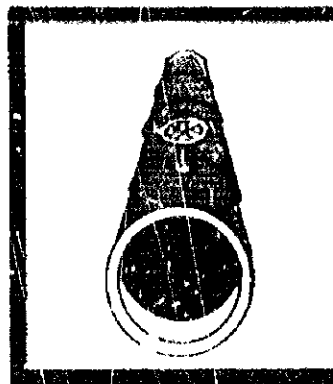
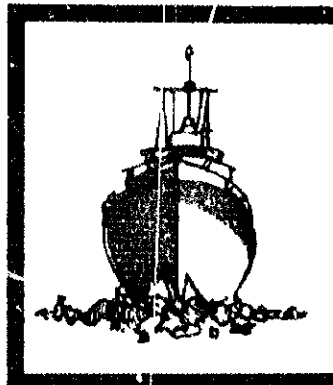
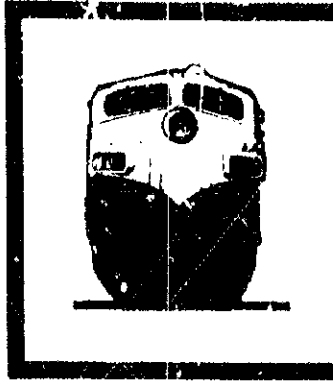
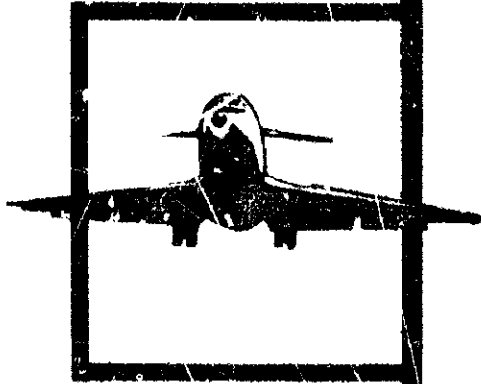


PB82-916305



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

**HEAD-ON COLLISION OF AMTRAK TRAINS
EXTRA 769 EAST AND NO. 195
BRISTOL, PENNSYLVANIA
MARCH 29, 1982**

NTSB-RAR 82-5

UNITED STATES GOVERNMENT

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<p>16. Abstract</p> <p>About 2:35 a.m., on March 29, 1982, Amtrak locomotive Extra 769 East, a rescue locomotive which had been dispatched from the 30th Street Station in Philadelphia, collided head-on with standing disabled train No. 195 near Bristol, Pennsylvania. The rescue locomotive was not derailed, but the locomotive and first car of train No. 195 were derailed. Twenty-three passengers and 6 crewmen were treated at local hospitals; 2 passengers and 1 crewman were admitted because of cuts, abrasions, strains and sprains. Damage was estimated at \$823,000.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the inadequate supervision by the trainmaster which allowed the engineer to operate Extra 769 East at a speed in excess of the speed authorized by train order and insufficient brake application by the engineer to stop the locomotive short of the standing train. Contributing to the cause of the accident were the lack of adequate emergency training on flag protection for a disabled train and the crewmembers' insufficient experience with the equipment and their unfamiliarity with the territory in the area of the accident.</p>			
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WASHINGTON, D.C. 20594**

RAILROAD ACCIDENT REPORT

Adopted: August 26, 1982

**HEAD-ON COLLISION OF AMTRAK TRAINS
EXTRA 769 EAST AND NO. 195
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SYNOPSIS

About 2:35 a.m., on March 29, 1982, Amtrak locomotive Extra 769 East, a rescue locomotive which had been dispatched from the 30th Street Station in Philadelphia, collided head-on with standing disabled train No. 195 near Bristol, Pennsylvania. The rescue locomotive was not derailed, but the locomotive and first car of train No. 195 were derailed. Twenty-three passengers and 6 crewmen were treated at local hospitals; 2 passengers and 1 crewman were admitted because of cuts, abrasions, strains and sprains. Damage was estimated at \$823,000.

The National Transportation Safety Board determines that the probable cause of this accident was the inadequate supervision by the trainmaster which allowed the engineer to operate Extra 769 East at a speed in excess of the speed authorized by train order and insufficient brake application by the engineer to stop the locomotive short of the standing train. Contributing to the cause of the accident were the lack of adequate emergency training on flag protection for a disabled train and the crewmembers' insufficient experience with the equipment and their unfamiliarity with the territory in the area of the accident.

INVESTIGATION

Events Preceding the Accident

Train No. 195.--Westbound National Railroad Passenger Corporation (Amtrak) train No. 195 originated at Boston, Massachusetts, on March 28, 1982, and was destined for the 30th Street Station at Philadelphia, Pennsylvania, via New York City, New York. 1/

At New Haven, Connecticut, Amtrak electric locomotive unit No. 933 replaced the diesel-electric unit that had brought train No. 195 from Boston. The engineer who boarded train No. 195 at New Haven and was to operate the train from New Haven to New York said that on boarding the locomotive at the motor storage facility, he noticed that the operating compartment lights were dimmer than normal. However, he said that the no-charge battery indicator light was not illuminated on the Fault and Indicator Light Panel in the operating compartment on either end of the locomotive. (There was a fully equipped operating compartment at each end of unit No. 933.) Illuminated indicator lights would have indicated that the battery was not being charged. The engineer further stated that the engine dispatcher had told him that unit No. 933 had recently been repaired and that this would be the first trip for the unit since the repairs.

1/ Timetable direction for trains between Boston, New York, and Philadelphia is east and west. Timetable direction will be used in this report.

After a proper and satisfactory brake test at New Haven, train No. 195 departed for New York. According to the engineer, train No. 195 was delayed between New Haven and New York because of electrical problems which he said occurred on about 20 occasions. The Hotel Electric Power (HEP) unit which supplies power to the coaches had failed just west of New Haven. That failure required the engineer to reset and restart the HEP unit. On several occasions, the engineer had to operate the propulsion reset button on the S-7 panel in the equipment room and the reset button at the operating position to correct the problem. Some of the electrical problems were caused when the pantograph separated from the catenary, and the most serious electrical problem occurred when the pantograph dropped while the train was moving across a 300-foot catenary phase break ^{2/} at Cos Cob, Connecticut. When train No. 195 moved onto the phase break section, the pantograph dropped away from the catenary and all of the lights on the locomotive were extinguished. When the pantograph dropped, a penalty ^{3/} brake application was imposed on the train and the engineer was forced to bring the train to a stop. On this occasion, the engineer had to operate a battery override device and then an auxiliary battery-operated air compressor from controls on the S-7 control panel in the equipment room to restore the pantograph to the catenary. The engineer encountered the same problem at a phase break farther west at Pike Tower near Rye, New York, but he was able to restore the pantograph to the catenary by operating the reset button at the operating position and the propulsion reset button. In addition to the pantograph's dropping at these two locations, the engineer said that three momentary electrical outages occurred because of pantograph bounce which in each instance he corrected by resetting the appropriate button. In all instances, he was able to restore the pantograph to the catenary and resume power control of the locomotive for normal operation.

In addition to problems with the pantograph, train No. 195 arrived at New York's Penn Station with the cab signals inoperative on the locomotive. Under such circumstances, the engineer was required to observe a maximum speed of 79 miles per hour (mph) in accordance with the provisions of Amtrak operating rule 557. (See appendix C.)

While train No. 195 was being inspected and the brakes tested at New York, the outbound engineer radioed the train director at "A" Tower, located in the Penn Station terminal, to test the radio and to verify that he was to continue to operate according to train No. 195's schedule to Philadelphia with locomotive No. 933 under the provisions of rule 557. The radio operated to his satisfaction and the train director at "A" tower confirmed the operation of train No. 195 with locomotive No. 933 under the provisions of rule 557. Therefore, the train's maximum authorized speed was 79 mph versus 110 mph, which was the maximum authorized speed had the cab signals been operable. The engineer said that the Fault and Indicator Light Panel (tell-tale) on the locomotive, which is an indicator panel that provides a fault indication for selected malfunctions in the locomotive's electrical and control systems, did not indicate any problems when he assumed control of the locomotive in New York. The engineer who had operated the train from New Haven told the outbound engineer about the electrical problems that had occurred. The inbound engineer later stated that the problems had been recorded on the locomotive trouble report form on the locomotive. The outbound engineer did not express any concern.

^{2/} An electrical separation of two A.C. power systems that have a different phase relationship.

^{3/} A service brake application automatically imposed when specific predetermined conditions are present, i.e., the loss of power requires an engineer to stop. If he failed to take action to stop the train under such circumstances, the train would be stopped by the penalty brake application.

After a satisfactory inspection and airbrake test, train No. 195 departed New York on time at 11:45 p.m. on March 28, 1982. A five-man crew, ^{4/} two men on the locomotive and three men in the coaches, operated the train which consisted of locomotive No. 933 and six passenger cars.

The engineer said that the trip from New York through Trenton, New Jersey, a distance of 57.1 miles, was made without incident at a maximum speed of 79 mph. He made the scheduled station stops without incident and he noted that en route he heard the usual railroad radio communications over the radio system, but he said he did not remember using the radio after the train left New York.

At 12:49 a.m. on March 29, 1982, train No. 195 departed Trenton where it had been crossed over from the No. 4 track to the No. 3 track. The train continued west on the No. 3 track and passed Grundy Tower Interlocking, located at milepost 65.6, at 12:55 a.m. Within seconds after passing Grundy Tower, the pantograph dropped away from the catenary and a penalty service brake application was automatically imposed which required the engineer to bring the train to a stop. The train was stopped at milepost 66, in a 0° 32' curve to the right, on a 0.40-percent ascending grade westbound. The front of the locomotive was standing 2,273 feet east of the Bristol Station, Bristol, Pennsylvania, located at milepost 66.8. (See figure 1.)

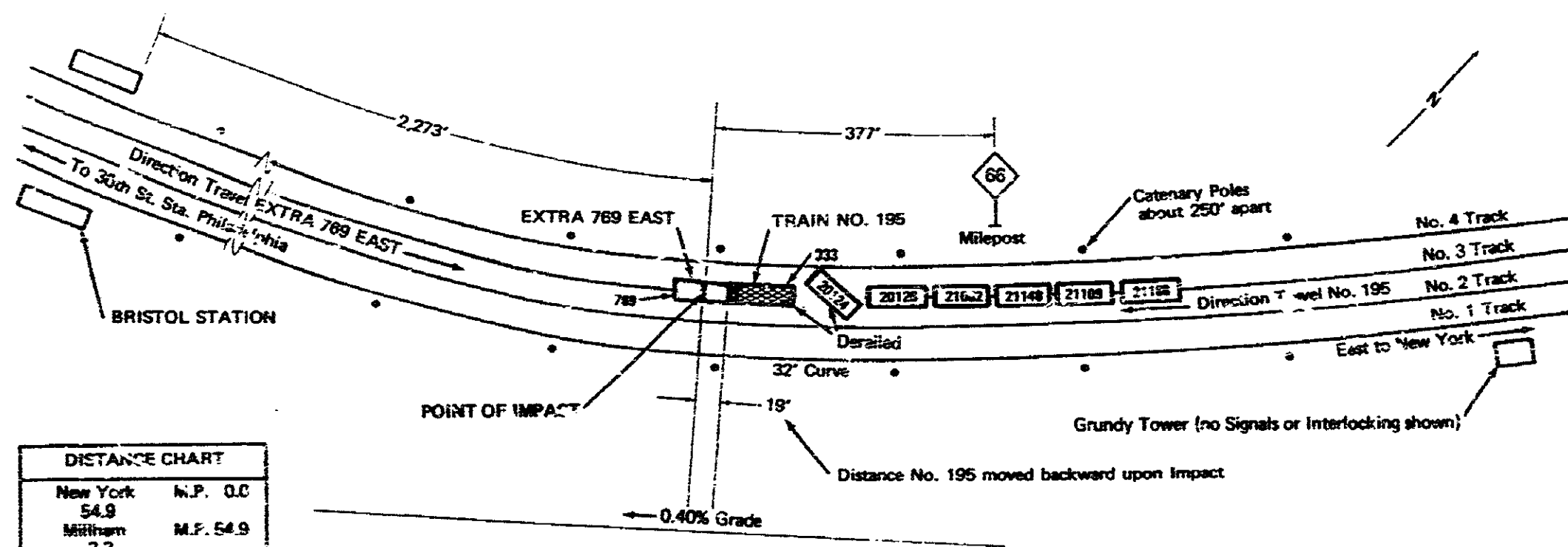
The engineer said that when the 11,000 V.a.c. catenary power was lost on the locomotive, the battery protector relay was tripped which caused all the lights on the locomotive to go off including the headlight and the marker lights. He said he does not remember seeing any indication lights on the Fault and Indicator Light Panel, and to the best of his memory there was complete darkness. At the same time the pantograph dropped on the locomotive, the main lights in the coaches went off and only the battery operated emergency lights remained illuminated. During this time, the engineer did not attempt to use the locomotive radio.

The engineer unsuccessfully attempted to raise the pantograph by use of the remote controls located adjacent to the operating position. After this attempt, he sent the fireman back into the locomotive equipment room to the S-7 control panel, where manual controls for various operating features of the locomotive and certain indications are located. The fireman also was unsuccessful in his attempt to restore the pantograph to its operating position against the catenary.

