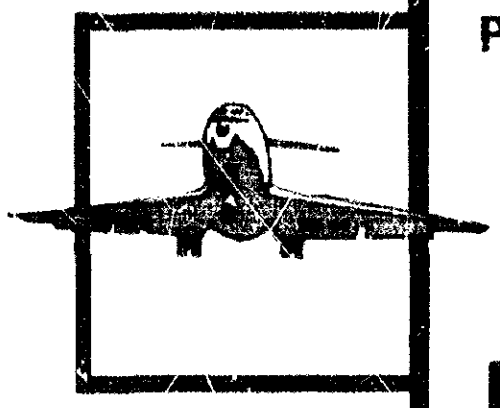
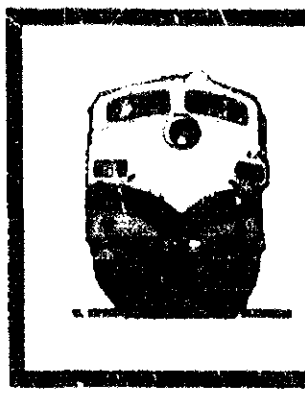
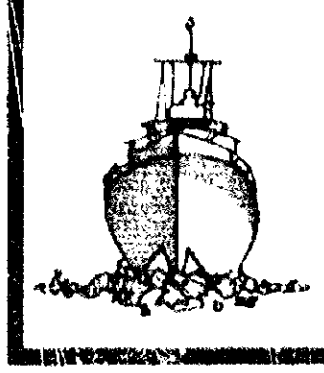
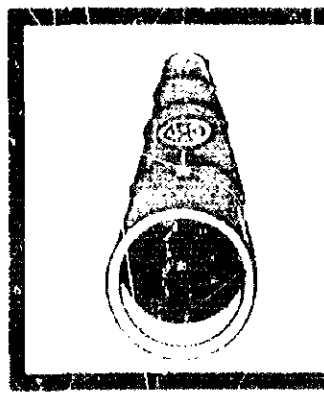
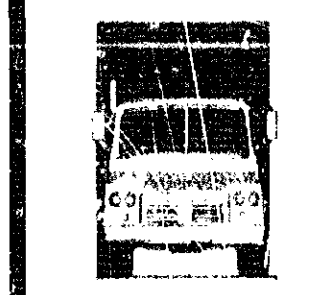
PB88-916301











NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

REAR-END COLLISION OF
AMTRAK PASSENGER TRAIN 94, THE COLONIAL
AND CONSOLIDATED RAIL CORPORATION
FREIGHT TRAIN ENS-121,
ON THE NORTHEAST CORRIDOR
CHASE, MARYLAND
JANUARY 4, 1987

NTSB/RAR-88/01

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB/RAR-88/01	2. Government Accession No. PB88-916301	3. Recipient's Catalog No.
4. Title and Subtitle Railroad Accident Report--Rear-end Collision of Amtrak Passenger Train 94, the Colonial and Consolidated Rail Corporation Freight Train ENS-121, on the Northeast Corridor, Chase, Maryland, January 4, 1987		5. Report Date January 29, 1988 6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 4544B 11. Contract or Grant No.
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		13. Type of Report and Period Covered Railroad Accident Report January 4, 1987 14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

About 1:16 p.m., eastern standard time, on January 4, 1987, northbound Conrail train ENS -121 departed Bay View yard at Baltimore, Maryland, on track 1. The train consisted of three diesel-electric freight locomotive units, all under power and manned by an engineer and a brakeman. Almost simultaneously, northbound Amtrak train 94 departed Pennsylvania Station in Baltimore. Train 94 consisted of two electric locomotive units, nine coaches, and three food service cars. In addition to an engineer, conductor, and three assistant conductors, there were seven Amtrak service employees and about 660 passengers on the train.

At this time, the Edgewood block station operator requested that switch 12 at Gunpow, a remote-controlled interlocking, be lined for straight through movement for train traffic on track 2, on which Amtrak train 94 was operating. The wayside signal aspects displayed for train 94 approaching Gunpow on track 2 were

17. Key Words	18. Distribution Statement		
Wayside signal; automatic control systems; ACS; ATC; ATS; predeparture tests; drugs; safety backup systems; high-speed trains; Northeast Corridor; supervisory oversight; crashworthiness; interior design	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161		
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 208	22. Price

NTSB Form 1765.2 (Rev. 9/74)

"clear" at both the distant (81-2) and home (2N) signal locations, and the wayside signal aspects displayed for train ENS-121 on track 1 was "approach" at distant signal 816-1 and "stop" at the home signal 1N. Automatic control systems in both trains should have displayed aspects corresponding to those of the wayside signals, except that the cab signals of train ENS-121 should have displayed a "restricting" aspect beginning 4,450 feet south of signal 1N.

About 1:30 p.m., Conrail train ENS-121 entered switch 12 onto track 2 causing the switch to realign for movement from track 1 to track 2. When train ENS-121 entered switch 12, the aspect of signal 2N for track 2 changed from "clear" to "stop." The engineer of train 94 apparently recognized that the aspect of signal 2N was "stop" and put his train into emergency braking. However, the train was traveling between 120 and 125 mph and could not be stopped before colliding with train ENS-121. The engineer and 15 passengers aboard train 94 were fatally injured; 174 other person aboard the trains received minor to serious injuries. The rear Conrail locomotive unit, both Amtrak locomotive units, and the head three passenger cars were destroyed. The middle Conrail locomotive unit was heavily damaged, and the rear nine cars of the passenger train sustained varying degrees of damage.

The National Transportation Safety Board determines that the probable cause of this accident was the failure, as a result of impairment from marijuana, of the engineer of Conrail train ENS-121 to stop his train in compliance with home signal 1N before it fouled track 2 at Gunpow, and the failure of the Federal Railroad Administration (FRA) and Amtrak to require and Conrail to use automatic safety backup devices on all trains on the Northeast Corridor.

Contributing to the accident were: 1) the failure of the brakeman of ENS-121 to observe signal aspects and to alert the engineer when they became restrictive; 2) the failure of the crewmembers of train ENS-121 to make the required automatic cab signals (ACS) test; 3) the muting of the ACS alerter whistle on the lead unit of train ENS-121; and 4) the inadequacies of the FRA oversight of Amtrak's and Conrail's supervision of corridor trains.

Operation of Amtrak train 94 at 125 mph, rather than its restricted speed of 105 mph, contributed to the severity of the accident.

CONTENTS

EXECUTIVE SUMMARY

About 1:16 p.m., eastern standard time, on January 4, 1987, northbound Conrail train ENS -121 departed Bay View yard at Baltimore, Maryland, on track 1. The train consisted of three diesel-electric freight locomotive units, all under power and manned by an engineer and a brakeman. Almost simultaneously, northbound Amtrak train 94 departed Pennsylvania Station in Baltimore. Train 94 consisted of two electric locomotive units, nine coaches, and three food service cars. In addition to an engineer, conductor, and three assistant conductors, there were seven Amtrak service employees and about 660 passengers on the train.

At this time, the Edgewood block station operator requested that switch 12 at Gunpow, a remote-controlled interlocking, be lined for straight through movement for train traffic on track 2, on which Amtrak train 94 was operating. The wayside signal aspects displayed for train 94 approaching Gunpow on track 2 were "clear" at both the distant (81-2) and home (2N) signal locations, and the wayside signal aspects displayed for train ENS-121 on track 1 was "approach" at distant signal 816-1 and "stop" at the home signal 1N. Automatic control systems in both trains should have displayed aspects corresponding to those of the wayside signals, except that the cab signals of train ENS-121 should have displayed a "restricting" aspect beginning 4,450 feet south of signal 1N.

About 1:30 p.m., Conrail train ENS-121 entered switch 12 onto track 2 causing the switch to realign for movement from track 1 to track 2. When train ENS-121 entered switch 12, the aspect of signal 2N for track 2 changed from "clear" to "stop." The engineer of train 94 apparently recognized that the aspect of signal 2N was "stop" and put his train into emergency braking. However, the train was traveling between 120 and 125 mph and could not be stopped before colliding with train ENS-121. The engineer and 15 passengers aboard train 94 were fatally injured; 174 other person aboard the trains received minor to serious injuries. The rear Conrail locomotive unit, both Amtrak locomotive units, and the head three passenger cars were destroyed. The middle Conrail locomotive unit was heavily damaged, and the rear nine cars of the passenger train sustained varying degrees of damage.

The Safety Board's investigation of this accident focused on a number of issues relating to the safety of train operations on Amtrak's Northeast Corridor. Among these issues are:

1. the performance of the trains' crewmembers, including their predeparture tests and their operation of the trains and the possible impairment from the use of drugs of the Conrail train crew;

2. the adequacy of the signal and safety backup systems;

3. Amtrak's dispatching and maangement concern with on-time performance;

4. the compatibility of freight trains with high-speed passenger trains in a high-density train environment;

5. the quality of Amtrak and Conrail sueprvisory oversight of corridor operations;

6. the FRA's oversight of the corridor improvements, the operating practices of Amtrak and Conrail, and the implementation of the drug and alcohol testing rules and other safety regulations;

7. the adequacy of the emergency response; and

8. the crashworthiness of Amtrak's passenger-car interiors.

The National Transportation Safety Board determines that the probable cause of this accident was the failure, as a result of impairment from marijuana, of the engineer of Conrail train ENS-121 to stop his train in compliance with home signal 1N before it fouled track 2 at Gunpow, and the failure of the Federal Railroad Administration (FRA) and Amtrak to require and Conrail to use automatic safety backup devices on all trains on the Northeast Corridor.

Contributing to the accident were: 1) the failure of the brakeman of ENS-121 to observe signal aspects and to alert the engineer when they became restrictive; 2) the failure of the crewmembers of train ENS-121 to make the required automatic cab signals (ACS) test; 3) the muting of the ACS alerter whistle on the lead unit of train ENS-121; and 4) the inadequacies of the FRA oversight of Amtrak's and Conrail's supervision of corridor trains.

Operation of Amtrak train 94 at 125 mph, rather than its restricted speed of 105 mph, contributed to the severity of the accident.

Recommendations concerning these issues have been made to the National Railroad Passenger Corporation, the Consolidated Rail Corporation, and the Federal Railroad Administration.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: January 25, 1988

REAR-END COLLISION OF AMTRAK PASSENGER TRAIN 94, THE COLONIAL, AND CONSOLIDATED RAIL CORPORATION FREIGHT TRAIN ENS-121 ON THE NORTHEAST CORRIDOR CHASE, MARYLAND JANUARY 4, 1987

INVESTIGATION

The Accident

About 1:16 p.m., eastern standard time, on January 4, 1987, northbound Consolidated Rail Corporation (Conrail) freight train ENS-121 left Conrail's Bay View Yard at Baltimore, Maryland, and entered the Northeast Corridor (NEC) 1/ mainline of the National Railroad Passenger Corporation (Amtrak) (see figure 1). The train consisted of three diesel-electric freight locomotive units, all under power and manned by an engineer and a brakeman. The train's destination was Harrisburg, Pennsylvania, which necessitated its use of the NEC as far as Perryville, Maryland, 32.4 miles north of Bay View Yard.

Leaving Bay View, train ENS-121 was routed over Amtrak's main track 1 for the 12.2 miles to Gunpow, a remote-controlled interlocking south of the Gunpowder River where the four-tracked NEC converged to the two tracks on the bridge spanning the river (see figure 2). Gunpow marked the north end of track 1, where it converged with the adjacent track 2 by what Amtrak identified as switch 12.

Almost simultaneously with the departure of train ENS-121 from Bay View Yard, Amtrak's northbound passenger train 94, the Colonial, left the Pennsylvania Station in Baltimore, 3.8 miles south of Bay View (see figure 1). Train 94 consisted of two electric locomotive units, nine coaches, and three food service cars. In addition to an engineer, conductor, and three assistant conductors, there were seven Amtrak service employees and about 660 passengers on the train. Except for the first car behind the locomotive units, all the cars were occupied, many to capacity.

1/ The Northeast Corridor line connects Washington, D.C., with Baltimore, Maryland; Philadelphia, Pennsylvania; New York, New York; and Boston, Massachusetts. The section between Washington and New York is electrified and is owned and operated by Amtrak. It was formerly part of the Pennsylvania Railroad and its successor, the Penn Central Railroad.

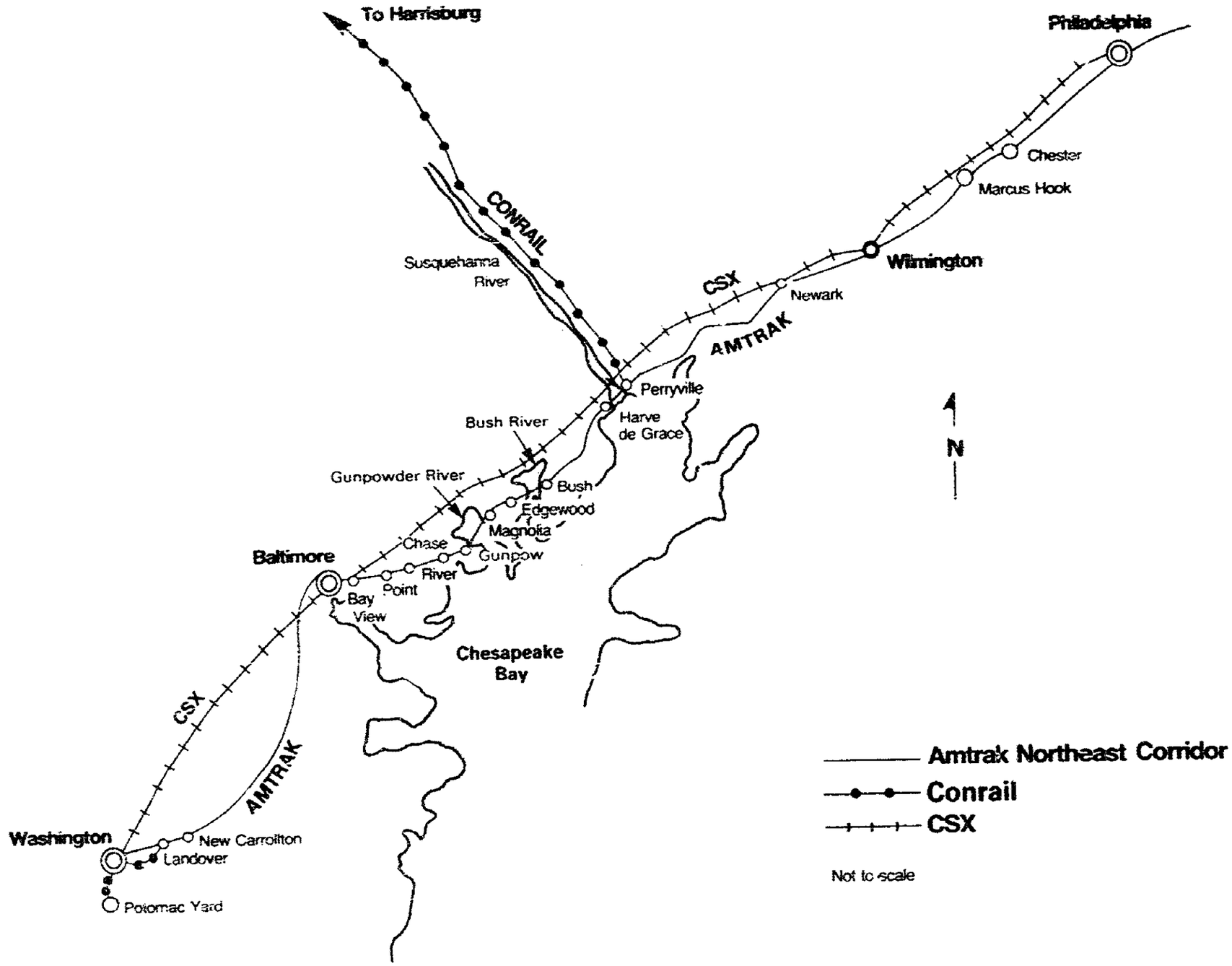


Figure 1. Amtrak's Northeast Corridor line between Washington and Philadelphia, the paralleling line of the Chessie System, and Conrail's Port Road Branch between Harrisburg, Pennsylvania, and Perryville, Maryland.

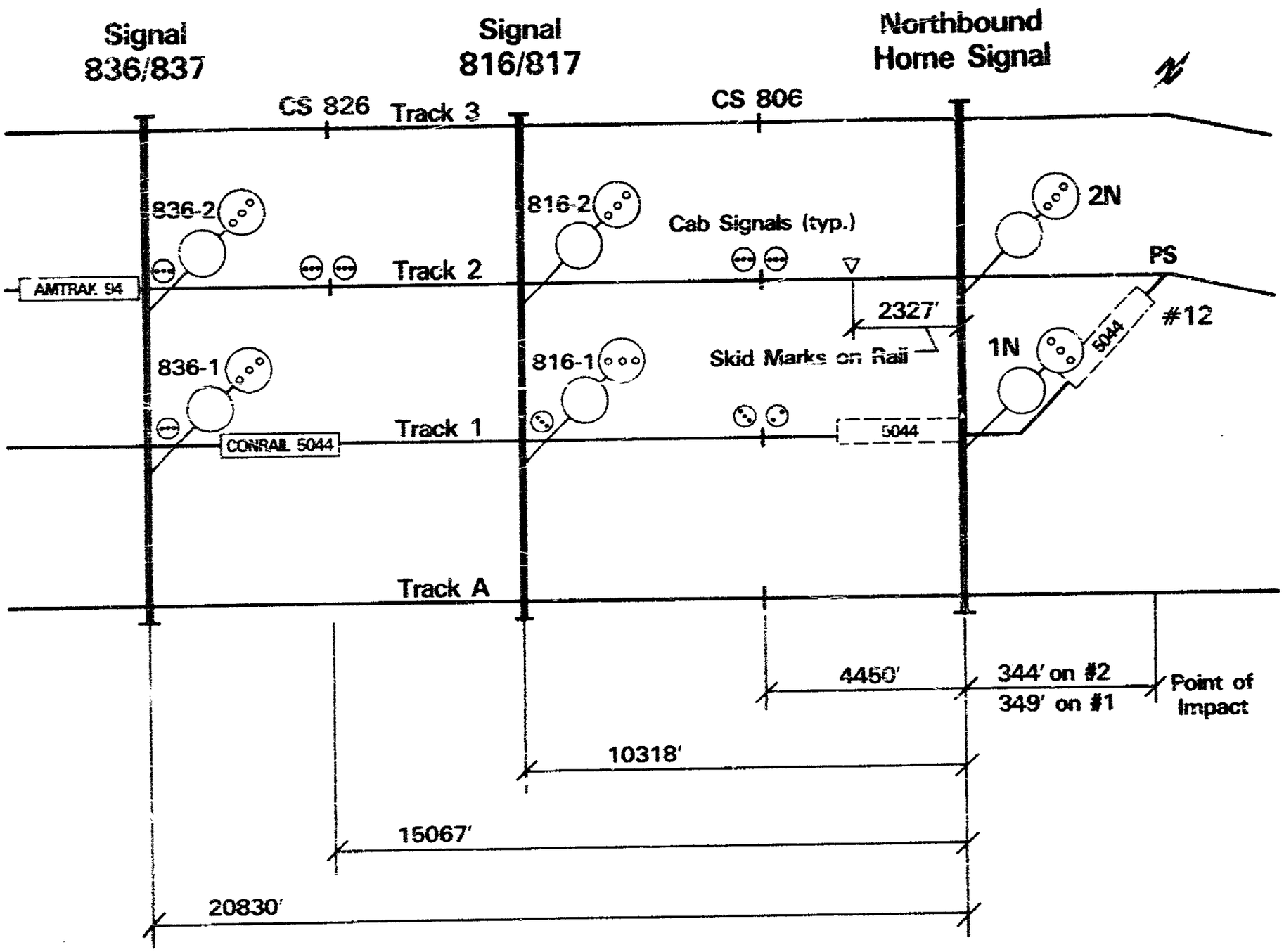


Figure 2. Plan view of the track layout and signals of Gunpow interlocking.

En route from Washington, D.C., to Boston, Massachusetts, train 94 left Baltimore about 5 1/2 minutes behind schedule. It was routed over main track 2 to Gunpow and beyond and was to be followed on this track by Amtrak passenger train 112, the noon Metroliner out of Washington, D.C. Train 112 left Baltimore about 4 minutes behind train 94 and about 47 minutes behind schedule.

The Amtrak dispatcher had given precedence to trains 94 and 112 over Conrail train ENS-121 north of Gunpow. As a result, the block station operator at Edgewood requested the automatic setting up of a route for train 94 through Gunpow interlocking by way of track 2. 2/ This process involved clearing the northbound home signal 3/ for track 2 at Gunpow. Because of safeguards built into the system, the home signal would not display a "clear" aspect until all switches along the route were properly positioned. According to the operator, switch 12, connecting track 1 to track 2, was already aligned for through movement on track 2 (see figure 2).

With switch 12 in normal position and track 2 unoccupied north of Gunpow, the wayside signals displayed for train 94 should have been "clear," permitting the train to proceed at maximum authorized speed. Thus, the northbound home signal for track 1 at Gunpow should have displayed a "stop" aspect and the northbound distant signal for track 1, located 10,318 feet south of the home signal, should have displayed an "approach" aspect for train ENS-121. Automatic cab signals (ACS) in the lead locomotive cabs of both trains should have registered aspects corresponding to those of the wayside signals for their respective tracks, except that the cab signals of train ENS-121 should have displayed a "restricting" aspect beginning at a point 4,450 feet south of the home signal for track 1 at Gunpow. (For a more detailed discussion, see the section on the Automatic Cab Signal System.)

About 1:30 p.m., Conrail train ENS-121 entered switch 12 at Gunpow and moved onto track 2. A few seconds later, train ENS-121 was struck in the rear by Amtrak train 94. There was no radio communication from either train before the collision.

