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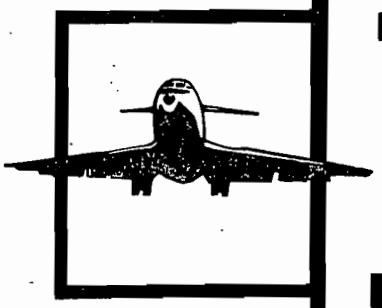

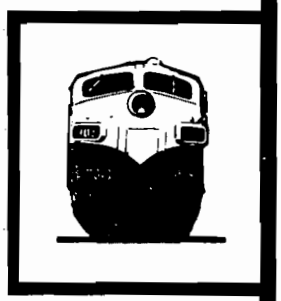

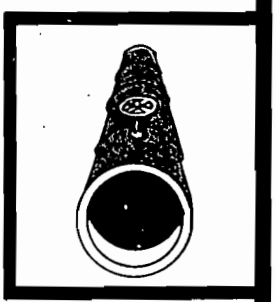

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

HEAD-ON COLLISION OF
BOSTON & MAINE CORPORATION
EXTRA 1731 EAST AND
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
TRAIN NO. 570
ON FORMER BOSTON & MAINE CORPORATION TRACKS
BEVERLY, MASSACHUSETTS
AUGUST 11, 1981

NTSB-RAR-82-1

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

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15. Supplementary Notes		

16. Abstract

About 4:15 p.m. on August 11, 1981, Boston & Maine Corporation freight train Extra 1731 East and Massachusetts Bay Transportation Authority westbound commuter train No. 570 collided head-on on the former Boston & Maine Corporation tracks near Prides Crossing, Beverly, Massachusetts. The train dispatcher allowed Extra 1731 East, a yard switcher, to enter onto the main track because he understood that a coworker would instruct the train to clear the main track for westbound No. 570. The coworker did not have the same understanding about the train's routing as the dispatcher, and Extra 1731 East was allowed to proceed eastward on the same track on which No. 570 had been authorized to proceed westward. The engineer of No. 570 and two trainmen and an unauthorized passenger on Extra 1731 East were killed. The engineer and foreman of Extra 1731 East, and the conductor, the trainman, and 28 passengers on No. 570 were injured. Damage was estimated at $1,683,200.

The National Transportation Safety Board determines that the probable cause of this accident was that the train dispatcher gave westbound train No. 570 exclusive right over opposing trains on the eastward track of the Gloucester Branch between Manchester, Massachusetts, and Congress Street in Beverly, Massachusetts, without first determining that there were no opposing trains between those two locations. Contributing to the cause of the accident was the failure of the train dispatcher and the train director to reach a common understanding regarding the planned movement of Extra 1731 East.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: March 9, 1982

HEAD-ON COLLISION OF BOSTON & MAINE CORPORATION EXTRA 1731 EAST AND MASSACHUSETTS BAY TRANSPORTATION AUTHORITY TRAIN NO. 570 ON FORMER BOSTON & MAINE CORPORATION TRACKS BEVERLY, MASSACHUSETTS AUGUST 11, 1981

SYNOPSIS

About 4:15 p.m. on August 11, 1981, Boston & Maine Corporation freight train Extra 1731 East and Massachusetts Bay Transportation Authority westbound commuter train No. 570 collided head-on on the former Boston & Maine Corporation tracks near Prides Crossing, Beverly, Massachusetts. The train dispatcher allowed Extra 1731 East, a yard switcher, to enter onto the main track because he understood that a coworker would instruct the train to clear the main track for westbound No. 570. The coworker did not have the same understanding about the train's routing as the dispatcher, and Extra 1731 East was allowed to proceed eastward on the same track on which No. 570 had been authorized to proceed westward. The engineer of No. 570 and two trainmen and an unauthorized passenger on Extra 1731 East were killed. The engineer and foreman of Extra 1731 East, and the conductor, the trainman, and 28 passengers on No. 570 were injured. Damage was estimated at $1,683,200.

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INVESTIGATION

The Accident

The westward track of the two-track Gloucester Branch 1/ was out of service for repairs west of Manchester, Massachusetts, on August 11, 1981. Bulletin Order No. B1-420 required both eastbound and westbound trains to use the eastward track of the Gloucester Branch between Manchester and Beverly Junction in Beverly, Massachusetts, and the eastward track of the Eastern Route Main Line (ERML) between Beverly Junction and Congress Street in Beverly. Westbound trains returned to the westward track at Congress Street. (See figure 1.) Eastbound trains could proceed normally, governed by the aspects of wayside automatic block signals. Westbound trains could move westward beyond Manchester only by special provisions under the arrangements and control of the train dispatcher at North Billerica, Massachusetts.

1/ The Gloucester Branch was formerly owned by the Boston & Maine Corporation and is now owned by the Massachusetts Bay Transportation Authority.

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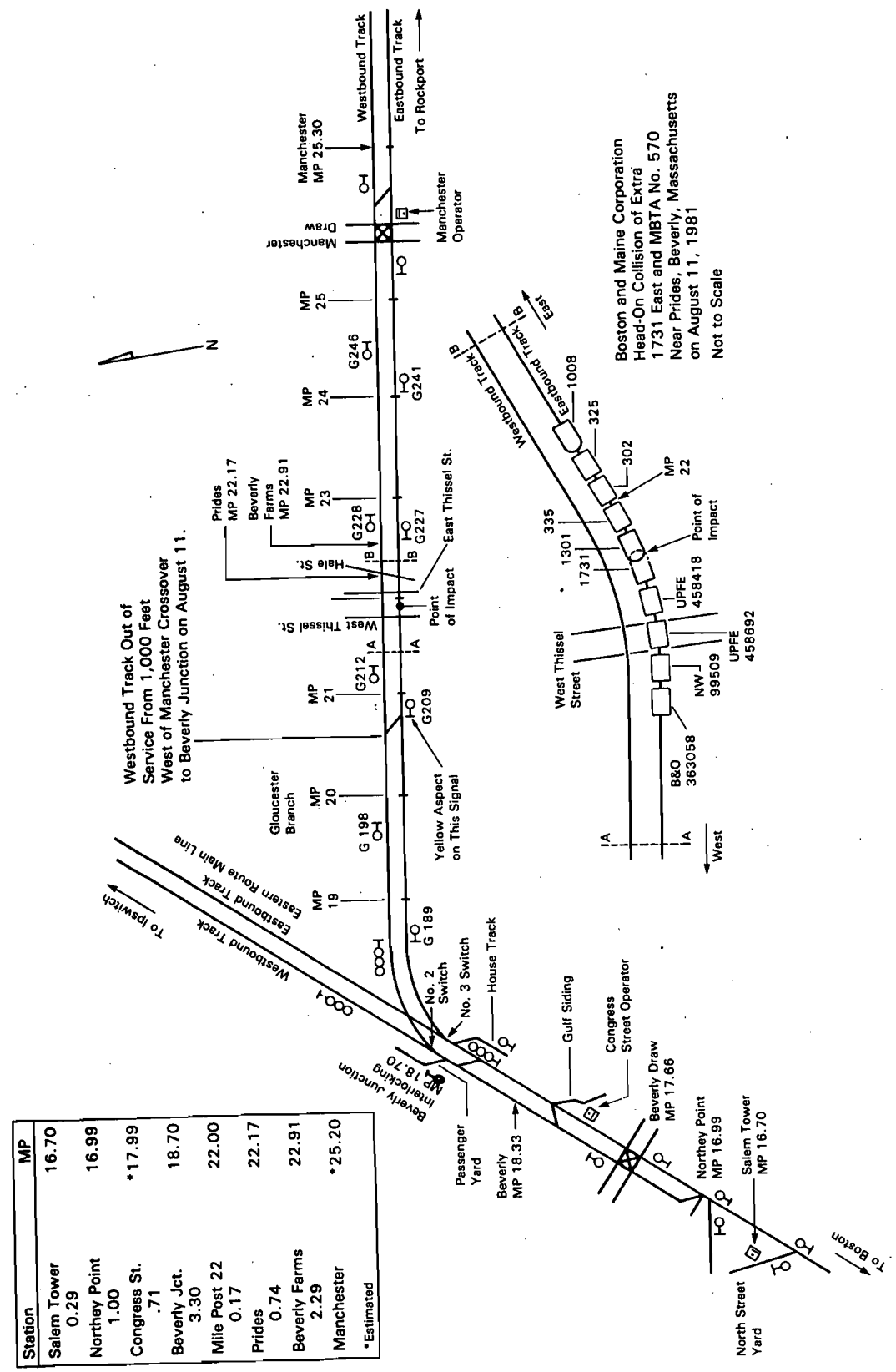

Station	MP
Salem Tower	16.70
0.29	
Northey Point	16.99
1.00	
Congress St.	*17.99
.71	
Beverly Jct.	18.70
3.30	
Mile Post 22	22.00
0.17	
Prides	22.17
0.74	
Beverly Farms	22.91
2.29	
Manchester	*25.20

*Estimated

Figure 1.—Plan view of accident site.

Extra 1731 East.--The four crewmembers of Boston & Maine Corporation's (B&M) 1459 (hours) switcher (the engineer, the foreman, and two trainmen) reported for duty at the B&M's Salem Tower facility, Salem, Massachusetts, about 2:45 p.m. on August 11, 1981. The foreman and the engineer were advised by the train director at Salem Tower that their train would operate eastbound, first to Gloucester/Rockport, Massachusetts, and then to Newburyport, Massachusetts. Locomotive unit 1731 was assigned to the 1459 switcher, which became the train identified as Extra 1731 East. Extra 1731 East was authorized to depart the yard at Salem and to operate to Gloucester/Rockport by operating rule D-97 of the B&M Operating Rules (see appendix B). After the foreman and the engineer checked with the train director for any train orders, messages, bulletin orders, or work directives that affected the movement of their train, the crew proceeded into North Street Yard with the locomotive near Salem Tower where they coupled to their train consisting of four cars and no caboose.

The foreman did not take a caboose with the train because he considered the available caboose to be in an unsafe condition. The foreman said that he considered the caboose unsafe because the doors on both ends did not have locks on them, and the motion of the train would cause the doors to swing open and closed. He also said that the doors inside the caboose to the toilet and lockers would not stay closed and that they too would swing. B&M rule 108 states that in case of doubt or uncertainty about factors affecting the train operation, the safe course must be taken.

After the train had been coupled, the crew made a train airbrake test to which they took no exception. The engineer tested the locomotive radio with Salem Tower on the yard channel only, and he did not take any exceptions to its performance. The locomotive radio also had the frequency assigned for use as a road channel, but that frequency was not tested as required by B&M rule 714C.

About 3:35 p.m., Extra 1731 East, with the long hood of the locomotive unit forward, moved past Salem Tower on a yard track toward Northey Point (see figure 1), where it could enter onto the eastward main track of the ERML when it was given a permissive signal from Salem Tower. The dispatcher authorized the train director at Salem Tower to release Extra 1731 East after eastbound Massachusetts Bay Transportation Authority (MBTA) commuter train No. 227 2/ passed Northey Point on the eastward track. After No. 227 passed Northey Point about 3:53 p.m., Extra 1731 East, with the four crewmembers and an unauthorized passenger, who was a friend of the engineer, in the operating compartment of the locomotive, entered the eastward main track and departed Northey Point at 3:55 p.m. The train director did not report Extra 1731 East's departure time to the dispatcher at that time. The train proceeded to Beverly Drawbridge in Beverly, where upon receiving a proceed hand signal from the operator at the temporary Congress Street train order office, the crew moved the train forward and stopped adjacent to the office.

The foreman of Extra 1731 East descended from the locomotive and received a clearance card Form A (clearance card) and a train order 3/ from the operator. The traincrew of Extra 1731 East knew from the timetable that the scheduled time of westbound MBTA commuter train No. 570 would place No. 570 in conflict with the eastward movement of Extra 1731 East. Therefore, they questioned the operator about the status of No. 570. The operator replied, "They are letting you go." Extra 1731 East

2/ Numbered trains referred to are MBTA scheduled commuter trains operated by B&M crews over MBTA tracks.

3/ For train movements not provided for by timetable or special instructions, a train order is used.

departed Congress Street at 4:01 p.m. The crewmembers of Extra 1731 East and the operator did not discuss their train's getting clear of the eastward main track by moving into either Beverly Gulf Siding or Beverly Yard at Beverly Junction, two accessible clearance points. The operator then reported the train's arrival and departure times to the dispatcher. The operator did not report the train to anyone else, nor was she required to do so by B&M operating rules. At 4:06 p.m., Extra 1731 East passed onto the Gloucester Branch at Beverly Junction, an interlocking plant remotely controlled by the train director at Salem Tower; the train director did not report this passing time to the dispatcher immediately.