The engineer then attempted to raise the pantograph by following the more detailed procedure outlined in the operating manual. He said he disconnected all the electrical circuits that were powered from the locomotive battery in order to have the maximum battery power available to operate the equipment associated with raising the pantograph to its operating position. He said that he heard some relay "chatter" ^{5/} while he was attempting to raise the pantograph, but he still was unable to restore the pantograph to its position against the catenary. The engineer then left the locomotive to find the conductor. He informed the conductor that he could not restore power to the locomotive and that help or another locomotive would be required to move the train the remaining 23.6 miles to the 30th Street Station at Philadelphia.

^{4/} All traincrew operating personnel were Conrail employees.

^{5/} Insufficient power to energize a relay positively will cause the circuit to be energized only momentarily before the relay returns to the deenergized position. Repeated energizing/deenergizing will produce a fast clicking noise or a hum.



DISTANCE CHART	
New York	M.P. 0.0
54.9	
Millham	M.P. 54.9
2.2	
Trenton	M.P. 57.1
8.5	
Grundy Tower	M.P. 65.6
0.4	M.P.
Milepost 66	M.P. 66.0
0.8	
Bristol Station	M.P. 66.8
10.4	
Holmes Tower	M.P. 77.2
12.4	
30th Street	M.P. 88.1
Philadelphia	+ 1.5

Drawing not to scale

Figure 1.--Location of equipment following the impact and distances involved.

About 1:15 a.m., eastbound Consolidated Rail Corporation (Conrail) train No. TV-24, operating on the No. 2 track, stopped adjacent to train No. 195. The conductor of train No. 195 boarded the caboose of train No. TV-24 and used the caboose radio to notify Grundy Tower that train No. 195 was disabled. During this radio contact, the train dispatcher, located at the 30th Street Station, issued a train order 6/ to the conductor and engineer of No. 195 which directed train No. 195 to remain standing at its location on the No. 3 track until a rescue locomotive arrived. (See appendix D.) The train order was relayed to the conductor by the block operator at Grundy Tower via the caboose radio of No. TV-24. At the same time, the block operator told the conductor of No. 195 that a rescue locomotive, Extra 769 East, was being dispatched from Philadelphia to move the disabled train to the 30th Street Station.

While the crewmembers of train No. 195 were waiting for the rescue locomotive to arrive, the conductor sent the flagman to the rear of the train to provide flag protection, even though it was not required by Amtrak operating rules. Similarly, the engineer had instructed the fireman to place lighted fusees several hundred feet in front of the train to provide flag protection. The crewmembers also maintained lighted fusees at the immediate front of the locomotive to provide light since their only available source of light was hand flashlights.

The engineer said that during the time the crewmembers of train No. 195 were waiting for the arrival of the rescue locomotive, he returned to the locomotive to make another effort to raise the pantograph, and that if that attempt failed he planned to condition the locomotive for towing. While he was on board the locomotive, after an unsuccessful attempt to raise the pantograph, he saw the headlight of the approaching rescue locomotive reflected on the surface of the rails to the west. He said he got off the locomotive and assumed a position near the locomotive coupler so that he could assist in coupling the rescue locomotive to the disabled locomotive of train No. 195.

As the rescue locomotive rounded the curve and approached train No. 195, the crewmembers of No. 195 became alarmed at the closing speed and began waving their flashlights giving a stop signal. Because the rescue locomotive did not appear to be slowing sufficiently to stop before striking train No. 195, those crewmembers of No. 195 who were on the ground ran for safety.

Extra 769 East.--The four-man crew for Conrail yard assignment RE-1-C reported for duty at 11:59 p.m., on March 28, 1982, at the Race Street Roundhouse facility in Philadelphia. Before the crew began its routine yard work, the conductor and engineer of the yard crew were assigned to work with an Amtrak trainmaster who was going to pilot 7/ a light locomotive 8/ to Bristol to rescue disabled Amtrak train No. 195. The trainmaster was not a qualified locomotive engineer. The engineer stated that he tested the locomotive brakes, radio, and cab signals and everything operated satisfactorily. Accompanied by an assistant roundhouse foreman from the Race Street Roundhouse facility, the conductor and engineer of the yard crew and the trainmaster boarded locomotive No. 769 and departed Race Street about 1:30 a.m.

6/ A train order is issued to cover movements of trains not otherwise covered by the timetable.

7/ An employee [who is qualified on the route and who is] assigned to a train when the engineman, conductor, or track car driver is not qualified on the physical characteristics or rules of the railroad or portion of the railroad over which the movement is to be made.

*Definition from Amtrak operating rules. Bracketed information added.

8/ A locomotive with no cars.

The conductor said that while the crew was assembling he told the trainmaster that Bristol was located east of Holmes Tower and that he (the conductor) was not authorized to operate a train in that area because he had not been examined by a company officer and had not passed a test on the characteristics of the railroad east of Holmes Tower. The conductor said the trainmaster told him that he (the trainmaster) would assume full responsibility for the train on the trip to Bristol. The engineer said he was not told where he was going and that he did not learn his destination until the rescue locomotive arrived at Holmes Tower Interlocking located at Holmesburg, Pennsylvania. The engineer further stated that he knew the locomotive assigned to him had a speed restriction when it was being operated light, but that he did not remember the maximum allowable speed and he did not check to verify that speed.

With the short hood forward, locomotive Extra 769 East made an uneventful trip from Race Street to Holmes Tower where it arrived at 2:05 a.m. The engineer said that he operated the locomotive's independent brake several times between those points and it operated properly. At Holmes Tower, the block operator relayed the following train order to Extra 769 East over the radio: "Extra 769 East pass home signal in stop position on No. 1 track at Holmes and proceed east on No. 3 track to a point approximately 7 catenary poles ^{9/} east of Bristol Station where No. 195 engine 933 is standing disabled." (See appendix D.) Extra 769 East then departed Holmes Tower on the No. 3 track at 2:13 a.m.

The engineer of Extra 769 East said that when he heard the train order, it was his first knowledge that he was going to Bristol. He said that at that time he told the trainmaster that he was not authorized to operate a locomotive east of Holmes Tower for the same reasons that the conductor had earlier specified. He said the trainmaster told him he would accept full responsibility for the trip.

The Accident

The trainmaster said that he observed the speed indicator at one point between Holmes Tower and Bristol and that Extra 769 East was moving about 40 mph. He was seated in the fireman's seat on the north side of the locomotive and he said that he did not take any exception to the speed or the engineer's operation of the locomotive. He said that he called out stations and mileposts by mile number to the men in the operating compartment as the train moved eastward and continually gave the approximate distance before they would reach train No. 195.

Although there were passenger shelters at the track level on the north and south sides of the tracks at Bristol Station, the platform lights were not illuminated and there were no station signs by which the station could be identified from a passing train when Extra 769 East approached Bristol Station on the morning of March 29. However, the trainmaster said that when Extra 769 East was about 500 feet west of Bristol Station, he told the engineer that they were approaching Bristol Station and that he should slow down from the approximate 40-mph speed Extra 769 East was moving at that time. (See figure 2.) The trainmaster said the engineer reduced the throttle and applied the brakes but that the locomotive did not seem to slow appreciably. Therefore, about 550 feet east of the station, the trainmaster told the engineer to apply more brakes. Immediately thereafter, the trainmaster said he saw the red glare of fuses reflected on the surface or the gauge side of the rails and he told the engineer "there he is Frank get some more brakes down." The trainmaster stated that the engineer responded and applied more

^{9/} Catenary poles are about 260 feet apart in the Bristol area.



Figure 2.--Approach view to standing train No. 195.

brakes but that the locomotive still did not seem to be slowing. The trainmaster said that about that time either he or the conductor said "dump it Frank," and the engineer responded by placing the locomotive brakes in emergency. The trainmaster said that after 1 or 2 seconds he still was not satisfied that the locomotive was stopping or that the brakes had been put in emergency so he opened the emergency brake valve located at the fireman's position on the locomotive. The speed tape from Extra 769 East shows a decrease in speed from about 48 mph beginning at what would appear to be Bristol Station. The trainmaster said that he did not get any more braking effect or brakepipe exhaust and when he realized that the locomotive was not going to stop before striking train No. 195, he said he lay down on the floor to await the expected impact. Shortly thereafter, about 2:35 a.m., Extra 769 East, moving about 22 mph, ran head-on into the locomotive of train No. 195. A light deposit of sand was found on the rails just a few feet ahead of the point of impact.

Testimony of Extra 769 East Crew

The testimony given by the conductor of Extra 769 East agreed with the trainmaster's testimony on the events at Holmes Tower. He said he offered no objections when the trainmaster copied the train order. Further, he added that he was under the impression that the trainmaster's authority to run the crew took precedence over his authority since he was not authorized to operate east of Holmes Tower. He said that as Extra 769 East proceeded toward Bristol he did not take any exception to the manner in which the locomotive was being operated nor did he think the authorized speed was being exceeded, because he thought the locomotive was traveling about 30 mph. He said that as Extra 769 East moved eastward the trainmaster called the mile number of the mileposts as they passed them. The conductor said that as Extra 769 East approached Bristol Station he recognized the area and as the train approached the left hand curve that started west of Bristol Station, he saw lighted fusees. He also said that he saw the lighted headlight on the locomotive of train No. 195. When he saw the fusee lights from where he was standing behind the engineer, he said he cautioned the engineer to slow down and that the trainmaster also had called for the engineer to apply brakes. Although the engineer had applied the locomotive brakes, the conductor stated that he did not think the locomotive was slowing. He said he did not hear a brakepipe air exhaust and that he believed the engineer had used the dynamic brake. Since he was convinced that the locomotive was not slowing even though the locomotive brakes had already been applied in emergency, the conductor stated that he left the operating compartment through the door behind the engineer and started back on the walkway along the long hood of the locomotive to reach and set the locomotive handbrake. He said that he had not reached the handbrake control when the impact occurred and that he was thrown backward against the locomotive operating compartment.

The engineer testified that after Extra 769 East departed Race Street, the only exception he took to the operation of the locomotive was that the speed indicator was not operating. Extra 769 East had slowed at one location between Holmes Tower and Bristol Station because of trackmen working and the brakes had operated effectively in that instance. He further stated that the brakes had operated effectively on each occasion that he had used them after leaving Race Street.

The engineer said that no one cautioned him or took any exception to his speed or the manner in which he was operating the locomotive at any time. He estimated he ran at only 15 to 20 mph between Holmes Tower and Bristol. Based on a time-distance calculation, the average speed of Extra 769 East between Holmes Tower and the point of impact was about 33.6 mph. The engineer further stated that no one told him when Extra

769 East had arrived at Bristol Station, and that no one warned him that the lights associated with the standing train had been sighted. He said he did not and could not see any lights in front of train No. 195 because he was on the outside of the left-hand curve in which train No. 195 was standing. He said his first knowledge that he was near the disabled train was when someone told him to stop. He further stated that when he heard the shouted alarm to stop, he moved the throttle from the No. 2 position to idle, put the automatic brake handle in the emergency position, set the independent locomotive brake to full stop, and then released the deadman control pedal. He testified that he did not hear a brakepipe air exhaust and immediately after setting the brakes the impact occurred and he was thrown forward against the controls and the front of the operating compartment.

Injuries to Persons

<u>Injuries</u>	<u>Passengers</u>	<u>Amtrak</u>	<u>Conrail</u>	<u>Total</u>
Fatal	0	0	0	0
Serious	2	1	0	3
Minor	<u>21</u>	<u>2</u>	<u>3</u>	<u>26</u>
Total	23	3	3	29

Damage

Train No. 195 was moved back about 19 feet as a result of the impact force. The locomotive and the first car of train No. 195 were derailed; the first car was moved to the north where it fouled the No. 4 track.

The front end of locomotive unit No. 933 was crushed 7 feet 3 1/2 inches to the rear. The locomotive operating compartment, the engineer's control console, and the engineer's and fireman's respective seats were badly damaged. The automatic brake valve and its associated piping were bent and twisted. The throttle and related wiring were twisted and broken. The windshield was broken and the side doors of the operating compartment were bent. There was no evidence of damage to the equipment room located behind the bulkhead of the operating compartment. (See figures 3 and 4.) The derailed passenger car had only slight damage to the body.

