests and Research

Sight and Stopping Distances.—On May 8, 1986, sight and stopping distance tests were conducted at the accident location. Equipment similar to the equipment in train No. 5324 was used for the tests. To simulate the passenger loading, the coaches were filled with sand bags with a total weight of approximately 87,000 pounds. The weather was cool, sunny, and dry at the time of the sight and stopping distance tests.

A large plywood board measuring 4 feet by 8 feet, painted the color of the blue trailvan on the rear car of train TV-14, was placed at the location of the last car after the impact. Then test train No. 5324 was backed away from the plywood marker until the marker could just be seen by the engineer of the test train. This point was marked on the track and used as the point of brake application in the stopping tests.

It was determined that the maximum sight distance available to the engineer of train No. 5324 was 485 feet. The maximum sight distance available to a person on the left side of the operating compartment was 562 feet.

The speed of the test train was verified with a portable radar unit. Seven stopping tests were made with the following results:

Test Run	Speed (mph)	Stopping Distance (feet)
1	5	41
2	10	69
3	15	137
4	20	185
5	30	476
6	50	1,560
7	30	668

Tests 1-5 were emergency stops.
Tests 6-7 were full service stops to prevent inducing flat spots into the wheels of the equipment.

Speed Recorders.—Control coaches Nos. 1300 and 1310 and locomotive 1100 were equipped with Barco Electronics speed recorders; the control coaches were equipped with model 401, and the locomotive with model 400. After the accident on May 7, 1986, B&M supervisors removed the speed recorder tapes from the locomotive and control coaches. The speed tape from locomotive 1100 had no recording marked on the tape. When the recording unit was inspected, it was found that the stylus was not bearing against the chart. The speed tape from the recorder unit on control coach No. 1300 had a stylus marking on the tape which was identified by B&M personnel as the results of calibration testing performed sometime before May 7. Therefore, the recording units in train Nos. 5309 and 5324 did not provide useful speed markings.

The speed tape from control coach 1310 indicated that train No. 5324 had attained a maximum speed of 50 mph between signal 6.2E and the point of collision. Further, the speed tape indicated a speed of 25 mph just before impact occurred (see figure 4). The accuracy of the speed recorder from coach No. 1310 was tested by applying a prescribed frequency test signal, directly to the recorder unit which corresponded to a speed in miles

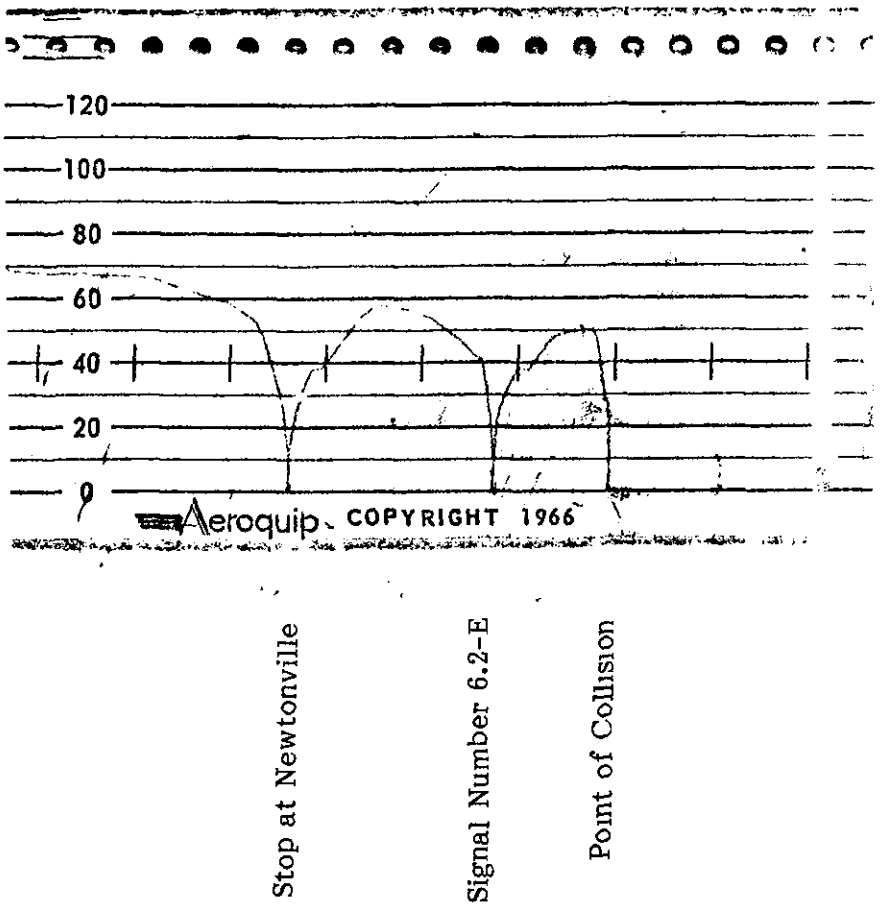


Figure 4.--Speed tape of train No. 5324.