About 4:10 p.m., the crew of Extra 1731 East was able to view wayside automatic block signal G-209 near milepost 21, which was displaying an approach aspect. The foreman on Extra 1731 East radioed the dispatcher several times successively in an effort to determine why the signal was displaying the approach aspect. He finally received an acknowledgment of these calls from the dispatcher, but because of the events that followed, the foreman did not have time to talk with him. As Extra 1731 East entered a 2° curve while moving about 18 mph, the engineer saw an opposing train on the eastward track only a few hundred feet ahead. He placed the train's brakes in emergency and shouted for everyone in the operating compartment to jump. He left the operating compartment through the door behind the operating position, moved under the railing along the walkway, and jumped to the ground where he landed on the westward track structure. The foreman left the operating compartment through the door in front of the fireman's position, and he was either on the walkway or the steps leading from the operating compartment to the walkway when the two trains collided about 4:15 p.m, at a calculated impact speed of 12 mph. The two trainmen and the unauthorized passenger did not leave the operating compartment and were killed.

Train No. 570.--The three crewmembers of MBTA commuter train No. 570 (the conductor, the engineer, and the trainman) reported for duty at Rockport on the afternoon of August 11, 1981. After contacting the train director at Salem Tower and determining that there were no train orders or messages for No. 570, they departed Rockport via bus at 3:19 p.m. for Gloucester where, at 3:35 p.m., they assumed charge of their train, which consisted of four coaches and a pusher locomotive. Upon completion of the federally required airbrake test, in which the crewmembers took no exceptions to the brakes, No. 570 departed Gloucester on the westward main track at 3:49 p.m. The train made two stops between Gloucester and Manchester, Massachusetts, and neither the conductor nor the trainman took any exceptions to the manner in which the train was handled or in its stopping.

No. 570 arrived at Manchester on time at 4:02 p.m. After receiving a clearance card and a train order from the operator at Manchester giving No. 570 right 4/ over opposing trains on the eastward main track between Manchester and Congress Street, No. 570 crossed from the westward to the eastward main track and departed Manchester at 4:07 p.m. The operator at Manchester said he initiated a call and reported No. 570's arrival and departure times to the dispatcher, but he did not report the train's departure time to either the operator at Congress Street or the train director at Salem Tower. He was not required by B&M operating rules to do so. Also, he did not check with the operator at Congress Street to determine if the traffic block on the eastward main track between the two train order offices was clear of trains, and he did not request the block between the two offices for the exclusive use of No. 570. The B&M operating rules did

4/ A train order supersedes other operating instructions, and the term "right" means that the train addressed in the train order is superior to other trains between the points specified in the train order and that its movement takes precedence.

not require that he perform either of these procedures. Although the dispatcher did not record the reported arrival and departure times of No. 570 at Manchester, his relief dispatcher later recorded the times.

No. 570 stopped at Beverly Farms, Massachusetts, for passengers, and the brakes operated properly. By this point, there were an estimated 58 passengers aboard. The train left Beverly Farms and continued westbound on the eastward main track. When No. 570 was near Prides Crossing in Beverly, the conductor, who was in the last car of the train, felt the train brakes apply in emergency and heard a long blast on the train whistle. That whistle signal was not the standard signal required by B&M operating rules for a highway grade crossing. (See appendix B.) After the long blast stopped, he heard two short whistle blasts. At the time of the sounding of the second short blast, according to the corrected locomotive speed tape, the train was being operated about 36 mph, and after slowing slightly, No. 570 collided head-on with Extra 1731 East about 4:15 p.m. in a 2° curve to the right. The impact speed for No. 570 was calculated at 19 mph. The collision occurred about 100 yards east of the West Thissell Street crossing in Beverly. The engineer of No. 570 was ejected from the operating compartment during the collision and was killed.

After briefly surveying the accident scene, the conductor of No. 570 attempted to call the dispatcher and the train director from the pusher locomotive radio. He heard Salem Tower calling No. 570, but he could not interrupt the train director to respond. He knew that the call to No. 570 was not in response to his call, so he went to a private home nearby and used a commercial telephone to call the train director and the dispatcher to report the collision. The train director notified the Beverly Police Department of the accident, and the police department notified other emergency units.

No. 570's control car, which was the lead car in the train, and locomotive unit 1731 coupled upon impact. The deformation of the control car effectively provided a "ramp" so that the car rode up onto the top of locomotive unit 1731. (See figure 2). Locomotive unit 1731 and the control car of No. 570 were derailed. The three trailing cars and the pusher locomotive of No. 570 and the four cars of Extra 1731 East did not derail and the cars in each train remained coupled.

Events Preceding the Accident

Bulletin Order No. B1-420.--On July 28, 1981, B&M Superintendents of Freight, Boston Division, and Commuter Service issued Bulletin Order No. B1-420 to become effective at 12:01 a.m., on Sunday, August 2, 1981. (See appendix C.) This bulletin order established temporary train order offices at Congress Street in Beverly (the western terminal) and at Manchester (the eastern terminal). Additionally, the bulletin order provided for single-track operation on the eastward main track of the Gloucester Branch between the temporary train order offices while the westward main track was being rehabilitated. The bulletin order required that all eastbound trains obtain, as a minimum, a clearance card to pass the train order signal at Congress Street. Westbound trains had to receive train order authorization and a clearance card at Manchester to operate on the eastward main track between Manchester and Congress Street.

At the company hearing after the accident, the B&M Director of Operating Rules, testifying as a company witness, said that a proper interpretation and application of Bulletin Order B1-420 required the dispatcher to issue a Form J holding order, which directs the operator or train director to hold all trains at a specified location (see appendix B), to the train director at Salem Tower for the purpose of holding all eastbound trains for the Gloucester Branch at a point west of or at Beverly Junction. In connection

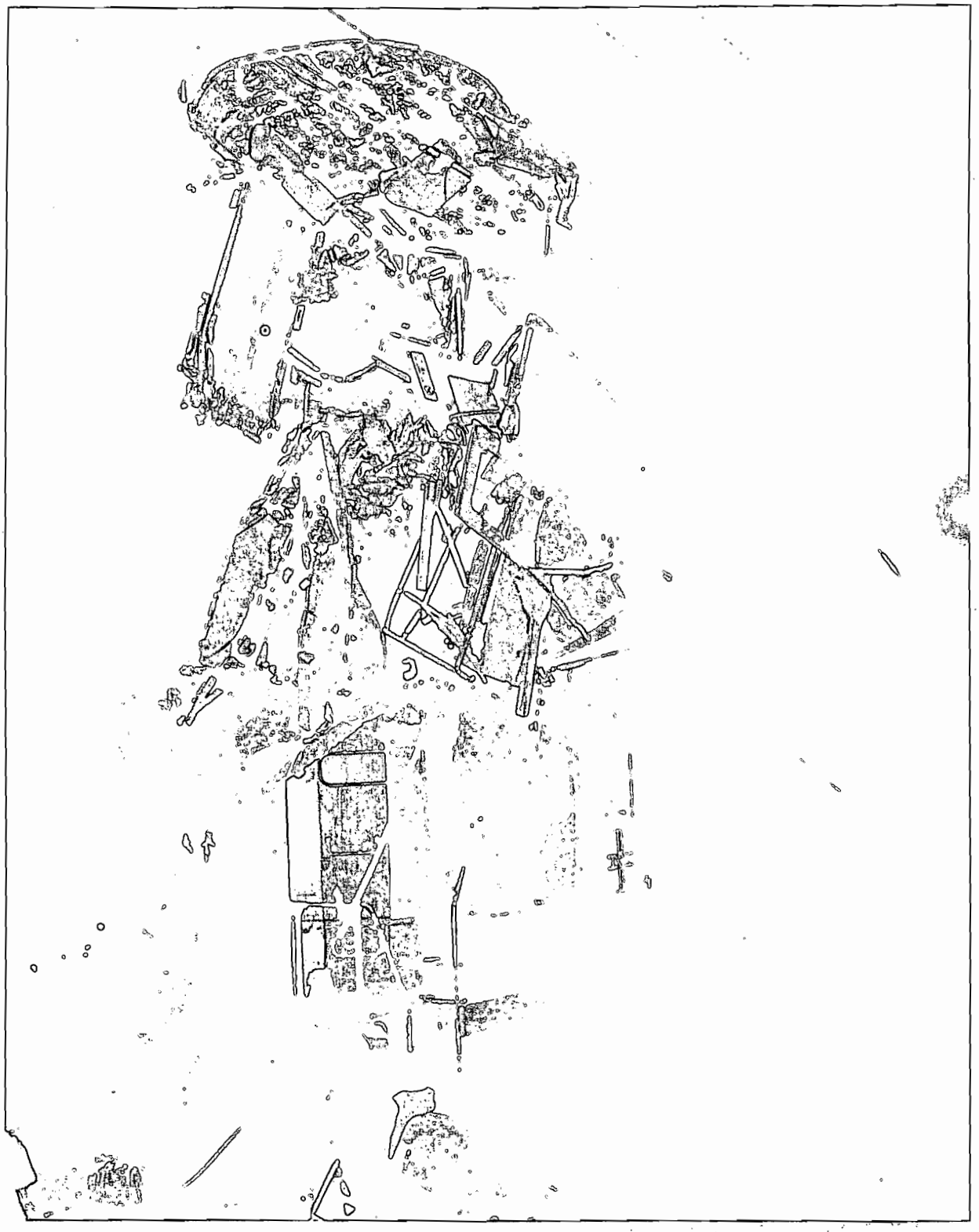

Figure 2.—Damaged control car of No. 570 and locomotive unit 1731.

with the Form J order, a blocking device 5/ also was required to be applied to the console unit control levers for switches and signals in Salem Tower governing access to the restricted route. A Form J order was not placed at Salem Tower to require that all trains be held at Beverly Junction until after the accident on August 11. A Form J order had not been used before the accident. The Director of Operating Rules also said that, according to the rules, Extra 1731 East should have received a copy of the train order addressed and delivered to No. 570 at Manchester.

The Train Director.--When the second-shift train director at Salem Tower reported for duty about 2:45 p.m. on August 11, 1981, the first-shift train director told him that Bulletin Order B1-420 was still in effect, and he was given a message about the operation of the 1459 switcher. The second-shift train director said that a blocking device was affixed to the console unit control lever which controlled the No. 2 track switch at Beverly Junction leading from the westward main track of the Gloucester Branch to the westward track of the ERML. He said that it was the only blocking device on the console control unit when he reported for duty.

When the train director observed Extra 1731 East moving through the yard toward Northey Point about 3:35 p.m., he used the dispatcher's telephone to call the dispatcher at North Billerica. The train director said that the dispatcher told him that Extra 1731 East would have to wait in the yard until after the time of the evening rush-hour commuter traffic. The train director suggested to the dispatcher that Extra 1731 East could follow eastbound No. 227, which was due past Northey Point at 3:46 p.m., and that if it became necessary he could get Extra 1731 East clear of the eastward main track of the ERML at either Beverly Gulf Siding or Beverly Yard.

The train director said that after they studied the schedule of trains due in the area, the dispatcher told him that Extra 1731 East could follow No. 227 from Northey Point. The train director said that during the conversation they discussed the possibility of a conflict between Extra 1731 East and No. 570, which was due to pass Manchester at 4:02 p.m. and which would need to use the eastward main track. The train director told Safety Board investigators that he understood from this discussion that the dispatcher would hold Extra 1731 East on the eastward main track of the ERML at Congress Street until No. 570 had crossed back over to the westward main track at Congress Street. He said that the dispatcher did not tell him to get Extra 1731 East clear at Beverly Gulf Siding. Therefore, after No. 227 passed Northey Point, the train director released Extra 1731 East to proceed on the eastward main track of the ERML toward Congress Street. The significance of the blocking device restricting train movements past Beverly Junction from the ERML onto the Gloucester Branch was not discussed.

After Extra 1731 East had departed Congress Street, which the train director could determine by the detector track lights on his console control unit, and while it was between Congress Street and Beverly Junction, the train director radioed to the engineer and asked him, "What are they going to do with you?" The engineer replied, "They are letting us go." The train director said he then contacted the dispatcher and asked him what he was going to do with Extra 1731 East. The train director said that after the dispatcher told him, "He has a 'may go'," he established a permissive signal at Beverly Junction Interlocking for Extra 1731 East to allow it to proceed onto the Gloucester Branch. The train director had remotely aligned the switch earlier.

5/ A blocking device should prevent the movement of the switch or signal operating lever to which it is applied. Only a dispatcher can authorize the removal of a blocking device applied under a dispatcher's direction. However, the blocking devices used at Salem Tower would not prevent the control levers from being operated.

The train director said that the dispatcher called him about 4:10 p.m. and asked him for the location of Extra 1731 East. The train director told him, "He should be approaching Manchester," to which the dispatcher replied, "Oh, I thought he was going in the clear." Immediately, the train director began calling Extra 1731 East on the radio in an effort to determine its location. Extra 1731 East did not respond to those calls. The train dispatcher also tried unsuccessfully to contact No. 570. Shortly thereafter, about 4:25 p.m., the conductor of No. 570 called Salem Tower by commercial telephone and reported the collision and asked for emergency assistance.