Extra 769 East was not derailed and had light damage to the short hood end and to the steps and hand railings which made contact with the standing train. The impact caused the diesel engine power unit to shift on its base, but there was no apparent mechanical damage. The fuel tanks on Extra 769 East began to leak after the collision and the engineer of train No. 195 said he extinguished the fusees near the front of train No. 195 because he was afraid the fuel oil might ignite. The commutator riser and slip ring of the main generator were damaged. (See figure 5.) The damage to the track was insignificant and the catenary and signal systems were not damaged. The estimated total damage was:

<u>Unit</u>	<u>Damage</u> <u>(\$)</u>
769	18,000
933	800,000
Car 20124	2,900
Track	<u>2,500</u>
Total	\$823,400

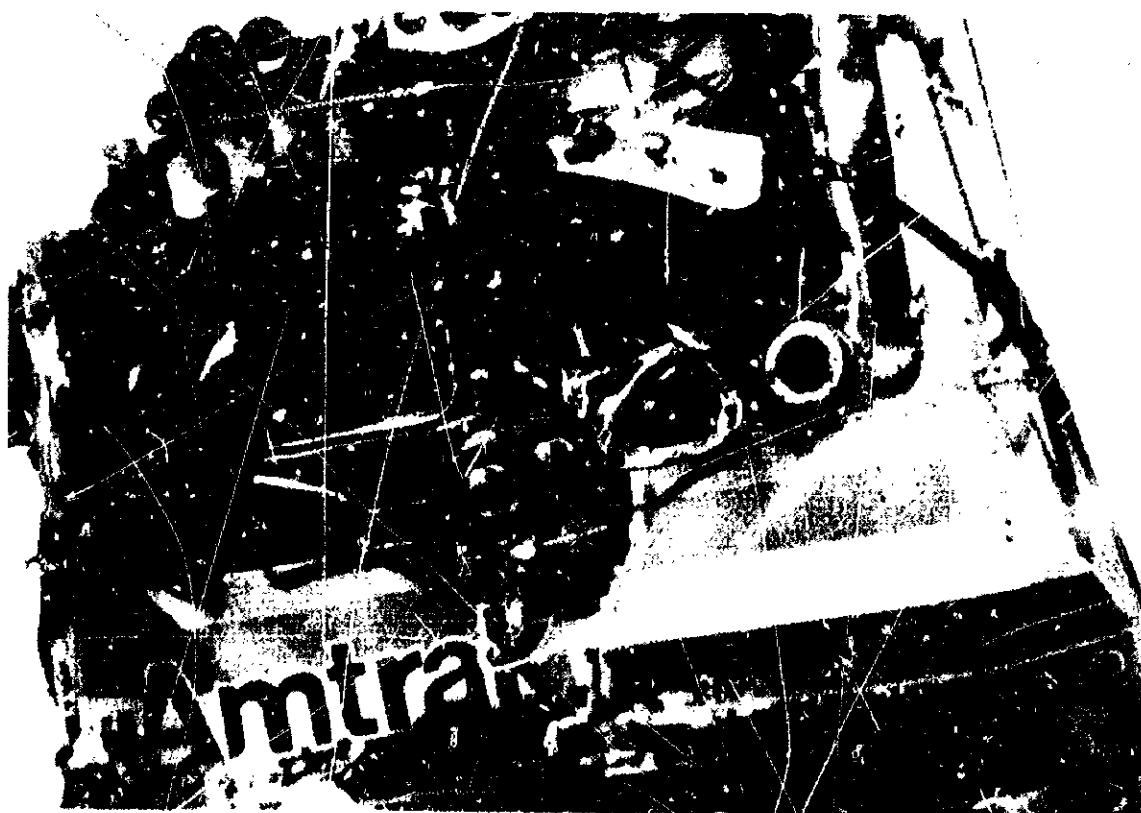


Figure 3.--Locomotive unit No. 933 of train No. 195.

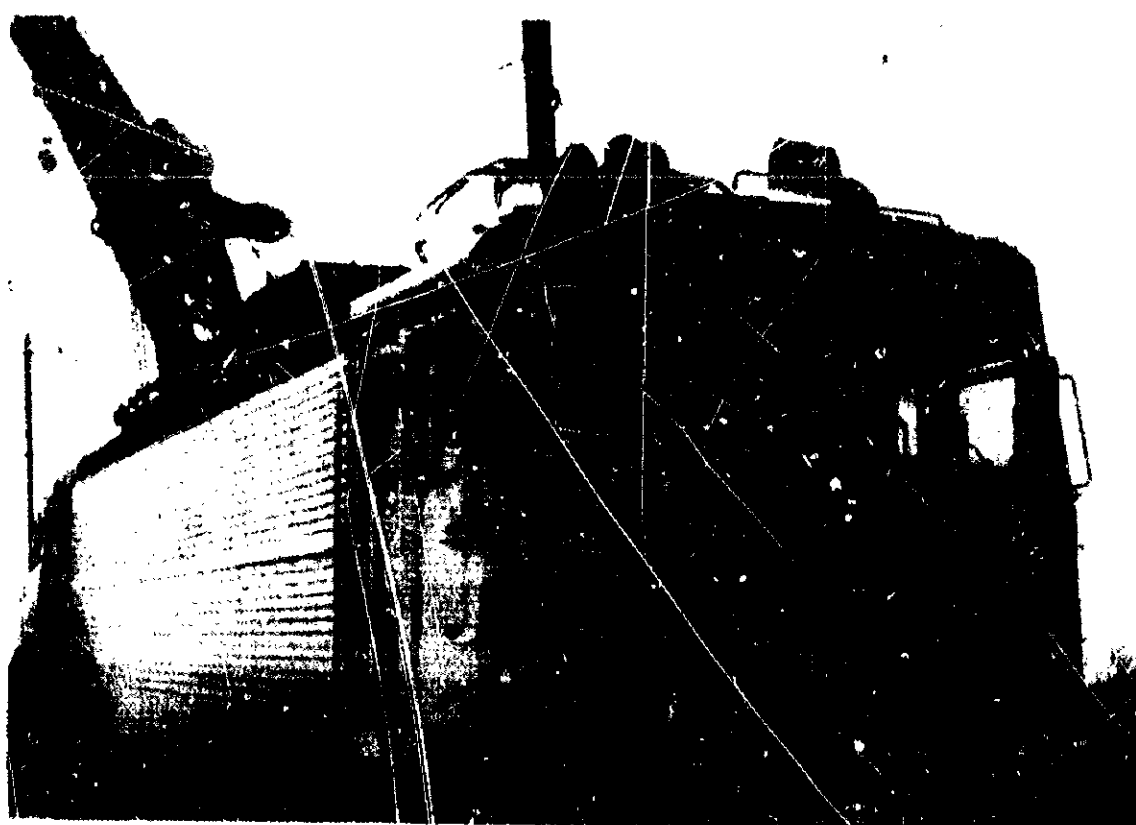


Figure 4.--Undamaged end of locomotive unit No. 933.

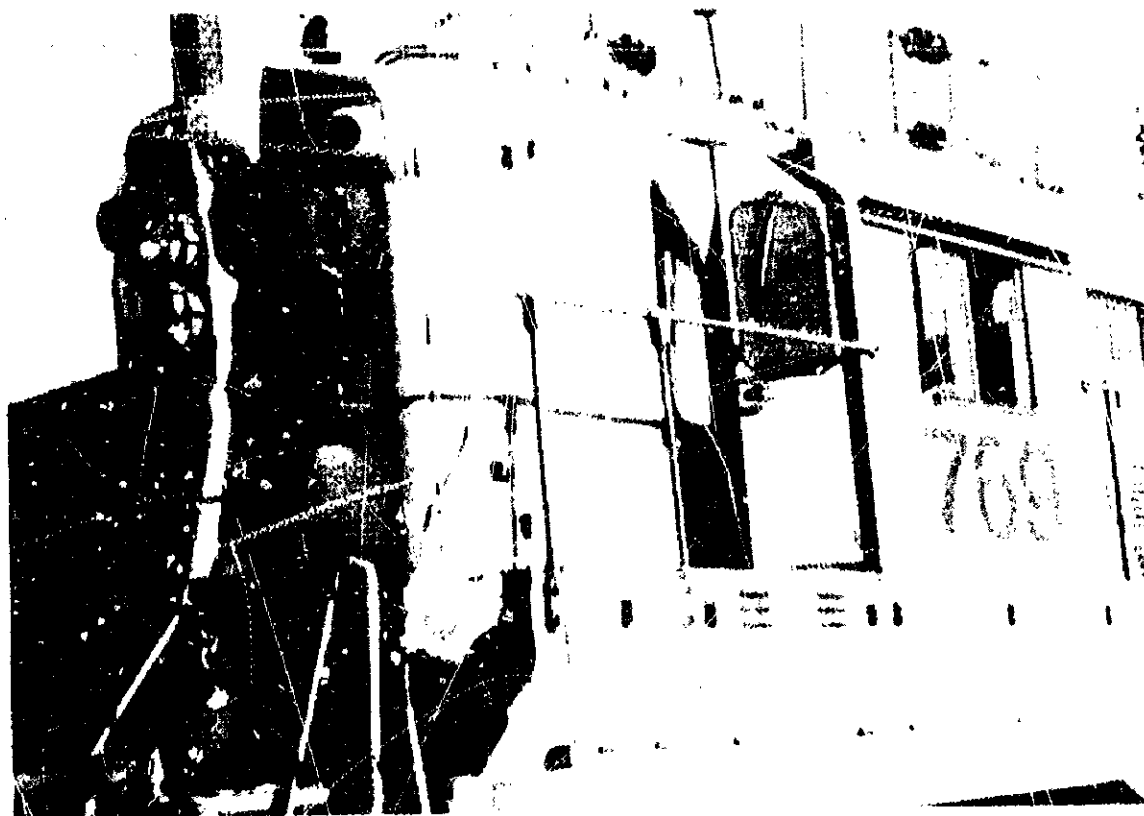


Figure 5.--Locomotive unit Extra 769 East.

Personnel Information

The trainmaster was an Amtrak employee who had been promoted to that position from assignments in the mechanical department which provided very little experience in the operation of trains. He had not been given any formal training by Amtrak except when he attended a school for new block operators.^{10/} He was conversant with the operating rules and he had successfully passed an examination on those rules. During the accident investigation, the Safety Board was provided a copy of the trainmaster's work performance. In one evaluation, his supervisor commented about the trainmaster's apparent reluctance to report violations of operating and safety rules, and that he believed the trainmaster should show more interest and become involved in trials and investigations involving railroad employees charged with violating company rules and procedures. However, in both written and oral performance evaluations, the supervisor rated the trainmaster as a good performer and employee. The trainmaster expressed the belief that had he been a qualified locomotive engineer he could have functioned more effectively in his role as pilot of Extra 769 East.

The conductor and engineer of Extra 769 East were Conrail employees who were members of a relief yard crew assigned to the Philadelphia Terminal. The territory in which they were approved to work in an eastward direction was limited to Holmesburg Junction, the location of Holmes Tower. Both men were up to date on operating rules examinations and on their medical examinations. They were qualified for their respective assignments in accordance with Amtrak and Conrail operating requirements. The engineer told Safety Board investigators that he had only operated a locomotive similar to

^{10/} Interlocking towers, such as Grundy, are manned by block operators.

unit 769, a model GP-9, once -- about 2 months before the accident -- and only for about 4 hours. He also said he had never operated a train in the vicinity of milepost 68.

The engineer of train No. 195 was a Conrail employee and he seemed to be knowledgeable of the operation and trouble shooting procedures for the model AEM-7 locomotive (unit No. 933) used on train No. 195. He said he had operated model AEM-7 locomotives since they had been placed in service on the Northeast Corridor, about 2 years ago, and that he had previously experienced dropped pantographs with the model AEM-7 but he was always able to restore them to the catenary and complete the trip. He was qualified for the assignment as engineer in accordance with Amtrak and Conrail operating requirements.

The conductor of train No. 195 was a Conrail employee and a regularly assigned flagman on the crew that operated that train. However, on March 28-29, 1982, he was assigned the duty of conductor. He was qualified for the position of conductor in accordance with Amtrak and Conrail operating requirements.

The head brakeman and flagman of train No. 195 were also Conrail employees and both were qualified for their respective assignments in accordance with Amtrak and Conrail operating requirements.

Train Information

Amtrak locomotive unit No. 769 was a diesel-electric model GP-9 manufactured by the Electro-Motive Division (EMD) of General Motors Corporation. The unit was equipped with cab signals, but was not equipped with speed control that would operate in conjunction with the cab signals. The unit was equipped with a speed control unit that functioned only when it was used in yard humping operations. Unit No. 769 was equipped with a 28-L airbrake system with a pressure maintaining feature, a permanently installed radio, an operable Barco electric speed indicator and recorder, and a foot-pedal-controlled deadman safety device. The locomotive weighed about 240,000 pounds. Amtrak special instructions, which were contained in timetable No. 3 and which were in effect at the time of the accident, imposed a maximum speed restriction of 30 mph for a model GP-9 locomotive operated without cars.

Unit No. 769 had received a 24-month airbrake inspection, a periodic cab signal inspection, and a general inspection at Amtrak's Wilmington, Delaware shops on March 5, 1982.

Locomotive unit No. 933 was a model AEM-7 electric locomotive of Swedish design built by the EMD of General Motors Corporation under a license agreement with a Swedish Manufacturer. The locomotive is designed to operate from an overhead power source of 11 kV at 25 Hz, 12.5 kV at 60 Hz, and 25 kV at 60 Hz. The unit has a maximum speed rating of 125 mph.

The model AEM-7 has a fully equipped operating compartment at each end and two Faiveley DS-11 two stage pantographs by which propulsion power is obtained from a catenary power source. Both pantographs are designed to be raised remotely by controls from the engineer's operating position or from an S-7 locomotive control panel in the locomotive equipment room. Each pantograph is operated by an arrangement of three springs. The force of one of these springs is neutralized by a piston which is operated by 85 to 100 psi air pressure. When the force of the one spring is neutralized, the other two springs raise and hold the pantograph against the catenary. When the air pressure is exhausted from the piston, the pantograph is retracted by spring force. The electrical control mechanism is operated in conjunction with the piston air pressure.

The model AEM-7 locomotive is equipped with a 64-volt nickel cadmium battery composed of 48 cells rated at 170 Ampere Hours (AH) over an 8-hour period. In addition to providing power for the headlight and marker lights, the battery also provides power for low voltage control circuits and for raising the pantograph when the pantograph is down. In a situation where the pantograph is down and the battery is not being recharged, a fully charged battery will maintain power to the low voltage control circuits for about 1 1/2 hours, or until the battery voltage reaches 55 volts, after which it will be automatically disconnected from these circuits. The battery also supplies power for the radio, the cab signals, and the intratrain communicating systems in the absence of catenary power.