per hour and by-passing the sensor unit. The coach wheels were measured to determine the correction factor for wheel wear. The tests indicated that the speed recorder was accurate to plus or minus 2 mph over the speed range at which the commuter trains were operated.

In response to questions by Safety Board investigators in a deposition proceeding, the chief mechanical officer for the B&M said that the speed observed during bench calibration tests may differ as much as 10 mph when the unit is placed in service on a piece of equipment because the testing did not include the sensor unit and the wiring on the equipment. The speed recording unit from control coach No. 1310 was then placed back into service on other coach equipment. The recorder units of locomotive 1100 and control coach 1300 were not tested.

The End of Train Device.—The EOT on train TV-14 was a Glenayre Electronics model Digitair 6621. The photo-electric cell was tested with the batteries that were in the device after the accident and the EOT functioned properly. The EOT was not required to display a light during daylight conditions.

The Train Brakes.—The train brakes were tested at the accident site by B&M and MBTA personnel and a Federal Railroad Administration (FRA) inspector. Control coach 1300 was damaged to the extent that the brakes could not be operated from the controls in its operating compartment. Therefore, the brakes were operated for testing from the controls on locomotive unit 1100. The brakes were found to be operating properly after the accident.

For about 2 years before the accident, crewmembers complained about poor brakes on the commuter trains when equipment with types D-22 and 26 airbrake systems were intermixed. As a result, B&M Mechanical Department personnel, assisted by FRA inspectors extensively tested the functioning of intermixed train brakes. B&M and FRA were accompanied by members of the Brotherhood of Locomotive Engineers (B of LE). No test details were documented, but the regional director for Region 1 of the FRA and the chief mechanical officer of the B&M reported to Safety Board investigators that the braking response of a train consisting of equipment with the intermixed brake systems was slower than a consist made up of cars equipped with all type 26 brake system. However, the performance and operation of the brakes in a train with such intermixed type brake systems was within the tolerances prescribed by the Federal Power Brake Law. Therefore, the use of equipment with the D-22 and the 26 airbrake systems intermixed, was deemed to be safe by the B&M and the FRA. However, the engineer probably would have to apply the brakes somewhat sooner to stop at a prescribed location.

The Radios.—Neither the radio in the locomotive nor the control coach 1310 was tested after the accident, but the radio in control coach No. 1300 was operable after the accident.

The Signal System.—The signal system was checked in detail through the area where the accident occurred and no defects or faults were found. All testing and records required of Conrail by the FRA were up to date.

ANALYSIS

The Accident

When the train dispatcher decided to allow train TV-14 to leave Framingham ahead of commuter train No. 5324, he was fully aware that the engineer of train TV-14 would not be able to pull the entire train into the Beacon Park Yard, thereby leaving the main track obstructed for the passage of train No. 5324. He had discussed this situation with his immediate supervisor and both were willing to impose the anticipated 10-minute delay on train No. 5324.

The train dispatcher was not required to advise the crew of train No. 5324 of his decision concerning train TV-14. The workload of a train dispatcher often will not allow him to pass such information to train crews under his jurisdiction. However, he did issue an advisory to the engineer of train No. 5324, while the engineer was still operating westbound as train No. 5309, indicating that train TV-14 was running through the station at Framingham on No. 2 track. Since the radio tape monitor does not record a response, it is not known if the engineer of train No. 5309 heard the dispatcher. Further, the train dispatcher could not advise the engineer of train No. 5324 that the train would be held at

CP-4. That interlocking location was the only location available to the train dispatcher where he could have established a stop and stay signal. However, train TV-14 extended into the signal block between CP-4 and signal 6.2E, causing signal 6.2E to display a stop and proceed aspect. Any attempt by the dispatcher to provide additional information to that already conveyed by the signal system could have caused him to violate Conrail operating Rule No. 711. Moreover, if the train dispatcher were to be expected to provide any such additional information, it would have to be provided in all situations, even though he would not always have total access to information regarding all those situations which might arise during normal daily operations. Such a situation might result in an engineer's tendency to disregard other conditions affecting a signal aspect, such as a broken rail, of which the dispatcher would have no knowledge.