Shortly after the accident, the engineer of train ENS-121 stated to Conrail supervisors that he observed an "approach medium" aspect on the distant signal. Later in a sworn statement made to the Safety Board, he stated the aspect was "approach limited." The approach signal could only have displayed an "approach limited" aspect when switch 12 was aligned for movement from track 1 to track 2; in this event the home signal

---

2/ Gunpow interlocking was operated by remote control from the Edgewood block station, 4 miles north. The operator requested the route for train 94 by manipulating a lever and pushing a button on his modelboard.

3/ Amtrak defines a home signal as "a fixed signal governing entrance to an interlocking."

would have displayed an aspect permitting movement through and beyond the switch without stopping. The engineer further stated that he observed a "stop" aspect displayed by the home signal for track 1, although he was unable to estimate how far he was from the signal when he observed it. When the engineer perceived the stop signal, he immediately placed the train's brakes in emergency. According to the event recorder, the train was then traveling at about 64 mph. However, the train was not stopped short of the home signal but ran through switch 12, which was 349 feet beyond the home signal. Train ENS-121 came to a stop on track 2 with the rear of the last unit standing in the turnout.

The Edgewood operator stated that he could no longer exercise control over the Gunpow interlocking at 1:30 p.m., and he immediately reported the event to the dispatcher. The dispatcher had already been informed by the operator at Bay of a similar problem at the River and Point interlockings. Also at 1:30, the operators at Bay, Perry, and Union block stations notified the dispatcher of an indicated loss of propulsion power in the catenary 4/ overhead at those locations.

At the time the Edgewood operator reported the Gunpow control problem, he was apprehensive that a derailment had occurred because the modelboard's train occupancy lights for all four tracks at Gunpow were lit and he was unable to get an indication of the position of switch 12. At 1:31 p.m. he received what he described as a weak and broken radio transmission, prefaced by the word "emergency." The operator could not determine who was sending the message, but he heard enough to understand that an accident had occurred at Gunpow and that ambulances were needed there. The operator relayed this to the dispatcher who notified his immediate supervisor. The supervisor, in turn, notified emergency response forces and senior Amtrak officials.

Injuries

The engineer and 15 passengers aboard train 94 were fatally injured; 174 other persons aboard the trains received minor to serious injuries. Thirteen of the fatally injured passengers were aboard the second car of train 94; the others were aboard the third car.

4/ The catenary is the overhead wire system that provides electrical power to locomotives on an electrified railroad.

Injuries	Conrail Crew	Amtrak Crew	Amtrak Service Employees	Passengers	Total
Fatal	0	1	0	15	16
Serious	1	0	0	9	10
Moderate	0	0	3	12	15
Minor	1	4	4	140	149
None	0	0	0	484	484
Total	2	5	7	660	674

Damage

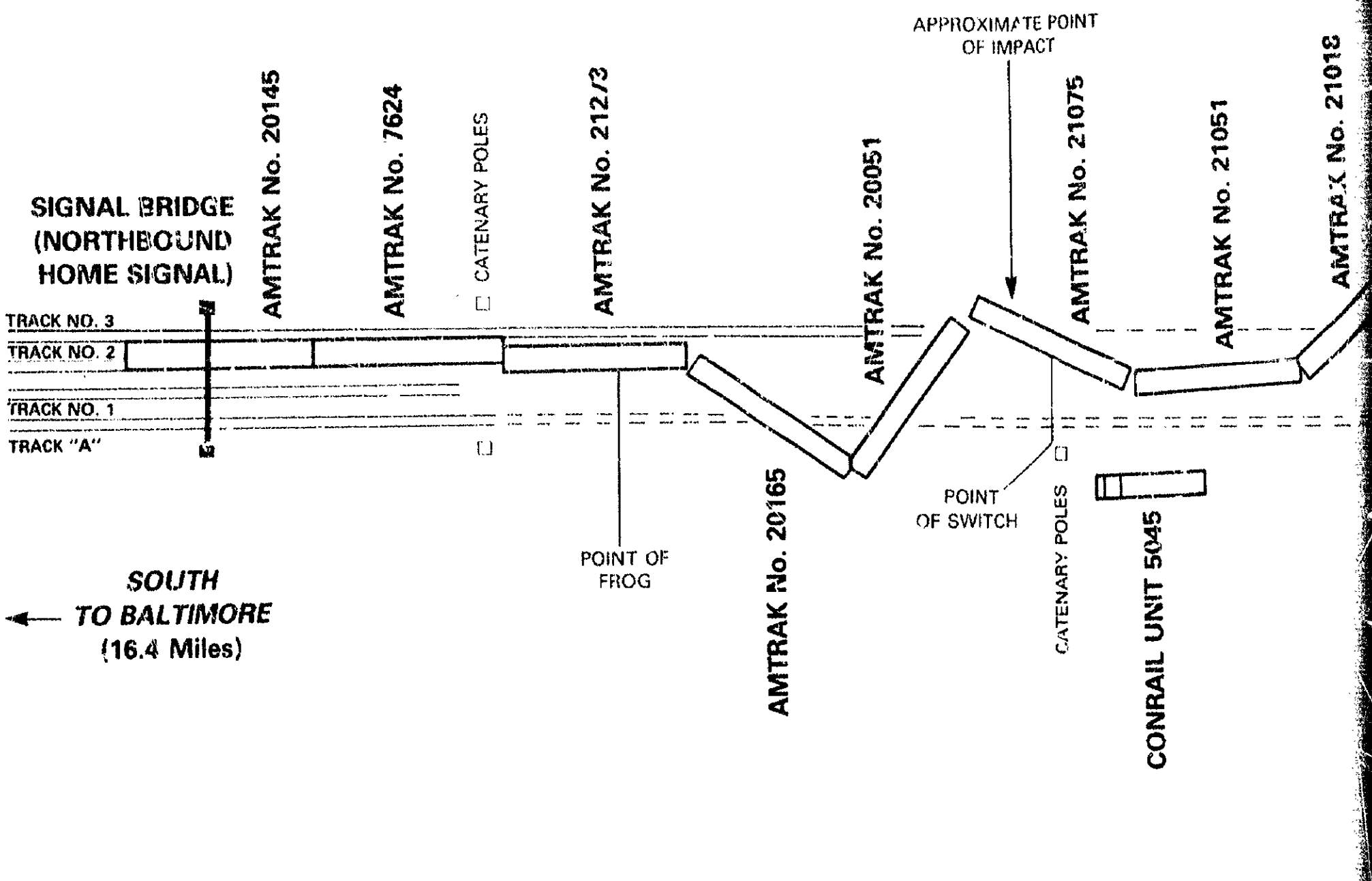
The rear Conrail locomotive unit, both Amtrak locomotive units, and the head three passenger cars were destroyed. The middle Conrail locomotive unit was heavily damaged, and the rear nine cars of the passenger train sustained varying degrees of damage.

The rear Conrail unit was virtually disintegrated with parts scattered across the tracks and property east of the tracks. The largest piece of wreckage came to rest about 150 feet northeast of the collision point. The rear of the middle Conrail unit was crushed by the rear unit. Uncoupled from the lead unit, it was propelled forward on track 2 for about 700 feet. Only the rear truck of this unit derailed. The lead Conrail unit sustained relatively superficial damage, although driven forward about 900 feet, it was the only piece of equipment in the two trains that was not derailed.

The forward cab and superstructure of the lead Amtrak locomotive unit was crushed downward and inward to the underframe. Separated from the trucks, the remains of the car body came to rest west of the tracks about 400 feet north of the collision point. The trailing Amtrak unit remained in line with the track, although separated from its trucks, and came to rest leaning about 45^{0} to the right at a point about 450 feet north of the collision point (see figure 3).

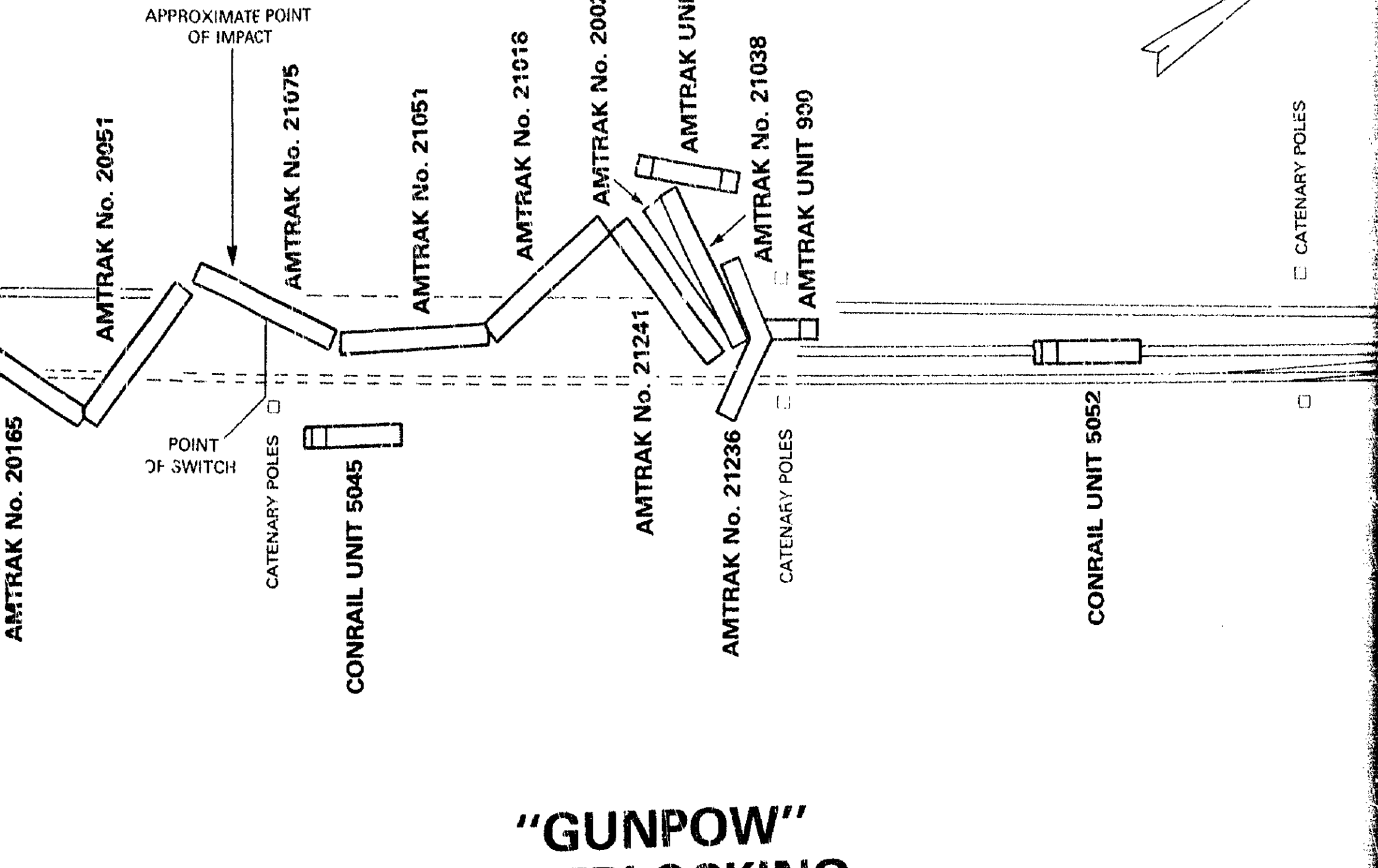
The head car of the passenger train, an unoccupied food service car, came to rest behind the trailing Amtrak locomotive. After passing over the food service car, the second car came to rest on its side on top of the rear of the trailing Amtrak locomotive unit. It was more or less perpendicular to the track, badly deformed and bent or crimped downward in the middle at an angle of about 30^{0} (see figure 4). The third car stopped diagonally to the track, leaning to one side, on top of the crushed food service car. One end was crushed between the second and fourth cars. The fourth car stopped diagonally to the track, upright and with the car body essentially intact. The 5th through 12th cars remained coupled and upright, although the 5th, 7th, 8th, and 9th cars had jackknifed and stopped diagonally to the track. The other derailed cars remained in line with the track (see figure 5).

Figure 3. Aerial view of the accident site.



IN
WRECKAGE
CHA

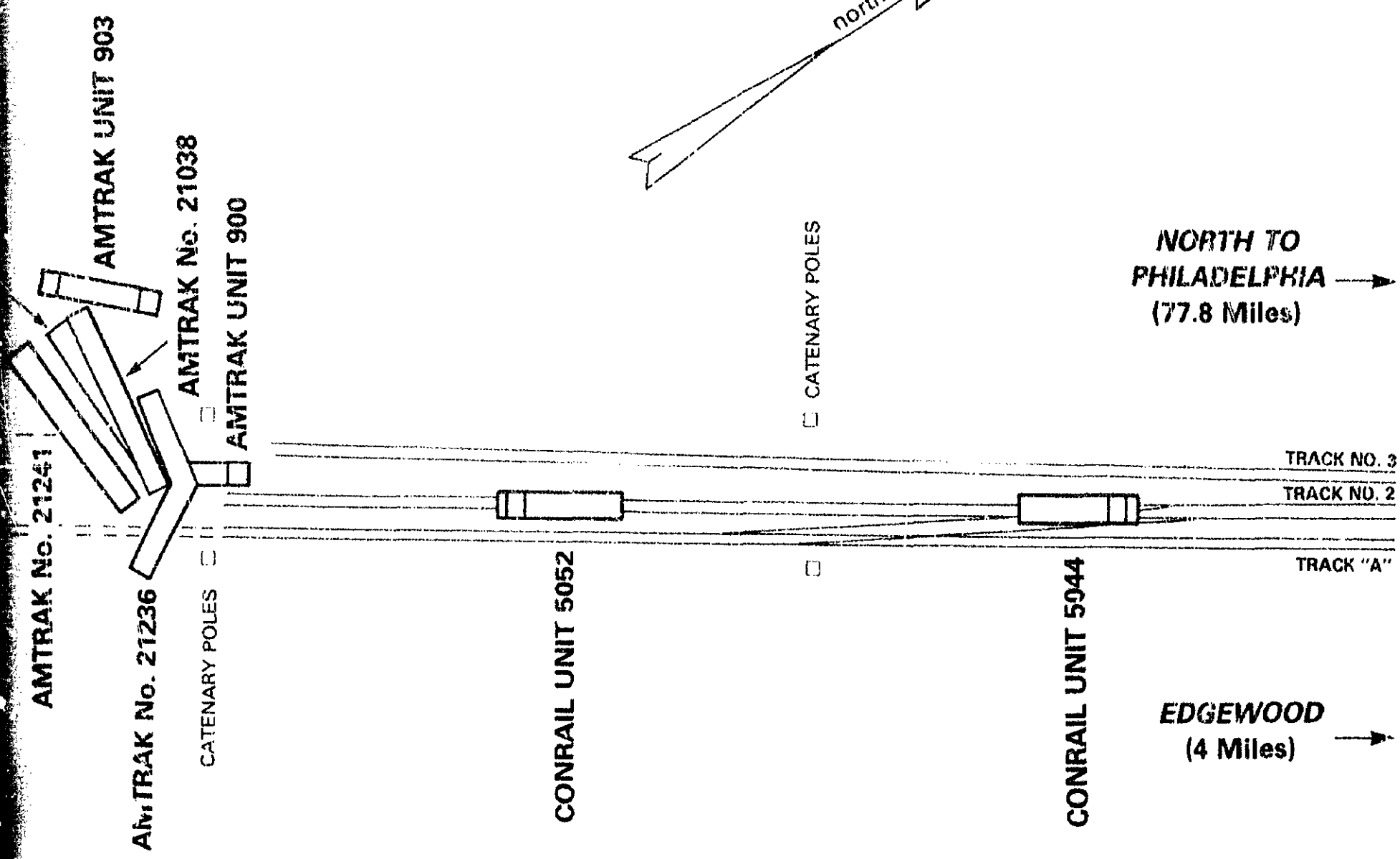
Figure 4



"GUNPOW" INTERLOCKING WRECKAGE DISTRIBUTION PLAN CHASE, MARYLAND

(Not to Scale)

Figure 4. Wreckage Diagram.



NPOW"
LOCKING
STRIBUTION PLAN
MARYLAND

to Scale)

Wreckage Diagram.

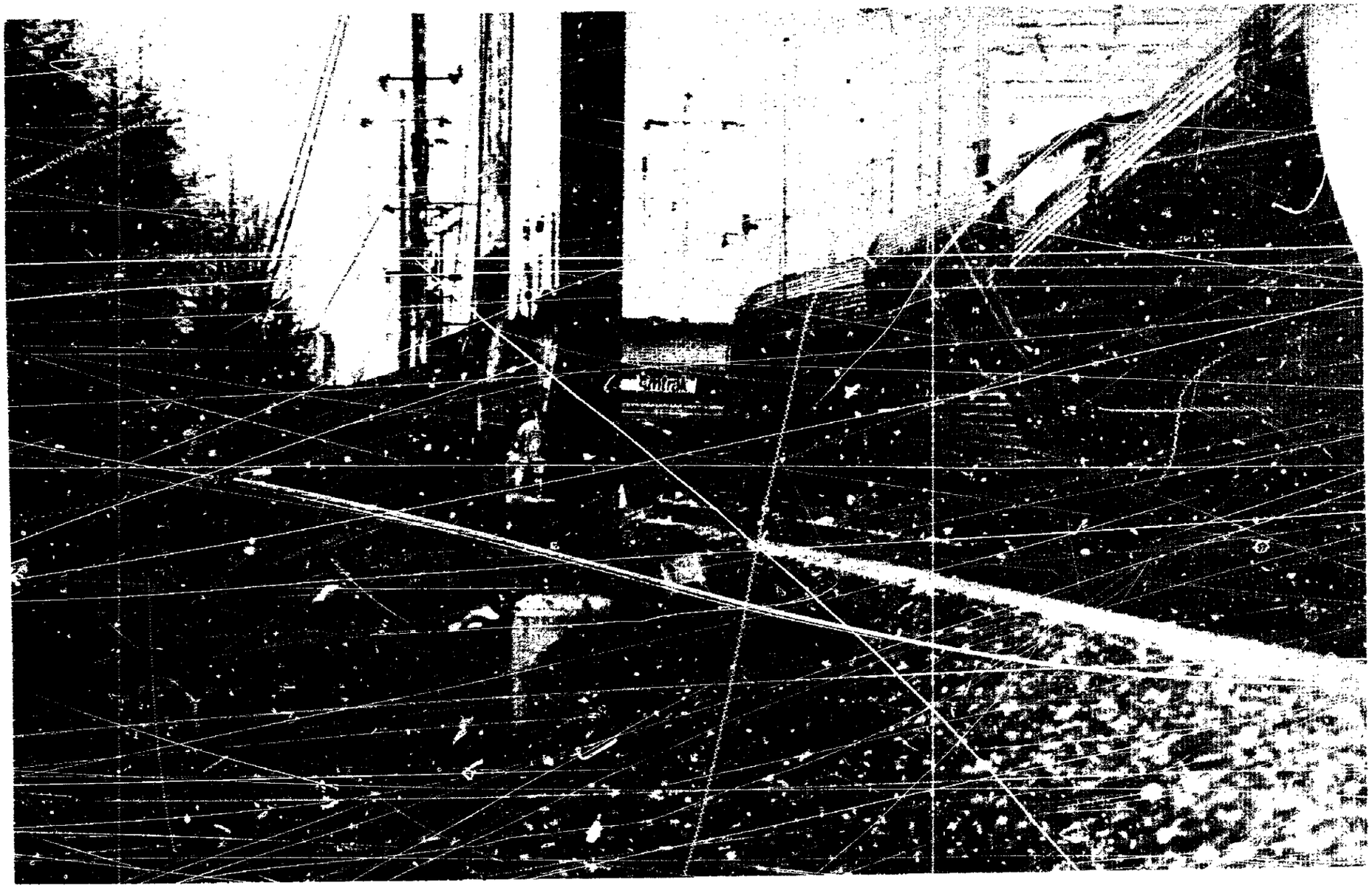


Figure 5. View from west side of the tracks facing north and showing derailed passenger cars of train 94. The car at the extreme right was the rear car of the train, and the car ahead of it was the second car from ther ear. The piles in the middle held up the catenary wires. Fallen catenary and high-voltage transmission lines are on both sides of the poles.

Derailed locomotive units and cars struck and brought down two steel support poles and the electrical catenary that had been suspended over the four tracks. As a result, the catenary wires over the four tracks were extensively damaged. In addition, the high-tension power transmission lines connecting the NEC substations with the power source were knocked down, which resulted in the immediate loss of propulsion power for all electrically powered trains between Washington, D.C. and a point 22 miles north of Gunpow. The downed wires also ignited diesel fuel from the destroyed Conrail locomotive unit producing dense, black smoke that entered the wrecked passenger cars. Small fires also broke out in residential property and wooded lots adjacent to the accident site.

The derailment destroyed switch 12 and destroyed or damaged about 2,800 linear feet of each of the four tracks at the accident location. About 5,700 linear feet of the tracks had to be replaced along with two steel support poles.

Rescue and wreckage clearing operations prevented the restoration of through-train operations for 2 days resulting in disruption of travel and a substantial loss of revenue to the carriers. In addition, Amtrak incurred substantial expense in moving stranded electrically powered trains and providing alternative transportation to passengers after the accident.

The damage was estimated as follows:

Conrail locomotives	$1,325,000
Amtrak locomotives	7,400,000
Amtrak cars	6,423,000
Track	500,000
Overhead catenary system	285,000
Signals and communications	30,000
Cost of clearing wreckage	598,000
Total	$16,561,000

Method of Operation

Speed Restrictions.--Amtrak's NEC timetable No. 4, effective April 27, 1986, as revised by general order No. 403 effective at 12:01 a.m., October 26, 1986, was in effect at the time of the accident. These regulations imposed the following maximum operating speeds on trains using the corridor (see appendix D).