The battery is charged by a thyristor controlled battery charger when catenary power is being supplied to the locomotive. The battery charger has a rated output of 74 volts d.c. and is capable of supplying the low voltage control power if the battery voltage is low. The battery is protected by a battery protector relay which becomes deenergized if the battery voltage drops to or below 55 volts and the battery charger is inoperative. When the battery protector relay is tripped and the battery switch is closed, the main circuit breaker opens which in turn results in the lowering of the pantograph. If the battery protector relay becomes deenergized when the reverser lever is either in the forward, neutral, or reverse positions, the radio, intratrain communicating system, and the cab signal circuits will be energized. However, if the reverser is in position "O" or the battery switch is open, all circuits will be dead. No lighting circuits are available when the battery protector relay is deenergized.

Each operating compartment has a permanently mounted radio, a Fault and Indicator Light Panel, and an alertness and deadman control safety device. The locomotive is equipped with air and dynamic braking which is blended for maximum efficiency through a 26-LIC, CS-1 brake valve. The locomotive is also equipped with cab signals and automatic train control featuring overspeed control. The weight of the locomotive is about 201,750 pounds.

Method of Operation

Trains are operated through the area where the accident occurred by the signal aspects of an automatic block signal system, train orders and special instructions provided by bulletin orders and timetable. An automatic train control system, which provides speed and cab signal control, is in service in the area, however, not all of the locomotives that operate in the area are equipped with the speed or overspeed control feature. The operation of trains is supplemented by a radio system that enables traincrews to communicate with each other and with the block operators.

The four tracks through the area are numbered one through four from the south to the north. In particular, operating rule No. 251 applies which specifies that trains on the No. 3 track, or other specified track, will run with reference to other trains in the same direction by block signals whose indications will supersede the superiority of trains. (See appendix C for applicable operating rules.) The maximum authorized speed for passenger trains is 110 mph in the vicinity of milepost 66 where the accident occurred, but was 70 mph for train No. 195 in accordance with rule No. 557, since the cab signals were inoperative.

The train dispatcher, located at the 30th Street Station in Philadelphia, controls the movement of trains by receiving and maintaining a record of the times trains under his jurisdiction pass specified reporting points. The block operators at Grundy Tower, located

at milepost 65.6, and Holmes Tower, located at milepost 77.2, control the movement of trains in the "block" between their respective interlocking limits and in the blocks between interlocking towers on either side of them in conjunction with those block operators as instructed by the train dispatcher. When a train passes an interlocking tower, the block operator at that tower records and reports the passing time to the train dispatcher, to the block operator at the tower in the direction the train is traveling, and to the block operator at the tower in the direction from which the train came. Thus, the block operator in advance of the train knows it is coming, and the block operator to the rear of the train knows the train has passed from the block between his tower and the intermediate tower. The block operators control the signals and switches for train routing at tower interlockings and at remote interlocking locations, and also control the radio communications with the trains. In addition, on instructions from the power director, the block operators operate sectionalizing power switches from their tower control points affecting the 11,000 volt 25 Hz catenary power.

A Form "Q" train order is used to provide for the movement of a train against the established direction or current of traffic to assist a disabled train. The "Q" order format and its directed application follow:

This format of Train Order consists of two (2) separate Train Orders which are issued under different numbers but must be issued in conjunction with each other. Example (1-A) must be made "complete" and delivered to the disabled train before example (1-B) is issued.

(1-A) No. 59 Eng 3752 remain where you are standing on No. 2 track 1 mile east of signal 690 until extra 4745 east arrives.

For use when train, operating in direction for which traffic has been established, stops disabled between two block or interlocking stations and helping engine is to be moved against the established direction of traffic to assist disabled train.

(1-B) Extra 4745 east pass home signal in Stop position on No. 1 track at B and proceed east on No. 2 track to a point 1 mile east of signal 690 where No. 59 Eng 3752 is disabled.

For use when an engine is to move against the established direction of traffic to assist disabled train standing between block or interlocking stations.

Under the Train Order, the designated train 11/ must operate at Reduced Speed and use the track specified between the stations or points named.

Before delivering this Train Order at a point where the interlocking signal is also the block signal, the Operator must know that the switches are properly lined for the route indicated in the order and all signals governing movements over routes that conflict with the route to be used display their most restrictive indication.

NOTE--Manual block signal system rules do not apply.

11/ Train--An engine or more than one engine coupled with or without cars displaying markers.

The speed of the train receiving a Form "Q" order is limited to reduced speed which requires that the engineer be prepared to stop within one-half the range of vision but not to exceed 20 mph. When the block operator directed the trainmaster to copy a train order at Holmes Tower, the block operator did not preface the instruction with the identity of the form, i.e. Form "Q," and he was not required by rules to do so. Also, the speed restriction imposed on the train is not contained in the body of the order. (See appendix D for the Form "Q" train orders issued just before this accident.) The trainmaster expressed the belief in his sworn statement that if the Form "Q" order had been identified when it was issued, he may have remembered the speed restriction inherent in the order.

Amtrak operating rules provide for the movement of a train over a portion of the railroad by an engineer or conductor if neither is authorized to operate a train in that area because they have not been tested and passed satisfactorily by a supervisor on the characteristics or the operating rules of the railroad. When such a situation occurs, a "pilot" is assigned to oversee the movement of the train. A pilot is "an employee assigned to a train when the engineman, conductor, and track car driver is not qualified on the physical characteristics or rules of the railroad or portion of the railroad over which the movement is to be made." According to Rule 906, the conductor, even though he may not be assigned the duty of "pilot," still has general charge of the train. Rule 907 states that if a qualified locomotive engineer serves as a pilot, he will operate the train unless otherwise instructed.

Amtrak and Conrail have an operating agreement whereby Amtrak trains are operated by Conrail engine and train crewmen. The Conrail crewmen are required to pass an Amtrak operating rules examination and adhere to Amtrak operating practices on Amtrak property.

Amtrak Timetable No. 3, which was in effect on March 29, has schedules and special instructions affecting the Northeast Corridor which extends from Washington, D.C., to Boston, Massachusetts. The Timetable covers the Boston, New York, Philadelphia, and Baltimore divisions and is comprised of about 450 pages. A great amount of information is provided in the Timetable which engineers, conductors, and trainmen are required to know. For example, an engineer operating a train between Washington and New York will move over the Baltimore, Philadelphia, and New York Divisions. Information the engineer must know and be able to instantly apply includes speed restrictions on certain curves, bridges, tunnels and tracks, which operating rule applies to specific sections of track, and whether speed restrictions apply to the locomotive assigned to his train. In addition, he is required to know current bulletin orders and train orders which affect the operation or movement of his train and the various requirements such as whistle sounding for the several States in which the train is operated. Amtrak and Conrail operating personnel are required to know a large amount of information that affects the safety of train movements.

Until just recently, the jurisdictional limits of the Philadelphia Terminal extended eastward to Holmesburg Junction, milepost 77.2. The conductor and engineer of Extra 769 East were authorized to perform service to that point. However, on February 7, 1982, the limits of the Philadelphia Terminal were extended eastward about 22 miles to Millham, New Jersey, milepost 54.9, which included milepost 66. Neither the conductor nor the engineer had been tested by company officers and approved to operate a train over the territory covered by the extended limits.

Flag protection for standing trains, according to the provisions of Amtrak operating Rule 99, is not required in the Commonwealth of Pennsylvania, but the State of New Jersey requires that flag protection be provided. (Since the accident, this requirement has been rescinded.)

Meteorological Information

At the time of the accident, the weather conditions at Bristol were clear, visibility was good, there was no fog or precipitation, and the temperature was about 40° F.

Medical and Pathological Information

The engineer of Extra 769 East, who was thrown forward upon impact, received a cut over his left eye, superficial lacerations, and a nose bleed. He was not admitted to a hospital the day of the accident but he admitted himself to a hospital briefly a few days later for reasons not determined in the investigation. The conductor of Extra 769 East had cervical and lumbar strain and sprains and contusions. He was not admitted to a hospital. The trainmaster received a twisted ankle and the roundhouse foreman a strained back; neither of them was admitted to a hospital.

The head brakeman of train No. 195, who was in the first car at the time of the collision, received a possible neck injury, but he was not hospitalized. An Amtrak service employee, who was also in the first car, received a concussion, multiple contusions, and abrasions and lacerations of the right forearm. He was admitted to a hospital for observation.

One passenger was admitted to the Lower Bucks County Hospital for blunt abdominal trauma and another passenger was admitted to the Delaware Valley Hospital for acute lumbosacral strain and sprain, left hip contusions, and an injured left shoulder.

Other passenger injuries included cervical sprains, strains, lumbar and dorsal sprains and strains, multiple contusions and lacerations, knee and leg injuries, and one passenger had a cerebral concussion.

Survival Aspects

The conductor of train No. 195 notified the block operator at Grundy Tower of the collision who in turn notified the train dispatcher at the 30th Street Station. The chief train dispatcher notified emergency personnel of the accident and directed them to the accident site.

Amtrak police personnel arrived at the scene shortly after the accident and assisted in directing passengers to safety and giving directions to emergency personnel. Rescue and emergency personnel arrived on the scene about 15 to 20 minutes after the accident and immediately proceeded to remove the injured passengers and crewmembers. At 3:23 a.m., a train comprised of Multiple Unit (MU) commuter-type equipment was sent from Trenton to the accident site, and the other passengers and crewmembers were taken to the 30th Street Station where they arrived at 4:55 a.m.

The operating compartment of Extra 769 East was not damaged and the only injuries received by the occupants were from being thrown forward at the time of the impact. The two men who were on the floor of the operating compartment at the time of the collision had only minor injuries. The engineer was cut by control equipment in front of the operating position when he was thrown forward upon impact. The conductor, who had left the operating compartment, was thrown backward against the outside wall of the operating compartment by the impact, but he was not thrown from the locomotive.

None of the crewmembers of train No. 195 were on board locomotive unit No. 933 when the impact occurred. Because unit No. 933 was of lighter construction, it slightly overrode Extra 769 East. The operating compartment on locomotive No. 933 was crushed but no damage occurred to the equipment room. Also, the wheels of unit No. 933 have a greater diameter which causes the frame to be higher above the top of the rail than Extra 769 East. The damage to Extra 769 East, however, was very slight.

The passengers of train No. 195 were injured as a result of being thrown forward against the coach seats in front of them or being thrown to the floor of the coach. One passenger who was interviewed said she was thrown to the floor and partially pinned against the seat in front of her when the seat in which she was sitting unlocked, rotated slightly, and jammed against the seat ahead. One other passenger said he was thrown forward and injured his leg under the seat in front of him where he had it extended while his body was in a partially reclining position.

The Amtrak car attendant and the head brakeman of train No. 195 were knocked to the floor by the impact and as they fell struck objects in the car such as the overhead luggage rack and coach seats. Seat cushions were jarred loose from the seat but none became airborne and no baggage was reported having fallen or having been thrown out of the overhead luggage racks.

When the locomotive pantograph dropped away from the catenary, the only lights in the coaches were the small overhead emergency battery operated lights in the center of the car, spaced about 4 feet apart. Because of the lack of power, there was no heat in the coaches and the passengers had begun to get cold by the time of the accident.

Tests and Research

The speed tape from the Barco Electric speed recorder was obtained from the locomotive of Extra 769 East following the accident. The readout of the speed tape indicated the stop at Holmes Tower by Extra 769 East. It further indicated that the maximum speed reached by Extra 769 East between Holmes Tower and Bristol Station was 50 mph and that the speed of the train when it passed Bristol Station was approximately 48 to 49 mph. The speed tape indicated that Extra 769 East was traveling 22 mph at impact. (See appendix 3.)

At the scheduled 24-month inspection of locomotive 769 made on March 5, 1982, at Amtrak's Wilmington shops, the speed recorder and speed indicator were tested and indicated identical speed readings at speeds of 0, 10, 40, and 80 mph. The speed indicator and recorder were tested again on March 31, 1982, with the following results:

Test Speed (mph)	Indicator (mph)	Recorder (mph)
0	0	0
10	10	8
40	40	40
80	80	81

On the evening of March 29, 1982, the brakes on locomotive 769 were inspected and tested at Amtrak's Race Street terminal. The brakes performed normally in all tests. The only exception taken to the operation of the locomotive was broken marker lights and an inoperative sander on the front of the locomotive, which were both the result of crash damage.

The unobstructed sight distance from the engineer's position on a locomotive of the same series as unit 769 to a point where the locomotive of train No. 195 was standing was approximately 4 1/2 catenary poles, a distance of about 1,170 feet.

Sixteen test runs were made with a model GP-9 locomotive in an effort to determine the stopping capability of the light locomotive. The tests were conducted on April 7, 1982, at approximately 2:35 a.m. The rails were dry and the visibility was good; these conditions were similar to those on the morning of the accident. Stopping test speeds ranged from 20 to 60 mph. Various points of brake application were used and combinations of the locomotive independent brake and the automatic brake were made. The locomotive dynamic brake was not used in any of the tests. In some tests, the locomotive independent brake was applied and released repeatedly in a fast sequence. In all but three tests, at various test speeds and at various distances, the locomotive was stopped before the point of impact. In one test, the Amtrak officer conducting the tests attempted to duplicate with the test locomotive the speed indicated on the speed tape from Extra 769 East. That test approximately duplicated the movement of Extra 769 East on March 29, except that the initial brakepipe reduction was not made just west of Bristol Station as it was on the morning of the accident. However, the speed of Extra 769 East was duplicated passing Bristol Station. Test No. 9 was conducted as follows:

* * * * *

Test No. 9 After passing Bristol Station, throttle still in second throttle position. After passing a pole length (260 feet) east of Bristol, close the throttle to off position. Locomotive drifting at 45 miles per hour for approximately three (3) pole lengths (780 feet) when an automatic brake application of about 10 pounds was made. Approximately another pole length, (260 feet) I made another 5-pound reduction and immediately thereafter saw Engine 933 and a fusee burning at which time I dumped the engine into emergency and struck 933 at 21 miles per hour and stopped approximately 100 feet east of the mark. That was Test No. 9. (Parenthetical Interpole distance information added.)