The First-Shift Dispatcher.--The first-shift dispatcher had issued Track Car Permit (TCP) No. 121 to a Maintenance of Way Department foreman to provide protection for him for a specific period of time while he was occupying an in-service main track. The TCP was issued and made complete 6/ at 2:49 p.m. TCP's are handled in the same manner as train orders and are written in the dispatcher's train order book as they are being transmitted. The operating rules require that, in conjunction with a TCP, a blocking device be applied by an operator on the console unit control lever at an appropriate protective point. The times of application and removal of the blocking devices are also to be recorded in the train order book. No entry is shown in the train order book to record the application of a blocking device in conjunction with TCP 121. However, an entry indicates that a blocking device was removed at 3:02 p.m. The exact location of the blocking device was not specified.

The first-shift dispatcher also issued and made complete at 3:30 p.m. TCP No. 123 directly to a maintenance of way foreman, which gave track time to him on the eastward track of the Gloucester Branch until 4 p.m. An entry beside TCP No. 123 in the train order book indicates a blocking device was applied at 3:30 p.m., but no specific location is given. The first-shift dispatcher said he instructed the train director at Salem Tower to apply a blocking device on the control lever for Beverly Junction Interlocking in conjunction with TCP No. 123, and said he emphasized this point to the second-shift (3:30 p.m. to 11:30 p.m.) dispatcher to whom he was making a transfer of duties at the time. There is no entry in the train order book that indicates that the blocking device was removed, although an entry on the dispatcher's train sheet, later transferred to the train order book, indicates that TCP No. 123 was released by the maintenance of way foreman at 3:56 p.m. The train director at Salem Tower said he was not instructed to, nor did he apply, a blocking device on the console unit control levers governing switches and signals leading to the eastward track of the Gloucester Branch at Beverly Junction Interlocking.

The Second-Shift Dispatcher.--The second-shift dispatcher said that when he assumed the duties of the dispatcher's position from the first-shift dispatcher at 3:30 p.m., he received information that: (1) a hold order was in effect at Congress Street affecting all eastward trains; (2) a "may go" order had been issued to the operator at Congress Street for eastbound trains Nos. 571 and 227; (3) an unexpired TCP (No. 123) affecting train operation between mileposts 19 and 20 on the eastward main track of the Gloucester Branch was still in effect; and (4) a blocking device was applied to the console unit control lever which operated the No. 3 track switch at Beverly Junction Interlocking leading from the eastward track of the ERML to the eastward main track on the Gloucester Branch.

6/ A train order or track car permit is not valid until it has been correctly repeated to the dispatcher by the receiver. When the dispatcher has determined that the train order or track car permit has been received correctly, he or she gives a completion time.

When the train director at Salem Tower called the dispatcher about 3:35 p.m. and reported that Extra 1731 East was ready to leave Northey Point for Gloucester, the dispatcher said he told the train director that they (he and the train director) would wait until after the time of the evening rush-hour commuter traffic before releasing Extra 1731 East. The dispatcher said he suggested that the freight train might be allowed to leave Northey Point after No. 537, due past Northey Point at 5:52 p.m. The two men then had a discussion about scheduled trains and the movement of Extra 1731 East. When the train director suggested that Extra 1731 East could follow No. 227 and that if it became necessary he could get Extra 1731 East in the clear at either Beverly Gulf Siding or in Beverly Yard, the dispatcher said he told the train director, "Let him follow No. 227 and put him in the clear at Beverly Gulf." They did not discuss the blocking device restricting train movements past Beverly Junction from the ERML onto the Gloucester Branch.

The dispatcher said he called the operator at the train order office at Congress Street on a telephone and told her, as information, that Extra 1731 East would back into Beverly Gulf Siding to clear the main track for No. 570. The operator at Congress Street denied that the dispatcher ever gave this information to her. The dispatcher said he knew that Extra 1731 East would need a clearance card to pass the train order signal at Congress Street so that it could proceed to Beverly Gulf Siding and get into the clear, so he directed the operator at Congress Street to copy a running order addressed to Extra 1731 East, which would be fulfilled 7/ east of Manchester, and a "may go" train order addressed to the operator at Congress Street. Both train orders, Nos. 124 and 125, respectively, and the clearance card were issued and made complete at 3:52 p.m. (See appendix D.)

The dispatcher said that after he finished the necessary work with the operator at Congress Street to advance Extra 1731 East, he contacted the operator at Manchester by telephone and issued train order No. 126 which gave No. 570 right over opposing trains on the eastward main track from Manchester to Congress Street. Train order No. 126 and the clearance card were issued and made complete at 4:01 p.m. (See appendix E.) The dispatcher said that he did not issue a copy of order No. 126 to either the operator at Congress Street or the crew of Extra 1731 East because he did not think it was necessary and because, to his knowledge, the B&M operating rules did not require it. Furthermore, he said that at that time he had not ordered the train director at Salem Tower to remove the blocking device from the No. 3 switch control lever controlling the switch at Beverly Junction Interlocking leading to the Gloucester Branch and that he believed it was still applied. He said he was relying on the blocking device as additional protection for No. 570 equivalent to a Form J holding order. Additionally, he said that he believed that Extra 1731 East was in the clear at Beverly Gulf Siding. He said that, for these reasons, he did not believe that it was necessary to issue a Form J holding order to the train director at Salem Tower to hold all eastbound trains for the Gloucester Branch at some point west of Beverly Junction.

The dispatcher testified that after he had completed the train order for No. 570 to leave Manchester, he received a telephone call from the operator at Congress Street to report Extra 1731 East's arrival and departure from Congress Street. He believed that this call came about 4:07 p.m. He asked the operator if Extra 1731 East was clear in the Beverly Gulf Siding. The operator said "No," and that the train had gone east. The dispatcher said that about that time the train director at Salem Tower called him on the dispatcher's telephone, interrupting the conversation with the operator, and asked him if he was holding No. 570 at Manchester. The dispatcher said he responded, "Why should I be

7/ When the terms or conditions of the train order have been complied with, the order is considered to have been "fulfilled," and it has no further validity.

holding No. 570?", and then, "What happened to getting them [Extra 1731 East] clear in the [Beverly] Gulf [Siding]?" (This statement was heard by a witness who was in the dispatcher's office at that time.) The dispatcher said that the train director then said, "Oh, well I'm sorry," and "Extra 1731 East is by Beverly." The dispatcher said he instructed the train director to "stop that train." He then called Manchester to see if No. 570 had left Manchester. The operator at Manchester told him that No. 570 had left 2 minutes earlier. About that time, another dispatcher who worked in an adjacent office space told the dispatcher that Extra 1731 East was calling him on the radio. The dispatcher answered Extra 1731 East, to which the train responded by saying, "1731," and then all that was heard was a hissing noise. The dispatcher continued calling both trains but he did not receive a reply. Shortly thereafter, the train director at Salem Tower told the dispatcher that the two trains had collided.

Injuries to Persons

Injuries	B&M employees	Passengers	Total
Fatal	3	1	4
Serious	2	3	5
Minor	2	25	27
None	0	30	30
Total	7	59	66

Damage

The lead car of No. 570 was destroyed. The estimated replacement cost was $800,000. The front end of the car body was completely detached. The front truck and suspension, the coupler and the center sill back to the bolster, the operating compartment, the electrical cabinet, and the undercar wiring were extensively damaged. The interior of the car from about 5 feet from the head end rearward, the rear doors, and the rear platform were slightly damaged.

The second car of No. 570 had roof damage where it contacted the lead car. In each of the three following cars, from two to four welds were broken in the stabilizer struts which hold the bolster stabilizer bars. The pusher locomotive of No. 570 was not damaged.

The locomotive unit of Extra 1731 East was destroyed. The replacement cost of the unit was estimated at $875,000. The front coupler had marks indicating a heavy strike. The locomotive car body and the components under the long hood were destroyed. The electrical cabinet was driven into the operating compartment and came to rest about 11 inches above the floor. The four freight cars were not damaged.

Personnel Information

The engineer, the foreman, and the two trainmen of Extra 1731 East, who began their tour of duty at 2:59 p.m. on August 11, had been off duty the required period of time for compliance with the Federal Hours of Service Law. The crewmembers were qualified for their respective assignments in accordance with the B&M operating rules.

The conductor and engineer of No. 570 reported for duty at Rockport at 2:49 p.m. and 3:03 p.m., respectively, on August 11. The trainman of No. 570 began his tour of duty that day at 6:21 a.m. All crewmembers had the required legal rest period between duty

assignments and all were qualified for their respective positions in accordance with the B&M operating rules.

The second-shift dispatcher was a "spare" dispatcher who worked various shifts upon assignment when temporary vacancies occurred. On August 11 he reported at North Billerica about 3:10 p.m. to work a temporary assignment as the second-shift Boston East Train Dispatcher. When he arrived at the office, he read the dispatcher's bulletin board, checked the message board, reviewed the train order books, and routinely followed those tasks he felt were necessary to familiarize himself with the status of train operations before he relieved the first-shift dispatcher. He had been off duty the required legal rest period since his last assignment. He said that he was not fatigued, had no personal problems on his mind, was not taking any medication, and was not aware of any distractions. He had qualified for his position by on-the-job training, and he said he had worked the Boston East dispatcher's position "more than a hundred times," and had worked the position during the time that Bulletin Order B1-420 had been in effect. He was also qualified to work the Boston West dispatcher's position.

The train director reported for his assigned second shift at Salem Tower about 2:45 p.m. on August 11. After a briefing by the first-shift train director about the operational status of trains moving or to move in the territory under the jurisdiction of the train director at Salem Tower, he began work. He had the required legal rest period between assignments, and he said he was not fatigued. He said he was not worrying about any personal problems nor was he taking any medication. The train director had qualified for his position by on-the-job training. He had worked various shift assignments at Salem Tower for the past 2 years, and he had been assigned regularly to the second shift at that point for about 14 months.

The operators at Congress Street and Manchester each began their respective assignments at 2:30 p.m. on August 11 after discussing with the first-shift operators outstanding train orders and other information. Both operators had worked similar assignments before, and they had been working their respective positions about 1 week. They had qualified for their assignments by on-the-job training and by passing an examination on the B&M operating rules. Each had had a legal rest period, and each said that they were not concerned with any personal problems. (For additional information see appendix F.)

Track Information

The eastward main track on the Gloucester Branch was constructed of 131-pound continuous welded rail (CWR). The track is laid on timber crossties on a crushed-stone ballast. The two main tracks are built on 12-foot track centers. The 2° curve in which the accident occurred has a 2-inch superelevation and extends eastward on a 0.76 percent descending grade. The track is maintained to a Class 3 track standard in accordance with the Federal Railroad Administration (FRA) track standards. The Safety Board investigators took no exceptions to the conditions of the track or roadway.

Train Information

Extra 1731 East had a train consisting of two empty refrigerator cars and two loaded gondolas, for a trailing tonnage of about 270 tons. The model GP-9 locomotive unit was manufactured by the Electro-Motive Division of General Motors Corporation. It was equipped with a 24 RL airbrake schedule with a pressure-maintaining feature. The dynamic brake capability had been removed by the B&M. The unit was equipped with a Chicago Pneumatic speed recorder and an operable four-channel radio capable of transmitting with 45 watts of output power. Only two channels were used, one for the

yard service and one for freight road or main line service. The unit was equipped with a deadman safety control, but it did not have an alerting device. Locomotive unit 1731 weighed about 247,000 pounds.

Train No. 570 consisted of four cars and a pusher locomotive which provided the propulsion power. The lead car, unit 1301, was a passenger coach modified to accommodate operating controls so that the pusher locomotive could be remotely controlled. The train could be operated in either direction from either end. The control car and the pusher locomotive, unit 1008, were equipped with four-channel radios capable of 45 watts of output power. One channel was assigned to main line freight service, one channel was assigned to commuter rail service, and two channels were assigned frequencies for use on other B&M lines. The radio on the pusher locomotive was known to be operable in the receive mode. There are no records available of predeparture radio tests at Gloucester.

The control car weighed 85,000 pounds and had a seating capacity of 95 passengers. Each of the three coaches (Nos. 335, 302, and 325, front to rear) weighed 82,000 pounds and had a passenger seating capacity of 99 persons. The cars were built by Pullman-Standard in 1979.

The cars' body structure consisted of high-strength alloy steel with an aluminum superstructure. The cars were designed to withstand a buff (compressive) load of 800,000 pounds. The collision posts were designed to withstand a load of 300,000 pounds applied at a height of 18 inches above the floor. The cars were equipped with emergency escape windows interspaced along each side.

The pusher locomotive, a model F40PH weighed 259,000 pounds and was manufactured by the Electro-Motive Division of General Motors Corporation in 1978. The unit was provided with a 26L airbrake schedule and a Barco speed recorder.

Method of Operation

The Gloucester Branch was formerly owned by the B&M but it is now owned by the MBTA. By agreement, the B&M operates commuter service for the MBTA and the B&M is allowed to operate its freight trains over the Gloucester Branch.

The Eastern Route Main Line (ERML) extends from Boston easterly to Newburyport. Though it has short segments of single track, parallel eastward and westward tracks extend from Northey Point through Beverly Junction. Access to the Gloucester Branch is at Beverly Junction. The switches and signals at Beverly Junction are remotely controlled from Salem Tower.

The Gloucester Branch consists of an eastward (outbound) track, which is the southerly track, and a westward (inbound) track, which is the northerly track, extending from Beverly Junction 12.58 miles to Wilson, Massachusetts, and a single track from Wilson to Rockport. On the double track, trains are operated by the signal aspects of an automatic block signal system. On August 11, the maximum authorized speeds were 30 mph for passenger trains and 25 mph for freight trains.