Locations	Distance (miles)	Freight Trains Track A (mph)	Freight Trains Track 1 (mph)	Passenger Trains Track 2 (mph)
Baltimore to Union	0.2	- - -	- - -	45
Union to Bay	3.6	- - -	- - -	60
Bay to Point	1.8	*	50	110
Point to River	0.8	*	50	110
River to Milepost 85	4.3	50	50	110
Milepost 85 to Gunpow	5.7	50	50	110
Gunpow to Milepost 78	1.9	- - -	- - -	110
Milepost 78 to Edgewood	2.7	- - -	- - -	120
Edgewood to Bush	3.7	- - -	- - -	120

* Track A from Bay to River was designated a running track with operation at restricted speed. Amtrak defines restricted speed as "prepared to stop short of train, obstruction, or switch not properly lined, looking out for broken rail, but not exceeding 20 mph outside interlocking limits, 15 mph within interlocking limits."

Effective at 12:01 a.m., October 27, 1986, Amtrak issued bulletin order No. 4-27 which increased the maximum authorized speed for passenger trains on track 2 between Bay and Point and between milepost 85 and Bush to 125 mph (which formerly was 110 mph), except for a curve just north of the Gunpowder River bridge that remained restricted to 100 mph. These modified speeds, reissued in the most recent bulletin order No. 4-36, effective December 29, 1986, were in effect at the time of the accident (see appendix E). There were no temporary slow orders in effect on tracks 1 and 2 between Bay and Bush.

At the time of the accident, NEC timetable rule 1157-G1 restricted the maximum authorized speed of Amtrak's AEM-7 class locomotive units (which were used on train 94) to 125 mph when pulling a train. Amtrak's E60CP electric locomotives were restricted to a maximum of 90 mph for locomotives numbered 600 through 615, and 80 mph for locomotives numbered 950 through 975. Amtrak's Amfleet-class passenger cars, series 20000 through 28024, were restricted to 125 mph, but according to the timetable rule, Amtrak Heritage-class passenger cars were restricted to 105 mph (see the section on Train Information). The maximum speed of any Amtrak train on the corridor was the lowest allowable speed for any locomotive unit or car in the train. Amtrak train 94 was being operated on January 4, 1987, with one Heritage-class passenger car.

Amtrak has not provided the Safety Board with a written procedure that it uses to inform dispatchers of trains that contain restricted-speed Amtrak-owned cars or locomotive units.

The E-section dispatcher 5/ stated that he was unaware that train 94 included a restricted-speed car, and he said there was no procedure for stationmasters or operators to provide dispatchers with such information. The general superintendent in charge of the Philadelphia Division section of the corridor between Philadelphia and Washington testified at the Safety Board public hearing (see appendix A) that conductors were responsible for determining if their trains contained such restricted-speed equipment and to notify their engineers when they did. Amtrak operating rule 80 required that dispatchers be notified in advance of any condition that would delay a train or prevent it from making normal speed (see appendix C). The general superintendent stated that operating rule 80 requires conductors to advise dispatchers of any restricted-speed cars in their trains. The conductor of train 94 testified that he informed the engineer that their train contained a Heritage-class car before they left Washington.

Rule 1157-A2 in Amtrak timetable No. 4 required engineers to check indicated speed against elapsed time between marked mileposts (see appendix D). Between Washington and the accident location, there were two such marked miles, the first began at milepost 131, 5 miles north of Washington, and the second began at milepost 123, 13 miles north of Washington.

Amtrak timetable rule 1157-G1 also limited Conrail freight locomotive units 5000-5059, which included the units that made up train ENS-121, to operate at a maximum speed of 70 mph with cars and a maximum of 60 mph when operated as multiple locomotive units without cars (see appendix D). Rule SP-17 in Conrail's eastern region timetable No. 1, in effect at the time of the accident, also specified these restrictions to be in force on all divisions. However, the Conrail rule further stipulated, "Maximum authorized track speed must not be exceeded" (see appendix D). There was no similar stipulation contained in Amtrak's timetable special instructions or operating rules.

According to Amtrak's general manager, the 70-mph with-cars maximum speed allowed for Conrail's 5000-5059 units by rule 1157-G1 was superseded by the 50-mph maximum freight train speed authorized on track 1 between Bay and Gunpow. Conversely, the Amtrak general superintendent considered that the 50-mph track speed limit was superseded by the 60-mph maximum speed limit imposed by rule 1157-G1 on multiple freight locomotive units without cars. Amtrak defines a train as "an engine, or more than one engine coupled, with or without cars and displaying marking device" (see appendix C). The general superintendent also testified that he considered train ENS-121 to have been a freight train.

5/ The E-section dispatcher is the Amtrak dispatcher responsible for the section of NEC that incudes the accident site.

On November 10, 1987, Amtrak's general manager of transportation informed the Safety Board that Amtrak did not identify a "multiple light movement as a freight train and; therefore, the movement is not restricted by the maximum authorized freight speed as defined in Section 1157-C1." He further stated that the track speed for passenger trains applied to train ENS-121, and, as a result, the train was permitted to operate at 60 mph approaching Gunpow on track 1.

Operational Strategy.--At 1:11 p.m., when the E-section dispatcher authorized the Bay operator to allow train ENS-121 to leave Bay View Yard via track 1, there was only one other train in the 24.1 miles of railroad between the Baltimore station and Bush interlocking. This train was a southbound Metroliner which passed Bay at about 1:12 p.m. and arrived at the Baltimore station at about 1:20 p.m., 1 minute behind schedule. By 1:15 p.m., trains 94 and 112 were both in the station at Baltimore, train ENS-121 was about to leave Bay View, and there were two southbound Amtrak trains north of Bush. Both southbound trains were restricted-speed trains. Conventional passenger train 81 was restricted to 90 mph because it was powered by a 600-series E60CP locomotive. At 1:11 p.m., train 81 was running 10 minutes late and was 20 miles north of Bush. Mail train 15, powered by a 125-mph AEM-7 locomotive but restricted to 105 mph by the baggage cars in its train, was closing on train 81. At 1:06 p.m. train 15 was 9 minutes ahead of schedule and 3 minutes behind train 81. At 1:28 p.m., when train 81 reached Perry, 12 miles north of Bush, it was only about 2 minutes ahead of train 15 (see figure 1).

With train 94 out of Baltimore at 1:16 p.m. and train 112 out behind it on track 2 at 1:20 p.m., these trains should have reached the north end of the 7.7-mile two-track section between Gunpow and Bush at about 1:33 and 1:37 p.m., respectively, if they remained on track 2, maintained maximum track speeds, and were not delayed. The dispatcher instructed the Edgewood operator to route trains 94 and 112 through Gunpow and Bush on track 2. Conrail train ENS-121 was to have been held at Gunpow until train 112 passed and was then to have followed it north on track 2.

As instructed, the Edgewood operator requested the northbound home signal for track 2 at Gunpow to be cleared for train 94. He recalled that he did this at about 1:23 p.m. when he heard the operator at Bay report that train 94 had passed that location. It was not necessary for the Edgewood operator to request the realignment of any switch at Gunpow. He testified that switch 12 had been aligned for through movement on track 2 immediately after a northbound freight train had passed through it from track 1 at about 10:34 a.m.

At 1:28 p.m., the E-section dispatcher told the Edgewood operator that trains 81 and 15 would come to Bush on tracks 3 and 4, respectively, and that he was thinking of "double-barreling" the trains, more or less side by side, down the two-track section

between Bush and Gunpow. Whichever of the trains reached Bush first would be routed over track 3; the other would be routed over track 2. Given the relative locations of the trains, the dispatcher thought that northbound train 112 would pass Bush before the trailing southbound train reached that point. If the mail train failed to overtake the slower train 81 north of Bush, this strategy would permit it to do so south of Bush.

When the dispatcher decided to "double-barrel" the southbound trains, he had in mind holding train ENS-121 at Gunpow until the southbound train, using track 2, passed that point. However, the Edgewood operator suggested there would be time enough for train ENS-121 to be advanced to Magnolia Siding where it would make a "running meet" 6/ with the southbound train. At 1:28:26 p.m. the dispatcher agreed this should be done; he stated later that he was thinking of "double-barreling" the southbound trains "all the way" (to Baltimore). None of the projected movements required changing switch positions or signals at Gunpow until after trains 94 and 112 had passed that location.

Northeast Corridor Users.--The portion of the NEC between Washington and New York is owned, operated, and supervised by Amtrak. In addition to its passenger trains that are drawn by electric locomotives, Amtrak also operates nonrevenue work trains to maintain the tracks and the overhead electrical catenary system. At the time of the accident, these work trains were pulled by diesel-electric locomotives.

Three commuter authorities also operate passenger trains over portions of the corridor between New York and Washington. These are the New Jersey Department of Transportation (NJDOT) in New Jersey, the Southeastern Pennsylvania Transportation Authority (SEPTA) betweeen Philadelphia and Marcus Hook, Pennsylvania, and the Maryland Department of Transportation (MARC) between Baltimore and Washington.

Conrail provides all freight and switching service to the industries located on the corridor as well as on lateral branches connected to the corridor. It operates the freight classification yards and ancillary facilities at several locations on the corridor, including Bay View Yard which serves the Baltimore industrial complex. Conrail also operates through freight trains to and from the north over the corridor as far south as Landover, Maryland. These trains use Conrail's own tracks from Landover to Potomac Yard in Alexandria, Virginia. Conrail freight trains to and from the west operate over Conrail's Port Road Branch between Harrisburg, Pennsylvania, and the corridor at Perryville, Maryland. These freight trains may originate or terminate at Bay View Yard or Potomac Yard. About

---

6/ If the timing worked out, it would not be necessary to stop ENS-121 in Magnolia Siding, which was more than a mile long. Hence, the reference to a "running meet."

1981, Conrail stopped using the overhead catenary system on the Port Road Branch and between Landover and Potomac Yard. Since that time, all of Conrail's freight trains using the corridor have been powered by diesel-electric locomotives.

Amtrak also grants user rights on the corridor to the Delaware & Hudson Railway (D&H) which operates freight trains between Harrisburg and Potomac Yard by way of Conrail's line to Perryville and the corridor line. These freight trains are also powered by diesel-electric locomotives.

Trains are operated over the corridor between Bay View Yard and the accident location by aspects displayed by wayside signals of an automatic block signal system and by ACS, as provided by Amtrak operating rules 261 and 550 through 563 (see appendix C). Signal indications provide the authority to operate in either direction over the designated main tracks. The number of main tracks varies from two to four between Washington and Philadelphia.

The Corridor "Window".--There is a "window" or period when no passenger trains are scheduled to operate over the corridor between Washington and Philadelphia. After the last passenger trains of the day reach Washington and Philadelphia at 12:55 a.m., there is only the 3 a.m. mail train northbound from Washington until the 6 a.m. Metroliner leaves Washington and a 5:41 a.m. southbound conventional passenger train leaves Philadelphia. The "window" in the section between Perryville, Gunpow, and Bay View is substantially longer because this section is essentially midway between Philadelphia and Washington.

Southbound freight trains will encounter no on-time passenger trains after 11:56 p.m. at Perryville or before 6:43 a.m. at Bay View. For northbound trains the maximum "window" begins at Bay View at 12:07 a.m. and ends at 6:47 a.m. at Perryville. No passenger trains are scheduled to pass Gunpow between 11:58 p.m. and 6:51 a.m. During the 17 hours passenger trains operate through Gunpow on weekdays, the headway between trains averages 32 minutes, and on the average, a train passes through the interlocking every 16 minutes. On the day of the accident, the average frequency would have been 17 minutes.

Officials of Amtrak and Conrail testified that every effort was made to operate Conrail's freight trains over the corridor during the "window" hours. According to the train sheet kept by the Edgewood block station operator, on the morning of January 4, Conrail trains passed Gunpow at 12:41, 1:09, 3:22, 3:26, 5:20, 6:20, 9:44 and 10:34 a.m. All but the last two trains cleared the Bay View-Perryville section before the first passenger trains reached that section.

According to Amtrak, during the 30-day period preceding the accident, 402 freight trains and 394 passenger trains passed through the turnouts at Gunpow. Track 2 was used almost exclusively by northbound trains during this period. Train movements through the turnouts were as follows:

Northbound	Passenger trains	Passenger trains
Track 2 to track 2	872	93
Track A to track 2	0	66
Track A to tracks 2 and 3	0	3
Track 1 to track 2	19	85
Total	891	247

Southbound	Passenger trains	Passenger trains
Track 2 to track 2	3	4
Track 2 to track 1	0	48
Track 2 to track A	0	66
Track 3 to track A	0	37
Total	3	155

Train Mix and Density.--At the time of the accident, Amtrak operated four types of revenue trains on the corridor--Metroliners, "conventional" passenger trains, commuter passenger trains, and mail trains.

Metroliners were operated between Washington and New York every hour in both directions from 6 a.m. to 6 p.m. on weekdays with a 7 p.m. schedule on some days and a reduced schedule on weekends. Only AEM-7 locomotives and Amfleet cars were used on the Metroliners; typically, a Metroliner consisted of one locomotive unit and five or six cars. No baggage cars were used in these trains, and they were permitted to operate at maximum track speeds of up to 125 mph. The fastest Metroliners made four mandatory stops between Washington and New York, and they were scheduled to make the 225.4-mile trip in 169 minutes at an average speed of 80 mph. The slowest Metroliners with six mandatory stops were scheduled at 179 minutes with an average speed of 75.5 mph.

"Conventional" passenger trains were regularly scheduled standard-fare trains operated on slower schedules than the Metroliners. Some trains included baggage cars and/or Heritage-class cars and therefore, were restricted to 105 mph or less if they had an E60CP locomotive. Others, such as train 94, normally included only AEM-7 and Amfleet equipment and were permitted to travel at the same speeds as the Metroliner.

The schedule of train 94 included six mandatory stops between Washington and New York in the 201-minute trip requiring an average speed of 67 mph. At the Safety Board's public hearing, the Amtrak general superintendent asserted that train 94 could meet this schedule without exceeding 105 mph at any time.

The schedule of train 94 required the train to cover the 16.6 miles between Bay, Gunpow, and Edgewood in 10 minutes, the same time allowed for all northbound Metroliners. Train 94 was allowed 2 minutes to cover the 4 miles between Gunpow and Edgewood; the northbound Metroliners were allowed either 2 or 3 minutes between these points. Between Bay and Perryville, 32 miles, train 94's schedule allowed 19 minutes for an average speed of 101.3 mph. Eleven northbound Metroliners were allowed the same time; the remaining five Metroliner schedules allowed 18 minutes between Bay and Perryville. Track 2 between these points had a 125-mph speed limit except for 7.1 miles where the limit was 110 mph, 2.2 miles where the limit was 80 mph, and 0.9 mile where the limit was 90 mph. There was also a 100-mph permanent speed restriction in a curve north of Gunpow.

On the 3 days preceding the accident, train 94 was operated at or just under its scheduled running time of 201 minutes; on each of those days it was powered by AEM-7 locomotives and was made up exclusively of Amfleet car equipment. On January 1, it had 1 locomotive and 9 cars; on January 2, it had 1 locomotive and 10 cars; and on January 3, it had 2 locomotives and 11 cars. On January 3, the train, operated by the engineer who was operating train 94 at the time of the accident, traveled from Washington to New York in 200 minutes after leaving Washington 30 minutes late.

Commuter passenger trains were operated by Amtrak for MARC between Baltimore and Washington on weekdays. At the time of the accident, 10 commuter passenger trains were operated each work day; since the accident, the number has been increased to 14. These trains used MARC cars restricted to a maximum of 105 mph and MARC AEM-7 locomotives equipped similarly to Amtrak AEM-7 units. Between Marcus Hook and Philadelphia, SEPTA operated 56 commuter trains on weekdays, 30 on Saturdays, and 18 on Sundays. These trains were composed of multiple-unit electric cars with maximum permitted speeds of 75 to 95 mph.

Mail trains normally included only baggage cars that were restricted to 105 mph, and they were permitted to travel at that speed with an AEM-7 locomotive.

Excluding commuter train passengers, the daily number of persons riding the NEC passenger trains had increased from 17,500 passengers in 1985 to 29,500 in 1987. (According to Amtrak, this figure was greater than all the people using the airline shuttles between Washington and New York.) Since 1968, there had been a substantial increase in the number of trains operated daily

through Gunpow as well. In 1968, Penn Central operated a maximum of 38 trains. By 1984, Amtrak operated a maximum of 58, and by the time of the accident a maximum of 70.

Daily Amtrak Train Schedule on the NEC
at the time of the accident

Day	Metro-liners	Conven-tional	Mail	Total
Monday	24	39	1	64
Tuesday	24	38	1	63
Wednesday	24	39	2	65
Thursday	24	38	2	64
Friday	26	42	2	70
Saturday	2	38	2	42
Sunday	12	39	2	53
Total	136	273	12	421

Because of the New Year holiday, Amtrak was operating on an expanded Sunday schedule on the day of the accident. Six additional Metroliners and an extra southbound "conventional" passenger train were to be operated for a total of 60 trains on that day. 1/ Metroliner 112, close behind train 94 at the time of the accident, was regularly operated on Sundays. Metroliner 114, which was following train 112, was one of the "extra" Metroliners.

Conrail operated more freight trains between Perryville and Baltimore than on any other section of the corridor. The number of trains operated by Conrail through Gunpow had been reduced substantially since 1968. However, Conrail had been able to divert a higher percentage of its trains from the section of the corridor between New York and Philadelphia. This diversion was a result of Conrail's acquisition of a paralleling railroad at the time it succeeded Penn Central.

Two regularly operated Conrail freight trains had been diverted to the Chessie System (now CSX Transportation Company) line paralleling the corridor between Philadelphia and Landover, Maryland, and Conrail was negotiating to divert additional trains to the CSX line at the time of the accident. However, the capacity of the CSX line is limited because it is a single-track line between Baltimore and Philadelphia, and because of the substantial number of MARC commuter trains that use the double-track section between Baltimore and Washington. Although the CSX

1/ The employees' timetable showed four of the extra Metroliners to be operated January 4; the other two were erroneously shown to be operated January 14 because of a misprint.

and Conrail lines connect near Perryville, the connecting track is in a steep grade, has sharp curvature, and is practical only for trains operating north of the connection. 8/

According to Conrail, it operated 99 freight trains through Gunpow during the week preceding the accident, for an average of slightly more than 14 trains a day. The following table provides the average number of freight trains operated daily over various sections of the corridor from 1968 through 1987.

Freight trains	1968	1977	1984	1987
Oak Island-Trenton	30	30	20	6
Trenton-Frankford Jct.	14	7	2	0
Frankford Jct.-Philadelphia	16	16	2	6
Philadelphia-Wilmington	18	16	10	6
Wilmington-Davis	14	20	12	4
Davis-Perryville	14	22	14	8
Perryville-Bay View	22	28	20*	14*
Bay View-Landover	18	24	18*	10*

* Includes four Delaware & Hudson trains.

Dispatchers and Block Station Operators.--At the time of the accident, six Amtrak train dispatchers in Philadelphia and New York supervised and monitored the movement of trains in the corridor between Washington and New York. They instructed operators at block stations along the line on routing trains and decided which trains are given precedence. To communicate with block station operators, dispatchers used train wire telephone lines. Because dispatchers did not have modelboards, they depend on the block station operators who did have modelboards to track the progress of trains. Block station operators communicated directly with traincrews by radio, but dispatchers did not have this capability.

In addition to the interlockings at their block stations, the operators also operated remote-controlled interlockings at adjacent locations. Operators set up the routes for trains by aligning switches and requesting the display of signal aspects at the interlockings. They monitored train movements through the interlockings by observing indications of train occupancy lights on modelboards. Other lights on the modelboards also indicated the alignment of switches. The operators recorded and reported to the dispatcher the times when the rear ends of trains pass interlocking locations.

8/ Trains operating in both directions over the CSX line south of the connection would have to change the locomotive from one end to the other because this is not a two-way or Y-type connection. The physical restrictions caused by the proximity of the Susquehanna River valley had precluded the installation of a two-way connection.

At the time of the accident, maintenance personnel were installing a centralized traffic control (CETC) system on the corridor. By using the remote-controlled switches and signals from the Philadelphia dispatching center, the CETC system will eliminate the need for block station operators. However, this new system was not yet operational at the time of the accident.

The first block station south of the accident location is known as Bay. It is located at milepost 91.9, opposite Conrail's Bay View Yard, and is 6.6 miles north of Pennsylvania Station at Baltimore. The operator at Bay controls access of Conrail trains at Bay View Yard to the NEC tracks and also controls remote interlockings at Point (milepost 90.1) and River (milepost 89.3). The first block station north of Bay and the accident location is Edgewood, milepost 75.3. In addition to Edgewood interlocking, the Edgewood operator also controls remote interlockings at Gunpow (milepost 79.3), Magnolia (milepost 76.9), and Bush (milepost 71.6) (see figure 1).

Between Bay and Gunpow there are three main tracks designated as 1, 2, and 3, from east to west. Track 1 ends at Gunpow; tracks 2 and 3 continue north to and beyond Edgewood. There is a fourth main track, designated as A track, between River and Gunpow, a distance of 10 miles. This track also extends south from River to Bay, 2.6 miles, but this portion is designated as a running track rather than as a main track.

North of the Gunpowder River Bridge and between Magnolia and Edgewood, there is a long siding called Magnolia. Controlled remotely by the Edgewood operator, Magnolia Siding is connected at both ends with track 2 and is used to clear trains from opposing or overtaking trains on track 2. North of Magnolia Siding there are only tracks 2 and 3 for about 3 1/2 miles to Bush where a third main track (4) diverges from track 3.

The NEC between Washington and Philadelphia is supervised by three dispatchers. One dispatcher is assigned the 46-mile F-section between Washington and River interlocking; another dispatcher has the 60-mile E-section between River and Ragan interlocking, south of Wilmington, Delaware; and the third dispatcher supervises the 30-mile D-section between Ragan and Philadelphia. Edgewood block station and Gunpow interlocking are in the E-section. Because of the way the E- and F-sections are separated, the block station operator at Bay reports to both dispatchers working these sections, and both dispatchers were responsible in setting up the movements of trains 94 and ENS-121.