The Fault and Indicator Light Panel on locomotive unit No. 933 was checked for burned out indicator bulbs, but none was found. All of the circuit breakers were found to be in their "on" positions. The chassis fuse for the radio was blown on the unit in the forward operating compartment. The fuse was probably blown as a result of the collision.

The control circuit boards for the battery charger on unit No. 933 were tested in another AEM-7 locomotive. The battery charger and the control circuit boards from unit No. 933 functioned normally in the test locomotive except the output voltage was 80 volts d.c. instead of a nominal 74 volts d.c. No exception was taken to this higher voltage output because, in practice, the circuit boards are matched electrically to the battery charger to obtain an output of about 74 volts d.c.

Some of the locomotive battery cells on unit No. 933 were broken because of the collision and no valid test could be made to determine their condition or state of charge. The fluid levels in the undamaged cells were normal and the battery cases did not indicate any results of damage from overheating or abuse.

The locomotive battery is mounted below the locomotive floor level in a closed compartment. The positive battery voltage is fed to the d.c. load via an insulated cable that is routed through a hole in the battery box and a hole in the locomotive floor. Both holes are lined with a protective rubber grommet. At the point where the cable passed

through the battery box, the insulation was damaged and signs of arcing were evident, but the insulation was not burned through. The battery cable was not damaged otherwise.

ANALYSIS

The Electrical Problems of Train No. 195

When the electrical problems occurred on locomotive unit No. 933 of train No. 195 between New Haven and New York, the engineer was able to cope with them without undue delay to the train by following prescribed procedures from either the engineer's operating position or the equipment room. However, at Cos Cob he was required to follow a more detailed procedure to restore the pantograph to the catenary after it dropped while the locomotive was negotiating the phase break. It is not unusual for the pantograph on a model AEM-7 electric locomotive to drop away from the catenary while it is moving. It can be caused by a fault on the locomotive, rough track, or a catenary irregularity. The engineer restored the pantograph to the catenary at Pike Tower by operating the reset button at the operating position, and also by operating the propulsion reset button on the S-7 control panel. The other problems incurred were corrected by alternately using a reset button at the operating position or on the S-7 control panel in a sequence dictated by the equipment design.

The engineer of train No. 195 outbound from New York also demonstrated a good understanding of the procedures necessary to raise the pantograph, and he showed initiative in his approach to that problem as well as in providing protection and safety to the standing train, notwithstanding the ultimate collision. The engineer apparently exhausted all of the procedures he knew in his efforts to restore the pantograph to the catenary after the pantograph dropped at milepost 66.

The pantograph's dropping at milepost 66, as well as at Cos Cob and Pike Tower, was probably caused by low battery voltage, which could occur as a result of a faulty battery, a short circuit in the battery cable, or insufficient output from the battery charger. This probability is supported by the sequence of events which followed at milepost 66. The circuit apparently responded as it was designed: the battery voltage fell below 55 volts; the battery protector relay tripped; the engineer received a battery protector relay trip indication on the Fault and Indicator Light Panel; ^{12/} the main circuit breaker became deenergized; and the pantograph came down. The battery apparently had sufficient energy for the engineer of train No. 195 to successfully restore the pantograph to the catenary east of New York when the restoral procedures given in the AEM-7 operating manual were followed, but insufficient energy for the engineer to successfully restore it at milepost 66, even when virtually all of the power drain on the battery was removed. The fact that the engineer heard relay "chatter" while attempting to reposition the pantograph also indicates that there was low battery voltage.

The circuit boards associated with the battery charger on locomotive unit No. 933 operated satisfactorily in a test locomotive even though the output voltage was a little high. If this same high output condition had existed on locomotive unit No. 933, there was no evidence of it because the undamaged battery cells did not show any visible signs of overcharge or abuse. Since some of the cells were destroyed, the battery could not be tested accurately. Individual shorted battery cells could cause an overall low battery voltage or prevent the battery from either taking a full charge or maintaining a full charge for any length of time.

^{12/} Even though the engineer did not remember seeing the indication for a tripped battery protector relay, the investigation of the accident revealed no reason that it should not have been indicated.

If the battery cable from the battery to the d.c. load had touched the locomotive metal parts, a short circuit could have occurred and could have caused the battery voltage to drop. However, the damage to the cable did not appear to have been extensive enough to indicate that a short circuit had occurred. Further, the type of damage to the cable was consistent with it having occurred during the accident.

The low battery voltage was probably a result of the battery charger's having been inadvertently switched off or having become disconnected from the battery or its not functioning properly en route from New Haven. Even if the battery were not charged to 55 volts or more during the operation of the locomotive, an output voltage greater than 55 volts from the battery charger should have prevented the battery protector relay from becoming deenergized. This, in turn, would have prevented the main circuit breaker from opening and the pantograph would not have dropped because of low voltage. It could not be determined whether the battery charger control switch was "on" before the accident. However, the engineer of train No. 195 east of New York stated that on boarding the locomotive at New Haven he did not see either no-charge light illuminated. If the battery charger had been disconnected, the battery no-charge indicator light on the Fault and Indicator Light Panel should have been illuminated. Since experience has shown that an AEM-7 locomotive battery will provide power to operate the essential low voltage control circuits for 1 to 1 1/2 hours when it is not being charged, and since there was insufficient power for the engineer to raise the pantograph at milepost 66, even after removing all the power drain on the battery, the Safety Board concludes that the battery charger was either not activated or that it did not have sufficient output to maintain the battery in a fully charged condition, or that the battery had an undetermined fault. Since the locomotive had been in the shop for repairs, it is possible that the battery voltage had dropped during the time it was undergoing repairs because a charge was not being applied to it, and the battery was not adequately recharged to maintain the low voltage control circuit load during the westward trip.

Since the electrical equipment on the locomotive derives its power from the catenary via the pantograph, a separation between the two results in the locomotive and thus the train becoming electrically dead. The locomotive battery will provide power for emergency lights and radio until the battery voltage drops below 55 volts. At that time, the headlight, marker lights, and most of the low voltage control circuits are no longer powered adequately by the locomotive battery, and the locomotive has no visible identifying lights. This creates a potentially hazardous condition when a rescue train might be required to move in against the standing train in order to couple to and move it, especially at night. The passenger coaches have their own batteries from which emergency lights and rear marker lights are powered but these lights would not be visible to a train approaching from the front.

The engineer of No. 195 exercised good judgment when he had the fireman place lighted fusees ahead of the locomotive. Since the headlight and the marker lights on the locomotive were not illuminated, the fusees and hand flashlights were the only means by which the presence of the train could be indicated. The first indication to the trainmaster of Extra 769 East that the rescue train had come upon the disabled train was the lighted fusees. At that time, the trainmaster told the engineer of Extra 769 East to apply more braking. If the engineer from train No. 195 had not had the fireman place the lighted fusees ahead of the train, the accident might have been more severe. However, had lighted fusees been maintained at the beginning of the curve rather than closer to the standing train, they would have been visible a substantially greater distance down the track, and the accident might have been averted. Amtrak, in any event, should install an emergency marker light on the locomotive that is powered independently of the locomotive battery to provide warning signals for an extended period of time when catenary power is not available for whatever reason.

Operation of Locomotive Unit Extra 769 East

Since locomotive unit 769 had been in the shop for inspection and tests a short time before the accident, the locomotive was probably in good mechanical condition. The mechanical department personnel had placed the locomotive on the "ready track" at the Race Street Roundhouse, and the engineer had obtained satisfactory brake test results before departing from Race Street. Further, during the trip from Race Street to Bristol Station the engineer had not complained to the onboard personnel of Extra 769 East about the operation of the airbrakes. The engineer stated that he had operated the locomotive's independent brake several times between Race Street and Holmes Tower and the brake had operated properly. The postaccident tests on locomotive unit 769 disclosed that the brakes functioned properly. Further, the brake tests performed by Amtrak officers on April 7 indicated that even at the excessive speeds which had been used, if the brakes had been properly and timely applied, the locomotive had the capability of being stopped before striking train No. 195 when it was first sighted. The sight distance as also determined during the tests was a sufficient distance for Extra 769 East to have been stopped before striking train No. 195 at a speed twice the maximum allowable speed (20 mph). Based on the performance of the locomotive brakes during the trip to Bristol Station and on the postaccident tests, the Safety Board concludes that the brakes and control functions of unit 769 were capable of performing properly.

The testimony of the engineer of Extra 769 East that no one told him when Extra 769 East had arrived at Bristol Station and that the first knowledge that he had of being near train No. 195 was when someone called for him to stop must be discounted. The trainmaster and the conductor both said that the mile numbers of the mileposts were called aloud and that it was announced when Extra 769 East arrived at Bristol Station. In addition, both stated that they told the engineer to slow the train's speed before the call for an emergency stop.

The trainmaster had told the engineer and conductor that he was assuming the responsibility for the movement of Extra 769 East to Bristol. Nevertheless, there was a lack of positive control of the situation by the trainmaster. The engineer's statement that he did not know what his destination was until he heard the train order issued to Extra 769 East at Holmes Tower indicates a disinterested approach to his job. There is no indication that the engineer acknowledged the milepost indicators that the trainmaster called out. The trainmaster should have insisted on a more positive response from his traincrew when he called the location identifiers en route to Bristol and particularly between Bristol Station and the standing passenger train, and overall he should have insisted on a more positive effort by all the men in the operating compartment on coordinating the progress of Extra 769 East and on locating standing train No. 195. None of the three men began a catenary pole count after the train passed Bristol Station, which was the identifying marker given Extra 769 East by the train order. Train No. 195 was actually about 11 catenary poles beyond the station, and even though the mileposts were called out and the arrival at Bristol Station was announced, a pole count might have alerted the engineer to the distance that remained before reaching train No. 195 and prompted him to stop the locomotive before it struck train No. 195. Since the engineer and conductor were unfamiliar with the Bristol area, they should have insisted upon a more positive delineation of distance to train No. 195's position when Extra 769 East passed Bristol station. The actions of the men do not portray a coordinated team effort to accomplish their assignment safely.

The trainmaster and conductor said that the engineer made brakepipe reductions to slow the train at Bristol Station and again just past the station, but the brakepipe reductions did not seem to be effective. Neither man knew how much air the engineer

released at the time of the brakepipe reductions. The engineer claimed that he made an emergency brake application when a shouted alarm was called for him to stop. The trainmaster also said that he actuated the fireman's emergency airbrake valve. However, only a minute quantity of sand (automatically released in the case of an emergency brake application) was found a short distance ahead of the point of impact, and a pile of sand was found at the point of impact where Extra 769 East stopped. This indicates that the emergency brake application had been applied too late for the train to stop in the distance available at the speed it was moving.

The engineer was not experienced in operating a model GP-9 locomotive, although the controls were similar to those of the smaller locomotives he was accustomed to operating in the yard. Since he was accustomed to operating only a smaller and lighter locomotive at relatively low speeds and he had limited experience with the model GP-9, the stopping characteristics of the heavier locomotive were probably unfamiliar to him. Another factor that could have affected his judgment in stopping was the difference in stopping distance on the bright, slick rail surface on the main line as opposed to a more abrasive rail condition that he was accustomed to in yard service. The engineer's lack of experience with the operating characteristics of the model GP-9 locomotive could have caused him to make the same light brakepipe reductions that he was accustomed to making with the lighter yard diesels and thus not allowing sufficient distance for the locomotive unit to stop. The engineer's unfamiliarity with the operating characteristics of the model GP-9 locomotive is reflected in the fact that he estimated the speed of the moving locomotive at 15 to 20 mph. This estimate may be a self-serving exaggeration on the low side but it is also true that an estimate of apparent speed can be affected by the size of the locomotive. Accordingly, the apparent inability of the engineer of Extra 769 East to have estimated the speed of the train correctly appears to have been directly related to his limited experience in operating a model GP-9 locomotive.

Excessive speed was also a factor in the failure of the engineer to stop Extra 769 East before it struck No. 195. The engineer had testified that the speed indicator was inoperative, but the trainmaster stated that he had observed it at one point and that the train was moving about 40 mph. The speed tape indicated that a maximum speed of about 50 mph had been attained on the outward trip and that the train was traveling between 45-48 mph when it passed Bristol Station. The test results from the 24-month inspection made on March 5, 1982, and the results of the postaccident tests made on March 31, 1982, revealed that the speed indicator and tape essentially indicated the same speeds and that they were accurate.

Although the conductor and the trainmaster recently had passed the required operating rules examination and were considered by their supervisors to be qualified, neither man knew that a 30-mph speed restriction was imposed by the special instructions in the current timetable applicable to the operation of a light model GP-9 locomotive. Moreover, neither made the effort to check to see what speed restrictions might apply. The engineer, who also recently had passed the required operating rules examination, stated that he knew a speed restriction existed; nevertheless, he did not attempt to determine that speed. Had the engineer checked to find out what the restricted speed for the locomotive was and informed the trainmaster and conductor, it is possible that the traincrew would have assured that the train adhered to the restricted speed, thus providing sufficient time for Extra 769 East to have been stopped once train No. 195 had been sighted. The series of postaccident start and stopping tests disclosed that Extra 769 East could have stopped safely before striking train No. 195 at several combinations of speeds and distances. However, the results of test No. 9, which was designed to duplicate the circumstances preceding the accident, indicates that Extra 769 East could not have been stopped from the approximate 45-mph speed.