When both tracks were available for train operations, Rule D-251 (see appendix B) governed train movements between Beverly Junction and Gloucester. Rule D-251 gave traincrews the right to operate their train according to the aspects displayed by wayside automatic block signals. Bulletin Order B1-420 specified that Rule 221B (the authority for the establishment of temporary train order offices and train order signals) would

govern train movements past the Congress Street and Manchester train order offices. Further, it established that westbound trains would require a Form D-R train order, example 1, 8/ and if applicable example 2, 9/ (see appendix B) to proceed west from Manchester on the eastward main track. It did not specify that a Form J holding order be issued at Salem Tower (for Beverly Junction Interlocking) or at Congress Street to provide protection for westbound trains moving on the eastward main track. However, a Form J holding order was issued at Congress Street to hold all eastbound trains at Congress Street. By rule, the Form J order required that, "Approved blocking devices must be applied to switch or signal levers governing all routes to the track affected."

Neither Bulletin Order B1-420 nor the B&M operating rules required the operators at Congress Street or at Manchester to report the passing times of trains past their offices to each other or to the train director at Salem Tower. However, they were required by rule 222 (see appendix B) to report this passing time information to the dispatcher. They were not required to determine if the block between their respective offices was clear of trains, or request or dedicate the block exclusively to a train. Under the bulletin order and operating rules, the responsibility rested solely with the dispatcher to move all trains under his or her jurisdiction, to insure that the block was clear between Congress Street and Manchester, and to insure that there were no opposing trains in conflict. The Form D-R train order assigned to the dispatcher the responsibility of determining that there were no conflicting trains in the area in which right was conferred by the order to a train which otherwise had no right.

Rule 222 requires that the passing times of trains moving past reporting points be promptly reported by the operator to the dispatcher. The dispatcher records the passing time as a permanent record on his train sheet. The second-shift dispatcher on duty at the time of the Beverly accident followed an accepted practice (as did other dispatchers) by not requiring a prompt reporting of trains past reporting points. Instead, at a convenient time for him, he would call the operator at a reporting point and request and record an accumulation of trains' passing times.

Chapter 160, titled "Equipment - Engines and Cars," paragraph 154, subtitled "Brakes and Brakemen," of the Commonwealth of Massachusetts Laws Annotated requires, ". . . one brakeman for the last car in every freight train to be stationed thereon."

Meteorological Information

The weather conditions reported by the local weather bureau for Beverly on August 11, 1981, indicated that at 4 p.m. it was clear and 86° F. Visibility for the engineers of each train was limited only by the curvature of the track and light tree foliage.

Medical and Pathological Information

The foreman of Extra 1731 East was admitted to the Beverly Hospital for fractured ribs and a concussion received when the trains collided. The engineer of Extra 1731 East was treated for shock and an injured left knee at the same hospital and then released. The two trainmen and the unauthorized passenger on Extra 1731 East were fatally injured when the operating compartment of the locomotive unit was penetrated and crushed by the electrical cabinet adjacent to the long hood.

8/ Example 1 gives one train right over an opposing train between two points.
9/ Example 2 provides the authority for the dispatcher to issue a train order giving one train right over an opposing train(s) before the opposing train(s) arrives at the point of restriction.

The engineer of No. 570 died from injuries sustained when he was ejected from the operating compartment of the control car. The conductor of No. 570 was treated at Beverly Hospital for shock and then released. The trainman was admitted to the hospital for a fractured leg and nose, and possible head injuries.

Twenty-three passengers were treated and then released from either the Beverly Hospital or Hunt Memorial Hospital in Danvers, Massachusetts. Their injuries were variously listed as injuries to the head, back, leg, knee, ankle, and arm. Some had multiple lacerations and contusions, and one complained of chest pains. Two passengers were known to have been treated by private physicians.

Survival Aspects

When the Salem Tower train director learned of the accident, he notified the Beverly Police Department. The police department in turn notified the fire department, and other communities overheard the information on the local emergency communications network. Emergency response units arrived within 10 or 15 minutes after the accident occurred.

Some of the emergency units that responded to the call for assistance at the accident site were: the Massachusetts State Police; the Beverly Police and Fire Departments; O'Brien's Ambulance Service in Beverly; the Manchester Police Department; the Wakefield, Massachusetts Fire Department; and the Essex County District Attorney's and Medical Examiner's Offices.

A doctor from the Beverly Hospital headed an emergency response team from the hospital and established a triage station at the accident site. During the morning on the day of the accident, the Beverly Hospital had conducted its annual rehearsal for an emergency disaster drill; the team came almost directly from the rehearsal to the accident scene. Additionally, ambulances and Civil Defense and Red Cross units from many surrounding communities responded to the emergency. The hospitals were not able to receive an accurate count of the injured persons that were being transported from the accident site to the hospitals because not all emergency vehicles were equipped with a radio frequency that was compatible with that of the hospital.

Passengers stated that a major hazard caused by the derailment was seat bottoms, which either became detached and were airborne, or which were displaced partially from the seatframe so that they impeded escape. Only a few seatframes at the front end of the lead car were detached from their floor fastenings. The passengers also complained of curious passersby, reporters from the news media seeking information, and low-flying helicopters that created dust and flying debris and caused anxiety for fear of a crash into the accident area.

Tests and Research

An analysis of the speed recorder tape from the locomotive unit of Extra 1731 East indicated that the speeds registered on the recorder, as nearly as could be determined, were accurate. A bent idler wheel on the recorder (assumed to have been bent in the collision) prevented an accurate postaccident calibration. The accuracy of the recorder was determined by analyzing the average time-distance recordings shown on the tape. The tape indicated that the velocity of Extra 1731 East was about 18 mph when the brakes were applied and about 12 mph at impact.

The recorder in control car 1301 of No. 570 could not be calibrated because of crash damage. However, calculations were made based on time-distance information correlated to the speed recorder tape markings from unit 1301 when it operated as train No. 510 earlier on August 11. These computations indicated that the speed recorder on unit 1301 was about 16 percent fast. Thus, it was concluded that the speed of No. 570, shown as 45 mph on the recorder, was actually 36 mph when the brakes were applied and about 19 mph at impact.

Sight distance and stopping tests were conducted in the area of the accident on Saturday, August 15. Locomotive unit 1821 used in the tests was similar to unit 1731, in that the operating compartment was at the same height above the rails and the cab windows and other structural arrangements were the same. The same cars that were in the train of Extra 1731 East on the day of the accident were used in test train Extra 1821. Passenger equipment (control car No. 1307 and pusher locomotive unit 1005) used for test train Extra 1307 was of the same basic design and arrangement as the equipment for No. 570. The weather was overcast, as opposed to a clear day on August 11, and the temperature was 80° F. The headlights of each train were illuminated in the "bright" position, and they were distinctly visible. The rails were dry.

Extra 1307 was positioned with the control car standing where the front of locomotive unit 1731 (engineering station 0 + 00) stopped after the accident. The engineer of Extra 1821 could see Extra 1307 from 657 feet west of station 0 + 00. The minimal sight distance was 656 feet when Extra 1821 was 606 feet west and Extra 1307 was 50 feet east of station 0 + 00. From 2,000 feet east of station 0 + 00, the engineers of the two trains could see each other when Extra 1821 was 255 feet west of station 0 + 00 or a total distance of 2,225 feet separation. (The tabulated sight distances are shown in figure 3 and appendix G.)

When an emergency brake application was made at speeds of 26 mph, 30 mph, and again at 30 mph, Extra 1307 stopped in 316 feet, 395 feet, and 385 feet, respectively. Also, when an emergency brake application was made at a speed of 22 mph, Extra 1821 stopped in 438 feet. When the brakes of Extra 1307 were applied in emergency 328 feet from station 0 + 00 at a speed of 30 mph, the train moved about two-thirds of a car length past the point of collision. When Extra 1821 applied emergency brakes at a speed of 20 mph 415 feet west of the collision point, the train stopped 23 feet east of the point of impact. The emergency brake applications for these last two tests were made at the point where sand from each of the two accident trains had first appeared on the rails. (See appendix G.)

The two test trains were separated by a distance of 1,821 feet when the whistle of Extra 1821 was sounded. The whistle sound was barely audible in the control compartment of Extra 1307, and the engineer and test personnel concluded that it would not have been heard if the train had been moving.

Other Information

Train operation on the Gloucester Branch is supplemented by a radio communication system. The dispatcher has access to a 60-watt transmitter on either the road freight frequency or the commuter frequency. The dispatcher also has the capability of selecting one of three transmitter/receiver sites which permits transmitting from the base station nearest the train or party the dispatcher wishes to contact. In receiving signals, the system will automatically select the strongest signal being received from the field through one of these transmitter/receiver base stations and feed it to the dispatcher. The

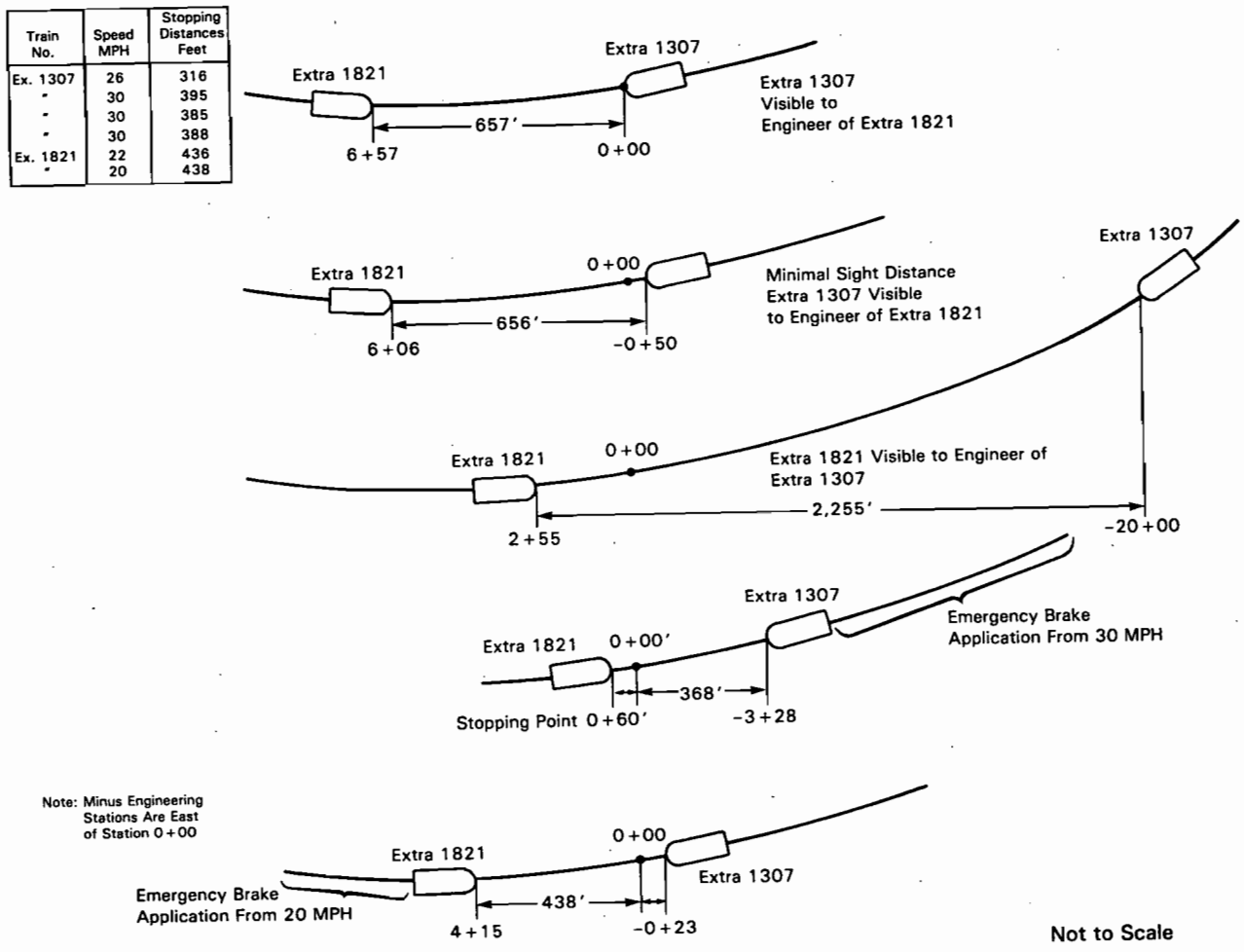

Figure 3.—Summary of data from sight distance tests.

remote transmitter/receiver base stations are reached over leased telephone lines and the radio system is shared with the Boston West dispatcher.

The Salem Tower train director has a multichannel radio system which, in the receive mode, has a scan capability to monitor the yard channel, the road freight channel, and an engineering channel. The train director can transmit on any one of these three channels, via a four-channel, 45-watt output transmitter and still monitor the other two channels. The fourth channel in the transmitter is not used.