Although the engineer of train No. 5324 initially told Safety Board investigators that he saw train TV-14 somewhere east of Framingham, he later testified that he did not remember seeing train TV-14. However, whether he saw train TV-14 or not (while he was enroute westbound on train No. 5309), he should not have diminished his alertness or performance while travelling eastbound on train No. 5324. The aspects of the automatic block signals to the rear of train TV-14 provided for the protection of that train. Those displayed signal aspects indicated a maximum authorized speed and ensured a safe distance separation for any following trains. Therefore, the undesired emergency brake application on train TV-14, and the fact that train TV-14 left some of its cars on the No. 2 eastward main track should not have presented a hazard to train No. 5324.

As train No. 5324 approached signal 8.2E, the signal displayed an advance approach aspect. (This was verified by the engineer.) This aspect was displayed because some of train TV-14's cars were on the track between CP-4 and signal 6.2E. Similarly, the intermediate wayside signals (7.2E and 6.2E) displayed approach, and stop and proceed aspects, respectively. All of these signal aspects reflected that the track was occupied with the cars of train TV-14.

The speed recorder tape from control coach No. 1310 indicated that train No. 5324 attained a maximum speed of about 50 mph after stopping at signal 6.2E shortly before the collision. The results of the stopping tests conducted after the accident verified that a speed of about 50 mph was attainable with similar equipment and passenger loading. Although the B&M's chief mechanical officer stated that the calibration of the speed recorder from control coach No. 1310 could have been off by as much as 10 mph, the Safety Board notes that the speed recording device from control coach No. 1310 was placed back into service on other coach equipment. That return to service indicates that the B&M mechanical department management was confident that the speed recording device was accurate. Although the engineer of train No. 5324 stated that the maximum speed he attained after stopping at signal No 6.2E was about 20 mph (which would have been in violation of Conrail Operating Rules) his claim is not supported by the stopping distance tests. At a speed of 20 mph, the stopping distance was 185 feet, far short of the 485 feet maximum sight distance available. While the accuracy of the speed recording device may not have been exact and the maximum speed at which train No. 5324 was operated cannot be precisely established, the Safety Board believes that the speed recording device does confirm that the engineer of train No. 5324 operated his train considerably in excess of the maximum 15 mph allowed by the operating rules. Had the engineer of train No. 5324 operated his train according to the operating rules, he could have stopped his train in time to avoid the accident.

The Engineer's Actions

The engineer of train No. 5324 stated that the presence of the railway and bus inspector in the operating compartment did not distract him. He further stated that he believed that the stop and proceed signal aspect displayed by signal 6.2E was caused when the dispatcher displayed a red (stop and stay) signal aspect on the interlocking home signal on the No. 2 track at CP-4. The engineer also believed that this was because of Bulletin Order No. 1-8 which removed the No. 2 main track from service between CP-3 and -4 beginning at 8:00 a.m. on May 7.

Under the operating conditions imposed by Bulletin Order No. 1-8, the dispatcher would have caused the eastbound interlocking home signal on the No. 2 track at CP-4 and the westbound interlocking home signal on the No. 1 track at CP-3 to display a red (stop and stay) aspect. With the opposing interlocking home signals at stop, the dispatcher could control the movement of trains in either direction over the No. 1 track between CP-3 and -4. However, if a red (stop and stay) signal had been displayed at the CP-4 interlocking home signal on the No. 2 track, and the signal block between CP-4 and signal 6.2E had been unoccupied, a stop and proceed aspect would not be displayed by signal 6.2E. Instead, the signal at 6.2E would have displayed an approach aspect. Similarly, if the CP-4 interlocking home signal on the No. 2 track displayed a restricted proceed aspect, as would have been the case if the route were aligned for an eastbound train to move from the No. 2 main track through the crossover to the No. 1 yard track, signal 6.2E would have displayed an approach aspect. The Safety Board thus concludes that the engineer of train No. 5324 probably misinterpreted the reason for the stop and proceed aspect displayed at signal 6.2E and was not prepared to stop his train before arriving at CP-4.