Had the engineer and conductor been tested and qualified to operate trains over the extended Philadelphia terminal area, which includes Bristol when the area was extended, they would have been familiar with the area and the accident might not have occurred.

Operating Rules

The actions of the conductor of train No. 195 and some actions of the trainmaster, the conductor, and the engineer of Extra 769 East reflect a recurring problem involving railroad employees of which the Safety Board has become acutely aware as a result of a number of accident investigations. In a number of instances, crewmembers and other employees have been able to cite operating rules verbatim, but it has been clear that they did not understand how to apply them. The Safety Board issued a special report and made recommendations about training ^{13/} as a result of circumstances found in several accident investigations. In most instances, railroad management has responded by putting more emphasis on training, but there is still need to determine that employees not only know the rules but that they know how and when to use them. This can be done through training, including the use of simulator instruction, that deals with the application of the rules as well as their precise wording. In addition, there was a lack of good crew coordination which may have contributed to this accident which also can be corrected through training.

The conductor of train No. 195 knew that rear-end flagging was required by operating rule No. 99 in the State of New Jersey and under certain circumstances in the Commonwealth of Pennsylvania. However, since his train was not stopped by an emergency brake application, and since the train was operating in automatic signal territory, rule No. 99 was not applicable in the Commonwealth of Pennsylvania. (See appendix C.)

The trainmaster was aware that the operating rules provided for a rescue locomotive or train to move in an opposing direction to reach a stalled train and that a speed restriction applied. However, he did not recognize the Form "Q" train order when it was issued to him, and the order was not so identified by the block operator and hence it did not occur to him that the train was restricted to a 20-mph maximum speed for this movement.

When the block operator at Holmes Tower told the trainmaster of Extra 769 East to copy the train order, he did not identify the order as a Form "Q" order nor was he required to do so by the operating rules. If he had identified the train order as a Form "Q" before he transmitted it, the men on the locomotive may have associated the form of the order with a reduced speed requirement. However, the body of the order has a fixed format and there is no reference to a speed restriction. The fact that a train operating on the authority of a Form "Q" train order must observe a reduced speed movement is set forth in a note in the operating rule book following the train order format. The Safety Board believes that it is possible and quite likely that an individual could operate for long periods of time without receiving and having to operate on the authority of a Form "Q" train order. Therefore, the Safety Board believes that the transmission of a Form "Q" train order should be prefaced with the identity of the train order format, and further that the speed restrictions imposed by that order should be included in the body of the order. An employee should not be forced to rely entirely upon his memory for information concerning the movement of a train that he may not see regularly and that he will be required to apply only infrequently. Means should be devised to provide employees reminders of rules which arise only infrequently. If such a procedure for the speed of the

^{13/} Results of a Survey on Occupational Training in the Railroad Industry.
(NTSB-SIR-79-1)

locomotive or for the Form "Q" train order had been followed in this instance, the accident might have been avoided.

The conductor of Extra 769 East had successfully passed the operating rules examination and should have known that by operating rule No. 906 he was in general charge of the train. However, he instead allowed the trainmaster to assume that role. The trainmaster as a pilot was not authorized to take charge of the operation of the train; he was authorized to provide guidance and instructions about the territory over which the train was to move since the conductor and engineer were not authorized to operate a train in that area.

The engineer did not determine the destination of the locomotive he was assigned to operate even though reaching that destination could involve his operating the locomotive into an area over which he was not authorized to operate. According to his testimony of the events that occurred, he apparently operated the locomotive unmindful of the unfamiliar surroundings. The engineer was also qualified on the operating rules and should have known his responsibilities according to the operating rules which in part assign him the responsibility for safe operation of the locomotive including observance of signals and controlling the speed of the train.

The employees involved in this accident had satisfactorily passed examinations on the operating rules, but apparently some of them were unable to apply and execute the rules in the situations they encountered. In general, when employees participate in a reexamination rules class and are able to cite rules and pass the examination on the rules, their supervisors believe that the employees comprehend and understand the rules, when in fact in many instances they are unable to apply the rules in an actual situation.

The Amtrak operating rules do not require that a pilot be a qualified engineer. The trainmaster said he recognized Bristol Station when Extra 769 East arrived at that point and that he told the engineer they had arrived. Further, he said that he gave the approximate distance remaining to be covered when he called out the mile number of the mileposts before they would arrive at train No. 195's location. Although he had not been examined by another company officer and officially qualified on the characteristics of the railroad on which Bristol is located, he apparently knew the location and identity of Bristol Station. The Safety Board believes it is not a good policy for company officers to self-qualify themselves (an officer of the company stated to a Safety Board investigator that this was not a usual practice on Amtrak). Despite the fact that the "pilot"-trainmaster knew where he was, it would have been beneficial if he had been a qualified locomotive engineer. Had he been a qualified locomotive engineer, he might have "sensed" the braking requirements or he might have operated the locomotive himself according to the operating rules, thus eliminating the need for the operation of the locomotive by an engineer who was inexperienced with a model GP-9 locomotive and not familiar with the main line in that area.

The conditions on a railroad that affect the movement of the trains are always changing, and pertinent information regarding these changing conditions must be disseminated to operating personnel. From time to time, operating personnel change their job assignments. However, they may or may not be required to pass an examination on that particular assignment before they report since they may be considered to be qualified on the basis of prior examination. It is possible that an employee could work an assignment for one tour of duty and not work the same or similar assignment for a number of months. It is difficult for such an employee to stay abreast of all operating information that is essential for that employee to work an assignment safely. Information that is often released in the form of a bulletin order or a general order may eventually

become part of the special instructions of the timetable. The timetable then becomes a formidable document with which traincrews have to become familiar and by which they must safely move trains entrusted to them. Information of a current nature, such as information given in a train order, generally presents no problem, but information that is seldom needed for train movement and is buried in a timetable can become obscure or forgotten. For example, as can be noted in appendix D, the train dispatcher erred initially in his approach to authorizing Extra 769 East to operate on the No. 3 track from Holmes Tower to the disabled train; he issued a train order of the form used to move trains against the established current of traffic and when he discovered his error he voided the train order and issued the Form "Q" train order.

The operating rules do not preclude the pilot of a train or a trainmaster from copying a train order provided the individual is qualified on the operating rules. However, the conductor is designated by the operating rules as being in charge of the train. As such, he could have delegated this task to either the engineer or he could have requested the trainmaster to copy the train order since each was qualified on the rules. The reason the conductor gave for allowing the trainmaster to copy the train order was that since he (the conductor) was not authorized to operate a train east of Holmes Tower, the trainmaster's authority took precedence over his authority to run the crew. The conductor was still within the bounds of his operationally authorized territory when the train order was sent. He gave the impression to the Safety Board investigator that he was unduly influenced by the trainmaster's position and presence. Conrail and Amtrak supervisors should impress upon employees that the presence of a supervisor does not relieve an individual of his assigned responsibilities unless the supervisor gives an order to this effect or makes an operating decision that the employee is directed to follow.

Rescue Procedures

The prompt response of the emergency forces made it possible to remove the injured persons in a short time. All persons who were known to be injured or who required treatment were moved expeditiously to either of two nearby hospitals where they received prompt attention. The uninjured passengers were moved without incident to the 30th Street Station.

Safety Aspects of Amtrak Coaches

On May 18, 1981, the Safety Board issued Safety Recommendation R-81-57 to Amtrak as a result of its investigation of an accident involving an Amtrak train at Dobbs Ferry, New York. ^{14/} The recommendation was made in an attempt to prevent passengers from receiving leg injuries in the event of an accident as a result of having their legs extended beneath the seat in front of them. The Safety Board recommended that Amtrak "Establish a retrofit schedule to provide skirts at the bottom of seats to prevent leg injuries because of leg entrapment." On August 3, 1981, Amtrak made the following response to Safety Recommendation R-81-57: "Amtrak has reviewed this recommendation and believes it is impractical. For operational reasons, seats must be capable of rotation. For their comfort, passengers use the space below the seat base to stretch their legs. Providing a skirt would prevent Amtrak from properly cleaning the floors of the cars under the seats. It is our belief that leg injuries would best be minimized by installing locking devices on rotating seats to prevent their undesired rotation." The Safety Board is currently classifying Recommendation R-81-57 as Open--Unacceptable Action.

^{14/} 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).

On the same date, the Safety Board also issued Safety Recommendation R-81-58 to Amtrak as a result of the same accident. Recommendation R-81-58 urged Amtrak to: "Install an adequate locking device on rotating seats which will prevent undesired rotation in accidents." On August 3, 1981, Amtrak responded to Safety Recommendation R-81-58: "Amtrak is progressing with the installation of anti-rotational devices on seats on the Amfleet and Superliner cars as the cars go through normal maintenance inspections and overhaul. The installation of anti-rotational devices on the enhanced metroliners is complete, and this material is on order for the turboliners. The new Amfleet II cars currently on order will have the anti-rotational devices on the seats as the cars are delivered." The Safety Board is currently classifying Recommendation R-81-58 as Open--Acceptable Action.

After receiving Amtrak's responses to the two recommendations, the Safety Board directed a letter to Amtrak on April 7, 1982, asking that Amtrak reconsider recommendation R-81-57. Amtrak responded in a letter dated June 22, 1982, that Amtrak management was still of the opinion that skirts fitted to the bottom of the seats are not practicable nor the solution to the problem and that only seven cars remained to be fitted with the anti-rotational device installed pursuant to recommendation R-81-58.

In this accident, one passenger is known to have received injuries because one of his legs was extended beneath the seat in front of him, and one other passenger is known to have been injured because the seat unlocked and rotated during the collision. The Safety Board continues to believe that Amtrak should reevaluate the intent of recommendation R-81-57 and if the proposed solution is not acceptable, determine if an alternate solution is feasible.

Crashworthiness

Locomotive unit 769 received very little damage to the impacted end and no damage to the operating compartment. Since the most severe damage occurred where the hand brake control of the locomotive is located at the front of the long hood, the conductor of Extra 769 East was fortunate that he did not reach the hand brake control or he may have been killed.

Locomotive unit No. 933, being the lighter of the two units, slightly overrode the heavier freight locomotive unit 769. The operating compartment of locomotive No. 933 was crushed by locomotive unit 769 and it is doubtful if an occupant in the operating compartment of unit No. 933 could have survived. The equipment room to the rear of the operating compartment of unit No. 933 was not damaged and the equipment remained intact.

CONCLUSIONS

Findings

1. The engineer of train No. 195 was able to cope with the electrical problems that occurred between New Haven and New York by following procedures delineated in the operating manual for a model AEM-7 locomotive, from either the engineer's operating position or the equipment room.
2. The operation of train No. 195 without operative cab signals westward from New York had no bearing on the problem at milepost 60 which caused the pantograph to separate from the catenary and retract.

3. In attempting to restore the pantograph to the catenary, the engineer of train No. 195 demonstrated a good understanding of the necessary procedures to follow.
4. The pantograph separated from the catenary at milepost 66 because of low battery voltage, and as a result of this low voltage, the engineer could not restore the pantograph to the catenary.
5. No specific cause could be determined for the locomotive battery voltage to have dropped below 55 volts, although such low voltage clearly occurred.
6. After the battery voltage fell below 55 volts and the pantograph separated from the catenary, no visible identifying lights were available on the locomotive of train No. 195 to mark the presence of the train from the head end.
7. The predeparture tests and operation of locomotive unit 769 en route and the postaccident tests indicate that the controls and brakes of locomotive unit 769 were functioning as designed in all mechanical and operating aspects.
8. Extra 769 East was being operated too fast for it to stop in the distance available when train No. 195 was determined to be immediately ahead, and its failure to stop was not the result of defective brakes.
9. The engineer of Extra 769 East was inexperienced with the stopping characteristics of the model GP-9 locomotive and thus was unable to properly judge the distance needed to stop.
10. The engineer of Extra 769 East was told when his train arrived at Bristol Station, and he was told to slow the train before someone called for him to stop.
11. If the lighted fusees had not been placed ahead of train No. 195, the impact would have been more severe.
12. If the operating compartment of locomotive unit No. 933 on train No. 195 had been occupied at the time of the collision, the occupants may have been seriously injured or killed.
13. The trainmaster recognized Bristol Station and knew when Extra 769 East arrived at that location.
14. An individual qualified as a locomotive engineer would have been a more effective pilot.
15. The train order issued to Extra 769 East was not identified as a Form "Q" train order nor did it specify the speed requirement for the train in the body of the order, neither of which was required by the operating rules. If such a procedure had been followed, the speed restriction may have been recalled by the trainmaster and crewmembers.
16. Three of the men on Extra 769 East were qualified on the operating rules but they were not aware that locomotive unit 769 was restricted to 30 mph when it was operated without cars.