Although separated by opaque partitions, the E- and F-section dispatchers sat across from each other and could freely communicate. According to the E-section dispatcher, he verbally "handed off" trains passing to the F-section dispatcher.

Track Information

Between milepost 85 and Gunpow, tracks 1, 2, and 3 are maintained to comply with Federal Railroad Administration (FRA) class 6 standards. Track A is maintained to FRA class 4 standards and has a maximum 80-mph authorized speed limit for passenger trains. Amtrak designates tracks 2 and 3 as high-speed tracks and FRA has granted Amtrak a waiver to operate over these tracks at speeds higher than the 110-mph maximum specified for class 6 track. 9/ All tracks met the minimum FRA track safety standards for their designated classes. Maximum track speed for freight trains on all four main tracks was 50 mph.

Track 1 converges into track 2 at Gunpow at switch 12 through a left-hand No. 20 turnout with 39-foot Sampson switch points and undercut stock rails. The turnout was destroyed in the accident, but the left-hand switch point rail was recovered. Wheel marks were found on the field side of the switchpoint rail approximately 24 feet 4 inches from the switch point end. The remaining attached segments of connecting rods 2 and 3 were bent, and there were wheel marks on the stops. Skidmarks were found on both rails of track 2 beginning 2,671 feet south of switch 12. No skidmarks were found on the rails of track 1.

Amtrak inspected the track twice weekly in compliance with the requirements of FRA track safety standards and had last inspected the tracks on January 2, 1987. Amtrak also performed automatic track geometry measurements on track 1 on February 19, 1986, and on track 2 on December 12, 1986. Switch 12 was last inspected by Amtrak on November 25, 1986. No defects were noted during these inspections.

Signal Information

Wayside Signal System.--Considerable changes were made to the wayside signals associated with Gunpow interlocking when the track layout was changed in 1985. Formerly, the tracks were signaled only for their designated direction of traffic. Hence, there were only double-aspect northbound home signals for then tracks 1 and 2 at Gunpow. In the 1985 modification, all tracks were signaled in both directions, and northbound home signals were installed for all four tracks. These signals were mounted on a signal bridge spanning the tracks with each signal located above the track it governed. The centers of the top aspects were about 35 feet above the tops of the rails (see figure 6). The new home signals for newly designated tracks 3, 2, 1, and A were designated 3N. 2N, 1N, and 9N, respectively. In the new track configuration, switch 12 was located 344 feet north of signal 2N and 349 feet north of signal 1N.

9/ Amtrak designates the maintenance standards for tracks 2 and 3 as class 7 to distirguish them from the FRA class 6 standards.

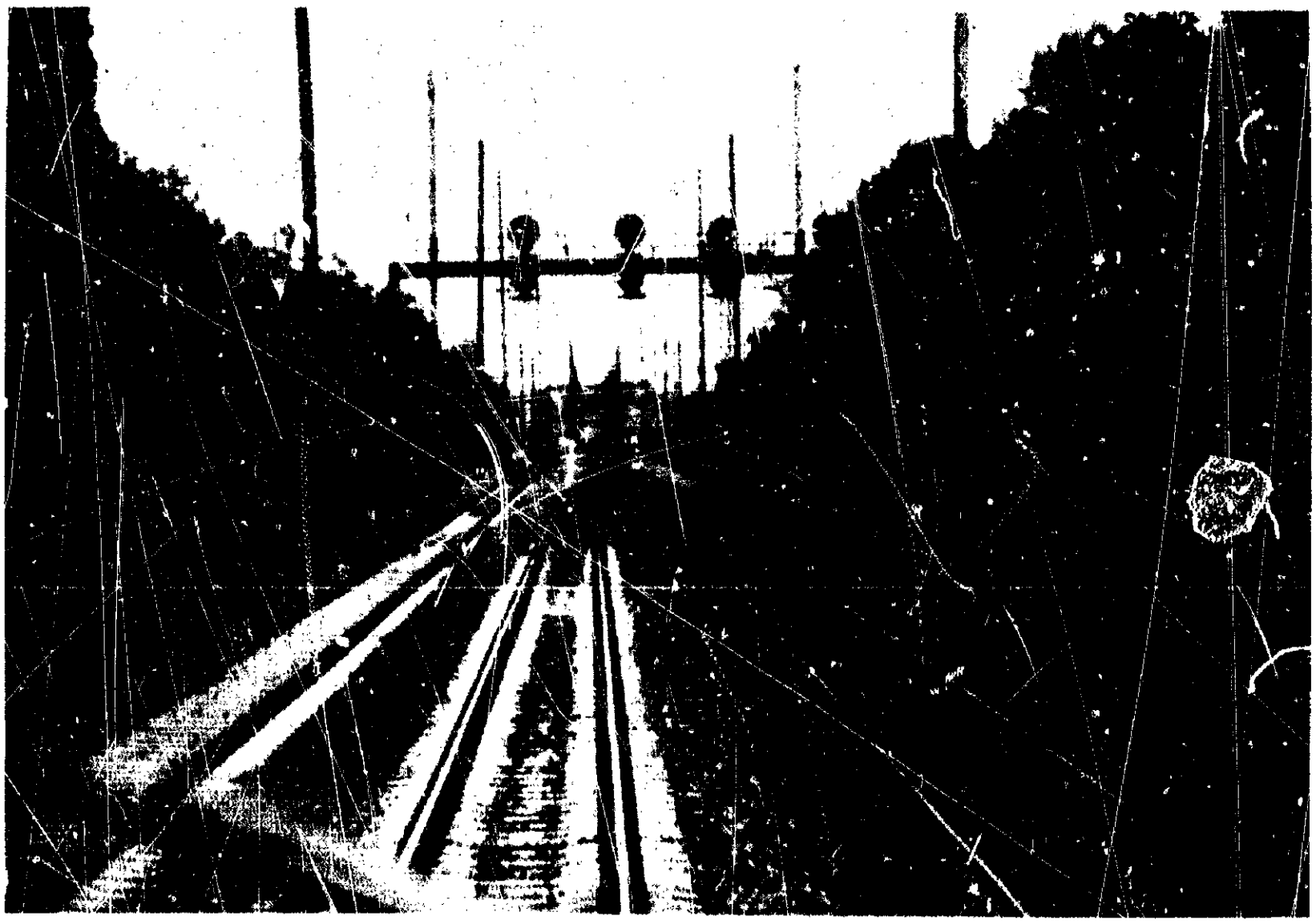


Figure 6. The northbound home signals at Gunpow as viewed from a northbound train moving at 125 mph on track 2. The aspect displayed for the train by signal 2N is "clear;" those displayed for the other tracks are "stop." From left to right, the tracks are 3, 2, 1, and A.

Formerly, the northbound distant signal for Gunpow was located near milepost 82, 12,585 feet south of the home signals. As part of the 1985 modification, the signal was moved 1,897 feet north and redesignated signal 816/817. Signal aspects were provided for all four tracks. As with the home signals, the distant signals were mounted on an overhead signal bridge with top aspects about 35 feet above the rails. Signal 816/817 was located in a long $0^{o}18'$ left-hand curve northbound (see figure 7). Relocation of the distant signal as well as relocation of the home signals reduced the distance between them to 10,318 feet.

Gunpow is an all-relay type manual interlocking using General Railway Signal (GRS) Phase Selective code system track circuits and GRS remote-controlled power switch machines. The switch machines protect against gaps between switch points and mated stock rails of 1/4 inch or more, and they cannot be readily

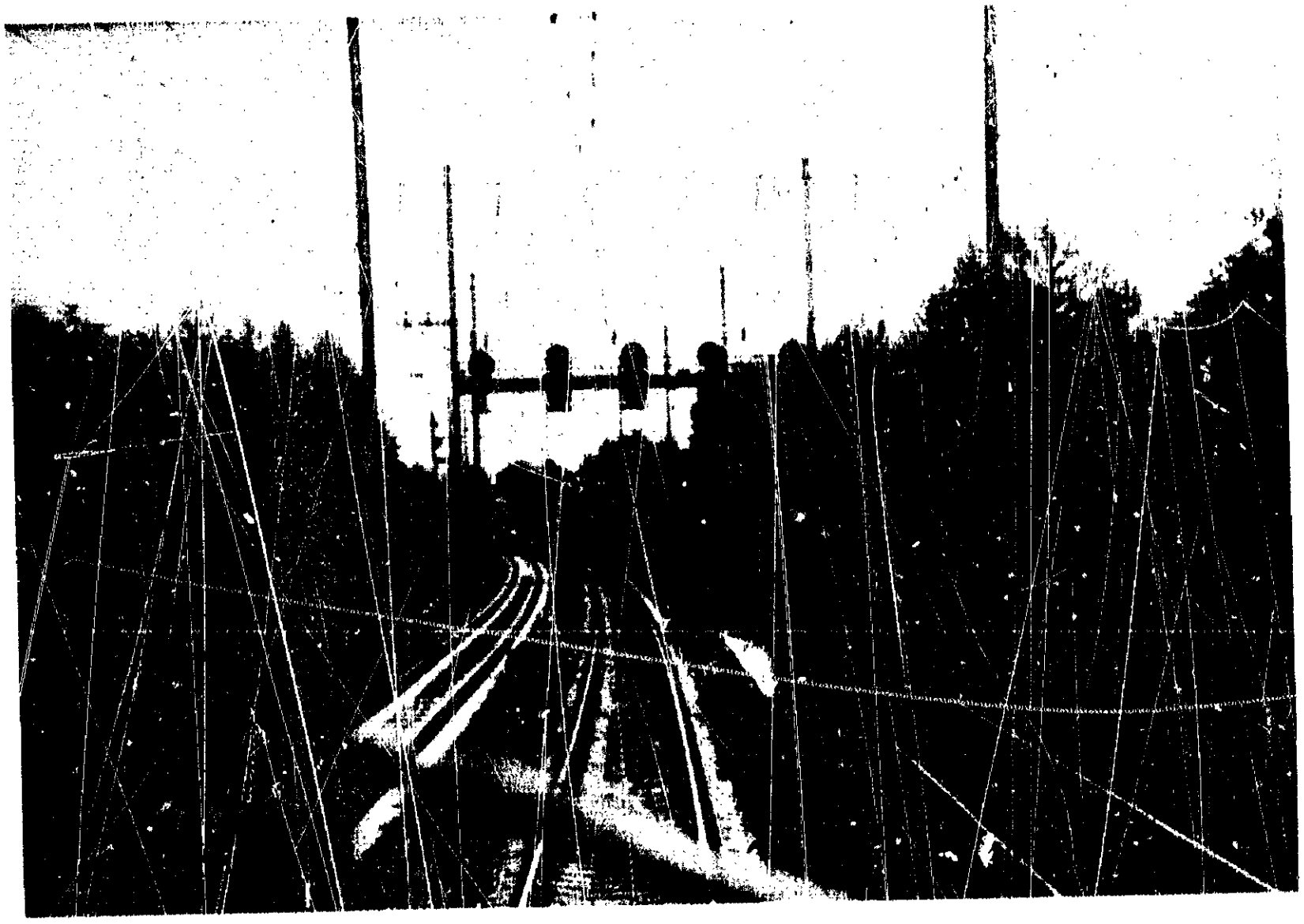


Figure 7. Distant signal 816/817 located 10,318 feet south of the home signals at Gunpow, as viewed from a northbound train moving at 125 mph on track 2. The aspect displayed for the train by signal 816-2 is "clear;" the aspects displayed for track 1 and track A to the right are "approach." A stop aspect is displayed for track 3 because the track is set up for a southbound train.

taken out of motor control and thrown by hand. Aspects of the approach signals are automatically determined by the aspects displayed by the corresponding home signals through the transmission of 100 Hz energy in the rails. The code rates (intermittent impulses of energy transmitted per minute) and the resulting distant signal aspects are as follows:

Code Rates	Aspect
None	Stop and Proceed
75	Approach
120	Approach Limited
180	Clear

When the operator at Edgewood block station requests the desired aspect on the appropriate home signal by moving a lever on the modelboard, the system automatically checks safety circuits to determine if the request conflicts with any existing condition. If no conflict exists and after switches have been properly aligned to establish the correct route through the interlocking, the machine displays the proper signal aspect.

A green signal indicator light is displayed on the operator's modelboard when the request has been fulfilled. A red light over the switch lever indicates that the switch involved is locked in position for the desired route. As a train approaches the interlocking on the requested route, a yellow train occupancy light is displayed. Once the train has passed the home signal, the signal indication light changes from green to red. The home signal itself displays a "stop" aspect after being passed by the train, and it continues to do so until the operator requests a redisplay of the route or a different route. Because of the design of Gunpow interlocking, once a route has been established, it cannot be changed until the home signal aspect has been changed to "stop" and a minimum timelock of 4 minutes 29 seconds has passed.

The relay instrument control house of Gunpow interlocking was monitored by a computerized event recorder that provided digital data on the position of all relays in the interlocking system and the times to the tenth of a second that the positions of relays changed. All signal aspect displays, switch positions, and traffic circuits associated with the interlocking were thus recorded. The initial clock time for the microprocessor-generated output was set by a signal maintainer during regular inspections, but no effort was made to synchronize the time with standard time because it was necessary only to measure the time elapsed between changes. The event recorder performed a 1-second test every hour and could record 1,500 relay position changes before recycling.

The wayside signals at and approaching Gunpow from the south were double-aspect, one-color, position-light type, and they were continuously illuminated. The upper aspect consisted of a flat steel plate disc about 52 inches in diameter with a black face. There were from three to seven amber lights with lenses of 5 3/8-inch diameter mounted on the disc. One light was in the center of the disc; the other lights were arranged along the perimeter, opposed to each other in pairs and aligned with the center light. Three lights were displayed at a time in a straight-line configuration, vertically, horizontally, or diagonally (45^{0} to 225^{0}), depending on what aspects the signal was designed to display. The distance between the centers of the outside lights of any three-light combination was 36 inches.

The lower and top signal aspects were similar except that the lower aspect was not a complete disc and it was narrower. It could not display the horizontal combination of lights and could

have either three or five lights. The lights of both top and bottom aspects were shielded by black hoods that protruded about a foot forward from the plate face.

Home signal 2N for track 2 at Gunpow had a top aspect with seven lights arranged to display vertical, horizontal, and diagonal configurations. The bottom aspect had five lights and could display vertical and diagonal configurations. Home signal 1N had three lights in the top aspect arranged horizontally. The five-light bottom aspect was the same as signal 2N. Signal 816-2, the approach signal for track 2, had a seven-light top aspect identical to signal 2N and a vertical three-light bottom aspect. Signal 816-1, the distant signal on track 1, also had a vertical three-light lower aspect, but its upper aspect had five lights arranged horizontally and diagonally (see figure 8). (Appendix C also provides more details on the signal aspects.)

The position-light signal combinations that could be displayed at Gunpow for northbound trains on tracks 1 and 2 were as follows:

If the Edgewood operator had encoded the route for a northbound train to proceed through Gunpow interlocking on track 2 with the track clear through Magnolia, the following aspects should have been displayed:

Distant Signal 816-2 and Home Signal 2N

Rule	Aspect	Name	Indication
281	Vertical on top aspect.	Clear	Proceed

Distant Signal 816-1

Rule	Aspect	Name	Indication
285	Diagonal on top aspect.	Approach	Proceed; prepared to stop at next signal. Train exceeding medium speed must reduce to that speed at once. 10/

Home Signal 1N

Rule	Aspect	Name	Indication
292	Horizontal on top aspect.	Stop signal	Stop

10/ Amtrak defines medium speed as "not exceeding 30 mph."

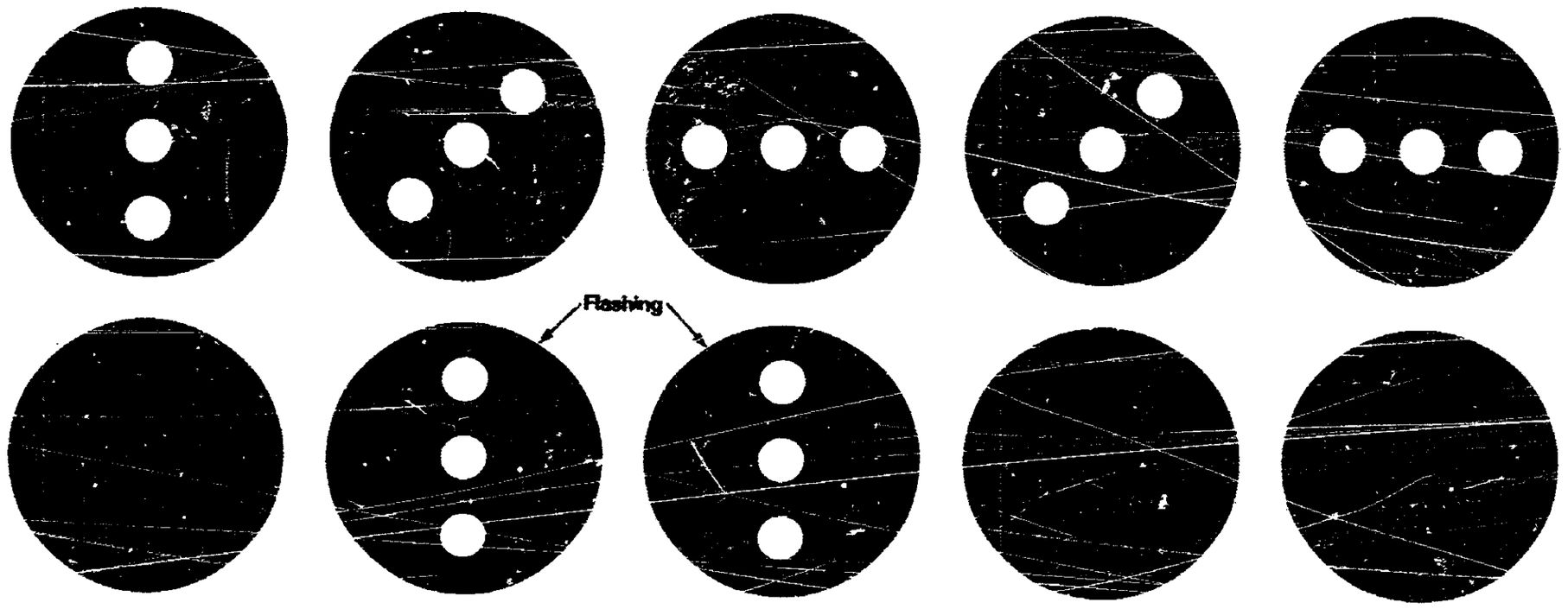


Figure 8. Aspects that could be displayed by home signals 1N and 2N and distant signals 816-1 and 816-2 at Gunpow. (The numbers in parentheses refer to the relevant operating rules.)

The following aspects should have been displayed had the operator encoded the route for a northbound train to proceed from track 1 to track 2 and then either north on track 2 or through the crossover to track 3, then north on that track; in either case, the tracks should have been clear through Magnolia:

Distant Signal 816-2

Rule	Aspect	Name	Indication
285	Diagonal on top aspect.	Approach	Proceed; prepared to stop at next signal. Train exceeding medium speed must reduce to that speed at once.

Home Signal 2N

Rule	Aspect	Name	Indication
292	Horizontal on top aspect.	Stop signal	Stop

Distant Signal 816-1

Rule	Aspect	Name	Indication
281(B)	Diagonal on top; flashing vertical below.	Approach limited	Proceed; approaching next signal at limited speed. 11/

Home Signal 1N

Rule	Aspect	Name	Indication
281(C)	Horizontal on top; flashing vertical below.	Limited clear	Proceed; limited speed within interlocking limits.

11/ Amtrak defines limited speed as not exceeding 45 mph for passenger trains and not exceeding 40 mph for freight trains.

If the operator routes a northbound train from track 1 to either tracks 2 or 3 and the first signal north of Gunpow in either case displays a "stop and proceed" aspect, the following aspects should have been displayed:

Distant Signal 816-2

Rule	Aspect	Name	Indication
285	Diagonal on top aspect.	Approach	Proceed; prepared to stop at next signal.

Home Signal 2N

Rule	Aspect	Name	Indication
292	Horizontal on top aspect.	Stop signal	Stop

Distant Signal 816-1

Rule	Aspect	Name	Indication
281(B)	Diagonal on top; flashing vertical below.	Approach limited	Proceed; approaching next signal at limited speed.

Home Signal 1N

Rule	Aspect	Name	Indication
286	Horizontal on top; flashing diagonal below.	Medium approach	Proceed at medium speed preparing to stop at next signal. Train exceeding medium speed must reduce to the speed at once.

The following aspects should have been displayed if the operator routes a northbound train from track 1 to either tracks 2 or 3 when the first block north of Gunpow in either case is occupied:

Distant Signal 816-2

Rule	Aspect	Name	Indication
285	Diagonal on top aspect.	Approach	Proceed; prepared to stop at next signal.

Home Signal 2N

Rule	Aspect	Name	Indication
292	Horizontal on top aspect.	Stop signal	Stop

Distant Signal 816-1

Rule	Aspect	Name	Indication
285	Diagonal on top aspect.	Approach	Proceed; prepared to stop at next signal.

Home Signal 1N

Rule	Aspect	Name	Indication
291	Horizontal on top; center light displayed below.	Stop and proceed	Stop; then proceed at restricted speed.

The one-color position-light signal system, which is now unique to the NEC, was developed by the Pennsylvania Railroad and used universally throughout its system and the lines of some of its affiliates, most notably the Norfolk and Western Railway. An advantage of this kind of signal was the ability to recognize signal aspects based on universal railway hand signals--horizontal for stop and up and down for "go ahead" or proceed. However, the more widely used practice was the use of various color-light signal systems based on the traditional colors or combinations of those colors--red for danger, yellow for caution, and green for safety. A third system, the color-position type, was an effort to make the identification of signal aspects even easier by combining the traditional positions and colors--the red horizontal lights, the yellow diagonal lights, and the green vertical lights.