The temporary train order offices at Congress Street and Manchester did not have radio equipment, but instead they shared a dedicated New England Bell System telephone line with the drawtenders at Beverly and Manchester draws. Operators in these offices could contact the dispatcher at North Billerica by a direct commercial number or through the B&M telephone switchboard operator. Similarly, they could reach Salem Tower or reach each other by their commercial telephones.

The dispatcher at North Billerica has an open intercom-type dispatcher's line to Salem Tower and other train reporting locations. The dispatcher can reach an employee at any point served by this line by simply speaking to them. However, the dispatcher's line was not available at the Congress Street or Manchester train order offices. The dispatcher also has a six-button key telephone providing a hold feature. The button selection makes available two B&M PBX lines and two commercial measured business service lines. Thus, the dispatcher can receive calls through the switchboard attended by a telephone operator or can be reached directly by in-dialing. The dispatcher also has access to a wide area telephone service (WATS) network. To reach either the Congress Street or Manchester offices, the dispatcher has to use either the commercial telephone or go through the switchboard operator.

Salem Tower has the dispatcher's telephone system and a code line which serves several locations along the road, including Congress Street, and a direct line to Rockport. A commercial telephone and a line to the B&M telephone switchboard operator is also available at Salem Tower. Portable radios were available at Salem Tower for traincrews if they were needed. Supervisory personnel have automobile radios connected into the radio system compatible with their particular service, as do personnel in the maintenance of way department.

ANALYSIS

Train Operations

Extra 1731 East was authorized to operate from the North Street Yard by B&M operating rule No. D-97. However, its movement was subject to operating instructions provided by bulletin orders, train orders, verbal instructions, and signal aspects. The foreman and the engineer of Extra 1731 East fulfilled the prerequisites of their departure from the yard by checking with the train director for train orders, messages, bulletin orders, and work directives. Although the radio was not checked on the road channel as required by the operating rules, subsequent transmissions verify that it was working before the accident. A brake test was made to the satisfaction of the crew. Therefore, when the permissive proceed signal was presented to Extra 1731 East at Northey Point, it was proper for the train to depart.

Similarly, Extra 1731 East was being operated in compliance with the operating rules approaching Congress Street, and upon receipt of the clearance card and train order, it proceeded within its authorized rights. The correct permissive signal displayed

for Extra 1731 East at Beverly Junction Interlocking was the final authorization for the train to proceed eastbound on the regularly assigned eastward track. The permissive signal apparently was given by the train director at Salem Tower when he understood from his conversation with the dispatcher that Extra 1731 East had a "may go."

The foreman of Extra 1731 East correctly questioned the approach signal aspect displayed by signal G-209, and he exercised good judgment when he radioed the dispatcher to make an inquiry. Since an approach or a red signal aspect does not necessarily mean that there is a train one or two signal blocks ahead, the engineer and the foreman had no reason to suspect that an opposing train was approaching them on the same track. The clearance card received at Congress Street reinforced this logic. The accident occurred before the train passed a red signal aspect. The operational procedures for that aspect would have required the train to stop, which might have prevented the accident. The response the dispatcher received from the radio calls to Extra 1731 East was just before the two trains collided, and the foreman jumped from the locomotive operating compartment before any further conversation could develop. The foreman said he did not hear the train director at Salem Tower call his train.

The lack of restraining fasteners on the end and locker doors of the available caboose for Extra 1731 East could have been hazardous to crewmembers occupying the caboose. It is not uncommon for caboose occupants to lose their balance because of slack action or side roll while a train is moving, and swinging doors would have the potential for causing an injury. It is doubtful if a train of four cars would produce significant slack action, but nevertheless, if the foreman was in doubt, he could have decided justifiably against using the available caboose. However, this decision did not give him license to ignore the Massachusetts State statute that requires that a person be stationed on the last car of every freight train. Although the statute does not specifically state that a caboose be attached at the rear of every freight train, it is likely that the statute intended the use of one to provide the person with shelter, heat, light, safety appliances, and a back-up hose. 10/ Whether a person could have been stationed on the rear of Extra 1731 East even without a caboose under the existing conditions is questionable, but nevertheless none was so stationed. Because of the impact at a relatively low speed and the lack of damage to the freight cars, it is likely that a caboose would not have been damaged in the accident, and anyone riding in the caboose probably would have survived.

No. 570 departed Gloucester on timetable schedule authority. The brakes were operating properly as evidenced by the interim station stops, and no other problems with the train were apparent. The operational status of the control car radio is unknown, and it is not known whether the radio on the pusher locomotive operated in a transmit mode. Whether it could have been operated in a transmit mode had no effect on the accident since there was no one on the pusher locomotive to use the radio until after the accident when the conductor was unsuccessful in his attempt to use the radio.

Extra 1731 East and No. 570 each had the freight road radio channel as a common communication frequency, but neither engineer made an attempt to contact the other. While the engineer of No. 570 had no reason to suspect the presence of another train, the engineer of Extra 1731 East had received an approach signal at signal G-209 and he was on the scheduled time of No. 570. During the company hearing held regarding this accident, it was evident in a discussion of the various radio channels used by the B&M that train employees generally did not know that the two trains could have communicated with one another, and they did not seem to know about the compatibility of the several

10/ A back-up hose attaches to an air hose of the airbrake system. It has a whistle for signaling and a control valve for applying the train brakes.

radio channels when they were referred to by channel designation such as channel 1 or channel 2.

The train order and clearance card issued and delivered to No. 570 at Manchester by the operator were valid authority for the train to depart westbound from Manchester on the eastward main track. No. 570 had complied with the operating rules and Bulletin Order B1-420 at Manchester.

The speed tape for No. 570 indicates that the train was being operated about 6 mph in excess of the authorized speed limit. No. 570 left Manchester 5 minutes late and the engineer may have been trying to regain the scheduled time. The overspeed was not hazardous under the existing track conditions. Nevertheless, if the train had been operated within the authorized speed limit, the sequence of events would have been somewhat different and the accident might have been avoided.

The sight distance and stopping tests indicated that the engineers of the two trains saw each other at about the maximum available sight distance. The points at which sand was first observed on the rails placed the two trains about 750 feet apart when the brakes were applied, and the sand on the rails is an indication that the brakes of each train were applied in emergency. Also, the conductor of No. 570 said he felt the brakes applying, and the speed indications shown on the speed tapes indicated that the speed of the two trains had reduced. The sight distance was limited because Extra 1731 East was in the 2° curve and the trains were out of sight of each other. Whether or not the brakes functioned effectively, the trains could not have stopped in the distance available to them. Each engineer made an effort to stop as evidenced by the emergency brake application. It is questionable whether either engineer heard the whistle from the other train.

Because of the overcast skies the day the sight tests were made, as opposed to a bright day on August 11, the actual and test sight distances might vary slightly. The headlights of the locomotives were probably not as conspicuous to the engineers on August 11 as they were on the day the sight tests were made. However, a variance in sight distance because of a different light intensity is probably not significant when related to the line of sight interference presented by the track curvature.

Train Handling

There was considerable conflict in the testimony of the train dispatcher, the train director, and the train order office operators at Congress Street and Manchester concerning train arrivals, train departures, and the placement of a blocking device. The operator at Manchester said that he reported the arrival and departure times of No. 570 on his own initiative. Yet, 2 minutes after the train departed, the dispatcher called Manchester seeking to locate No. 570 in an attempt to stop the train. This discrepancy in the testimony of the operator and the dispatcher is inconsequential. It is simply a matter of whether the operator did or did not promptly report No. 570's arrival and departure times as he said, or whether the dispatcher failed to receive these times or just failed to record them. It is evident that the dispatcher did not record the arrival and departure times because the times were later recorded by his relief dispatcher. It did not affect the outcome of the accident since Extra 1731 East was past Beverly Junction before No. 570 left Manchester.

There is evidence that the dispatcher and train director at Salem Tower did not reach a mutual understanding in their conversation. Their testimony agrees up to the point that the dispatcher told the train director to have Extra 1731 East get clear at

Beverly Gulf Siding. Either the train director failed to hear the dispatcher, the train director forgot to relay this information to Extra 1731 East, or the dispatcher did not verbalize direct instructions to the train director. According to B&M operating rule 733 (see appendix B), the dispatcher was charged with the responsibility of being certain that his instructions were clearly given and understood. The dispatcher did not check to make certain that his instructions had been understood.

When the engineer of Extra 1731 East, while at Congress Street, told the train director that, "They are letting us go," the train director could have understood that "they" included the dispatcher. However, when the dispatcher told him that Extra 1731 East had a "may go," he did not question the previously discussed possibility of the freight train's getting in the clear at Beverly Gulf Siding or Beverly Yard. From his testimony, it appears that the dispatcher was talking about authority for the freight train to pass the train order signal at Congress Street so that it could get clear at Beverly Gulf Siding. Also, according to his testimony, he believed that the blocking device that had been required by track car permit No. 123 was in place at Beverly Junction Interlocking, and the train director could not and would not allow Extra 1731 East to pass that point without his permission. This series of events indicates a failure on the part of the dispatcher and train director to understand each other's intent. There also appears to have been either a failure on the part of the first-shift dispatcher to call Salem Tower and have the train director apply a blocking device at Beverly Junction Interlocking, or the train director failed to apply the blocking device when he was directed to do so. During the time of the transfer to his successor, the first-shift dispatcher may have intended to call Salem Tower to have a blocking device applied as required but overlooked completion of the task.

According to the dispatcher's testimony, when he prepared to issue a train order to No. 570 at Manchester, he believed that the required blocking device was in place on the switch at Beverly Junction Interlocking leading to the Gloucester Branch, and that Extra 1731 East was clear of the main track in Beverly Gulf Siding. However, the dispatcher should not have made the train order complete that authorized No. 570 to operate to Congress Street on the eastward track until he had confirmed that Extra 1731 East had cleared. He apparently did not check on the blocking device when he came on duty or when he issued the train order to No. 570 because his transfer record indicated that his predecessor had ordered the device applied and he had been told verbally that the device was in place. Although he could be expected to accept with confidence the information passed to him in transfer from the first-shift dispatcher, it would have been prudent for him to have checked and verified the status of the blocking device since he was depending on the blocking device to protect No. 570. As the operating rules are written, it is the dispatcher's responsibility to determine that there are no conflicting moves in the block for which a train has been given right by train order. He did not check at any time to insure that Extra 1731 East was in the clear or that the blocking device was in its proper place.

The B&M could have distributed the operational responsibility for insuring a clear block for No. 570 and similar trains by assigning the operators at Congress Street and Manchester more responsibility for that operation. Management could have required that the operators report trains to each other when they passed their respective offices. Thus, if the operator at Congress Street had reported the passage of Extra 1731 East to the operator at Manchester, the operator at Manchester would have known that there was a conflict for No. 570. Also, the operator at Manchester could have been required to obtain the block between Congress Street and Manchester for the exclusive use of No. 570, which is a procedure followed under manual block rules. This would have insured that one train or the other would have had to wait until the block was clear.

The practice of the dispatcher's regarding the receiving and recording of train passing times in violation of the operating rules left the dispatcher operating much of the time without knowing the location of his trains. If the dispatcher had received the passing time of Extra 1731 East past Beverly Junction promptly, he would have known the train's location and that he could not allow No. 570 to leave Manchester when it did. Since there had been discussions between the dispatcher and the train director about Extra 1731 East, the train director would have provided a vital check if, in conformance with the rules, he had promptly reported Extra 1731 East's passing at Beverly Junction. The Safety Board believes that the absence of these simple procedures, and the failure of supervisors to enforce the rule requiring a prompt reporting and recording of the time of trains past reporting points, eliminated some of the safety backup measures available for the operation. Also, these procedures would have provided the dispatcher assistance in carrying out the responsibilities of his job.

Additional backup safety measures could have been provided if a common dispatcher's telephone circuit had been available to all train order offices. On most railroad properties, the dispatcher's telephone circuit is amplified through a speaker which is usually on. Operators, for whatever reason, tend to listen to the activity over the dispatcher's telephone to keep abreast of train movements, especially in offices where work is slow. If the operator at Congress Street had known, as she might have had she been on the dispatcher's telephone circuit, that No. 570 was leaving Manchester after Extra 1731 East had been cleared to proceed east to Manchester, she could have alerted the dispatcher or train director to the conflict.

Another unavailable backup feature was that train orders issued to one office were not available to other offices which were not addressed. Had they been, another source for detecting conflicting moves might have been alerted. Finally, the sharing of telephones by the operators at Congress Street and Manchester with the drawtenders presented a hazard of potential delays in communicating vital information in a timely manner.

While the Form J holding order is an effective instrument to control train movements as a protective measure, it is only available to the operator at the location to which it is addressed. Similarly, a blocking device is effective to restrict train movements at a given point only if it is used as prescribed by the rules and if it performs its design function. However, there is no backup system or crosscheck on the B&M to insure that the blocking device is, in fact, in its proper place. According to the operating rules, the dispatcher orders an operator to apply a blocking device. The rules are explicit about how blocking devices are to be regarded relative to train movement and how they are to be removed. The notation entry in the dispatcher's train order book does not specify where a blocking device is applied, although a record is maintained of its application and removal adjacent to the train order or track car permit that generated a requirement for it. These entries should be specific as to where the blocking device is applied, the number of the switch or signal lever to which the blocking device is applied, and by whom it was applied. A more positive means of applying a blocking device would be by a train order or similar directive.