Although the engineer of train No. 5324 said that the presence of the railway and bus inspector and the entrance of the conductor into the operating compartment did not distract him, passenger statements indicated that the two (the engineer and the inspector) were engaged in conversation. Further, since the railway and bus inspector rode in the operating compartment of train No. 5324 regularly, the familiarity of the engineer and the inspector would probably have facilitated conversations between them. The failure of the engineer of train No. 5324 to account for the restricting signal aspects correctly could have been the result of his being distracted, and thereby, erroneously interpreting the signal aspects indicating that he would be diverging to the No. 1 track at CP-4. The Safety Board believes that the actions of the engineer of train No. 5324 indicate an assumptive manner of operation, which resulted from his inattention or his becoming distracted while conversing with the railway and bus inspector.

Notwithstanding the failure of the engineer to comply with the speed restriction mandated by the stop and proceed aspect of signal 6.2E and his inattention, this accident could have been prevented if train No. 5324 had been equipped with a backup system to control the train as required by the signals. The Safety Board has long been an advocate of systems which provide backup control when an engineer fails to properly control a train. Following the investigation of a head-on collision of two Burlington Northern (BN) freight trains near Wiggins, Colorado on April 13, 1984, and a rear-end collision of two BN freight trains at Newcastle, Wyoming, on April 22, 1984, 10/ the Safety Board reemphasized the need for adequate backup safety devices in a letter to the FRA dated May 16, 1985, citing past Safety Recommendations including R-76-3 and R-84-31 regarding automatic train control and alerter devices, respectively.

10/ For more detailed information read, Railroad Accident Report--Head-On Collision of Burlington Northern Railroad Freight Trains Extra 6714 West and Extra 7820 East, Wiggins, Colorado, April 13, 1984, and Rear-End Collision of Burlington Northern Railroad Freight Trains Extra 7843 East and Extra ATSF 8112 East near Newcastle, Wyoming, April 22, 1984" (NTSB/RAR-85/04).

The text of these recommendations to the FRA is as follows:

R-76-3

Promulgate regulations to require an adequate backup system for mainline freight trains that will insure that a train is controlled as required by the signal system in the event that the engineer fails to do so.

R-84-31

Develop and promulgate a requirement that locomotives operated in main track service be equipped with an alerting device which will stop a train if the engineer fails to respond to an alarm indicating that he or she had fallen asleep or has become incapacitated.

The FRA's latest response to R-76-3 indicates that it found the installation of automatic train control too costly to be justified. With respect to R-84-31, the FRA said it was developing data to support a locomotive cab safety review to address the issue of alerting devices; however the FRA stated that it had not yet formed an opinion on the effectiveness of such devices.

The Safety Board is aware that the railroad industry is involved in an Advanced Train Control Systems (ATCS) Project which is adapting modern technology to train operating problems. The project involves designing and testing systems which could be applied to U.S. railroads regardless of their length or method of operation. This would allow railroads to select the system which best suits their operational and economic needs.

Unfortunately, the ATCS Project lacks any FRA oversight to ensure a successful completion of the project from an operational safety standpoint. In conversations between the FRA and Safety Board staff, the FRA has indicated that their only involvement with ATCS has been through briefings by the industry and monitoring by technical staff. FRA has not indicated to the Safety Board that they were exploring other advanced technologies or systems for controlling movements of trains. The Safety Board believes that the railroad industry is presently designing and testing state-of-the-art railroad operating systems and that the FRA should take an active role to help formulate the operational and safety aspects of these systems. Further, by taking a more active role, the FRA could assure that train separation is a required component of any train control system ultimately installed.

The Safety Board believes that FRA's response of January 20, 1987, to Safety Recommendations R-76-3 and R-84-31 is unacceptable. Accordingly, the Safety Board issued a new safety recommendation to the FRA which again asks the FRA to promulgate regulations requiring separation of trains on mainline track by means of train control systems and it has placed Safety Recommendations R-76-3 and R-84-31 in a "Closed--Unacceptable Action/Superseded" status.

Crashworthiness

Many passengers sustained their injuries when they struck the metal on the seats. Other passengers were injured by dislodged objects from the overhead luggage racks. Many passengers were injured when they were thrown by the impact forces and fell on or against each other. The older equipment of the type used on trains Nos. 5309 and 5324 was

not designed to accommodate standing passengers. No overhead handholds are provided and the equipment is not suitable for transporting standing passengers. The overloaded condition of the train probably contributed to the numbers and severity of injuries received.