In the 1970s, Norfolk and Western modified its one-color Pennsylvania-type signals to the color-position type. When Conrail was formed as a result of the Penn Central reorganization, it took over the former Pennsylvania lines exclusive of the NEC lines that passed to Amtrak. Conrail has modified all of the Pennsylvania one-color position interlocking signals by replacing the amber lenses of the horizontal position lights with red lenses. According to Amtrak's chief signal engineer, a similar modification was planned for the corridor signals under the Northeast Corridor Improvement Project, but was dropped due to a cut in funding.

According to Amtrak, there were three "false clear" signals reported on the corridor during 1986. 12/ All of the "false clear" signals occurred in station areas and resulted from the introduction of foreign current into the signal system. There were no reports of "false clear" signals at Gunpow before this accident.

Automatic Cab Signal System.--On the corridor between New York and Washington there is a continuous-induction ACS system that repeats the wayside signal aspects on a four-aspect cab signal installed in the cabs of the locomotives. At the time of the accident, all locomotives and multiple-unit commuter cars operating on the corridor were equipped with these cab signals. As the train passes a wayside signal, the corresponding aspect of the cab signal is illuminated. From top to bottom, the four aspects are "clear," "approach medium," "approach," and "restricting" (see figure 9). Wayside signal aspects "approach limited" and "stop" are displayed on the cab signals as "approach medium" and "restricting," respectively. The same 100 Hz energy in the rails that activates the wayside signals also activates the cab signals. The code rates 13/ and resulting cab signal aspects are as follows:

Code Rates	Aspect
None	Restricting
75	Approach
120	Approach Medium
180	Clear

On high-speed track 2 approaching Gunpow, there is a cab signal code change point, identified as CS-826, 4,749 feet south of northbound distant signal 816-2. If signal 816-2 were to change to an "approach" aspect because home signal 2N had changed to a "stop" aspect, then the aspect of the cab signal of a northbound train that had been running on a "clear" aspect on track 2 would have changed to "approach medium" at CS-826. This code change point was installed when the Gunpow signals and track configuration were changed in 1985. In effect, it provides northbound trains with 15,067 feet of stopping distance compared with the 12,585 feet available before the modifications. There is no code change on track 1 at CS-826, but there is another code change point, CS-806, on all four tracks 4,450 feet south of the northbound home signals at Gunpow (see figure 10).

12/ A "false clear" is a signal aspect less restrictive than that which should have been displayed.

13/ The "code" generated by a code transmitter that controls the current supplied to the track circuit in the rails so that the rails will be intermittently energized with "on" and "off" periods of approximately uniform length. The rate at which these periods occur determines the "code".

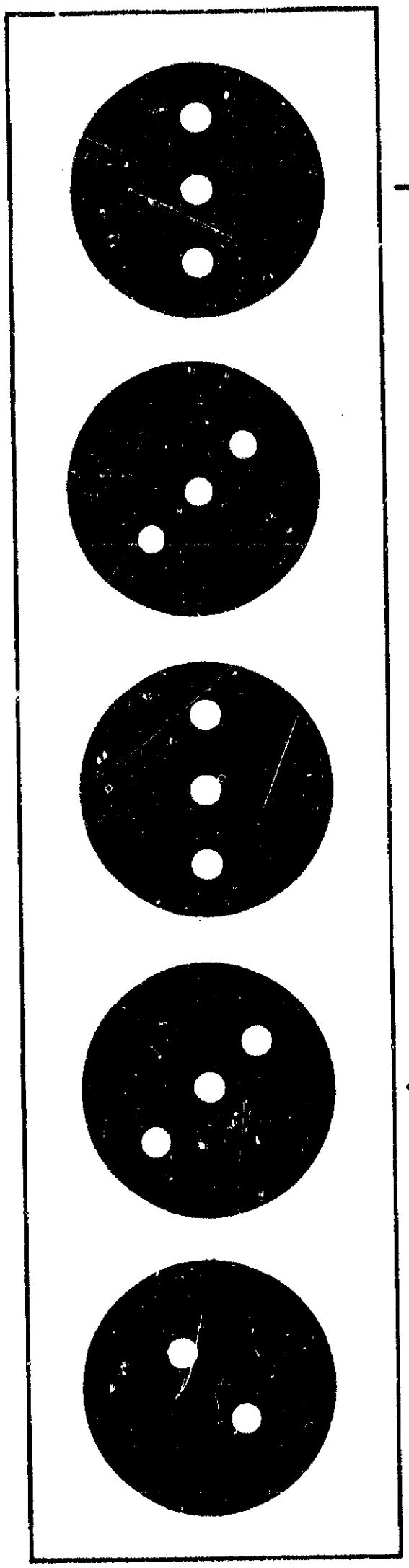


Figure 9. Aspects displayed by the ACS system, as they are arranged on the signal box inside the signal box inside the locomotive cab.

Figure 10. Code chande point CS-806 as seen from a northbound train on track 2. Th nearest catenary support poles mark the location of the code change point. The Gunpow home signals are in the distance.

A northbound train on track 1, having received an "approach limited" aspect displayed by distant signal 816-1 and thus concurrently displaying an "approach medium" on the cab signals, would have had the cab signals change to "approach" if home signal 1N changed to "stop" before the train reached CS-806. When the train reached CS-806, the cab signals would change to "restricting." If the train was already past CS-806 when the home signal changed to "stop," the cab signals immediately would have changed to "restricting" as a result of the loss of the code rate.

Similarly, a northbound train on track 2 proceeding on a "clear" aspect received at signal 816-2 would have had a cab signal change to "approach" if home signal 2N changed from "clear" to "stop" before the train reached CS-806 and from

"clear" to "restricting" at CS-806. Again, the cab signal would have changed to "restricting" if the home signal changed after the train passed CS-805.

Amtrak and Conrail rule 34 require the crewmembers in the cab of a locomotive unit to observe and call out the aspects of all signals to other crewmembers. Rule 551 of both railroads requires that the engineer comply with the more restrictive aspect when wayside signal and cab signal aspects differ and to take action at once to reduce to "restricted speed" when the cab signal changes to "restricting." The rule further states that the cab signal apparatus must be considered to be in failure when any "damage or fault" occurs to any part of the cab signal apparatus, including a failure of the cab signal alerter whistle to sound when the cab signal changes to a more restrictive aspect. Amtrak and Conrail rule 554 states that a train may not leave its initial terminal when the cab signal apparatus is in failure (see appendix C). If failure occurs en route, the dispatcher or operator must be notified promptly; the train may proceed according to signal indication, but it may not exceed 40 mph. However, with the ACS in failure, a train may not pass a "stop and proceed" signal unless authorized to do so by the dispatcher.

Train Information

Amtrak Train 94.--Train 94 was assembled on the morning of the accident and consisted of Amtrak electric locomotive units 903 and 900, 11 Amfleet-class passenger cars, and 1 Amtrak Heritage-type passenger car. The trailing light weight of the train was about 634 tons. The locomotive units had been used on southbound passenger train 89 earlier the same day, arriving at Washington at about 11:35 a.m. The locomotive units were not turned, and therefore, unit 903, which had been the trailing unit on train 89, became the lead unit on train 94. Because unit 903 had no operable radio in either end, a radio unit from unit 900 was installed in the lead end of unit 903.

Amtrak mechanical employees performed the required predeparture inspections and tests at Washington. According to the equipment condition report (see appendix F), the mandatory test of the ACS equipment was completed at New York at 9 p.m., January 3, and the employee who performed the test attested to the state of the equipment. This report also indicated that the locomotive's speed indicator was "O.K."; that the airbrakes, brake rigging, dynamic brake, radio, and sanders were "operative"; and that there was 110 pounds brakepipe pressure and 140-130 pounds main air reservoir pressure when it was tested at Washington on January 4. The testing at Washington was completed at 12:20 p.m., January 4. The mechanical foreman on duty signed the equipment condition report and released train 94 to the engineer at 12:34 p.m., about 1 minute before the train left Washington's Union Station.

Train 94's locomotive consisted of two General Motors (GM)/ASEA model AEM-7 electric units delivered to Amtrak in 1979. 14/ The units were operated in multiple by electric current collected by a pantograph from the catenary at a nominal 11,000 volts a.c. and transformed and rectified into low-voltage direct current for the traction motors. Each unit, rated at 7,000 diesel-equivalent horsepower, was 51 feet 2 inches long, had two two-axle trucks with 51-inch-diameter wheels, and weighed 100,9 tons.

The AEM-7's four traction motors were geared for attaining a maximum operating speed of 125 mph. The units were equipped with overspeed control, Type F interlocking couplers, anticlimbers on the end sills, vapor electronic alertness control, Union Switch & Signal Schedule 384 ACS and train speed control systems, dynamic braking, and Schedule 384 ACS and train speed control systems, dynamic braking, and Schedule 26-L1C air brake system with pressure maintaining feature. The units were also equipped with speed cruise control with speed selection from 12.5 to 125 mph. When the selected maximum speed is achieved, the control modifies the controller setting to limit speed to the selected value. This device does not employ braking to govern speed.

The AEM-7 unit is double-ended with identical operating cabs and cab equipment at both ends. Laminated Triplex polycarbonate windshields run nearly the full width of the end bulkheads and are separated by the collision posts. The slightly concave end bulkheads are flush with the end sills, and there are no end doors or exterior platforms or walkways. Access to the cabs is through hinged doors on each side at both ends; the cabs are connected by narrow passageways through the car body. Access to the passageways is through hinged doors in the rear cab bulkheads. There is a floor-mounted swivel seat on each side of the cab and a retractable jump seat in the rear bulkhead of each cab.

The engineer's seat is on the right side of the cab behind a flat-topped desk-type operating console with a raised instrument panel. A controller with 10 motoring and 6 braking zones, the reverser, and the radio handset are on the left side of the console top. The handles for the automatic and independent brake valves are on the right side of the console. An analog-type speed indicator is on the instrument panel directly in front of the engineer's seat. A second speed indicator is mounted on the center collision post where it can be observed from the left-hand helper's seat. The source of the speed signal is an axle alternator that measures axle revolutions

---

14/ The AEM-7 is a Swedish-design locomotive built under license by General Motors. Its design was extensively modified for high-speed right-hand operation on the corridor. In addition to the 48 Amtrak units, 4 units have been built for MARC Baltimore-Washington commuter service on the corridor.

against time. The diameter of the wheels on the monitored axle is critical to the indicators' accuracy. According to Amtrak, the speed indicators are checked for accuracy every 45 days.

Service braking with the AEM-7 can be performed by either the automatic airbrake alone or by "blended" braking which is maximum dynamic braking supplemented by airbraking. Mechanical braking uses both iron-tread brakeshoes and disc brakes with composition pads.

Through a sensor in the engineer's seat, the alertness system can monitor the engineer's movements whenever the airbrakes are in the released position. If, within 24 seconds, the system cannot sense any movement of the engineer, a white light flashes on the instrument panel. Failure of the engineer to respond to the flashing white light results in the sounding of a siren. If the engineer does not respond to the siren after 8 seconds, a "penalty" full-service brake application is automatically initiated. Once initiated, the penalty brake application cannot be overridden, and the train will come to a complete stop.

The four-aspect cab signal is located on the center collision post. There is also a red indicator light to alert engineers to overspeed and an audible alarm to alert them when the cab signal changes to a more restrictive aspect. A pushbutton on the left side of the engineer's console must be depressed to acknowledge restrictive changes in the cab signals. It must also be depressed to reset the alertness control system after that system's alarm system is activated. Failure to acknowledge a more restrictive cab signal aspect or failure to initiate airbrake suppression if exceeding cab signal speed will also result in a penalty full-service brake application.

Cut-out cocks, normally sealed in the "in" or operative position, cut the train control and alertness control systems out of the airbrake system. They are in an equipment closet of the AEM-7 and are fully accessible to engineers without their having to dismount from the unit.

Amtrak's newest AEM-7 units 930-947 are equipped with Pulse event recorders that continuously record multiple data including speed, time, traction motor current, braking and motoring events, and direction of travel. However, AEM-7 units 900-929, which included the units assigned to train 94, were equipped with Aeroquip/Barco recorders that use paper tape to permanently record speed and distance. Both units of train 94 had operable recorders; the recorder tape in unit 903 was scaled 2 miles to the inch, whereas the tape in unit 900 was scaled 4 miles to the inch. Amtrak's chief mechanical officer testified that the Pulse event recorders were more reliable than the Barco recorders, and he stated that Amtrak planned to ultimately install the Pulse recorders on the older AEM-7 units.

According to the manufacturer's specifications, the AEM-7 electric locomotive can reach 120 mph from 0 mph in 4 minutes over a distance of 5 1/3 miles at the maximum acceleration rate. Nominal theoretical stopping distances of a single locomotive from 120 mph are 6,500 feet with full-service airbrake application, 6,000 feet with full-service blended brake application, and 4,800 feet with emergency brake application. The average deceleration rates are 1.75 mph/second with full-service blended brake application resulting in a stop from 125 mph in 71.4 seconds. The average emergency brake application deceleration rate is 2.25 mph/second which would achieve a full stop from 125 mph in 55.5 seconds.

Amtrak does not have a Train Dynamics Analyzer or other simulation computer, and as far as the Safety Board was able to learn, Amtrak had never used such a device to simulate high-speed braking performance of different equipment combinations under varying weather, profile, and alignment conditions. However, in April 1980, Amtrak performed actual braking tests with one AEM-7 unit and six unoccupied Amfleet-class cars at one location on the NEC under dry rail conditions. Stops were achieved from 120 mph in 7,200 feet with full-service airbrake application and in 6,900 feet using full-service blended brake application. No stops employing an emergency brake application were performed.

Amtrak's chief signal officer and chief mechanical officer estimated that a Metroliner passenger train traveling at 120 mph would require 10,700 feet stopping distance with a full-service brake application making allowance for reaction time plus a safety factor. The chief mechanical officer further testified that, on this basis, such a train could be stopped in 7,480 feet with an emergency brake application. He also stated that the longer the train, the higher the braking ratio and the shorter the distance needed to stop.

All of the cars in train 94 were of all-steel single-level construction, had two four-wheel trucks, were equipped with Type H tightlock couplers, and had laminated double-glazed sashes with Lexan polycarbonate shatterproof glazing on the inside.

There were four emergency escape windows in each car with two on each side near the ends. These windows were fitted with a red handle on the inside designed for pulling the glazing inward after removing the rubber molding around the window. Each car had a self-contained emergency lighting system, fire extinguisher, and emergency tools.

The passenger cars all had type 26-C passenger car brakes; the Amfleet cars had both composition tread shoes and disc brakes with composition pads, while the Heritage car had disc brakes only. According to the conductor, the communicating signal line connecting all the cars and the locomotive was inoperative since the train left Washington. Using a small portable radio, the

conductor was able to communicate with the engineer. Other than the train's public address system, the three assistant conductors had no means to communicate with each other and the conductor when they were separated. In addition, the conductor stated that a control for simultaneously opening or closing all the doors in the train from one location was also inoperative.

The makeup of train 94 from the front to rear was as follows:

Position in Train	Car Number	Car Type
1	20039	Food Service ("Amcafe")
2	21236	Coach ("Amcoach")
3	21038	Coach ("Amcoach")
4	21241	Coach ("Amcoach")
5	21018	Coach ("Amcoach")
6	20051	Food Service ("Amcafe")
7	21075	Coach ("Amcoach")
8	21051	Coach ("Amcoach")
9	21065	Coach ("Amcoach")
10	21273	Coach ("Amcoach")
11	7624	Coach ("Heritage")
12	20145	Food Service ("Amclub")

Except for Heritage coach 7624, all of the cars were of the "Amfleet" type built by the Budd company in 1977. They were nominally 85 feet long with vestibules at both ends and electrically powered sliding side doors on both sides of the vestibules. The sliding end doors were also electrically powered. The trucks had inboard roller bearings and combination air bellows and coil spring suspension.

The 52-ton coaches had 84 floor-mounted transverse seats with high reclining backs arranged in pairs, 21 pairs on each side of a center aisle (see figure 11). The seats could be manually rotated 180^{0}, and they had latches to prevent undesired rotation from impact or rollover forces. The coaches had a small coat locker at one end, two small toilet rooms at the other end, and open overhead luggage shelves above the seats on both sides.

There was a pantry and food serving counter located in the middle of each of the 58-ton food service cars. These areas contained unsecured microwave and convection ovens, coffeemakers, and other equipment. The "Amcafe" cars had a total of 53 passenger seats of the same type as in the Amfleet coaches arranged in passenger compartments on each side of the pantry-counter area. The "Amclub" car had 23 standard coach seats in one passenger compartment and 18 club chairs facing dining tables in the other compartment (see figure 11).

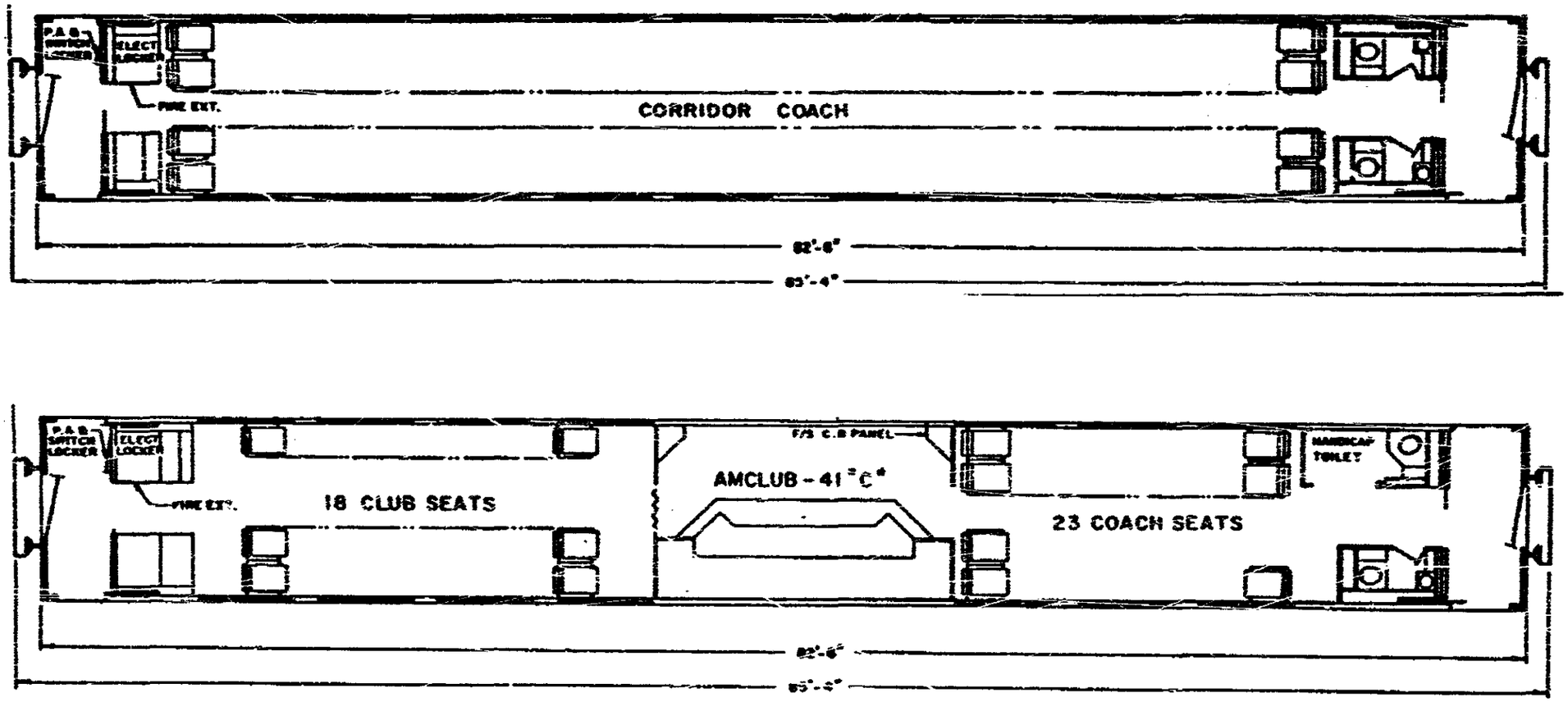


Figure 11. Floor plans of Amcoach and Amfleet food service cars.

Heritage-type coach 7624, second to the last car in the train, was nominally 85 feet long and weighed 61 tons. It was built by Budd in 1953 as a 48-passenger long-distance coach with 12 pairs of reclining seats on each side of the center aisle. Only one end had a vestibule with inward-swinging hinged end and side doors. The vestibule end contained a large women's lounge and a shelved luggage compartment. The other end contained two large men's toilets. Amtrak rebuilt the car about 1980, removing the women's lounge and the luggage compartment and adding 10 pairs of seats to each side. This remodeling increased the seating capacity to 88. As rebuilt, the car had open luggage racks the full length of each side over the seats.

The Heritage coach has conventional radial trucks with coil spring suspension only. According to a Department of Transportation (DOT) study, 15/ such trucks have a lower critical speed than the newer trucks with airbag/coil spring suspension on the Amfleet cars and, consequently, decreased lateral stability and curving performance. Operation at speeds beyond the performance limits of conventional trucks will result in severe truck and car body hunting, increased flanging when negotiating curves, and increased track-wheel forces and wear.

Conrail Train ENS-121.--Conrail ENS-121 consisted of three General Electric (GE) model B36-7 diesel-electric freight locomotive units that had been delivered to Conrail in 1983. Lead unit 5044 had its short hood or cab end forward; middle unit 5052 and trailing unit 5045 had their cab ends facing rearward. All three units were under power and were being operated in multiple from lead unit 5044. Coupled, the units were 180 feet long and weighed 407 tons. The units had two two-axle trucks with 40-inch-diameter wheels and a traction motor on each axle. The combined rated crankshaft horsepower of the units was 10,800.