The crewmembers of a train that has been given a right between designated points by train order are relying on the fact that the block is clear and that an absolute hold is in effect at the extreme end of the block in which their right is conferred. Two additional actions that would provide a measure of safety backup would be to provide the train operating by train order against the current of traffic a copy of the restricting order in effect at the exit end of the block covered by the right order, and, as a minimum,

providing the operator at the restricted entrance to the block a copy of the right order. If opposing trains were delivered a copy of the right order, added protection would be provided. The B&M Director of Rules indicated that even if Extra 1731 East had gotten clear at Beverly Gulf Siding, that train should have gotten a copy of the order given to No. 570. The B&M rules say this delivery will be made if or when practicable. The Safety Board believes that if the operator at Congress Street or the train director at Salem Tower had been given copies of the right order on which authority No. 570 left Manchester, the accident probably would have been avoided since each would have known the movements of both the trains.

Bulletin Order B1-420 did not specify that a holding order was necessary at Beverly Junction, even though the Director of Rules gave it an after-the-fact interpretation to that effect. In comparison, the bulletin order was specific about the form of train order to be used and other details. The operating rules say that prescribed forms will be used, but the prescribed forms are not identified. The B&M Director of Rules pointed out that a blocking device should be applied to the signal "and" switch control levers. If this is the interpretation that the B&M intends to place upon that rule, the phrase in the rulebook should be changed to read "switch and" instead of "switch or." "Or" definitely provides for a choice and the blocking device could be applied on either or both at the discretion of the dispatcher and/or operator.

In summary, the application of the operating rules as understood by those persons responsible for the operation of trains under the provisions of Bulletin Order B1-420 was too restrictive in the sense of sharing related developments and procedures. The instructions affecting the movement of a train at one location were not shared and disseminated to other offices on the route over which the train/trains would move. Therefore, the safety backup that could have been available, whether provided purposefully or that is inherent in the communication network, was lost.

The Safety Board discussed the potential problems that could result from unclear and inexplicit operating rules in its special study "Signals and Operating Rules as Causal Factors in Train Accidents" issued on February 7, 1972. 11/ The fallibility of blocking devices was discussed in a Safety Board report of an accident on the tracks of the Consolidated Rail Corporation at Dobbs Ferry, New York, in 1980. 12/

Crashworthiness

Because the long hood of the locomotive unit of Extra 1731 East was forward of the operating compartment, it would normally have served as a buffer between the operating compartment occupied by the crew and the lead car of No. 570. However, as often happens when light and heavy rail equipment collide, the 85,000-pound lead car of No. 570 rode up over the 247,000-pound locomotive unit of Extra 1731 East and pushed the underhood components of the locomotive into the operating compartment, killing three persons.

The need to improve the crashworthiness of locomotives, as well as passenger equipment, has been discussed in several Safety Board reports. The Safety Board believes that locomotive units in both freight and passenger service, including rail rapid transit service, can be designed to provide improved safety for crews and passengers. The

11/ Report No. NTSB-RSS-71-3.
12/ Railroad Accident Report—"Head-End Collision of Amtrak Passenger Train No. 74 and Conrail Train OPSE-7, Dobbs Ferry, New York, November 7, 1980" (NTSB-RAR-81-4).

FRA should continue its research and design efforts in this critical area of crewmember and passenger survivability.

The Safety Board has issued 16 or more recommendations regarding crashworthiness, and a number of these recommendations have been reiterated (see appendix H). Although the FRA has studied the crashworthiness of locomotives and much data have been developed, no significant changes in the crashworthiness design of locomotives have been made. Eleven recommendations made by the Safety Board to the FRA concerning locomotive crashworthiness are currently open pending a satisfactory response or close-out action. The Safety Board urges the FRA to expeditiously address those outstanding unresolved recommendations dealing with the crashworthiness of locomotive operating compartments and other studies related to passenger-carrying equipment.

The design of a locomotive unit to provide crash protection for a crew would require either heavier or stronger structural components for locomotive units used in both freight and passenger service, and the effects of such a design change on crew survivability must be considered. Design changes that would cause crewmembers difficulty in evacuating the cab in an emergency would reduce chances for survival. Also, since the operating compartment in rail rapid transit equipment is often part of a passenger-carrying car, the effects of design changes on passenger safety must be considered. The overriding and crushing action upon impact of the lead car of No. 570 reduced the impact forces on the car and undoubtedly averted more serious injuries to passengers. If the car had been constructed of heavier or stronger structural components for improved crashworthiness, more passengers might have been injured, passenger injuries might have been more severe, and some passengers might have been killed.

Emergency Response

The emergency response units carried out their mission in an effective and commendable manner. The lack of communications between the accident site and the hospitals was a handicap only in that the hospitals had more staff personnel standing by than was necessary because they were not able to obtain an accurate count of the injured being brought to the hospitals.

Since the accident occurred in an area that was easily accessible to the public, a number of passersby gathered at the accident site and moved around the area and disrupted rescue operations. Also, low-flying helicopters presented a problem because their presence caused anxiety among some persons at the accident site and created downdrafts which stirred up dust and debris.

CONCLUSIONS

Findings

1. The crew of Extra 1731 East was properly authorized to proceed from North Street Yard to Gloucester/Rockport in accordance with B&M operating rules and special instructions.

2. The crew of No. 570 was properly authorized to proceed from Gloucester to Manchester in accordance with B&M operating rules and special instructions, and it had a valid train order which authorized the train to proceed westward from Manchester to Congress Street on the eastward main track.

3. The B&M did not enforce its operating rule that requires operators to promptly report the times trains pass reporting points and dispatchers to receive and record these times when reported.

4. The first-shift dispatcher either did not notify the train director at Salem Tower to apply a blocking device in connection with a track car permit or the train director failed to apply it as required.

5. The second-shift dispatcher and the second-shift train director at Salem Tower did not communicate clearly their intentions about the planned movement of Extra 1731 East.

6. If the four persons involved in moving trains in the area covered by Bulletin Order B1-420 had been simultaneously informed of the procedures executed at each location, the accident probably would have been avoided.

7. The ultimate responsibility was vested with the dispatcher to determine that Extra 1731 East was clear at Beverly Gulf Siding before he released No. 570 from Manchester.

8. Discharge of the responsibility placed upon the dispatcher for insuring that there were no opposing trains in the block between Manchester and Congress Street could have been facilitated if the operators had reported trains to each other and if a manual block procedure had been in effect.

9. If a common communications system had linked the offices at North Billerica, Salem Tower, Congress Street, and Manchester, the accident might have been prevented.

10. The B&M should provide more positive guidance about the addressee of Form J holding orders and the manner in which a blocking device is applied.

11. Notations in the dispatcher's train order book concerning blocking devices should be written to be specific as to the location and control lever to which it is applied.

12. The engineers of each train applied their trains' brakes promptly at a point where they could first see each other, the brakes functioned, and the trains were unable to stop in the distance available.

13. The State statute did not specify that a caboose was required at the rear of a freight train, but that a person was required to be stationed on the rear car. The need for a person and/or the intent of the statute should be made clear.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was that the train dispatcher gave westbound train No. 570 exclusive right over opposing trains on the eastward track of the Gloucester Branch between Manchester, Massachusetts, and Congress Street in Beverly, Massachusetts, without first determining that there were no opposing trains between those two locations. Contributing to the cause of the accident was the failure of the train dispatcher and the train director to reach a common understanding regarding the planned movement of Extra 1731 East.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended that:

-- the Boston & Maine Corporation:

Develop and implement a system that will ensure that blocking devices are promptly and properly applied. (Class II, Priority Action) (R-82-26)

Enforce Boston & Maine Corporation operating rule 222 that requires operators to promptly report and the dispatcher to promptly record train passing times at locations where passing reports are required. (Class II, Priority Action) (R-82-27)

Provide a dispatcher telephone system common to all train order offices. (Class II, Priority Action) (R-82-28)

Revise the operating rule concerning Form J Holding Orders so that the rule specifically requires applying a blocking device to both the switch and the signal levers. (Class II, Priority Action) (R-82-29)

When it becomes necessary to divert a train from its normal route, require the dispatcher to inform all employees who will handle the diverted train of the planned move and further require that the operators handling a diverted train report the train's passing times to each other. (Class II, Priority Action) (R-82-30)

Require that Bulletin Orders issued to govern train operations in special circumstances specifically describe the mode of operation and cite the applicable operating rules. (Class II, Priority Action) (R-82-31)

Uniformly identify the radio channels used by Boston & Maine Corporation employees on a systemwide basis so that employees know which channels trains, mobile units, and manned base stations may use to communicate with each other. (Class II, Priority Action) (R-82-32)

—the Commonwealth of Massachusetts Public Utilities Commission:

Reevaluate that part of paragraph 154, chapter 160 of the Massachusetts General Laws Annotated which requires, ". . . one brakeman for the last car in every freight train to be stationed thereon. . . ," to determine the advisability and necessity of having a brakeman so positioned. If it is found necessary, then specify the accommodations that shall be provided. (Class II, Priority Action) (R-82-33)

--the Federal Railroad Administration:

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

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES E. BURNETT, JR.
Chairman

/s/ PATRICIA A. GOLDMAN
Member

/s/ G. H. PATRICK BURSLEY
Member

FRANCIS H. McADAMS, Member, did not participate.

March 9, 1982

APPENDIXES

APPENDIX A

INVESTIGATION

The National Transportation Safety Board received notice of this accident when an off-duty accident investigator saw a report of the accident on an evening television newscast. The Safety Board immediately dispatched an investigator-in-charge from Washington, D.C., headquarters who arrived on the scene about 1 a.m. on August 12, 1981. He was joined later by an investigator from the Safety Board's New York field office and a mechanical equipment specialist from Safety Board headquarters.

Groups formed to investigate the mechanical, operating, and human factors aspects of the accident were comprised of personnel from the Safety Board, the Federal Railroad Administration, the Massachusetts Bay Transportation Authority, the Boston & Maine Corporation, and the Massachusetts Department of Public Utilities.

Depositions were taken from five B&M employees at Tewksburg, Massachusetts, on September 11, 1981. There were no parties to the depositions.

APPENDIX B

EXCERPTS FROM BOSTON AND MAINE OPERATING RULES

Form J—HOLDING ORDER.

(1) Hold No 2 Eng 402.
(2) Hold all (or Eastward) trains.

When a train has been so held it must not proceed until the order to hold is annulled, or an order given to the operator in the form: _____ may go.

These orders will be addressed to the operator and acknowledged in the usual manner, and will be delivered to the trains designated by train dispatcher.

Approved blocking devices must be applied to switch or signal levers governing all routes to track affected.

* * *

Form D-R—PROVIDING FOR MOVEMENTS AGAINST THE CURRENT OF TRAFFIC.

(1) No 1 Eng 401
(or No 1 Eng 401
No 3 Eng 402
and No 5 Eng 403)
has (or have) right over opposing trains
on Eastward track F to C.

The designated trains must use the track only in the direction specified between the points named and have right over opposing trains on that track between those points. Unless otherwise specified, the right conferred extends only to the first crossover switch at the point last named. Opposing trains must not leave the point last named until the designated trains have arrived.

The designated trains must move at yard speed within yard limits.

All trains between the points named moving with the current of traffic in the same direction as the designated trains must, when practicable, receive a copy of the order and may then proceed on their schedules or rights.

The designated trains must be given copies of all train orders affecting them on the track named.

This may be modified as follows:

(2) After No 4 Eng 404
arrives at F
No 1 Eng 401
has right over opposing trains
on Eastward track F to C.

The train to be moved against the current of traffic must not leave the first named point until the arrival of the first named train.

A train must not be moved against the current of traffic until the track upon which it is to run has been cleared of opposing trains.

* * *

OPERATOR--
At stations—the employee who handles train orders.
At interlocking stations--the operator of interlocking; may be towerman, train director or train dispatcher.

* * *

14i(1) - - o - Approaching public crossings at grade.
To be prolonged or repeated until crossing is occupied by engine or leading car; the first blast to be begun at the location of the whistle post, and the last blast to be completed as the engine or leading car reaches the crossing.

NOTE: The signals prescribed are illustrated by "o" for short sounds; "————" for longer sounds. The sound of the whistle should be distinct, with intensity and duration proportionate to the distance signal is to be conveyed.

* * *

D-97. Extra trains on two or more tracks may be cleared from initial station and proceed without train orders by a proceed hand signal from operator or, where interlocking signals govern, a proceed signal indication, or when conductor is personally given permission by the train dispatcher.

Operators will not clear trains as above mentioned without authority from the train dispatcher. . . .

* * *

205. Each train order, Form 54 and Form TC must be written in full in a book provided for the purpose in the office of the train dispatcher; and with it recorded the time and the signals which show when, from what offices and by whom the order was repeated and the responses transmitted;

and the train dispatcher's initials. These records must be made at once and never from memory or memoranda. Additions to train orders must not be made after they have been repeated.