The Safety Board has been concerned about passenger injuries resulting from the inadequately designed interiors of passenger carrying cars and has addressed this issue in numerous accident investigations involving Amtrak. 11/ In its reports of these accident investigations, the Safety Board highlighted the sources of passenger injuries including inadequately secured seats, exposed headrest frames, and unrestrained luggage falling from overhead racks. The Safety Board has issued numerous recommendations to Amtrak urging elimination of these injuring-producing features. The following accident investigations illustrate the Safety Board's concern. As a result of an Amtrak collision at Wilmington, Illinois, on November 29, 1984, the Safety Board issued Safety Recommendation R-84-40:

> Correct the identified design deficiencies in the interior features of existing and new passenger cars, which can cause injuries in accidents, including the baggage retention capabilities of overhead luggage racks, inadequately secured seats, and inadequately secured equipment in food service cars.

The Safety Board's investigation of an Amtrak accident at Essex Junction, Vermont, on July 7, 1984, 12/ in which overhead luggage falling from the racks was again documented as a common cause of injuries, prompted the Safety Board to issue Safety Recommendation R-85-128:

> Develop and install effective retention devices on its overhead luggage racks to prevent the dislodging of luggage and other articles in a collision and/or derailment.

Evidence from the Amtrak accident at Chase, Maryland, on January 4, 1987, indicates that the interior features of the passenger cars were the source of numerous injuries. While Amtrak has responded favorably to many of these recommendations, and is

---

11/ For more detailed information, read Railroad/Highway Accident Report--"Collision of Amtrak Passenger Train No. 301 on Illinois Central Gulf Railroad with MMS Terminals, Inc., Delivery Truck, Wilmington, Illinois, July 28, 1983" (NTSB/RHR-84/02); Railroad Accident Report--"Derailment of Amtrak Train No. 21 (The Eagle) on the Missouri Pacific Railroad, Woodlawn, Texas, November 12, 1983" (NTSB/RAR-85/01); Railroad Accident Report--"Head-on Collision of National Railroad Passenger Corporation (Amtrak) Passenger Trains Nos. 151 and 168, Astoria, Queens, New York, July 23, 1984" (NTSB/RAR-85/09); and Railroad Accident Report--"Derailment of Amtrak Passenger Train No. 60, The Montrealer, on the Cantral Vermont Railway near Essex Junction, Vermont, on July 7, 1984" (NTSB/RAR-85/14).

12/ For more detailed information, read Railroad Accident Report--"Derailment of Amtrak Passenger Train No. 60, The Montrealer, on the Central Vermont Railroad near Essex Junction, Vermont , July 7, 1984" (NTSB/RAR-85/14).

looking at ways to eliminate these injury-producing features, 13/ the Safety Board believes that any carrier involved in passenger rail service, should make a concerted effort to improve the interior designs of its passenger cars and to prevent these types of injuries. As was demonstrated in this accident, a large number of the injured were standees who were thrown into each other or struck by falling luggage. The Safety Board believes that the MBTA should provide equipment which has adequately designed interiors, including overhead grab bars and seat handholds, to prevent the types of injuries that resulted in this accident.

The Safety Board also over the years has called on the FRA to take action in this area. As early as 1970, the Safety Board recommended that the FRA "institute immediate regulations requiring all future new and rebuilt passenger cars be equipped with secured seats and luggage retention devices." Although a study was initiated, no further action was taken. As recently as 1984, the FRA indicated in its Report to Congress on Railroad Passenger Equipment Safety that the interior of passenger cars merited additional study and that among the subjects to be addressed were the design and securement of seats, luggage retention, and interior contouring. The previously cited Amtrak collision at Wilmington, Illinois, on July 28, 1983, prompted the Safety Board to issue Safety Recommendation R-84-46 to the FRA:

> Expedite the studies on the interior design of passenger cars, described in the January 1984 Report to Congress, and publish recommended guidelines for securing seats and for luggage retention devices.

The Safety Board's investigation of an Amtrak train derailment at Kittrell, North Carolina, on March 5, 1984, again demonstrated further need for luggage retention devices and Safety Recommendation R-84-46 was reiterated to the FRA on March 20, 1985. On June 3, 1985, the FRA responded to the Safety Board's recommendation and indicated that it planned to take no further action. In a letter dated August 19, 1985, the Safety Board expressed disappointment at FRA's decision in view of the overwhelming documentation that injuries have occurred and continue to occur as a result of the features of the passenger car interiors, particularly unrestrained luggage from the overhead racks. The Safety Board cited another Amtrak accident in Astoria, Queens, New York, on July 23, 1984, which again revealed that these sources of injuries continue to pose a threat to passengers. The Safety Board urged the FRA to reconsider its decision and to take action to implement the Safety Board's recommendation. No further response from the FRA has been received and the recommendation is being held in an "Open--Unacceptable Action" status.