The Conrail locomotive units were equipped with the 26-L airbrake equipment with a pressure-maintaining feature. The units were also equipped with standard dynamic braking and a power control switch (PCS) without a time delay feature. 16/ The PCS was activated only by an emergency application of the automatic brake valve or a full-service brake application initiated by the "deadman" safety control.

15/ "Performance Limits of Rail Passenger Vehicles-Conventional Radial and Innovative Trucks," March 1982 (DOT-RSPA-DPB-50-81-28)

16/ When an emergency brake application occurs, the PCS acts to idle the locomotive's diesel engines. Not all diesel-electric locomotives have this device. Some railroads have adopted a modified PCS that delays the cutoff of engine power for as long as 20 seconds to prevent run-in of slack. The ENS-121 units did not have a PCS with the delay feature.

The Conrail units had end platforms with stepwells to both sides on both ends. There were walkways on both sides between the cab and the end platforms. A hinged door in the left side of the forward cab bulkhead opened to the left forward walkway and provided access to and from the forward-end platform. A similar door in the right side of the rear bulkhead gave access to the rear right-side walkway and the rear-end platform. The engineer's seat was on the right side in front of the rear door. There were two seats on the left side of the cab behind the front door (see figure 12). The distance from the front door to the left front stepwell and the front-end platform was about 3 feet.

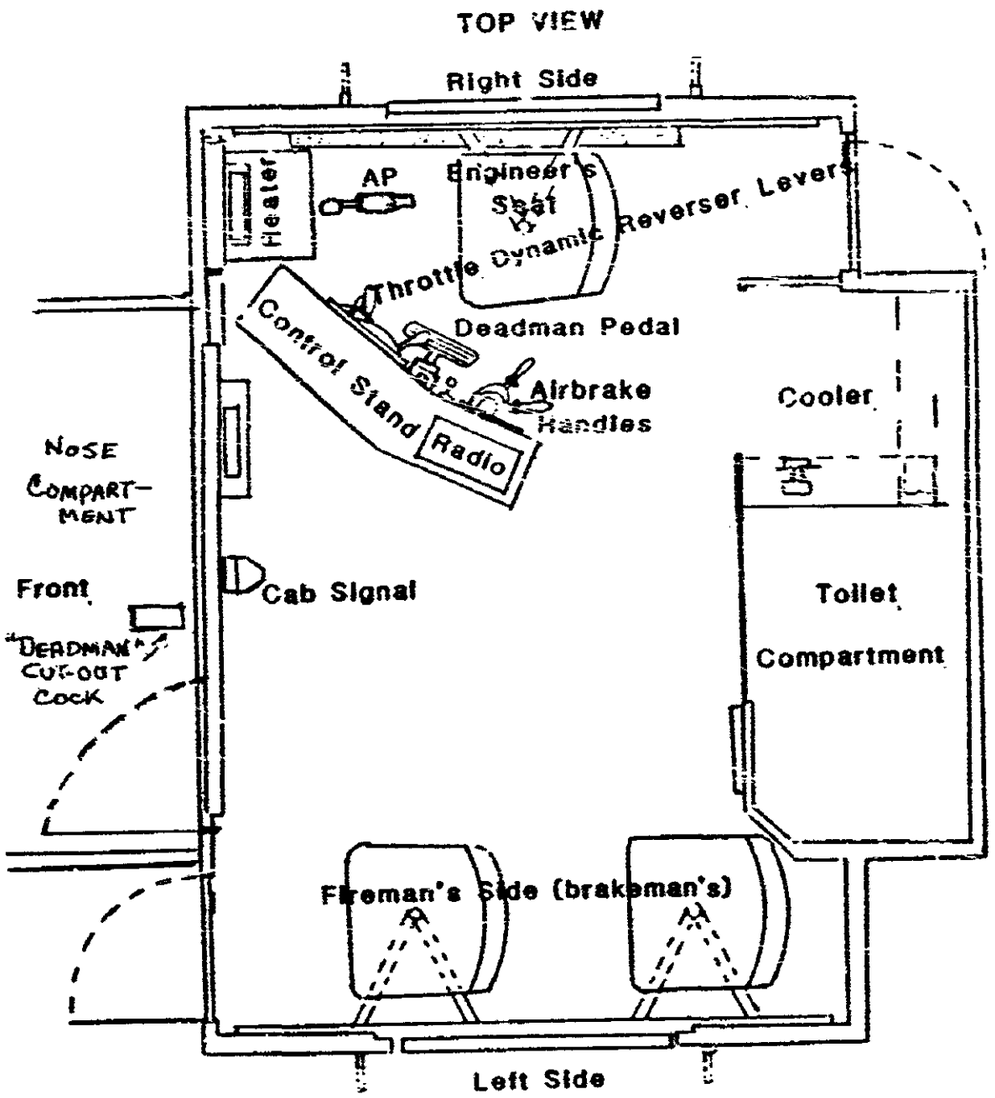
The windshield was located in the forward cab bulkhead above the short, low-profile front hood and was separated by a divider. The windshield was flanked by two smaller windows--one in the front door on the left side and one in front of the engineer's seat. All of these front windows were of laminated polycarbonate shatterproof material. A door to a small compartment in the front hood was located in the forward cab bulkhead under the windshield.

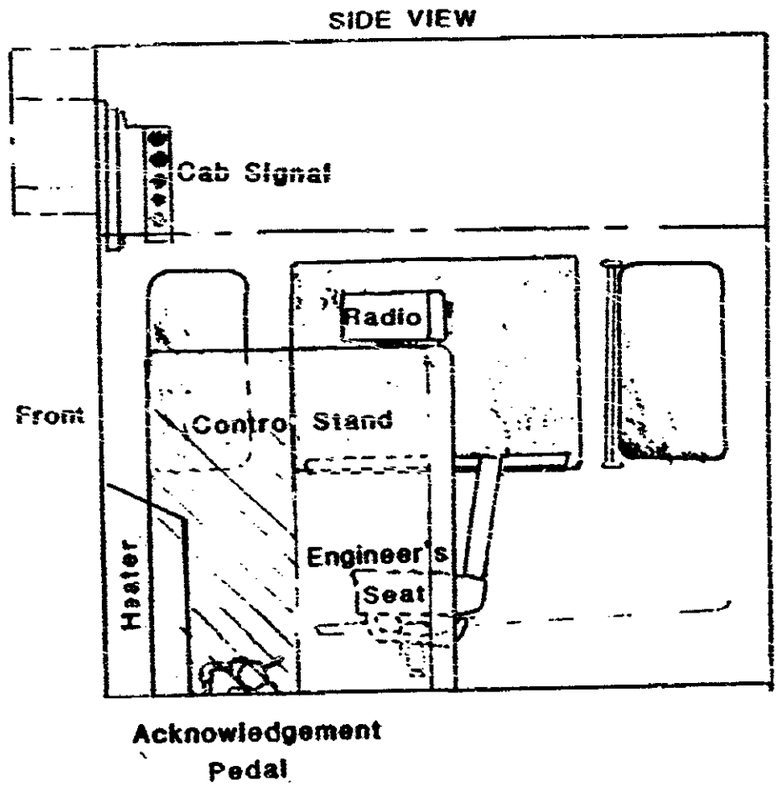
The control and airbrake stands were in the right side of the cab, and the throttle, dynamic brake, and reverser levers were in front of the engineer's seat with the airbrake handles and radio handset to the left of the seat (see figure 12). An emergency brake valve was located on the left side of the cab.

An elongated safety control or "deadman" foot pedal was on the floor in front of the control stand, forward and to the left of the engineer's seat. This pedal had to be kept depressed to prevent a "penalty" full-service airbrake application. The penalty airbrake application could also be prevented by cutting the deadman feature out of the airbrake system. A cut-out cock for this purpose was located inside the nose compartment and could be accessed without leaving the cab (see figure 12). According to Conrail, the deadman cut-out cocks are kept sealed in the "in" or operative position. After the accident, the deadman cut-out cock of unit 5044 was found unsealed and in the "out" position.

The four-aspect cab signal of unit 5044 was of the same configuration as the Amtrak AEM-7 locomotives; it was mounted in the middle of the forward cab bulkhead at the top of the windshield. The hinged cover had two sets of aspect ports set at oblique angles so that one could be viewed from each side of the cab. The top port was the "clear" aspect, the next two below were the "approach medium" aspect, the next below was the "approach" aspect, and the bottom port was the "restricting" aspect. There were screw-in receptacles in the signal box for four small white bulbs--one for each aspect. An examination of the signal box after the accident revealed that the bulb for the "approach" aspect was missing (see figure 13). All the other aspects had operative bulbs that were properly inserted.

CONRAIL LOCOMOTIVE CAB (5044)





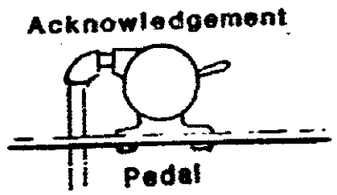


Figure 12. Floor plan and side elevation of the cab of Conrail locomotive unit 5044.

Figure 13. Cab signal of Conrail unit 5044 with the cover removed; the bulb for the "approach" aspect is missing.

As with the Amtrak cab signals, a change to a more restrictive cab signal aspect has to be acknowledged by the engineer. To acknowledge the signal, the engineer depresses and then releases the cab signal acknowledgment pedal on the floor in front of the cab heater where it was convenient for engineers to operate the pedal with their right foot. When an engineer failed to acknowledge a more restrictive cab signal aspect, a loud, shrill air-operated whistle was activated in the cab when the wayside signal was passed. Unlike the deadman pedal, the acknowledgment pedal could not be continuously depressed since only the action of releasing the pedal could silence the whistle. There was no penalty brake application initiated if the whistle was not acknowledged. All of Conrail's 1,300 road freight diesel-electric units were equipped with this type of automatic cab signal (ACS) apparatus. None of the units had an automatic train stop (ATS) or automatic train control (ATC) modification

that would stop the train if the engineer failed to acknowledge a more restrictive cab signal aspect. (See appendix L for more details on ATS and ATC.)

The 6 1/2-inch cab signal whistle was mounted in the airbrake control stand and could be accessed by unsnapping six latches that held the back cover in place. Following the accident, investigators removed the cover from the airbrake control stand of unit 5044 and found the port of the whistle wrapped tightly with duct tape (see figure 14). In this

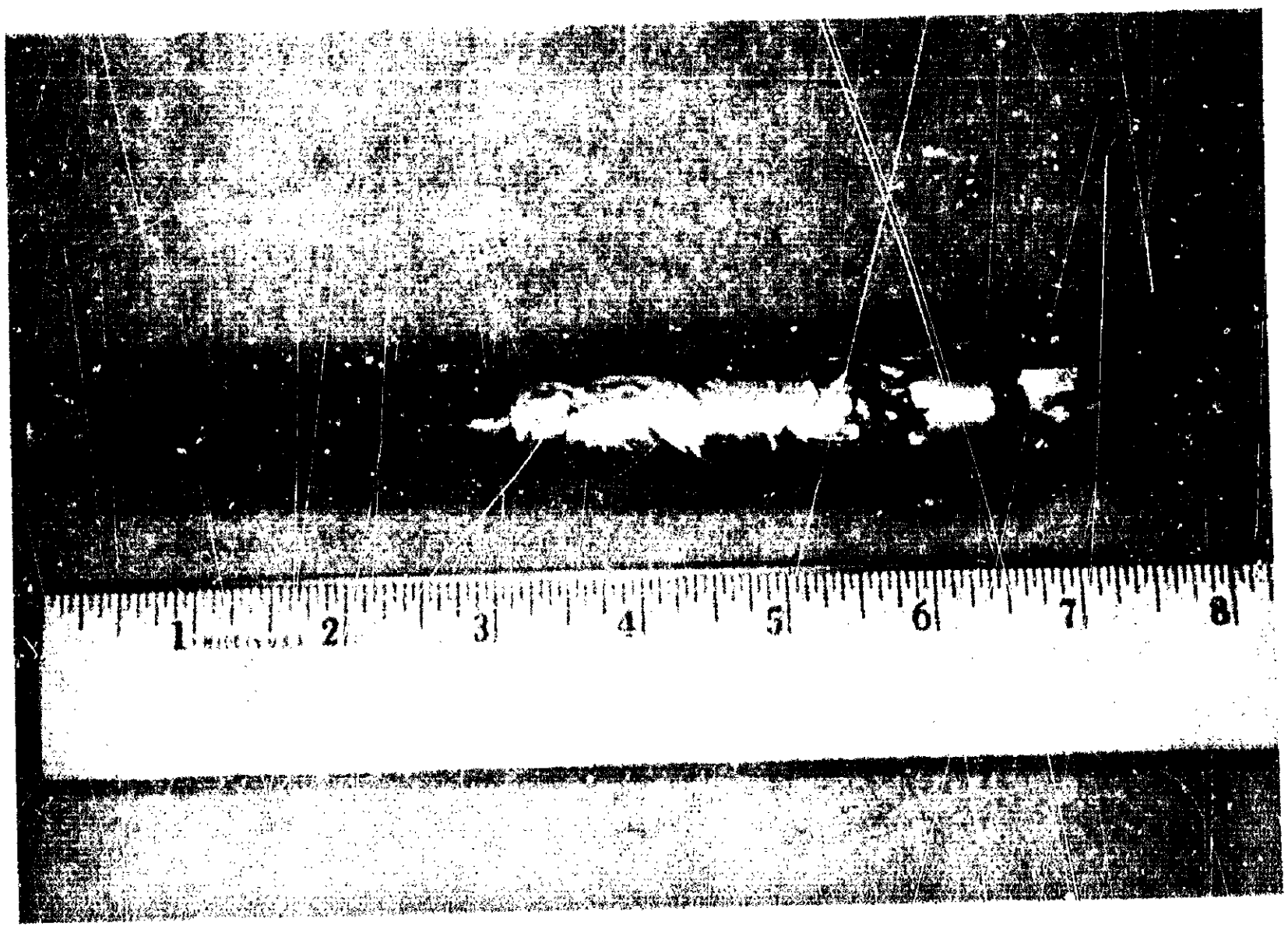


Figure 14. The cab signal whistle removed from Conrail 5044 with the port covered by duct tape.

condition, no sound could be heard over the sound of the idling engine of an adjacent locomotive. When the tape was slit at the port, the whistle emitted sound at a normal 95- to 105-decibel level.

According to Conrail's superintendent of locomotive power-east, he recalled 6 to 10 instances in which cab signal whistles had been removed from locomotives, but he knew of no instance where a whistle had been muted with tape. Following the accident, FRA inspectors reportedly found "six to eight" taped cab signal whistles on Conrail locomotive units at various locations.

In 1979 the Safety Board investigated a rear-end collision that killed two crewmembers on the Union Pacific Railroad (UP). 17/ In that accident, a brakeman muted the ACS alerter whistle with a rag; a relieving crew later went past a "stop and proceed" wayside signal with a "restricting" aspect on the ACS and struck another train. At that time, UP had ACS without ATS or ATC backup. As a result of its investigation, the Safety Board recommended that UP modify its ACS apparatus to provide for automatic penalty brake application when the engineer fails to acknowledge a more restrictive signal. UP subsequently complied with this recommendation.

Amtrak rule 136 and Conrail rule 132 prohibit employees from "altering, nullifying or interfering with the normal intended function of any device or equipment on engines..." Amtrak rule 553 requires that trains from connecting railroads be equipped with an operative cab signal system, and rule 550 of both railroads requires that when the engineer takes charge, the cab signal apparatus must be energized, and the audible indicator should sound when the acknowledging device is operated.

Amtrak and Conrail rule 550 also requires that the cab signal apparatus of the engine "....be tested at least once in each 24-hour period except when a single trip exceeds 24 hours..." and "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." The rule requires that with a locomotive consisting of two or more units, the test must be made "from front end of leading unit and rear end of trailing unit" (see appendix C). A test circuit was provided for such testing at Bay View Yard. The test circuit was not long enough to test both ends of the three-unit locomotive without moving the locomotive between the tests.

17/ Railroad Accident Report--"Rear-End Collision of Two Union Pacific Freight Trains, Ramsey, Wyoming, March 29, 1979" (NTSB/RAR-79/09).

According to the engineer and brakeman of train ENS-121, they tested the locomotive units before leaving Bay View. The brakeman asserted that he operated the four-position switch located adjacent to the test circuit. The engineer stated that all the cab signal aspects illuminated during the test and that the test was made on both the lead and rear units of the train. According to the engineer, the lead unit's cab signal whistle did not sound when he first attempted to make the test because the cab signals had been cut out. The engineer further related that after he cut the cab signals back in, he was able to make the test with the whistle emitting a faint sound.

The cab signal cut-out cock on Conrail's GE locomotives is in a compartment in the side of the car body just aft of the right front stepwell; it can be accessed from the stepwell. On Conrail's GM locomotives, which comprise about 75 percent of Conrail's road locomotive unit fleet, the cab signal cut-out cock is inside the nose compartment. As such, it is easily accessible from the cab. After the accident, the cab signal cut-out cock of the lead unit of train ENS-121 was found sealed in the open or "in" position.

The console radio unit on board the lead unit of train ENS-121 was a Harmon "Trackstar" eight-channel model with adjustable power output of 10 to 40 watts; Conrail used four of the eight channels. The handheld radio that had been checked out by the brakeman and was used by the engineer to report the accident was a 1978 Repco "Transceiver" model with 4-watt power output from a removable and rechargeable battery. Three of the radio's four channels were being used by Conrail.

The units of train ENS-121 were equipped with Pulse analog-type speed indicators, located above the window in front of the engineer's seat, and Pulse event recorders. The speed signal for both devices was received from an axle alternator. The operation of the event recorders was continuous with the recorded data preserved on the tape nominally for 48 hours before the tape was recycled. In addition to speed, distance, and time, recorded data included throttle position, traction motor current, operation of the automatic and independent airbrakes, dynamic braking, PCS application, and the operation of a Select-a-Power fuel saver. However, the direction of travel and aspects displayed by the cab signals were not recorded.

The units that made up Conrail ENS-121 arrived at Bay View at 1:03 a.m., January 4, with freight train TV-22 from Harrisburg. Unit 5045 was the lead unit; unit 5044 was the rearmost unit. They had been operated in this order from Chicago, Illinois, where the train, carrying the symbol TV-2, had originated on January 2. Between Chicago and Bay View, a distance of 800 miles, the train had been operated by six different crews. At each of the five en route crew change

points, the train had been "relayed" from crew to crew without additional testing. Train TV-2 had entered cab signal territory at Pittsburgh, Pennsylvania, midway between Chicago and Baltimore. Since the locomotive cab signals were required to have been tested before the train left Chicago, Conrail did not require that they be tested at Pittsburgh.

According to Conrail Form MP-94 Daily or Trip Inspection Report, unit 5044 had received an inbound inspection at the 51st Street engine house at Chicago on January 1 (see appendix G). On this form, items A.3., "Check Safety Control Operation & Seal Cut-out Cock," and B.7., "Make Cab Signal Test as required and apply Test Sheet in Cab; Time and Date of Test," were not indicated as having been performed. 18/ Conrail Form EL 106-A, Locomotive Inspection Report, was completed for train TV-2 at Chicago, and it showed that a cab signal test was performed on unit 5045 at the 51st Street engine house at 8:05 a.m., January 2. The test was apparently performed by an electrician who signed the form. The space for identifying the number of the rear unit was left blank (see appendix G). The superintendent of locomotive power-east testified that Conrail was unable to document the performance of a cab signal test on unit 5044 at Chicago.

Unit 5044 had last received a periodic shop inspection on November 18, 1986, and was in continuous service from that time to January 4, 1987. Conrail was able to determine that it was last used as the lead unit on a train from December 20 to 21, 1986, when it operated through non-ACS territory from Selkirk, New York, to Chicago, Illinois. There was also no indication on the inspection form that the cab signal and safety control systems tests were performed during the inbound inspection at the 51st Street engine house on December 21. According to the superintendent of locomotive power-east, the last documented cab signal test of unit 5044 was performed on December 16, 1986, at South Kearney, New Jersey, when it was the lead unit on a through train operated through ACS territory to Chicago.

After train TV-22 arrived at Bay View, the engineer noted on Form EL-106-A the condition of brakes and brake rigging as "operative" and reported as defects "clean cab and windows" and "open all sand pipes." Reference was made only to unit 5045, which the engineer had operated. He and other members of the crew stated they had not been aboard unit 5044 during the trip and had no knowledge of its condition.

18/ Conrail's superintendent of locomotive power-east testified that Conrail's rules required the cab signals to be tested on both the lead and rearmost units of a locomotive. He also stated that these tests would have been performed by maintenance of equipment employees during the inbound testing at the 51st Street engine house.

There were no maintenance of equipment employees on duty at Bay View when train TV-22 arrived. One such employee was on duty at Bay View after about 7 a.m. on January 4. According to Conrail officials, he was sent to refuel a locomotive at another location, and, as a result, no inbound or outbound mechanical inspection of the locomotive of train TV-22 was performed by maintenance of equipment employees at Bay View. According to Conrail officials, under these circumstances the crewmembers of train ENS-121 were required to perform the mandatory initial terminal tests of the cab signals, radio, safety control system, and airbrake system before they left Bay View.

Meteorological Information

According to the engineer and brakeman of train ENS-121, the sun was shining brightly from directly behind their train as it approached Gunpow. Some witnesses who were in the area at the time confirmed this; others recalled that there was hazy sunlight; still others said the weather was overcast. Photographs taken shortly after the accident indicate that there was hazy sunlight with soft shadows.

The National Weather Service office at Martin State Airport about 4.8 miles south of the accident location recorded weather observations at 12:45 p.m. and 1:45 p.m. on January 4, 1987. At 12:45 p.m. there were thin, broken clouds at 25,000 feet with 80 percent total sky cover and 30 percent opaque sky cover. Surface wind was measured at 10 knots from the northwest. The 1:45 p.m. observations were scattered clouds at 10,000 feet, thin cirrostratus overcast at 25,000 feet with 100 percent total sky cover and 50 percent opaque sky cover. Surface visibility at both times was reported as 10 miles.