17. The engineer of Extra 769 East knew that a reduced speed limit was applicable to the locomotive when it was being operated without cars, but he did not attempt to determine that maximum speed.
18. The conductor of Extra 769 East misunderstood the role of the trainmaster as a pilot in respect to his position as conductor of Extra 769 East.
19. Amtrak's Northeast Corridor timetable presents a large amount of information about conditions or circumstances that affect the operation of trains in the corridor that is not easily located when needed.
20. Because employees in train and engine service can transfer from assignment to assignment, they may forget the pertinent instructions applicable to a given assignment.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the inadequate supervision by the trainmaster which allowed the engineer to operate Extra 769 East at a speed in excess of the speed authorized by train order and insufficient brake application by the engineer to stop the locomotive short of the standing train. Contributing to the cause of the accident were the lack of adequate emergency training on flag protection for a disabled train and the crewmembers' insufficient experience with the equipment and their unfamiliarity with the territory in the area of the accident.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended that the National Railroad Passenger Corporation (Amtrak):

Install highly visible emergency marker lights on the front of model AEM-7 and similar locomotives that can be operated reliably from the locomotive battery or from an independent power source for an extended period of time. (Class II, Priority Action) (R-82-88)

Provide the engineer of model AEM-7 locomotives a d.c. current readout at the operating position, other than a light indication, so he can determine whether the locomotive battery is being charged or discharged, and a voltmeter so that the battery voltage can be read in volts. (Class II, Priority Action) (R-82-90)

Review the control circuitry on the model AEM-7 locomotives to determine if modifications can be made to either automatically or manually disconnect nonessential battery operated circuits, when catenary power is not available, to extend the battery's capability to provide power for emergency marker lighting and the locomotive radio. (Class II, Priority Action) (R-82-91)

Preface Form "Q" and similar train orders with the format identifier before the orders are transmitted, and include any speed restrictions within the limits covered by the order in the body of the train order. (Class II, Priority Action) (R-82-92)

Post the maximum allowable speed in a conspicuous location adjacent to the operating position when a locomotive has a speed restriction imposed because of operating restrictions. (Class II, Priority Action) (R-82-93)

Provide guidance for flag protection to the front and rear of passenger trains, including commuter trains when the train is disabled and unable to proceed without assistance, and until a rescue locomotive or train has arrived and is ready to depart. (Class II, Priority Action) (R-82-94)

Review Amtrak's current method of conducting operating rules examinations and review classes to determine if is adequate to permit employees to demonstrate that they not only know the wording of the rules, but that they understand how the rules are to be applied under actual conditions. If these objectives are not being achieved, restructure the operating rules classes to accomplish this goal. (Class II, Priority Action) (R-82-95)

Establish and implement training procedures to improve traincrew coordination particularly when crews work under unfamiliar and unusual circumstances. (Class II, Priority Action) (R-82-96)

Review the Northeast Corridor timetable format and contents to determine if its complexity can be reduced to make it easier to ascertain those schedules and special instructions that affect a train's operation over a given division and make appropriate changes. (Class II, Priority Action) (R-82-97)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM EURNETT
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G.H. PATRICK BURSLEY
Member

/s/ DONALD D. ENGEN
Member

PATRICIA A. GOLDMAN, Vice Chairman, did not participate.

August 26, 1982

APPENDIXES

APPENDIX A

INVESTIGATION

The Safety Board received notification of the accident from the National Response Center on March 29, 1982, about 3:50 a.m. The Bureau of Accident Investigation assigned an investigator-in-charge (IIC) who arrived at Bristol Station, Pennsylvania about 2:00 p.m. the same day. The IIC was accompanied by a General Engineer, Railroad, from the Safety Board's Bureau of Technology who headed a mechanical committee composed of the Safety Board and Amtrak personnel that assisted in the investigation.

Depositions were taken from three Amtrak and four Conrail employees during the period April 16, through 26, 1982. No parties to the depositions were designated.

APPENDIX B

CREWMEMBER INFORMATION

Extra 709 East

W. Stacey Hodgson, Trainmaster

Mr. Hodgson, about 38, was employed by Amtrak on January 1, 1974, as a mechanical representative. He was subsequently promoted to transportation supervisor, Supervisor Car Distribution and Trainmaster, about October 1979. He was last examined on the operating rules on February 12, 1981. His headquarters was the 30th Street Station in Philadelphia, Pennsylvania, and he most recently worked the 11:00 p.m. to 6:00 a.m. shift. He had made about 45 trips over the territory covered by the Philadelphia Terminal in the past 2 1/2 years. He had made about 10 trips each way at night. He had never been examined by a supervisor on his knowledge of the characteristics of the road. His supervisors considered him to be a conscientious employee.

Francis B. Aiken, Engineer

Mr. Francis B. Aiken, 59, was employed by the Pennsylvania Railroad Company on November 18, 1941, as a locomotive fireman. He was promoted to engineer on November 1, 1946, and was authorized to operate a locomotive only on the Philadelphia Terminal. He was last examined on and satisfactorily passed an operating rules examination on July 13, 1981. He attended a class on airbrakes on February 1, 1981. His last medical examination was on March 5, 1980.

Drakie Gosha, Conductor

Mr. Drakie Gosha, 40, was employed by the Pennsylvania Railroad Company on August 15, 1969, as a trackman. He entered train service on June 7, 1971, as a brakeman and was promoted to conductor on May 7, 1974. He passed an operating rules examination on June 23, 1980, and he had passed a medical examination on March 5, 1980. He was qualified to perform assignments on the Philadelphia Terminal.

Train No. 195

Albert Parkman, Engineer

Mr. Albert Parkman, 59, was employed by the Pennsylvania Railroad Company on January 12, 1942, as a fireman. He was promoted to engineer during 1947. His regular assignment included train No. 195 between New York and Philadelphia. He had passed an operating rules examination within the prescribed time limits and he was current on airbrake instruction.

Irwin Joseph Rivers, Head Brakeman

Mr. Irwin Joseph Rivers, 41, was employed by the Pennsylvania Railroad Company on October 13, 1972, as a brakeman. He was promoted to conductor on November 26, 1974. He had passed an operating rules and a medical examination within the prescribed time limits.

APPENDIX C

APPLICABLE OPERATING RULES

MANUAL BLOCK SIGNAL SYSTEM

NOTE--Rules 305 to 342, inclusive, will not be in effect except by Special Instructions.

303. Block signals govern the use of the blocks and, except where Rule 251 or 261 is in effect, do not supersede the superiority of trains nor dispense with the use and the observance of other signals whenever and wherever they may be required.

303a. Block signals will be used as Train Order Signals where separate Train Order Signals are not provided.

Interlocking signals which serve also as manual block signals will display manual block indications on top arm or light.

306. When a block station is open at an irregular hour, trains must be notified by Train Order or Bulletin Order. Operator must use hand signals in addition to block signals to give required indications until all trains have passed which have not been notified by Train Order or Bulletin Order that the block station is open.

D-306. When a train is operated against the current of traffic, manual block signal system rules must be observed; Rule 316 or 317 to apply as specified in the Timetable. Block stations named in the Timetable indicate limits of manual block, except when a train is authorized by Train Order to run against the current of traffic to an interlocking or a block station remote controlled, the portion of the main track between that interlocking or block station and the first block station or interlocking in the rear will constitute a block for that train. Operator must know the train has passed remote controlled interlocking before clearing the block.

309. Except as provided in Rules 801 to 800b equipment of a type which may not operate signals or shunt track circuits must not be operated in Manual Block Signal System territory without authority of the Train Dispatcher and permission of the Operator who must also be advised when the movement has entered a block. After such equipment has entered a block, the block signal must be restored to its most restrictive indication, approved blocking device applied, and must not be changed until the equipment has cleared the block or following movement has been notified by Train Order to look out for such equipment.

311. Signals must be kept in the position displaying the most restrictive indication except when displayed for an immediate movement.

312. Appliances must be operated carefully and only by those charged with that duty. If any irregularity affecting

their operation is detected, the signals must be displayed to give their most restrictive indication until repairs are made. Defects must be promptly reported to the Train Dispatcher.

316. (For Absolute Block for following and opposing movements on the same track.)

Before admitting a train or engine to a block, the Operator in charge of the block station at the entrance of the block must know that the block is clear and that no other train or engine has been given permission or a signal to enter the block.

Signals governing opposing movements, where provided, must display Stop signal. The Operator will then display Clear block signal for the train or engine to be admitted to the block.

A train or engine must not be admitted to a block unless it is clear except as provided in Rules 327, 333, or by Train Order.

317. (For Absolute Block for opposing movements and permissive block for following movements on the same track.)

When the block is clear of passenger trains and clear of opposing trains, the Operator in charge of the block station may permit a train other than a passenger train to follow a train other than a passenger train into the block by displaying a Permissive block signal.

Except as provided in Rules 327, 333, or by Train Order, a train must not be admitted to a block which is occupied by a passenger train or an opposing train and a passenger train must not be admitted to a block which is occupied by any train.

319. When a train enters a block, the control of which is divided between two block stations, the Operator must give the train, engine number, and time to the next block station in advance. On two or more tracks they must also specify the track.

When a train clears a block, the Operator receiving the information must give the record of the train to the block station in the rear.

A Station Record of Train Movements must be maintained for each block station on which information as to all movements within blocks under their jurisdiction must be recorded by the Operator. Any change in condition of block by radio or telephone after train has entered block must also be promptly recorded.

342. A block station must not be closed until the block in each direction is clear of trains moving under a block signal indication that would not be proper for the extended block.

To close a block station, the Operator must notify the Operator in charge of the block station in each direction that his block station is being closed and give the record of trains and track cars in the extended block. The block signals must then be secured in clear position, all lights in signals extinguished and block wires arranged to work through the closed block station.

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AUTOMATIC BLOCK SIGNAL SYSTEM

NOTE.—Rules 501 to 513, inclusive, will not be in effect except by Special Instructions.

501. Block signals, cab signals, or both govern the use of the blocks and where Rule 251 or Rule 261 is in effect, supersede the superiority of trains.

The use and the observance of other signals whenever and wherever they may be required must be observed.

Interlocking home signals governing the use of routes leading to a block will in addition govern the use of the block in the direction for which traffic has been established for a train to the next block signal.

502. A train or engine must not enter a block at a hand-operated switch or crossover nor foul the main track without permission of the Train Dispatcher or Operator.

Where Rule 261 applies and such switch or crossover is not equipped with electric lock, a Train Order must be issued authorizing the movement if the Normal Speed is over 20 MPH.

A train or engine entering a block between signals must proceed at Restricted Speed to the next signal. In cab signal territory, train may proceed in accordance with cab signal indication after complying with Rule 551(C).

(Rev. 3/26/52)

503. A train having passed beyond the limits of a block must not re-enter that block without a Train Order authorizing it to do so.

A train may make a reverse move within the limits of a block after a crew member has gone back a distance as required by Rule 39 to provide flag protection against opposing movements at Restricted Speed. Where Rule 261 applies, the block is defined to extend from point of reverse movement to the last block signal passed governing original movement. Trains must comply with indication of any opposing signal located between point of reverse movement and limits of the block.

A train moving beyond the limits of an interlocking, with the current of traffic, to receive an interlocking signal for movement in the opposite direction must not start the reverse movement until the crew member controlling the movement has ascertained that the track is clear, the signal is clearly visible and is displaying an indication more favorable than a Stop Signal. Engineman operating a light engine or MU train must operate from the leading end in the direction of movement if practicable.

Shifting movements made against the current of traffic or against the established direction of traffic may be made beyond the home signal a train length upon permission of the Operator, when authorized by the Train Dispatcher. The Operator must not give permission until he communicates with the Operator at the next block or interlocking

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station in the direction toward which the movement beyond the home signal is to be made. If no train has been authorized to move on the designated track from the next block station or interlocking, the Operator may give permission to the train to make a shifting movement.

Panel Blocking Devices must be activated or approved Blocking Devices applied to all switch and signal levers protecting the track on which the shifting movement is to be made. Train Dispatcher will make a record in the train order book or on the train sheet and the Operators on the block sheet.

When an Operator has given permission for a movement beyond the home signal, that Operator and the Operator in charge of the next block station or interlocking must know that the movement has been completed before admitting another train to the block. (Rev. 7/19/81)

504. Unless so directed by the Train Dispatcher the Operator must not give permission to a train or engine to enter a block at a hand-operated switch or crossover or foul the main track on which another train is moving or has been authorized to move in the direction of such switch or crossover from the next block station or interlocking.

When permission has been given by the Operator to a train or engine to enter a block at a hand-operated switch or crossover, the Operators in charge of the block stations or interlockings between which the block is located must know that the movement has been made before permitting another train to move between such block stations or interlockings and the switch or crossover where such movement is being made.

NOTE—The movement has been made when the train or engine has moved so that any portion of it occupies the main track. (Rev. 7/19/81)

505. When a train or engine clears the main track at a hand-operated switch or crossover and the switches have been restored to normal position, it must be reported clear to the Operator by the Conductor, Engineman, or member of their crew when authorized by the Conductor or Engineman.

NOTE—When such switches have been restored to normal position, even though the train or engine has not been reported clear of the block, it must not again enter that block except as provided in Rule 502.

506. Except as provided in Rules 801 to 830b equipment of a type which may not operate signals or shunt track circuits must not be operated in Automatic Block Signal System territory without authority of the Train Dispatcher and permission of each Operator in charge of the portion of the track over which the movement is to be made. Other trains must not be permitted to enter the track occupied by such equipment between a block station or interlocking and the next block station or interlocking in advance unless notified by Train Order to look out for the equipment which is occupying the main track without signal protection.

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When the condition of the track is such that track circuits may not shunt properly, not more than one train will be permitted between a block station or interlocking and the next block station or interlocking between which the affected track is located unless notified by Train Order to look out for other trains occupying the main track without signal protection.