* * *

222. Operators must promptly record and report to the train dispatcher the time of arrival and departure of all trains and the direction of extra trains.

They must observe trains and report at once to the train dispatcher if the proper signals are not displayed.

* * *

D-251. On portions of the railroad so specified in the timetable, trains or engines will run with the current of traffic by block signals whose indications will supersede the superiority of trains.

* * *

714C. . . . Employees shall make a voice test of channels provided when taking charge of such equipment. Such test shall be made between fixed stations, fixed stations and trains or other portable equipment and end to end test of trains. . . .

* * *

733. Train dispatchers will report to and receive their instructions from the Superintendent-Operations. They should bear in mind that many matters clear to them may not be as fully understood by others, and must always so clearly instruct that no one should misunderstand.

APPENDIX C

BULLETIN ORDER NO. B1-420

BULLETIN ORDER

No. B1-420 Page 1 of 2 NO. BILLERICA, MA July 28, 19 81

TO ALL CONCERNED

(A). GLOUCESTER BRANCH
TRACK OUT OF SERVICE
CROSSOVER IN MANCHESTER AND BEVERLY JUNCTION

Effective 0001 Sunday August 2, 1981 and continuing until further notice twenty-four (24) hours daily:

The Westward (inward) track is out of service between 1000 feet west of the crossover in Manchester and the easterly limits of Beverly Junction Interlocking.

During the period this Bulletin Order is in effect, operators will be stationed at the Crossover in Manchester and Congress Street Crossover (Eastern Route Main Line), both of which are hereby established as Temporary Train Order Offices during the following hours:

Crossover in Manchester - 0530 to 2330 Monday through Friday
0600 to 2330 Saturdays
0700 to 2230 Sundays and Holidays

Congress Street Crossover - 0530 to 2330 Monday through Friday
0600 to 2330 Saturdays
0700 to 2230 Sundays and Holidays

The operator in Manchester will display a double staff red flag in accordance with Rule 221b just west of the easterly end of the crossover on the Eastward track. Said signal will govern westward trains operating on the Eastward track only.

The operator at Congress Streetwill display a double staff red flag in accordance with Rule 221b just west of the easterly end of the crossover on the Eastward track. Said signal will govern all Eastward train and engine movements. No movements will pass beyond said signal without receiving a Clearance Form "A".

Due to the activation of the crossing protection at Congress Street, all Eastward train and engine movements must not proceed east of the drawtenders shanty at Beverly Draw without first receiving a hand proceed signal with a yellow flag from the operator at Congress Street Crossover. When said trains are informed to do so by the train director at Salem Tower, the gate protection must be cut out until the train is ready to proceed.

BULLETIN ORDER

No. B1-420- Page 2 of 2 NO. BILLERICA, MA July 28, 19 81

TO ALL CONCERNED

(A). GLOUCESTER BRANCH
TRACK OUT OF SERVICE
CROSSOVER IN MANCHESTER AND BEVERLY JUNCTION - continued

Westward (inward) Gloucester Branch trains will operate on the Eastward (outward) track between the crossover in Manchester and Congress Street Crossover (Eastern Route Main Line) under the Authority of Form D-R Train Orders received from the operator at the crossover in Manchester.

When there is a confliction of movement between a westward Gloucester Branch train and an eastward Eastern Route Main Line train, between Beverly Junction and Congress Street Crossover, the Gloucester Branch train will receive a combination of Form D-R example (1) and (2) Train Orders. In the event the Gloucester Branch train arrives at Beverly Junction Interlocking and does not see that the Eastern Route train has passed, verbal notification by the train director at Salem Tower that the specified train has passed will fulfill the "after arrival" requirements.

All Eastward (outward) trains must receive a Clearance Form "A" before proceeding east of Congress Street Crossover. This provision includes Eastern Route Main Line Movements. The Clearance Form "A" provision does not apply to train Nos. 553,1527 and 2515.

During the period this Bulletin Order is in effect the five minute wait as prescribed by Rule 513 does not apply in Manchester or at Congress Street.

Contractor will be rehabilitating the Westward (track) within the out of service limits. All enginemen must sound whistle signal 14(m) when approaching workmen.

Bulletin Order No. B1-373 is annulled at 0130 Saturday July 25, 1981 and must be removed from the Bulletin Board at that time.

E.R. Towle
Superintendent-Freight
Boston Division

E.E. Howland
Superintendent
Commuter Service

APPENDIX D

TRAIN ORDERS NOS. 124 AND 125 AND CLEARANCE CARD A

Standard Train Order Blank for 19 Order

FORM 19

BOSTON AND MAINE CORPORATION - DEBTOR
ROBERT W. MESERVE, BENJAMIN H. LACY, TRUSTEES

TRAIN ORDER NO. 124.

August 11 1981

To Engine 1731 East | At Congress ~~street~~

Engine 1731 has until 0300 August 12 1981 to run extra Wilson to Loop and return to Wilson and need not protect rear against following extras

BAC

Made Com Time 1552 Opr Matte

Standard Train Order Blank for 19 Order

FORM 19

BOSTON AND MAINE CORPORATION - DEBTOR
ROBERT W. MESERVE, BENJAMIN H. LACY, TRUSTEES

TRAIN ORDER NO. 125

August 11 19 81

To ~~Operator~~ At ~~Congress Street~~

Engine 1731 may go
BAC

Made Com Time 1552 Opr Matt

APPENDIX D

BOSTON AND MAINE CORPORATION - DEBTOR BM 431 1939

ROBERT W. MEESERVE, BENJAMIN H. LACY - TRUSTEES

CLEARANCE FORM A

August 11 1981

To... Extra 1731 East ..... at Conway Street .....

I have ... One ..... orders for your train.

Order No. 124 .....Order No. .....Order No. .....Order No. .....

Order No. .....Order No. .....Order No. .....Order No. .....

have been delivered and there are no further orders for your train.

.....

Operator ... Mattle .....

Made ... Conn. ... (Time) 1552 ..... Supt. BAC .....

(complete)

This does not affect any orders you may have received.

Manifold Copies will be made for each Conductor, Enginemen and Operator, the latter retaining a copy.

Conductors and Enginemen must, and when practicable members of crew in cab of engine and Trainmen will, see that their train number is correctly designated, and the information shown on this Clearance Form A corresponds with the Form 19 Train Orders received.

APPENDIX E

TRAIN ORDER NO. 126
AND CLEARANCE CARD A

FORM 19

BOSTON AND MAINE CORPORATION

FORM 19

Train Order No. 126

August 11 1981

To	At
No 570	Manchester.

No 570 Engine 1301 has right over opposing trains on Eastward track Manchester to Beverly Jct.
After No 227 Engine 6143 arrives at Beverly Jct. No 570 Engine 1301 has right over opposing trains on Eastward track Beverly Jct to Congress St Beverly.

BAC

Repeated at Hours

Made Conn Time 1601 Hours [illegible] Opr.

Employees addressed must each have a copy of this order.

675-1200-Pads O'M

CLEARANCE FORM A

August 11 19 81

To. No. 570 at Manchester

I have one orders for your train.

Order No. 126 Order No. Order No. Order No.

Order No. Order No. Order No. Order No.

have been delivered and there are no further orders for your train.

Operator J Hutchinson

Made. Com (Time). 1601 Supt. BAC

(complete)

This does not affect any orders you may have received.

Manifold Copies will be made for each Conductor, Enginemen and Operator, the latter retaining a copy.

Conductors and Enginemen must, and when practicable members of crew in cab of engine and Trainmen will, see that their train number is correctly designated, and the information shown on this Clearance Form A corresponds with the Form 19 Train Orders received.

APPENDIX F

PERSONNEL INFORMATION

Extra 1731 East

Edmund C. Grundstrom, 38, engineer on Extra 1731 East, was employed by the Boston and Maine Corporation on July 2, 1968, as a locomotive fireman. He was promoted to locomotive engineer on January 31, 1972. He attended an operating rules review on October 2, 1979, in which he was given a satisfactory rating.

Robert F. Moccia, foreman on Extra 1731 East, attended and passed an operating rules review class on September 6, 1979.

Wayne T. Fairbrother, brakeman on Extra 1731 East, attended and passed an operating rules review class on June 12, 1981.

Edward J. Purcell, brakeman on Extra 1731 East, attended and passed an operating rules review class on June 23, 1981.

No. 570

Paul H. Sullivan, 59, engineer on No. 570, was employed by the Boston and Maine Corporation on August 25, 1941, as a locomotive fireman. He was promoted to locomotive engineer on July 1, 1954. He attended an operating rules review on August 8, 1979, in which he was given a satisfactory rating. He received a letter dated July 3, 1979, from the Vice President-General Manager-Commuter Service commending him for assistance given to a commuter.

William S. Ring, conductor on No. 570, attended and passed an operating rules review class on March 11, 1981.

Angus C. Moore, trainman on No. 570, attended and passed an operating rules review class on March 13, 1981.

Other

Dennis W. McMaster, 28, train dispatcher (second shift), was employed by the Boston and Maine Corporation on August 13, 1972, as a yard clerk. He was promoted to operator on September 15, 1976, to train director on August 12, 1977, and to train dispatcher on January 21, 1980. He attended and passed an operating rules review class on March 19, 1980.

Paul R. Poley, 49, train director, was employed by the Boston and Maine Corporation on September 6, 1977, as a clerk operator. He was promoted to train director on December 29, 1977. He attended and passed an operating rules review class on May 10, 1980.

Michelle P. Matte, 34, clerk operator, was employed by the Boston and Maine Corporation on June 5, 1978, as a yard clerk. She was promoted to operator on August 2, 1979. She attended and passed an operating rules review class on June 6, 1980.

Leroy C. Hutchinson, 54, operator, was employed by the Boston and Maine Corporation on September 25, 1978, as a crossing tender. He became a drawtender on September 28, 1978, a station cleaner on January 5, 1979, and transferred to the position of operator on March 6, 1979. He attended and passed an operating rules review class in May 1979.

APPENDIX G

SIGHT DISTANCE AND STOPPING TEST RESULTS

INVESTIGATIVE TESTS: COLLISION OF AUGUST 11, 1981

DATE: August 15, 1981

SITE: Prides Crossing Station west to West Thissell Street, Beverly, MA on the Gloucester Branch

TIME: Approximately 1100 hours to 1500 hours

WEATHER: Overcast, humid @ 80°, headlights distinctly visible

EQUIPMENT: Commuter: 1307, 314, 340, 318, 1005
Freight: 1821, UPFE 458418, UPFE 458692, NW 99509, B&O 363058 (Frt. train weight about 270 tons)

CREWS: Commuter: Vincent Hayhurst, Engineer
Russell Thomas, Conductor
George Tsoukalos, Trainman

Freight: Thomas Ogden, Engineer
Joe Silver, Conductor
Ted Urbanski, Trainman

REPRESENTATIVES:

B&M:
F. G. Fotta
E. E. Howland
J. J. SantaMaria
J. F. Nugent
R. A. Silk
G. R. Covino
R. Leonard
J. McNall
J. Stoetzel
J. E. O'Keefe
W. Quimby
R. Currier
J. J. Urbanski
J. West

NTSB:
Hubert Jewell
William Fletcher
Joseph Haynes

M.B.T.A.:
C. W. England
W. A. MacDonald
P. Frazier
W. B. Williams
E. K. Skoropowski

D.P.U.:
Christopher Rich
John Shaughnessy

F.R.A.:
Edward Hassell
Roger Bergeron
Mark McKeon

TESTS RUN:

1. Commuter train spotted at point of collision and freight train is backed off 50 feet at a time to get freight engineers sight distance.

2. Freight train spotted at point of collision and commuter train is backed off 50 feet at a time to get commuter engineers sight distance.

3. Speed/braking tests on commuter train:

   A. Emergency application at 26 m.p.h.
   B. Emergency application at 30 m.p.h.
   C. Emergency application at 30 m.p.h.
   D. Emergency application at 30 m.p.h. - change location of application to Engineering Station 3 + 25 (point where brakes were most likely applied as based on position of locomotive sand on rails). Train stopped about 2/3rd's car length past point of collision.

4. Speed/Braking Tests on Freight Train:

   A. Emergency application at 20 mph at Engineering Station 4 + 15 from point of collision (west side of West Thissell Street grade crossing)

   - - stopped about 23 feet east of point of collision

5. Whistle Tests:

   A. Freight whistling at whistle post with commuter train just west of Prides Crossing Station. Engineer on commuter train could "barely" hear whistle with commuter train standing.

   B. Commuter train whistling with freight train backed off. Freight train engineer could not hear commuter train whistle when freight locomotive was in the 4th notch.

N.B.: All train speeds verified by Radar Gun. Detailed test data on following pages.

OFFICE OF:
Vice-President, General Manager
Commuter Service
August 18, 1981

TEST #1

VIEWS FROM FREIGHT LOCOMOTIVE #1821 TRAVELING EAST
LOOKING EAST FOR PULLMAN CONTROL CAR #1307
1145 hrs. to 1345 hrs.