The temperature recorded at 12:45 p.m. was 38° F; at 1:45 p.m. the temperature was 40° F, the high for the day. Thereafter, the temperature dropped to 36° F at 4:45 p.m., 32° F at 7:45 p.m., and 28° F at 11:45 p.m.

At 1:30 p.m., January 4, the sun was 25.3° above the horizon with an azimuth of 200.5° from true north at the accident location.

Personnel Information

All of the train crewmembers involved in this accident were originally employed by Penn Central or its predecessor, the Pennsylvania Railroad, and they ultimately became Conrail employees in 1976. Until January 1, 1983, all Amtrak NEC trains were operated by Conrail crews; thereafter, Amtrak assumed the responsibility for staffing corridor passenger trains with its own crews. When this change was made, Amtrak initiated the practice of using one-man enginecrews on its corridor trains.

Also at that time, train and engine service employees with seniority on the corridor had to decide to work for Conrail or Amtrak. However, Federal law (U.S.C. 588(c)(7)) requires that at least once every 6 months these employees are given the opportunity to transfer to the other organization.

All crewmembers of the trains were qualified under Amtrak operating rules; the crewmembers of train ENS-121 were qualified under Conrail rules as well. No train crewmember was restricted in any way. (See appendix B.)

Crewmembers of Amtrak Train 94.--The crew of train 94 consisted of a conductor, engineer, and three assistant conductors (all qualified as conductors), one of whom was assigned as flagman. The conductor, engineer, and an assistant conductor had worked for Amtrak since 1983; the regular assistant conductor and extra assistant conductor transferred from Conrail in 1986. The conductor, engineer, flagman, and the regular assistant conductor held regular relief assignments between Washington and New York with the home terminal at Washington. The third assistant conductor was assigned to the extra list and was being used in addition to train 94's normal crew complement because the train had more cars than normal. The conductor lived in York, Pennsylvania; the rest of train 94's crew resided in the Baltimore area.

The regularly assigned crewmembers normally worked a 5-day week making a round trip between Washington and New York. Typically, they were on actual duty 7 to 8 hours with 1 to 2 hours paid layover between trains at New York. These crewmembers were assigned to relieve regular crews of various conventional trains, and they generally worked different trains every day. The engineer's assignment, however, included operating a southbound Metroliner on Fridays. Only the conductor and flagman worked together continuously. They worked with the engineer twice a week, including train 94's run on Sunday. Saturday and Sunday were the only days the engineer worked on train 94; the conductor and flagman were assigned to the train on Sundays and Mondays.

The 35-year-old engineer was originally employed as a fireman by Penn Central on November 14, 1972, and he entered the Penn Central engineer training program on October 8, 1973. On January 8, 1974, he completed the classroom and on-the-job training and passed all tests. Also, on that date he was promoted to engineer. As an Amtrak engineer since 1983, he was qualified to operate passenger trains between Washington and New York. The engineer was last examined on the Amtrak rules and timetable on June 24, 1986, and he passed with a perfect score. He last passed the biennial Amtrak physical examination on April 26, 1986. At that time, he had uncorrected 20/20 vision in both eyes and had normal hearing. A urine screen for licit and illicit drugs was negative.

At the time of the accident, the engineer had been on duty for 1 hour 45 minutes. He had worked 8 hours 25 minutes the day before the accident, going off duty in Washington at 8:10 p.m. According to his wife, the engineer arrived home at 9:30 p.m., ate dinner at 10 p.m., and retired at 2 a.m. After awaking at about 8 a.m., he had breakfast before leaving for work between 9 and 9:30 a.m. The engineer had not worked December 31 through January 2, because these days were his assigned days off, and he had a compensatory day due him because his regular day off fell on the holiday. According to the engineer's wife, he had not drunk any alcoholic beverages since Christmas, was not a user of drugs, and he had not indulged in major physical activity during the 72-hour period preceding the accident. The engineer reportedly smoked a pack of cigarettes daily.

The Amtrak engineer was described by supervisors and coworkers as skilled and knowledgeable. His service record indicated he had been reprimanded by Conrail in 1978 for a violation of restricted speed and by Amtrak in 1984 for a 5-mph violation of a curve speed restriction. The engineer had no criminal record, but his Maryland driving record indicated he had been cited for speeding 11 times between 1969 and 1984, including 7 times after having completed a 6-month probation period in 1973.

The conductor and flagman did not work December 31 and January 1, which were their regular days off. They worked January 2, and on January 3 they were on duty 10 hours 10 minutes before going off duty in Washington at 8:10 p.m. Both men were off duty 15 hours 50 minutes before reporting to work on January 4. The other regular assistant conductor had been off duty since 10:15 p.m. on January 1 before reporting to work on train 94 on January 4. The extra assistant conductor had worked January 2 and 3 and had been off duty 13 hours 45 minutes before reporting for duty on January 4. At the time of the accident, the conductor and assistant conductors had been on duty 1 hour 30 minutes.

According to the conductor of train 94, he had face-to-face contact with all the other crewmembers in Washington, and he said that all the crewmembers were "100 percent when we went to work." Each trainman was responsible for three cars of the train; the conductor had the first three cars, and the flagman had the last three cars. As the flagman had no radio, he could not communicate directly with the conductor. According to the conductor, he had no contact with the flagman after train 94 left Washington.

Amtrak Supervision.--Inasmuch as train ENS-121 was on Amtrak's line at the time of the accident, its operation was governed by Amtrak rules, and the entire responsibility for supervising the crew was vested in Amtrak as a result of an argument with Conrail.

Amtrak's assistant vice president-transportation, headquartered in Washington, testified that he arrived at the accident site at 2:55 p.m. He was followed by three Amtrak operating department superintendents who stated they were on the scene at 3:30 p.m. The general superintendent, headquartered in Philadelphia and in charge of this part of the NEC, stated that he arrived at 4:30 p.m. The general superintendent stated that he knew of no effort to secure the Conrail locomotives against tampering or to interrogate or otherwise take charge of the Conrail crewmembers, although he testified that such actions were "technically" the responsibility of the Amtrak supervisors.

One of the first supervisors to arrive on the scene was Amtrak's Philadelphia Division safety supervisor and environmental engineer who lived in the Baltimore area. He testified that he was at the site at 2 p.m., and that about 30 minutes later he encountered the Conrail engineer with whom he was well acquainted. According to the safety supervisor, the engineer "told me that he ran a couple of signals and that it was pretty obvious what happened...." He further testified that the engineer had no visible injuries, but was emotionally upset about the accident and concerned about the Conrail brakeman's whereabouts. The safety supervisor further testified that he had no indication that the engineer had used alcohol or drugs.

Before 1985, the safety supervisor had been a substation electrician. At the time of the accident, he was assigned to the corridor between Washington and a point north of Philadelphia, but he was also responsible for Amtrak operations between Philadelphia and Pittsburgh. He testified that he had no involvement in train operations and had no responsibilities in connection with efficiency tests, operating rules training, or in dealing with Conrail crews operating over the corridor.

The general superintendent of the Philadelphia Division, which included the corridor between Philadelphia and Washington, testified that he had a division manager of safety and environmental control and two safety engineers who developed, implemented, and audited the division's safety program. According to the general superintendent, this was an independent program and was the division's whole safety "package" that covered everything from "A to Z."

Subsequently, the general superintendent testified that he did not know how to comment on the statements made by the safety supervisor regarding his responsibilities in connection with tests, training, or the crew. He stated that anything that occurs on Amtrak relating to safety would fall within the realm of the safety supervisor's responsibility. He later stated that he did not think a safety engineer's role should include speed and signal checks. Moreover, he stated that the responsibilities of Amtrak's safety department do not include operating rules compliance; this, he said, was the responsibility of the transportation department.

Amtrak's vice president-operations and maintenance testified that its conductors are responsible for determining that its crews are fit for duty and that to transfer that responsibility to supervisors would require 150 more supervisors nationwide.

Crewmembers of Conrail Train ENS-121.--Both the engineer and brakeman assigned to train ENS-121 had chosen to remain with Conrail on January 1, 1983, and as far as could be determined, they had never elected to transfer to Amtrak. Both the engineer and brakeman lived midway between the accident location and Bay View Yard, but not near the corridor rail line. On January 4, 1987, both men were assigned to the Bay View extra list. At the time of the accident, they had been on duty 1 hour 15 minutes.

The 32-year-old engineer had been hired as a brakeman by Penn Central on March 19, 1973, and was transferred to engine service as a fireman on January 24, 1974. He entered the Conrail engineer training program on October 13, 1975, and completed the requisite classroom and on-the-job training; he passed the tests on March 16, 1976. He was promoted to engineer on May 1, 1976. As an engineer he was qualified to operate trains between Potomac Yard, Virginia, and Harrisburg and Philadelphia, Pennsylvania.

On July 22, 1986, the engineer completed Conrail's biennial airbrake operation training, and he passed Conrail's annual rules examination with a score of 98 out of a possible 100. On July 24, 1986, he passed the annual Amtrak rules examination with a perfect score. The engineer's last Conrail physical examination on July 11, 1985, indicated he had uncorrected 20/20 vision in both eyes and had normal hearing. No drug screen was performed as part of the examination nor was one required at that time.

A review of the engineer's 1986 work record indicates he had worked or been paid for the equivalent of 172 days of service --49 days in actual yard service, 99 days in actual road service, and 24 occasions when he had been deadheaded by taxicab to or from Bay View. In addition, he had been paid for 15 days vacation and had marked himself as unavailable for duty 16 times for a total of 51 days--9 times for 31 days as "sick"; 6 times for 12 days for "car trouble" or "no car"; and 1 time for 8 days for "rules." 19/

The Conrail road foreman of engines stated that the engineer's work record was reviewed on a monthly basis and that the engineer's record of absenteeism was not consdiered to be excessive. The road foreman of engines further stated that he did not recall ever discussing attendance problems with the

---

19/ "Rules" was the only word on the computerized printout of the engineer's work record. The Safety Board has interpretted this to indicate that the engineer had laid off work to take the annual "rules" examination.

engineer. A Conrail trainmaster indicated that investigations concerning the personal lives of employees are not conducted, and that when supervisors are informed of employee personal problems, the employee counseling department is contacted for assistance.

During the first 4 1/2 months of 1986, the engineer was used almost exclusively as a fireman; thereafter, he was used exclusively as an engineer. His work record indicates that he frequently bid on regular job assignments, but was able to hold them only briefly before being "bumped" back to the extra list.

During 1986 and the first 3 days of 1987, the engineer worked the following road assignments, nearly all at night:

Assignment	Fireman (days)	Engineer (days)
Northbound through Gunpow	33	23*
Southbound through Gunpow	30	13
Total	63	36

*All but one of these trips were made after May 15, 1986.

During the 33 days preceding the accident, the engineer worked a total of 12 days, 6 of which were on a yard assignment at Bay View in the beginning of December. He was bumped from this assignment on December 13, took a 1-week vacation, and marked up on the road extra list on December 25. Between that time and January 2, he was deadheaded to Harrisburg, worked three trains between Bay View and Harrisburg (one north and two south), worked a train from Bay View to Philadelphia, and was deadheaded home from Philadelphia. All of the road trips were made at night.

Before the day of the accident, the engineer last worked on January 2, when he was on duty 2 hours 15 minutes as the engineer of a work train at Bay View. He was then off duty 49 hours 15 minutes before reporting for duty on January 4.

According to the Conrail engineer, he slept 7 to 7 1/2 hours the night before the accident and had received "proper rest" the 2 previous days. He further stated that he had eaten a pizza on the evening of January 3, but had not eaten between that time and the time of the accident. The engineer also stated that he had not used alcohol or drugs on the day of the accident. He refused to state whether he was a user of alcohol and/or drugs. The engineer did relate that he smoked four packs of cigarettes daily.

The Conrail engineer was described by supervisors and co-workers as skilled and well-versed in the rules, equipment, and physical characteristics of the railroad. A trainmaster at Bay View described him as "overconfident and surly" and "not

acceptable to suggestions." Coworkers and associates described the engineer as outgoing and friendly; however, a barmaid stated that he occasionally displayed a temper and obnoxious behavior when drinking alcoholic beverages. He had been separated from his wife since August 1983 and had been jailed by Baltimore City after his wife filed an assault and battery complaint. The charge of common battery was not prosecuted because the authorities failed to locate the complainant.

The Safety Board's investigation determined that the engineer often patronized several Baltimore-area taverns, including one near Bay View Yard that was patronized by railroad workers. According to bartenders at this establishment, on the evening of January 2, they served beer to the engineer and sold him a six-pack of beer to carry out. In addition, the engineer related to the Baltimore terminal superintendent and the Bay View trainmaster that he had consumed "three or four beers" on the evening of January 3.

Before December 1986, the Conrail engineer had been convicted of 12 traffic offenses, including 9 speeding violations that resulted in two suspensions of his driver's license between 1972 and 1985. Early on the morning of December 5, 1986, after leaving a tavern, the engineer was arrested for driving through a red traffic signal, driving through a stop sign, and driving while intoxicated (DWI) after failing police sobriety tests and submitting to a "breathalizer" examination that revealed a 0.12 percent blood alcohol concentration (BAC).

Following the accident, the engineer voluntarily underwent a supervised chemical-dependency program involving his hospitalization for 7 weeks at a private Baltimore-area treatment facility. He subsequently pleaded guilty to and was convicted of DWI and the other charges; he was fined $1,000 and ordered to undergo counseling.

The engineer's railroad service record indicated that while he was a fireman, he was assessed a 30-day suspension for passing a stop signal in December 1974. According to Conrail records, he was running the locomotive at the time, but the train's engineer was held to be primarily responsible for the infraction. In November 1984, the engiener of train ENS-121 was suspended for 7 days after speaking to a crew dispatcher in a "belligerent and threatening manner." The engineer was also reprimanded in March 1986 for engaging in an "apparent unauthorized work stoppage." After the accident, the engineer was held out-of-service by Conrail pending a formal investigation by Amtrak. He resigned from Conrail service before the investigative hearing was held.

In March 1987, the Baltimore County District public defender, acting as counsel for the engineer, informed the Safety Board that, if subpoenaed to testify during the Safety Board's public hearing, the engineer would invoke his privilege against self-incrimination. On May 4, 1987, the Baltimore County grand

jury indicted the engineer on 16 counts of manslaughter by locomotive as a result of his operation of train ENS-121 in a "grossly negligent manner." The engineer has not yet been brought to trial on the indictments.

The 33-year-old Conrail brakeman had been hired as a brakeman by Penn Central on April 3, 1973, and was promoted to conductor on April 1, 1976. He passed the annual Conrail and Amtrak rules examinations on June 6, 1986, and August 12, 1986, with scores of 95 and 85 percent, respectively. The Conrail test consisted of 55 questions (true-false and multiple-choice), including 11 questions on signals. The brakeman had 9 of the 11 correct.

The brakeman last underwent a Conrail physical examination on June 10, 1986, at which time he reportedly had uncorrected 20/20 vision in both eyes and normal hearing. No physical abnormalities or conditions were noted. The examination did not include a drug screen. According to the brakeman, he did not use tobacco.

The brakeman's 1986 work record indicated that he was used by Conrail only during summer vacation, hunting season, and holiday periods. He did not work for Conrail from January 1 to June 13, September 30 to November 5, and November 21 to December 22, a total of 231 days. According to the brakeman, he did not have a second job, but relied on unemployment compensation when not actively employed by Conrail.

During 1986, the brakeman worked the equivalent of 60 days, including four deadhead trips, and 25 of these days he worked on yard assignments. Of the 31 actual road freight assignments he worked, 29 were north of Baltimore--14 as a brakeman and 15 as a conductor. The Safety Board was not able to determine how many, if any, of these road assignments required the brakeman to be stationed on the lead locomotive unit with the engineer.

Before reporting for duty on January 4, the brakeman had been off duty for 38 hours 15 minutes. He had last worked for Conrail on January 2, completing an 8-hour 20-minute tour of duty at 10 p.m. The brakeman said he had slept 6 to 7 hours the night before the accident, and he had a similar period of rest the night of January 2. He also recalled that he had eaten supper about 6 p.m. on January 3, and he had a breakfast of egg, bacon, and milk between 8 a.m. and 9 a.m. on January 4.

The brakeman said he had not used alcohol or drugs before or after going to work on January 4. On the advice of counsel, he refused to state when he had last taken alcoholic beverages before that date. The brakeman's brother told Safety Board investigators that the brakeman was observed drinking "a couple of beers" at a tavern between 10 p.m. and 11 p.m. on January 3, and that he may have stopped at another tavern that evening.

The brakeman called himself a "yardbird," and coworkers stated that he was at his best when working a yard assignment. His work record indicated that he preferred such assignments at Bay View and avoided working at away-from-home locations by marking off duty. The brakeman was described as quiet, even-tempered, friendly, and an avid sports enthusiast. He had no criminal record, and his Maryland driving record revealed no moving traffic violations. His Conrail service record showed no disciplinary action other than a written reprimand for failure to report to a 1982 assignment.

The brakeman also resigned from Conrail service after the accident. He testified before the Baltimore County grand jury and was not indicted.

When questioned by Safety Board investigators, the engineer and brakeman of train ENS-121 could not recall any event or occurrence that may have distracted them as they approached Gunpow. However, the engineer did recall that he and the brakeman were conversing at the time. The brakeman said he was standing up and was preparing his lunch. As a result, he said he did not observe any of the wayside signals approaching Gunpow. He further said that he observed an "approach medium" aspect on the cab signal at the location of signal 816-1. Thereafter, he said, "I didn't observe the cab signal at all. I wasn't even looking at the cab signal."

Conrail Supervision.--Conrail's supervisory force at Baltimore was headed by a terminal superintendent and included trainmasters, road foremen of engines, and yardmasters. On January 4, 1987, a trainmaster and yardmaster were on duty at Bay View Yard. Neither was involved in the decision to operate train ENS-121; this decision was made by the Conrail power director at Philadelphia based on the need for locomotive power at Harrisburg. When the engineer and brakeman were called to operate the train, they were informed of this decision and the fact that they would be deadheaded back to Bay View by taxicab after arriving at Harrisburg.

Located in a tower overlooking the yard, the yardmaster had no direct contact with the crew of train ENS-121. The trainmaster had an office in the Bay View Yard office where he met the crewmembers about 12:45 p.m. During the ensuing conversation, the crewmembers informed the trainmaster that they had removed the console radio from the trailing unit and installed it on the lead unit. They also told him the radio did not work. The trainmaster testified that he did not ask what the crewmembers intended to do, but he had the impression they were going to use the radio from the middle unit. At the time, the

trainmaster noticed that the brakeman had a Conrail portable radio. According to the trainmaster, he was familiar with the crewmembers and they appeared to him to be normal and unimpaired. 20/

Shortly afterward, the trainmaster had a second face-to-face encounter with crewmembers of train ENS-121 when they asked the trainmaster to open the supply house so that they could get paper towels and fusees. Nothing further was said about the radio problem, and the crewmembers did not report any problem with the cab signal apparatus. Later, the trainmaster observed the engineer operating train ENS-121 from the lead unit as it was leaving the yard. He was in his office at the time, and although he had his console radio turned on, he did not hear the engineer make the required radio test. 21/

At 1:15 p.m., the trainmaster left the yard office to go home for lunch. While en route, the yardmaster notified him of the accident by radio. The trainmaster stopped at the first pay telephone he saw and notified the terminal superintendent.

At 2:20 p.m., the terminal superintendent arrived at the accident site, where he was joined a few minutes later by the trainmaster and a road foreman of engines. While the trainmaster and road foreman were removing the event recorder cassettes from the lead and middle locomotive units, the terminal superintendent examined the cab of the lead unit. He testified that he found the throttle in the eighth or fully open position, the automatic brake in emergency, and the reverser in reverse position. According to the terminal superintendent, all switches were off and the unit was dead.

The terminal superintendent stated that he did not inspect the cab signal or the cab signal whistle, but he did notice that the windshield was clean. He also observed "at least two" open grips (small valises) on the cab floor. The terminal superintendent stated that he did not examine the contents of the grips, but had them taken to the road foreman's office where they were later picked up by relatives of the crewmembers. The terminal superintendent testified that, as far as he knew, no supervisor ever examined the contents of the grips.

Not long after he arrived at the accident scene, the terminal superintendent met the engineer of train ENS-121. The engineer told the terminal superintendent that he had "gotten by

---

20/ The trainmaster testified that in August 1986, he received 2 days training in recognizing individuals under the influence of alcohol or drugs.

21/ The radio test was typically performed by outbound crews by notifying the Bay tower operator that they are ready to depart. According to the tower operator, he received such a radio transmission from the engineer of train ENS-121 at about 1:08 p.m.

a red signal." There was no discussion about the distant signal, and nothing was said about why the train had not been stopped short of the home signal. The terminal superintendent testified that he felt certain that the engineer was in shock and needed medical attention. As a result, he told the road foreman to put the engineer in an ambulance. He did not instruct the road foreman or any other supervisor to accompany the engineer to the hospital.

Supervisory Efficiency Checks.--According to the Conrail supervisors who were assigned to the Washington-Harrisburg territory, each supervisor was required to make 250 efficiency checks 22/ monthly with about 10 percent of these tests to be related to the cab signal rules. Other required tests included surveillance of wayside signal compliance, checks of compliance with radio rules, making radar speed checks, and monitoring event recorder data. Conrail supervisors tested their crews while they were operating over the corridor line, but did not report these tests to Amtrak.

Conrail had three road foremen of engines assigned to the Washington-Perryville territory with two headquartered at Baltimore and one at Washington; the road foremen were responsible for overseeing the performance of 60 enginemen. As part of their duties, the road foremen were required to evaluate engineers while riding with them during the entire course of their runs, and they were also required to submit written reports of these evaluations.