As a result of the collision the car interiors in train No. 5324 received relatively light damage. The operating compartment of control coach No. 1300 was not crushed. Some of the impact energy was probably absorbed by the cars in train TV-14, thus reducing the damage and impact reaction to the equipment and passengers of train No. 5324.

13/ In its March 13, 1985, response to Safety Recommendation R-84-40, Amtrak outlined steps to improve securement of seats and food service equipment in existing and new cars, and although it had designed a web-type luggage retention device to be installed on new cars, it had no plans to retrofit existing cars. Consequently, since the full intent of Safety Recommendation R-84-40 was not being met, it was placed in a "Closed--Unacceptable Action" status and a new recommendation, R-85-128, was issued to address specifically luggage retention devices. Subsequent to the Essex Junction, Vermont, accident, Amtrak indicated that it was investigating luggage restraint devices on new and existing cars; therefore, R-85-128 is being held in an "Open--Acceptable Action" status. Amtrak has advised the Safety Board that it is testing a new luggage retention system in some of its passenger cars in Northeast Corridor service.

End-of-Train Device, Train Radio, and Operating Rules

While the EOT device did not cause or contribute to this accident, the circumstances in this accident highlight the importance of a reliable radio system especially for EOT-equipped trains. The operating rules of most railroads require that when a train is stopped unexpectedly by an emergency brake application, all adjacent tracks should be protected from an approaching train that may collide with cars that have derailed. Since there are no crewmembers on the rear of a EOT-equipped train, there is no one to protect approaching trains on adjacent tracks moving in the same direction. Therefore, it is especially important in the case of an unexpected emergency stop that EOT-equipped trains have reliable radios so crewmembers can contact an approaching train to warn the train of the potential danger.

The railroad supply industry is moving rapidly to perfect and furnish railroad companies with the hardware and software to implement ATCS. The ATCS is comprised of four elements: a data communications network system; computers and display screens on locomotives; a transponder network or a satellite communications system; and a central computer for dispatching purposes. The equipment for the ATCS is available and, when implemented, will impose more exacting requirements on the radio systems which will be essential in ATCS operation. Therefore, the Safety Board believes that, more than ever before, dependable radio systems are needed. With the implementation of the new ATCS, concise and enforceable operating rules for the use of radios will also be required.

Mechanical Aspects

Following the accident, the brakes on train No. 5324 were found to be operating properly and no exceptions were noted. Even though B&M engineers had complained about the poor braking response on trains with intermixed D-22 and 26 types braking systems, tests conducted by the B of LE, the FRA, and the B&M indicated that the intermixed systems met regulatory requirements. The findings indicated that a slower braking response was common for mixed equipment using D-22 and 26 systems. However, since engineers are required to make a departure running brake test, they should know how the brakes will respond and operate their train accordingly.

Emergency Response

The Safety Board believes that the response of the emergency personnel to the accident site was very good. The triage facility was established quickly and the passengers received prompt attention. The injured passengers were dispatched to a hospital in a timely manner, and the emergency forces are to be commended. The failure of the radios on some of the emergency response equipment was unfortunate; the nature of the failure was not determined. Fortunately, in this instance, alternate communication facilities were available and contact with the hospitals was established and maintained.

The Safety Board encourages the Boston emergency forces to move forward on the development of their disaster preparedness plan to be in a posture to respond quickly and effectively to any disaster and to provide the most reliable communications facilities available.

CONCLUSIONS

Findings

1. The operation and movement of train TV-14 was in accordance with applicable operating rules.

2. The uninitiated emergency brake application within train TV-14 was not causal to this accident.

3. The signal aspects displayed to the rear of train TV-14 were correct; there were no deficiencies found within the signal system.

4. Although the engineer of train No. 5324 stated that he was not distracted by conversation with the railway and bus inspector, the manner in which the train was operated indicates inattentiveness on his part.

5. The engineer of train No. 5324 considerably exceeded the allowable maximum authorized speed of 15 mph between signal 6.2E and the point of collision.

6. Train No. 5324 could have been stopped short of a collision if the proper maximum speed of 15 mph or less had been observed after the stop at signal 6.2E.

7. The engineer of train No. 5324 probably misinterpreted the reason for the stop and proceed aspect displayed at signal 6.2E, and was not prepared to stop his train before arriving at CP-4.

8. The speed chart confirms overspeed train operation, and refutes the engineer's claim to have complied with the allowable speed limits.

9. Flagging of train No. 5324 was not required by the operating rules, but since the trainman was in doubt, he acted in a safe and prudent manner.