FRT. LOCO. AT STATION	CAN SEE PULLMAN CAR AT STATION	SIGHT DISTANCE
6 + 57 W	0 + 00	657
6 + 06 W	0 + 50 E	656
5 + 76 W	1 + 00 E	676
5 + 49 W	1 + 50 E	696
5 + 24 W	2 + 00 E	724
4 + 99 W	2 + 50 E	749
4 + 54 W	3 + 00 E	754
4 + 15 W	3 + 50 E	765
3 + 89 W	4 + 00 E	789
3 + 72 W	4 + 50 E	822
3 + 49 W	5 + 00 E	849
3 + 28 W	5 + 50 E	878
3 + 06 W	6 + 00 E	906
2 + 91 W	6 + 50 E	941
2 + 80 W	7 + 00 E	980
2 + 65 W	7 + 50 E	1,015
2 + 52 W	8 + 00 E	1,052
2 + 44 W	8 + 50 E	1,094
2 + 25 W	9 + 00 E	1,125
2 + 04 W	13 + 60 E	1,564
1 + 50 W	26 + 00 E	2,750

Notes:

1. "0" station is point of rest; front of locomotive 1731.
2. Stations indicated eastward and westward therefrom.
3. Weather Conditions: clear, overcast, no apparent sun, visibility good.
4. Freight locomotive was No. 1821, style GP-9, long hood pointed east.
5. Headlights were burning bright on both freight locomotive 1821 and Pullman Control Car 1307. Marker lights also burning on 1307.

VIEWS OBSERVED BY: Thomas Ogden, Engineer

RECORDED BY: James Diorio, Chief-Survey Crew

TEST #2

VIEWS FROM PULLMAN CAR #1307 TRAVELING WEST
LOOKING WEST FOR FREIGHT LOCOMOTIVE NO. 1821
1345 hrs. to 1445 hrs.

PULLMAN CAR AT STATION	CAN SEE FREIGHT ENGINEER AT STATION	SIGHT DISTANCE
20 + 00 E	2 + 55 W	2,255
8 + 07 E	3 + 00 W	1,107
5 + 50 E	3 + 50 W	900
4 + 42 E	4 + 00 W	842
3 + 60 E	4 + 50 W	810
2 + 79 E	5 + 00 W	779
2 + 27 E	5 + 50 W	777
1 + 74 E	6 + 00 W	774
0 + 96 E	6 + 50 W	746
0 + 14 E	7 + 00 W	714
0 + 50 W	7 + 50 W	700

Notes:

1. "0" station is point of rest; front of locomotive 1731.
2. Stations indicated eastward and westward therefrom.
3. Weather Conditions: clear, overcast, no sun, apparent visibility good.
4. Freight locomotive was No. 1821, style GP-9, long hood pointed east.
5. Headlights were burning bright on both freight locomotive 1821 and Pullman control car 1307. Marker lights also burning on 1307.

VIEWS OBSERVED BY:

Robert Silk, Sr., Trainmaster

RECORDED BY:

James Diorio, Chief-Survey Crew

TEST #3

Pullman Car #1307: Emergency Brake Application

M. P. H.	STOPPING DISTANCE
26	316
30	395
30	385

TEST #4

Freight Engine #1821: Emergency Brake Application

M. P. H.	STOPPING DISTANCE
22	438

TEST #5 WHISTLE TEST

Freight Engine at: 3 + 49 W
Pullman Car at: 5 + 00 E } Total Distance 849

1. Each could hear others whistle.
2. Neither engineer could hear the others whistle while sounding his own.

TEST #6

Freight locomotive at: 2 + 65 W
Pullman Car at: 7 + 50 E } Total Distance 1,015

Pullman Car's Whistle Blowing:

Freight engine's throttle set at 2 notches: could hear Pullman whistle.

Freight engine's throttle set at 4 notches: could not hear Pullman whistle.

TEST #7

Freight Locomotive: 8 + 71 W* Total 1,821 feet
Pullman car at; 9 + 50 E

* Sta. 8 + 71 W is location of "Long Whistle" sign for eastward trains.

Freight whistle almost inaudible in Pullman Control Car cab (standing test) - would have been inaudible if in motion.

Tests completed 1520 hours.

August 15, 1981

RECORDED BY:

James Diorio, Chief-Survey Crew

APPENDIX H

PAST SAFETY BOARD RECOMMENDATIONS ON LOCOMOTIVE CAB CRASHWORTHINESS

Recommendation No.: R-71-36 Status: Closed, Acceptable Action

Addressees: Federal Railroad Administration;
Association of American Railroads

Report: Railroad Accident Report—"Illinois Central Railroad Co. Train No. 1 Collision with Gasoline Tank Truck at South Second Street Grade Crossing, Loda, Illinois, January 24, 1970" (NTSB-RHR-71-1)

Recommendation:

The National Transportation Safety Board recommends that the Federal Railroad Administration consider possible changes in the design of locomotive control compartments, such as the shielding of the compartment against direct penetration of fire, the use of fire-resistent materials, protection of air inlets and vents, and the strengthening of doors, that would provide greater protection to the occupants of the locomotive when a tank truck carrying flammable material is struck by the train. Such studies should include the development of escape plans and the assurance of their performance by tests. Until such regulatory changes can be implemented, the Association of American Railroads and the Federal Railroad Administration should consider interim changes to locomotives exposed to truck traffic at grade crossings that would improve the chances of fire survival of the occupants of the locomotive.

* * *

Recommendation No.: R-71-44 Status: Closed, Acceptable Action

Addressees: Federal Railroad Administration;
Railroad Industry

Report: Railroad Accident Report—"Illinois Central Railroad Company and Indiana Harbor Belt Railroad Company Collision Between Yard Trains at Riverdale, Illinois, on September 8, 1970" (NTSB-RAR-71-3)

Recommendation:

Continue and expand cooperative efforts toward the timely improvement of the crashworthiness of railroad equipment particularly as it is related to the protection of the occupants of locomotive control compartments. Improvement efforts should consider all aspects of locomotive safety as related to the entire environment of railroad operation, and not be confined to the improvement of individual components.

Recommendation No.: R-72-5 Status: Closed, No Longer Applicable

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Penn Central Transportation Company Freight Train Derailment/Passenger Train Collision with Hazardous Material Car, Soundview, Connecticut, October 8, 1970" (NTSB-RAR-72-1)

Recommendation:

Continue to a conclusion recently initiated efforts in the matter of the improvement of the design of locomotive operator compartments to resist crash damage, and, in conjunction with the Association of American Railroads, undertake a review of modern design crashworthiness concepts in an effort to identify areas of applicability in the railroad industry.

* * *

Recommendation No.: R-73-9 Status: Closed, Acceptable Action

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Head-on Collision of Two Penn Central Freight Trains at Herndon, Pennsylvania, on March 12, 1972" (NTSB-RAR-73-3)

Recommendation:

Include in its present investigation of the safety of locomotive-control compartments a study of environmental conditions that could distract crews from their duties or cause them to fall asleep at the controls. Regulations should be promulgated to correct any undesirable conditions disclosed.

Recommendation Reiterated in:

Railroad Accident Report—"Rear-End Collision of Two Southern Pacific Transportation Company Freight Trains, Indio, California, June 25, 1973" (NTSB-RAR-74-1)

Railroad Accident Report—"St. Louis Southwestern Railway Company Freight Train Derailment and Rupture of Vinyl Chloride Tank Car, Lewisville, Arkansas March 29, 1978" (NTSB-RAR-78-8)

Railroad Accident Report—"Rear-end Collision of Two Consolidated Rail Corporation Freight Trains, Muncy, Pennsylvania, January 31, 1979" (NTSB-RAR-79-6)

Railroad Accident Report—"Head-on Collision of Baltimore and Ohio Freight Trains Extra 6474 East and Extra 4367, West Orleans Road, West Virginia, February 12, 1980" (NTSB-RAR-80-9)

Recommendation No.: R-74-20 Status: Open, Response Received

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Collision of State-of-the-Art Transit Cars With a Standing Car, High-Speed Ground Test Center, Pueblo, Colorado, August 11, 1982" (NTSB-RAR-74-2)

Recommendation:

Explore various technical approaches to crashworthiness of rail transit cars, such as determining means of preventing override during crashes of similar cars and investigating the use of plastic deformation as a means of absorbing crash energy. Those technical approaches which appear practicable should be crash-tested to insure that override would not occur and that a stated collapse cushioning effect will result as intended.

* * *

Recommendation No.: R-74-21 Status: Open, Acceptable Action

Adressee: Federal Railroad Administration

Report: Railroad Accident Report—"Collision of State-of-the-Art Transit Cars With a Standing Car, High-Speed Ground Test Center, Pueblo, Colorado, August 11, 1982" (NTSB-RAR-74-2)

Recommendation:

Review past escapes of motormen and engineers from operating compartments of rail transit and commuter cars during crash situations in order to establish design requirements and definite procedures for an operator's escape during impending crashes. Take action to ensure that these requirements and procedures are put into effect by the transit and railroad industries.

* * *

Recommendation No.: R-75-5 Status: Open, Response Received

Addressee: National Railroad Passenger Corporation

Report: Railroad Accident Report—"Derailment of Amtrak Train on the Tracks of The Atchison, Topeka and Santa Fe Railway Company, Melvern, Kansas, July 5, 1974" (NTSB-RAR-75-1)

Recommendation:

Require the installation of the lastest practical crashworthiness features when rolling stock is renovated or when new cars and locomotives are purchased.

Recommendation No.: R-75-38 Status: Open, Acceptable Action

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Collision of Two Penn Central Commuter Trains at Botanical Garden Station New York, New York, January 2, 1975" (NTSB-RAR-75-8)

Recommendation:

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.

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Recommendation No.: R-76-9 Status: Closed, Acceptable Action

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Penn Central Transportation Company Train Collisions, Leetonia, Ohio, June 6, 1975" (NTSB-RAR-76-2)

Recommendation:

Continue the investigation of the crashworthiness of locomotive cabs with emphasis on personnel safety and consideration of a readily accessible crash refuge.

* * *

Recommendation No.: R-76-30 Status: Open, Acceptable Action

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Collision of Penn Central Transportation Company Operated Passenger Trains Nos. 132, 944 and 939 Near Wilmington, Delaware, October 17, 1975" (NTSB-RAR-76-7)

Recommendation:

Require railroads to include emergency procedures for cab evacuation in its training program for operating employees.

* * *

Recommendation No.: R-77-13 Status: Open, Unacceptable Action

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Collision of Two Consolidated Rail Corporation Commuter Trains, New Canaan, Connecticut, July 13, 1976" (NTSB-RAR-77-4)

Recommendation:

Promulgate regulations for railroad commuter lines that will: Establish standards for the interior design of commuter cars to prevent and reduce injuries from accidents; insure that when the cars' power source fails emergency lighting is adequate, and doors can be operated easily from inside and outside; establish standards for the evacuation of passengers; and prevent a passenger train from entering an occupied block.

* * *

Recommendation No.: R-77-37 Status: Open, Acceptable Alternate Action

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Collision of Amtrak/Atchison Topeka and Santa Fe Railway Train and a Tractor-Cargo Tank Semitrailer, Marland, Oklahoma, December 15, 1976" (NTSB-RHR-77-3)

Recommendation:

Require all head-end locomotive units to be designed to prevent serious injury to crewmembers from penetration of flammable substances into control compartments.

* * *

Recommendation No.: R-77-40 Status: Open, Acceptable Action

Addressee: National Railroad Passenger Corporation

Report: Railroad Accident Report—"Collision of Amtrak/Atchison Topeka and Santa Fe Railway Train and a Tractor-Cargo Tank Semitrailer, Marland, Oklahoma, December 15, 1976" (NTSB-RHR-77-3)

Recommendation:

Strengthen and improve its locomotive unit operating compartment so that they effectively resist impact forces and deter entry of flammable liquids into locomotive cabs.

* * *

Recommendation No.: R-78-27 Status: Open, Unacceptable Action

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Collision of a Louisiana and Arkansas Railway Freight Train and a L. V. Rhymes Tractor-Semitrailer, Goldonna, Louisiana, December 28, 1977" (NTSB-RHR-78-1)

Recommendation:

Quickly conclude its study of improvements to the design of locomotive operator compartments to minimize crash damage, and promulgate necessary regulations to assure the adoption of appropriate findings.

* * *

Recommendation No.: R-79-11 Status: Open, Unacceptable Action

Addressee: Federal Railroad Administration

Report: Railroad Accident Report—"Head-End Collision of Louisville and Nashville Railroad Local Freight Train and Yard Train, Florence, Alabama, September 18, 1978" (NTSB-RAR-79-2)

Recommendation:

Expedite action on Recommendation R-78-27 of June 8, 1978, relating to its study of locomotive operator compartment design to minimize crash damage, and promulgation of appropriate regulations.

* * *

Recommendation No.: R-81-59 Status: Open, Unacceptable Action

Addressee: National Railroad Passenger Corporation (Amtrak)

Report: Railroad Accident Report—"Head-End Collision of Amtrak Passenger Train No. 74 and Conrail Train OPSE-7, Dobbs Ferry, New York, November 7, 1980" (NTSB-RAR-81-4)

Recommendation:

Revise turbotrains to improve cab crashworthiness in a collision.

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