After equipment of a type which may not operate signals or shunt track circuits has entered a block, the block signal must be made to display a Stop Signal (Rule 292) and approved blocking devices applied. The same procedure must be followed when the condition of the track is such that track circuits may not shunt properly. (Rev. 3/9/80)

507. Operators must maintain a station record of all train movements. All crossover movements on the main track must be entered on the record. When a train enters a block, the Operator must report the train, engine number, and the time to the next block station or Train Dispatcher in advance. This information must be entered on the station record.

Movements confined between a block and interlocking station and an interlocking remote-controlled by that station need not be reported to the station in advance, but must be entered on the station record of the station in control of the movement.

D-508. Except where Rule 261 is in effect, when a train is operated against the current of traffic, manual block signal system rules must be observed, Rule 316 or 317 to apply as specified in the Timetable.

Block stations named in the Timetable indicate the limits of the manual block, except as otherwise provided in Rule D-308.

509. Trains or engines must not pass a block signal indicating "STOP" (Rule 292). The Operator, when authorized by the Train Dispatcher, will permit a train or engine to pass such Stop Signal by the use of Clearance Permit Form "C".

Clearance Permit Form "C" must not be issued until the train has come to a stop at the signal and a member of the crew is fully informed of the situation. (Rev. 3/9/80)

511. Both switches of a crossover must be properly lined before a train or engine starts to make crossover movement and the movement must be completed before either switch is restored to normal position.

512. When a train or engine has passed a signal and is delayed in the block, it must proceed at Restricted Speed to the next signal. When it is known that the track is clear to the next signal and the next signal indicates proceed, train or engine may proceed in accordance with last signal indication received. In cab signal territory, train may proceed in accordance with cab signal indication. (Rev. 3/28/82)

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513. Trains or engines, before entering a main track or crossing from one main track to another, must obtain permission from the Train Dispatcher or Operator.

At bolt-locked switches, not electrically locked, after promptly operating the bolt-lock of all main track switches involved, members of the crew must wait five minutes before operating the switch or switches.

At non-bolt-locked switches, not electrically locked, members of the crew will promptly operate the switch or switches and wait five minutes before making train or engine movement.

This will not relieve employee in train service from the duty of promptly and properly protecting their train.

NOTE—Rule 513 will be in effect only where designated by Special Instruction. Where Rule 513 is in effect, Rule 504 will not apply.

CAB SIGNAL SYSTEMS

NOTE—Rules 550 to 553, inclusive, will not be in effect except by Special Instruction.

550. The Cab Signal System apparatus must be tested at least once in each 24 hour period except when a single trip exceeds 24 hours in which case the original test shall be valid for the entire trip. The test must be made prior to departure of an engine from its initial terminal to determine if apparatus is in service and functioning properly. When Cab Signal apparatus is put out or de-energized after departure test has been made, it must be tested again prior to entering equipped territory. Testing sections at locations other than terminals will be specified in the Timetable Special Instructions.

When an engine is to be delivered to the road Engineman, a departure test of the Cab Signal System apparatus must be made prior to engine leaving its initial terminal by the Engineman or Hostler delivering the engine or other employee authorized to make test to assure that the Cab Signal System is functioning properly. The prescribed form stating that engine has been tested must be delivered to the road Engineman. The form must show engine number, point at which tested, date, time, signature, and title of person making test.

The prescribed form stating that the Cab Signal System apparatus had been tested must accompany engine to its final terminal.

Road Engineman, after taking charge of a delivered engine, must assure himself that Cab Signal System apparatus is energized and that the audible indicator will sound when the acknowledging device is operated. If the Cab Signal System has been de-energized or the audible indicator

fails to sound when the acknowledging device is operated, the Engineman must not enter equipped territory and must communicate with the Train Dispatcher and advise him of the situation.

A departure test of the Cab Signal System apparatus will be required as follows:

- (a) On single unit engine equipped for forward and backward running, test will be made from both ends.
- (b) On engine consisting of two or more units, test will be made from front end of leading unit and rear end of trailing unit.
- (c) When test equipment is not available at a relay point and an intermediate unit is required in relay service, this unit must be tested and a prescribed form filled out by an authorized employee and delivered with the engine.

When it becomes necessary to dispatch an engine and a departure test cannot be made due to failure of test equipment, the prescribed form may be used when signed by Enginehouse Foreman or his representative provided inbound operating test indicated that the Cab Signals were functioning properly after last trip or that defects, if any, which existed have been corrected and a proper record made thereof. Engineman must be verbally notified by Enginehouse Foreman or his representative when this condition exists.

When necessary en-route to operate from an equipped unit or end that had not been given a departure test, the Cab Signals must be considered as not in operative condition and Rule 554 applied.

551. The Cab Signal System is interconnected with the fixed signal system so that the Cab Signal must conform with the fixed signal indication within three seconds after the engine passes fixed signal governing the entrance of the engine or train into the block in the direction for which the track and engine are equipped and Engineman will be governed as follows:

- (a) When Cab Signal and fixed signal indications conform when entering the block and conditions affecting movement of train in the block change, the Cab Signal will govern.
- (b) When Cab Signal indication changes to Restricting, the Engineman must take action at once to reduce train to Restricted Speed.
- (c) When Cab Signal indication changes from Restricting to a more favorable indication, speed must not be increased until train has run its length.

- (d) If the Cab Signal indication authorized a speed different from that authorized by the fixed signal, when the train entered the block governed by such fixed signal, the lower speed will govern. The Engineman will notify the Train Dispatcher or Operator by radio or by message as soon thereafter as will not cause delay to train, giving location and track on which non-conformity occurred.

- (e) When Cab Signal indication "flips" (momentarily changing indication and then returning to original indication), Engineman will, by radio or as soon thereafter as will not cause delay to train, forward a message in the following form to the Train Dispatcher reporting the occurrence:

Cab Signal flipped from *(state indication)* to *(state indication)* on No. _____ track at *(signal bridge or MP no.)*; or--between *(designate points if multiple occurrence)*.

When the "flip" holds indication for a duration which required Cab Signals be acknowledged, Engineman must so state when reporting occurrence.

- (f) The Cab Signal apparatus will be considered as having failed when:

- (1) The audible indicator fails to sound when Cab Signals change to a more restrictive indication.
- (2) The audible indicator continues to sound although Cab Signal change was acknowledged and speed of train has been reduced to speed required by Cab Signal indication.
- (3) The Cab Signal fails to conform at two fixed signal locations in succession.
- (4) Damage or fault occurs to any part of the Cab Signal apparatus.

When Cab Signal apparatus has failed, the train will proceed governed by Rule 554 and a report must be made to Train Dispatcher or Operator by radio or if not so equipped, at first point of communication where stop can be made without excessive delay.

Engineman must report reason that Cab Signal apparatus was considered as having failed and location where failure occurred on the prescribed form.

If the Cab Signal has authorized a speed greater than the speed authorized by the fixed signal, the Engineman, in addition to notifying the Train Dispatcher and making report on prescribed form, will verbally advise the Enginehouse Foreman or his representative on arrival at engine terminal so that the engine

may be withheld from service and equipment not disturbed.

When the Cab Signal apparatus has failed, the audible indicator may be cut out if it continues sounding after being acknowledged.

- (g) Cab Signals will not indicate conditions ahead when engine is:

- (1) Moving against the current of traffic, except as provided in the Timetable Special Instructions.
- (2) Pushing cars.
- (3) Not equipped with Cab Signal apparatus for backward movement and is running backward.

552. When the Cab Signal portion of the wayside signaling equipment is inoperative, the Train Dispatcher or Operator when authorized by the Train Dispatcher must so notify the Engineman and designate the limits of the area affected by such malfunction. The Cab Signal apparatus of the engine must not be de-energized or cut out during the movement through designated limits. Movement shall be made governed by fixed signal indications but not exceeding 40 MPH unless authorized to proceed as provided in Rule 557.

Normal operation may be resumed only after Engineman has ascertained that Cab Signals have conformed to two fixed wayside signals in succession immediately beyond the designated limits specified. If the Cab Signals do not conform to the first two wayside signals immediately beyond the designated area, they must be considered as having failed and Rule 554 will apply.

553. Trains from a connecting Railroad must be equipped with a Cab Signal System in operative condition or as specified in Timetable Special Instructions. The Cab Signal System must have been tested in compliance with Rule 550.

When a train from a connecting Railroad has experienced a Cab Signal failure en-route from its Initial Terminal and has been given authority to operate non-equipped, the Engineman must contact the AMTRAK Train Dispatcher or Operator, who will control movement, before entering onto the Northeast Corridor. The Engineman will inform the AMTRAK Train Dispatcher or Operator of the condition of his Cab Signal System and be governed by instructions.

554. The movement of a train equipped with cab signals not in operative condition for direction of movement is prohibited, except when cab signal failure occurs after leaving engine terminal.

If a failure of the cab signal apparatus occurs, as described in Rule 551, the Train Dispatcher or Operator must

be promptly notified and be given any pertinent information regarding the failure. The train may proceed according to signal indication but not exceeding 40 MPH. Trains must not pass a signal displaying a Stop and Proceed (Rule 291) indication unless authorized by the Train Dispatcher to do so.

When authorized by the Train Dispatcher the train may proceed as provided for in Rule 557. (Rev. 3/9/80)

555. The movement of a train not equipped with Cab Signal System apparatus is prohibited except as provided for in Timetable Special Instructions.

Movements authorized by Timetable Special Instruction shall operate at Reduced Speed and be governed by fixed signal indication. When authorized by the Train Dispatcher the train may proceed as provided for in Rule 557. (Rev. 3/9/80)

557. Movements being made as provided for in Rules 552, 554 or 555 may be authorized by the Train Dispatcher to proceed at Normal Speed, not exceeding 79 MPH and be governed by fixed signal indication. A train must not pass a signal displaying a Stop and Proceed (Rule 291) indication unless authorized by the Train Dispatcher to do so. (Rev. 3/9/80)

558. When the Cab Signal System apparatus has failed, the apparatus shall be considered inoperative until engine is cut off for repairs and has been tested and found to be functioning properly. Authority given to an Engineman by the Train Dispatcher or Operator for movement of his train by Cab Signal System rules will remain in effect for entire trip. Train Dispatcher will notify connecting Division or Railroad of any such authority given to a train.

559. Train Dispatcher will record on the train sheet the movement of trains with inoperative Cab Signals and the movement of any train that is not equipped with a Cab Signal System. Where Cab Signal System rules are in effect, Operators will make a record of all such moves on the block sheet and indicate those movements given authority to operate as provided in Rule 557.

In the application of Rule 552, Train Dispatcher and Operators involved will record the limits of the affected area and indicate those movements given authority to operate as provided in Rule 557.

561. Engineman, in addition to verbally reporting slips, failures, non-conformities, and other unusual occurrences

of Cab Signal System apparatus as required by these rules, will report the same occurrences on the prescribed form.

562. When the unit from which the train will be controlled is equipped with Cab Signals and not Speed Control or Train Control, the Engineman will advise the Conductor and other members of the crew before starting trip. When the Train Control or Speed Control apparatus fails or is cut out en-route, the Engineman must notify the Fireman, Conductor, and other members of the crew as soon as possible without causing undue delay to the train. The train or engine may proceed governed by Cab Signal (when known to be in operative condition) and fixed signal indications. Engineman will report failure of Train Control or Speed Control to Train Dispatcher or Operator by radio. Report also to be made on the prescribed form.

563. When the unit from which the train is being controlled is equipped with Cab Signals but not Speed Control or Train Control or when the Train Control or Speed Control is known to be inoperative, the member of crew nearest the operating compartment of the engine will go to the Engineman immediately if the audible indicator sounds for longer than six seconds.

APPENDIX D

FORM Q TRAIN ORDER

AMTRAK-NORTHEAST CORRIDOR REGION

RECORD OF TRAIN ORDERS, AUTHORITIES AND MESSAGES

March 29 19

ORDER NUMBER	ADDRESS	BODY OF ORDER	SIGNATURES	BLOCKING DEVICES (IN RED INK)	OPERATOR'S INITIALS AND TIME OF REPLETION	TIME
2504	CTE No 195	By 933 at Bristol via Grady			JE	
		No 195 by 933 remain before you are standing on No 3 track until after 769 East arrives	JSP	Blocked end. Switch at 135m	131a	131a
2505	CTE Etra 769 East		Hobbes			
		Etra 769 East has right over opposing train on No 3 track Hobbes to approximately 7 catenary poles East of Bristol Station where No 195 by 933 is standing disabled	JSP			

AMTRAK-NORTHEAST CORRIDOR REGION

NEC-88
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RECORD OF TRAIN ORDERS, AUTHORITIES AND MESSAGES

March 29 1982

ORDER NUMBER	ADDRESS	BODY OF ORDER	SIGNATURES	BLOCKING DEVICES (IN RED INK)	OPERATOR'S INITIALS AND TIME OF REPETITION	COMPLETE	
						TIME	DISPS INITIALS
<u>2506</u>	CTE Etn 769 East	Holmes Etn 769 East per home signal in stop position on No 3 track at Holmes and proceed light on No 3 track to a point approximately 7 ratemy poles East of Bristol station where No 195 & 933 are disabled JJP	Radford to Train master Hodgson at 210 am		Sm 150-	150-	RPS
<u>2507</u>	Op	Shore Hold all trains clear of No 3 switch in reverse position at Foul BQA - 3 am JJP			DC 223a SUPERSEDED OR ANNULLED ORDER NO. 2504 of 3/29/82		RPS
<u>2508</u>	Op	Shore Order No 2502 dated March 28 1982			DC		RPS