10. The passenger equipment, which lacked overhead grab bars and seat handholds, was not designed to accommodate standing passengers, and probably contributed to the injuries of some passengers.

11. Although providing braking that is slower in response time, the intermixed types D-22 and 26 brake systems meet the requirements of Federal regulations.

12. The use of radio in railroad operations is becoming increasingly important, and this vital role mandates a reliable and efficient system.

13. The emergency response to the accident was timely and the treatment and evacuation of passengers progressed smoothly.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer of train No. 5324 to properly interpret and comply, due to inattention or distraction, with the speed restriction mandated by the stop and proceed aspect of a wayside signal located to the rear of train TV-14.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations:

--to the Massachusetts Bay Transportation Authority:

Require that on-board speed recording instruments used on equipment in commuter service be maintained to perform their intended function. (Class II, Priority Action) (R-87-14)

Provide equipment for commuter service which has adequately designed interiors, including overhead grab bars and seat handholds, to prevent injury from exposed metal headrest frames and unrestrained luggage. (Class II, Priority Action) (R-87-15)

--to the Federal Railroad Administration:

Promulgate Federal standards to require the installation and operation of a train control system on mainline tracks which will provide for positive separation of all trains. (Class II, Priority Action) (R-87-16)

As a result of its investigation of this accident, the National Transportation Safety Board reiterates Safety Recommendation R-84-46 to the Federal Railroad Administration:

Expedite the studies on the interior design of passenger cars, described in the January 1984 Report to Congress, and publish recommended guidelines for securing seats and for luggage retention devices.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

JOSEPH T. NALL, Member, did not participate.

April 28, 1987

APPENDIXES

APPENDIX A

INVESTIGATION

The National Transportation Safety Board was notified of this accident about 10:05 a.m. on May 7, 1986. A railroad accident investigator from the Washington D.C., headquarters was dispatched to the scene. He was joined in the accident investigation by four investigators from the Safety Board's Bureau of Technology. Parties to the investigation were the Federal Railroad Administration, the Consolidated Rail Corporation, the Boston and Maine Corporation, and the Massachusetts Bay Transportation Authority.

On October 1, 1986, a deposition proceeding was convened at Framingham, Massachusetts, to take the sworn testimony of 11 witnesses. Parties to the deposition were the Boston and Maine Corporation, the Consolidated Rail Corporation, the Massachusetts Bay Transportation Authority, the Federal Railroad Administration, the Brotherhood of Locomotive Engineers, and the United Transportation Union.

APPENDIX B

CREWMEMBER INFORMATION

Theodore F. Lally, Engineer

Mr. Theodore F. Lally, 61, was employed in the mechanical department of the New York, New Haven, and Hartford Railroad Company on February 4, 1948, as a car cleaner. On July 2, 1955, he entered service in the transportation department as a locomotive fireman. For an interim period beginning on July 17, 1964, he worked as a yard crewman, but he returned to engine service and was promoted to engineer on September 14, 1967. As a result of railroad mergers, Mr. Lally became an employee of Conrail, and in 1977 he began operating commuter trains for the Boston and Maine Corporation. He had been on the assignment running trains Nos. 5309 and 5324 for 1 1/2 years at the time of the accident. He passed his last medical examination on July 15, 1984, and his last examination on Conrail operating rules on November 16, 1985. He was current on the examinations required for the B&M and Amtrak operating rules.

Joseph R. Harrison, Jr., Conductor

Joseph R. Harrison, Jr., 61, was employed by the Boston and Albany Railroad Company (New York Central System) as a yard brakeman on January 17, 1948. In 1977, after having worked for the New York Central, Amtrak, Conrail and the Penn Central, he became associated with the B&M as a conductor in commuter service. He passed his last medical examination on June 14, 1977, and his last Conrail operating rules examination on April 23, 1986. He was current on the rules examinations requirements for Amtrak and the B&M.

APPENDIX C

BULLETIN ORDER NO. 1-8

CT 10 R4 3-80 PRINTED IN U.S.A. 84

CONSOLIDATED RAIL CORPORATION

NORTHEASTERN REGION

Bulletin Order

Division: NEW ENGLAND DIVISION
Number: 1-8
Date Issued: May 5, 1986

Effective: 8:00 AM, Wednesday, May 7, 1986

(a) BOSTON LINE
CP 3 - CP 4

Single track between CP 3 and CP 4, out of service for MW work, Continuously from 8:00 AM, Wed., May 7, 1986 until 5:30 PM, Thurs., May 8, 1986.

Trains and engines operating between CP 3 and CP 4 will use Yard Track No. 1 Beacon Park during this period.

R. A. Bowes
Division Superintendent

APPENDIX D

OPERATING RULES

Rule B. Employees must be familiar with and obey all rules and special instructions.

They must follow instructions from proper authorities and must perform all duties efficiently and safely.

* * *

Rule N. Employees on duty in any division must comply with the orders and instructions of that division. While on another railroad, they must comply with the Rules, orders and instructions of that railroad.

* * *

Rule 102a When a train is delayed, the conductor and engineer, or other member of crew when instructed by conductor or engineer, must, as soon as the safety of their train will permit, ascertain the cause, and, as soon as practical, communicate with the train dispatcher or operator.

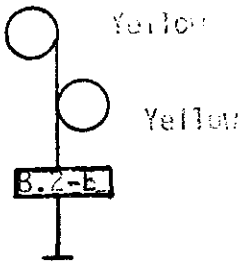
* * *

Rule 106. The conductor, engineer, and pilot are responsible for the safety of the train and the observance of the rules, and under conditions not provided for by the rules, must take every precaution for protection.

This does not relieve other employees of their responsibility under the rules.

* * *

Rule 282(A).

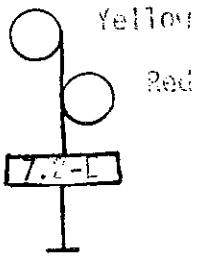


Indication: Proceed at Limited Speed prepared to stop at second signal. Reduction to Limited Speed must commence before engine passes Advance Approach signal.

Name: Advance Approach

* * *

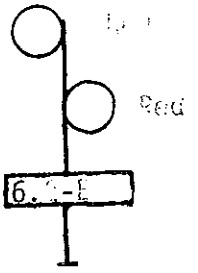
Rule 285.



Indication: Proceed not exceeding Medium Speed prepared to stop at next signal. Reduction to Medium Speed must commence before engine passes Approach signal.

Name: Approach

Rule 291.



Indication: Stop, then proceed at Restricted Speed until the entire train has passed a signal displaying a more favorable aspect.

Name: Stop and Proceed.

* * *

Rule 927. Engineers are responsible for the observance of and compliance with the indications of all fixed signals, and all other signals affecting movements of their engine. When the engine is moving, they must be vigilant and use care to prevent avoidable injury to persons, collisions, derailments and damage to lading and property.

They must, if anything withdraw their attention from constant lookout ahead, or if weather or other conditions make observation of signals or warnings in any way doubtful, at once regulate the speed of their train so as to make progress entirely safe.

Engineers must check the accuracy of the engine speed indicator by using their watch, mile posts and timetable speed table. This must be accomplished as soon as practicable after starting each trip. If the indicator is inaccurate or inoperative, the engineer and other members of the crew must make sufficient checks while enroute to insure that authorized speed is not exceeded. An indicator error in excess of four miles per hour must be reported as soon as praticable to the train dispatcher, and details outlined on the engineer's work report form.

* * *

Definitions

Speeds

Normal Speed: The maximum speed authorized by Timetable.

Limited Speed: Not exceeding 40 miles per hour.

Medium Speed: Not exceeding 30 miles per hour.

Slow Speed: Not exceeding 15 miles per hour.

Restricted Speed: A speed which will permit stopping within one-half the range of vision, which will result in stopping short of train, obstruction or switch improperly lined, looking out for broken rail and not exceeding 15 miles per hour.

APPENDIX E

EMERGENCY RESPONSE INFORMATION AND EMERGENCY PERSONNEL RESPONDING

The following tables provide information on the number of emergency response personnel, the equipment on the scene, and the hospitals' response.

Emergency Response Personnel

7	police officers
70	fire fighters
32	emergency medical technicians
14	paramedics

Equipment on the Scene

4	police patrol units
7	engine companies
6	ladder companies
1	rescue company
1	tower company
1	fire chief
3	deputy fire chiefs
1	arson squad
1	ambulance bus
16	ambulances
5	basic life support ambulances
2	advanced life support ambulances
2	MBTA Buses

Hospital Response

Hospital	Treated and Released	Hospitalized	Total
St. Elizabeth	18	1	19
Brigham & Women's	8	2	10
Beth Israel	11	2	13
Faulkner	6	0	6
University of MA	4	0	4
General Hospital	52	1	53
Boston City	24	2	26
New England Medical Ctr.	17	0	17
Mt. Auburn	4	1	5
Total	144	9	153

☆U S GOVERNMENT PRINTING OFFICE:1987-181-101:40093