Computerized Conrail records furnished to Safety Board investigators indicate that proficiency, fitness, and other types of supervisory checks were made of the Conrail engineer involved in this accident several times during the year preceding the accident. On two of these occasions, a road foreman of engines rode with the engineer and made a detailed evaluation of his performance throughout the entire run. In the first instance, on June 23, 1986, the engineer handled a 9,850-ton, 112-car northbound freight train out of Bay View. He was observed complying with an "approach" aspect at the approach signal for Gunpow and a "stop" aspect on the home signal at Gunpow. The second on-board evaluation took place on December 13, 1986, while the engineer handled a freight train between Bay View and Potomac Yards. The engineer's performance was rated as acceptable without failures on both occasions.

On June 11, 1986, while working between Harrisburg and Baltimore, the engineer was subjected to a series of lineside efficiency checks including compliance with two "approach" signal

---

22/ Efficiency checks are operational tests and inspections conducted by supervisory personnel to determine the extent of compliance with a railroad's code of operating rules, timetables, and special instructions.

aspects, speed, and radio rules compliance. No failures were noted on this occasion. On four other occasions during 1986, he was checked for compliance with safety rules. On January 7, 1986, he was cited by a road foreman for failure to properly regulate the speed of his train on the corridor. The citation resulted from a draft gear failure and consequent delay to the engineer's train, rather than from an efficiency check. The engineer was not disciplined as a result of the incident.

The Conrail brakeman was reported to have been the subject of nine supervisory checks after he resumed working in June 1986. None of the checks was of the on-board evaluation type. The brakeman's computerized work record indicated he worked on eight of the check dates--four in the yard and four on the road. He was not charged with any failures during any of the reported checks.

Amtrak also provided records of operational efficiency checks made by its supervisors on the two Conrail crewmembers. According to these records, the engineer was checked on July 24, 1985, and October 24, 1985, for compliance with five different rules on those dates, none of which were signal, speed, or radio rules. Amtrak's records show that the engineer took his annual Amtrak rules examination on October 24, 1985, and did not operate a train on that day. The check showed the engineer as having violated the Amtrak timetable rule requiring that he take the rules examination during the month of his birth (July). He had complied with Amtrak rule A (requiring that he have the rulebook and timetable in his possession when on duty), rule C (requiring that he pass the required examinations), and rule T (requiring that he report at the required time).

The reported July 24, 1985, Amtrak efficiency check also covered rules A, C, and T, as well as rule G (prohibiting the use and/or possession of alcohol and drugs). Amtrak could not explain why the engineer was checked on these particular rules. He was not being examined on Amtrak rules or otherwise in Amtrak service on July 24, 1985.

In the case of the Conrail brakeman, Amtrak reported that the brakeman had an efficiency check on August 12, 1986, but the check was not made in connection with his operation of a train. The brakeman's Amtrak rules examination record showed that he was examined on the rules on this date. He was in compliance with Amtrak rules A, C, G, and T.

Amtrak's records indicate that its supervisors checked the efficiency of the engineer of train 94 on 10 occasions during 1985 and 1986. In each year, four actual operational tests were made; the other checks were made when the engineer took the annual rules examination. The operational tests covered a total of 16 operating rules and 1 timetable rule. The report did not identify the methods of testing employed, but the combinations of rules indicated that two of the operational tests each year may have been of the on-board evaluation type. The engineer reportedly complied with timetable speed restrictions in all four

of these checks, and he complied with rule 281, the "clear" signal aspect. Compliance with radio rules was cited in one 1985 check. No other speed, signal, or radio checks were indicated as having been made in any of the reported efficiency checks. The only failure charged to the engineer was his failure to have his rulebook and timetable with him when he took the 1985 rules examination.

In the aftermath of the head-on collision of two Amtrak passenger trains at Hell Gate, New York, on July 23, 1984, 23/ the president of the Brotherhood of Locomotive Engineers (B of LE) wrote Amtrak's vice president-labor relations on August 14, 1984, asserting that Amtrak supervisors were encouraging and even "pressuring" corridor engineers to violate speed restrictions in order to maintain scheduled running times (see appendix H).

Amtrak's president responded in an August 31, 1984, letter to the B of LE president by stating that while engineers were expected to meet their schedules, encouraging or condoning the violation of timetable speed restrictions was against Amtrak management policy. Moreover, the letter stated that (1) supervisory pressuring or hassling of engineers to violate speed restrictions would not be tolerated and would result in disciplinary action against the responsible persons; (2) Amtrak's policy relative to its speed restrictions had been communicated to the engineers individually by telephone; (3) Amtrak and FRA had begun to make detailed speed compliance checks in the field; and (4) Amtrak would discipline any engineer who was detected operating in excess of authorized speed. (See appendix I.)

Beginning in August 1984, the FRA Office of Safety conducted an in-depth 4-month evaluation of train operation safety on the NEC. The report of this assessment was prefaced with the assertion that the corridor was "being managed effectively and operated with a high regard for the safety of the passengers, employees, and the general public." 24/ In addition, the report also stated:

> Before beginning the assessment, FRA had noted that Amtrak trains tended to be operated at speeds in excess of allowable [limits]. During the assessment, the percentage of trains exceeding authorized speed decreased dramatically but not entirely. Precise control of train speeds is vital where trains operate at the high speeds prevalent in the NEC, because the effects of speed, such as stopping distances, wheel-rail impact, and overturning tendencies, increase as a function of the square of the speed.

23/ Railroad Accident Report --"Head-on Collision of National Railroad Passenger Corporation (Amtrak) Passenger Trains Nos. 151 and 168, Astoria, Queens, New York, New York, July 23, 1984" (NTSB/RAR-85/09).

24/ Federal Railroad Administration, 1984 Safety Assessment, National Railroad Passenger Corporation, Northeast Corridor, December 1984.

> Efficiency testing from an operational viewpoint appears to be non-existent. Amtrak does not impose a required quota of efficiency tests for operating officers. Efficiency tests that would interfere with schedule requirements are not conducted. Some officers expressed the opinion that any delay to a train incurred as a result of an efficiency test, would result in immediate disciplinary action to themselves.

When Amtrak responded to the FRA assessment in April 1985, it reported that Amtrak had taken action to correct the speed situation by resetting overspeed devices to function at not more than 3 to 5 mph above the maximum allowable speed of the locomotive class, by individual counseling of all engineers by transportation managers, and by increasing speed and signal checks with "appropriate follow-up action where required."

As for FRA's report of efficiency test discrepancies, Amtrak replied that, "Amtrak strongly disagrees with the allegation that train delays resulting from efficiency tests would result in disciplinary action to the officer conducting the test." While admitting that it did not impose testing quotas on its supervisors, Amtrak asserted that to do so "would deteriorate the quality of tests performed." Finally, Amtrak stated it was structuring a more comprehensive "Tests" program to assure periodic observation of all employees and to increase the observations of employees of tenant carriers operating over the corridor. At the Safety Board's public hearing, the Amtrak general superintendent testified that he required his supervisors to perform one speed test and one signal test monthly.

In a followup report dated March 11, 1986, Amtrak advised the FRA that in August 1985 it had implemented a more effective computerized system to manage its operational testing program on the corridor. However, the report did not indicate what steps were being taken to increase the scope of efficiency testing.

The Safety Board has requested but FRA has not provided information on any follow-up action it has taken since it issued its 1984 assessment of safety on the corridor.

Medical and Pathological Information

Pathological examinations indicated the 16 fatally injured persons died from the following causes:

6	Compression asphyxia 25/
6	Multiple trauma
1	Multiple trauma and hypothermia
1	Multiple trauma and smoke inhalation
1	Cranial trauma and smoke inhalation
1	Cranial trauma

25/ Compression asphyxia is asphyxiation (the lack of oxygen), often the result of trauma to the respiratory system.

Many of the persons aboard train 94 who sustained survivable trauma were injured about the head, face, and mouth as a result of being thrown into seats or against other objects, and/or by being struck by luggage and other articles that fell from the racks above the seats. Of the 24 persons aboard train 94 who had moderate to serious injuries, 11 sustained bone fractures, 8 sustained severe contusions and/or lacerations, 3 sustained concussions, and 2 sustained cervical/spinal trauma.

The Conrail engineer received only minor injuries as a result of the accident. The Conrail brakeman had a fractured leg that he stated he sustained either when he alighted from the locomotive or when he ran from the track after the collision.

Toxicological Testing

At the time of this accident, FRA regulations (49 CFR Part 219, Subpart C) stipulated that all train crewmembers and other railroad employees subject to the Federal Hours of Service Act involved in a major train accident resulting in one or more fatalities were subject to mandatory toxicological testing. Dispatchers and operators directly involved in the accident were expressly covered under this requirement. Blood and urine samples for testing were specifically required from each surviving employee; body fluid and/or tissue samples were required to be taken from fatally injured employees. The regulations further required that the railroad "make every reasonable effort to assure that samples are provided as soon as possible after the accident." The FRA sold kits to the railroads that included vials for holding samples, as well as labels and containers for shipping the samples to the Federal Aviation Administration's Civil Aeromedical Institute (CAMI) Forensic Toxicology Research Laboratory at Oklahoma City, Oklahoma.

Both Conrail and Amtrak had amended their rules to conform with the FRA testing regulation. Amtrak had included its new rule 100G-A1 in NEC timetable No. 4, in effect at the time of the accident (see appendix D). The new rule stated that employees would be required to provide blood and urine samples after certain accidents and incidents as provided for under the Federal regulations. It also stated that employees refusing to submit to testing would be removed from service and would be subject to dismissal. According to Amtrak, corridor supervisors and managers were given a 2-day training course on the testing requirements and the techniques in taking and shipping samples to CAMI.

The surviving crewmembers of train 94, the Edgewood block station operator, and the E-section dispatcher testified that they understood Amtrak rule 100G-A1 and expected that they would be required to submit to toxicological tests after the accident.

The surviving crewmembers of train 94 were taken to hospitals for treatment of injuries. They were not accompanied by Amtrak supervisors and only one, the extra assistant

conductor, provided a specimen for testing. According to the extra assistant conductor, he gave a urine sample about 6 1/2 hours after the accident. No blood was drawn. The CAMI lab's screening of the urine was negative for alcohol and illicit drugs, but was positive for Acetaminophen (a pain relief medication) and phyenylpropanolamine (an apetite suppresant or decongestant). The CAMI report described these as "...compounds probably from over-the-counter or prescription medication."

The Edgewood block station operator, accompanied by his supervisor, provided samples of his blood and urine about 4 hours 40 minutes after the accident. CAMI's screening of the samples were negative for alcohol and drugs. No other dispatchers or operators were either asked to submit or submitted samples for testing.

A Baltimore County Fire Department officer testified that he detected a strong odor of alcohol on the breath of the flagman of train 94 when he met him shortly after the accident. He also stated that he noticed nothing unusual about the way the flagman walked or talked at that time. The fire department officer was a trained paramedic who had treated numerous accident victims later determined to have been under the influence of alcohol. The officer reported his observation to his superior, the deputy fire chief, the day after the accident. The flagman testified that he had not consumed any alcohol before, during, or after his tour of duty on January 4. Amtrak employees and supervisors who met the flagman after the accident stated that he appeared to be normal and that they did not detect the odor of alcohol.

A tissue sample from the Amtrak engineer was sent to CAMI for testing; the test was negative for alcohol. The toxicological report also stated that the specimen was unsuitable for further analysis.

The Amtrak general superintendent testified that he was aware that the FRA regulations and the Amtrak rule regarding toxicological testing did not give him discretion in deciding which employees should be tested. The general superintendent also testified that he decided that only the Edgewood operator "might have been contributory" and ought to be tested.

The senior Amtrak officer at the accident site was the assistant vice president-transportation. When he arrived at the site, the flagman and two other assistant conductors had not provided toxicological samples. The assistant vice president also testified that he decided that the performance of the crew of train 94 and the dispatcher had no bearing on the accident. In addition, he said that he thought that he had discretion in the matter, and therefore, he did not require the crewmembers to be tested.

On January 6, 1987, Amtrak's general manager informed the Safety Board that the dispatcher and the surviving crewmembers of train 94 had not been required to submit to testing. Shortly afterward, the Amtrak assistant vice president-transportation

advised a member of the Safety Board that he had talked to the FRA associate administrator for safety. The assistant vice president related that he told the associate administrator, "We're running out of time. They're [surviving crewmembers] really not involved. We'd like some relief on that...referring to the toxicological tests. We do not want to put these people through more. It would not prove anything."

According to the assistant vice president, the associate administrator replied, "Yes, I understand and I agree." (See appendix J.) During the Safety Board's public hearing, the FRA associate administrator testified that he did not think Amtrak was asking for a waiver of noncompliance after failing to comply with the regulations. On January 7, 1987, following the disclosure that the surviving crewmembers of train 94 had not been tested in accordance with the rules, the FRA Office of Safety cited Amtrak for violation of the testing regulations.

At the Safety Board's insistence, Amtrak asked the dispatcher, conductor, flagman, and regular assistant conductor to provide blood and urine samples for testing on January 8. These samples were sent to the Center for Human Toxicology (CHT) in Utah. According to the reports furnished by the CHT, no drugs were detected in the samples provided by the assistant conductors and the dispatcher. The samples provided by the conductor were found to contain small quantities of a muscle relaxant and its metabolites.

Less than an hour after the accident, Conrail officials at the accident site had put the engineer of train ENS-121 in an ambulance to be taken unescorted to a hospital. About 4 p.m., they learned that he had left the ambulance and was still at the accident site. The Conrail Baltimore terminal superintendent then directed the Bay View trainmaster and a Conrail police captain to take the engineer to a hospital to provide samples for toxicological tests. After locating the engineer, they arrived at Franklin Square Hospital at 4:25 p.m., and the engineer was immediately taken for examination and x rays.

At 4:30 p.m., the hospital drew blood from the engineer for diagnostic purposes. This blood was screened for drug use; the hospital's records show that the test revealed less than 10 mg/dl blood alcohol and was negative for all other drugs including the cocaine metabolite (benzoylecgonine) and phencyclidene (PCP). At 5:30 p.m., the trainmaster located the doctor who was examining the engineer and requested that more of the engineer's blood be drawn for FRA testing. The blood sample was drawn about 6:00 p.m.; shortly after, the trainmaster witnessed the engineer provide a urine sample.

The trainmaster and an Amtrak official also witnessed the drawing of enough blood to fill two 10-ml "vacuutainer" vials that were in the FRA test kit the trainmaster had brought with him. After sealing the vials, the trainmaster labeled the seals

and had the engineer initial them as prescribed. He then iced and sealed the container and affixed the shipping labels, completing the procedure at about 6:10 p.m.

At 8 p.m., Conrail supervisors learned that the brakeman had been admitted to Johns Hopkins Hospital. The Bay View trainmaster arrived at that hospital about 9 p.m. with an FRA test kit. He was not able to obtain the urine sample until 9:50 p.m. or the blood sample until about 10:15 p.m. Again, he witnessed the taking of the samples; in this instance, enough blood was drawn to fill three 10-ml vials. He repeated the sealing, labeling, and packing procedures he had followed in the case of the engineer.

The specimen containers from the Conrail engineer and brakeman were shipped by air express to CAMI that night. CAMI subsequently reported finding the following marijuana concentrations in the specimens:

	Nanograms per Milliliter		
Individual	delta-9-THC [1]	THC-COOH [2]	Hours after Accident
Engineer-serum	<5	42	5.0
Engineer-urine		67, 72	5.0
Brakeman-serum	<5	13	8.5
Brakeman-urine		87, 144 [3]	8.5

1/ Delta-9-THC (delta-9-tetrahydrocannabinol) is believed to be the primary psychoactive ingredient of the marijuana (cannabis) plant.
2/ THC-COOH (sometimes rendered as 9-carboxy-THC) is a major nonpsychoactive metabolite of marijuana found in blood and urine.
3/ CAMI reported two values on the urine marijuana carboxy (COOH) metabolite concentration using two different quantification techniques. The second values shown for THC-COOH were determined with the addition of a deuterated standard to the urine samples.

Only marijuana was found in the CAMI analysis; tests for the other drugs in the protocol were negative. CAMI reported less than 5 ng/ml of delta-9-THC in the serum of both men. According to the CAMI toxicologist, the level of delta-9-THC below 5 ng/ml was not quantified, although 5 ng/ml was apparently not the minimum level of sensitivity of the test.

After the Safety Board toxicologist reviewed the CAMI toxicology laboratory's analysis of the samples and after discussions among the Safety Board, the FRA, and CAMI, the Safety Board requested that any unused portions of the samples be shipped to the CHT for confirmation analysis. As a result, the serum and blood from the brakeman and urine from the engineer were shipped to the CHT. The CAMI toxicologist reported there

was insufficient serum from the engineer for a confirmation analysis. In addition, the Safety Board sent the vacuutainer vial that contained the hospital's diagnostic blood sample taken from the Conrail engineer to the CHT for testing. CHT reported that the three drops of blood in the vial were insufficient for marijuana analysis.

The CHT reported the following results of its testing of the specimens forwarded by CAMI:

	Nanograms per Milliliter		Hours after
Individual	delta-9-THC	THC-COOH	Accident
Engineer-serum	No sample	---	--
Engineer-urine		182	5.0
Brakeman-serum	Negative*	23	8.5
Brakeman-urine		80	8.5

* The sensitivity limit of serum delta-9-THC by the technique used by CHT is about 0.5 ng/ml.

In addition to cannabinoids, the CHT drug screen protocol included ethanol, opiates, PCP, amphetamines, barbiturates, cocaine, tricyclic antidepressant, antihistamines, carbamates sedative (meprobamate), and synthetic narcotics (meperidine or Demerol). The Conrail engineer's sample was found to be negative for all of these. The Conrail brakeman's urine tested positive for PCP; a gas chromatography/mass spectrometry (GC/MS) verification and quantification showed 45 ng/ml of PCP in his urine.

Inconsistencies in the CAMI test results and documentation prompted an investigation of the CAMI toxicology laboratory a month after the Chase, Maryland, accident. Subsequently, the inspector general of the DOT took over the investigation, the laboratory was closed, the biochemist in charge of the laboratory was relieved of his duties, and the FRA began using the CHT to analyze test samples.

On May 26, 1987, the CAMI biochemist pleaded guilty to Federal felony charges of providing false information to the FRA. According to the FRA, the CAMI laboratory had reportedly falsified blood serum test results in some previous train accident-related cases that occurred after the FRA test regulations were implemented early in 1986. The laboratory lacked the sophisticated GC/MS equipment needed to make the tests until late 1986, and no one in the laboratory had the expertise

to use the equipment when the Chase railroad accident tests were performed. The Safety Board further learned that the GC/MS equipment had not been calibrated for accuracy since December 5, 1986; moreover, it had been improperly calibrated at the time of the testing and had not been recalibrated since. A deuterated internal standard was not used in the serum marijuana analysis, nor were the serum THC data retained after the tests were made.

Following these developments, the CHT staff collected all FRA sample containers at the CAMI laboratory, including the original urine and blood sample containers for the Conrail engineer and brakeman. The engineer's blood sample container held a small amount of blood that was subsequently diluted, analyzed, and found to contain 52 nanograms per milliliter of the carboxylic acid metabolite (THC-COOH) of marijuana. The diluted blood sample was reported to contain less than the test detection level of psychoactive delta-9-THC. However, due to the very limited sample, the sensitivi' to detect THC was reduced. The urine sample of the engineer was found to contain 212 ng/ml of the carboxy metabolite of marijuana (see appendix K).

The specimens obtained for the Conrail brakeman were also reanalyzed. The results reported by CHT were 15 ng/ml of THC-COOH in the blood, 109 ng/ml of THC-COOH in the urine, and 64 ng/ml of PCP in the urine (see appendix K).

Survival Aspects

Amtrak Train 94.--The forward cab in which the engineer was riding was crushed in the collision. Only the rear cab of the lead locomotive of train 94 was not demolished.

The unoccupied first car of the train was crushed. The car bodies of the second and third cars were severely crushed and deformed. The second car was on its side, and the third car was leaning. All of the fatally injured and most of the seriously injured passengers were in these two cars. Many passengers were pinned or otherwise trapped between dislodged seats, luggage, and structural members of the cars, yet some occupants were able to free themselves and leave the cars before rescuers arrived at the scene.

The rearmost nine cars were not heavily damaged. All remained upright with car bodies intact. Five of these cars were jackknifed, but no car was bypassed and no car was struck in the side. The other four cars remained in line with the track. Most of the passengers in the rear nine cars were able to evacuate the train virtually without assistance. The four Amtrak trainmen and the service personnel, who had received training in evacuation procedures, assisted the passengers in the other cars.

When the trains collided, the conductor was passing between the vestibules of the third and fourth cars. Unable to hold on, he was thrown forward and out between the cars as they separated and landed on the ground under the fourth car. The conductor was able to crawl out from under the car and, despite multiple head and ear lacerations, he assisted passengers in the sixth and seventh cars.

The three assistant conductors were collecting tickets in the fourth, eighth, and ninth cars when the collision occurred. All were catapulted forward along the aisles and ultimately fell to the floor, yet all escaped serious injury and were able to assist the passengers. The forward assistant conductor stated he was struck and knocked down by falling luggage in the fourth car. Nevertheless, he helped evacuate the 80 passengers in the fourth car through the emergency windows after finding the sliding side doors jammed because of damage to the car ends. This assistant conductor repeated the procedure in the fifth car that also had jammed side doors. Afterward, he assisted the conductor in evacuating the sixth car.

Another assistant conductor evacuated the seventh and eighth cars; both cars were fully occupied. The evacuation from these cars was mostly through the side doors which the trainman was able to open. The flagman opened the side doors in the 10th and 11th cars. Most of the persons in the rear four cars left the train through them.

The train crewmembers related that most of the passengers remained calm and there was little panic, although the aisles of most of the coaches were blocked by fallen luggage. In the food service cars, unsecured microwave and convection ovens and other articles in the pantry sections were thrown to the floor and blocked movement through the cars (see figure 15).

Passengers throughout the train reported that they had been struck by fallen luggage. Others stated they were injured when thrown into sheet metal seatbacks exposed by dislodged cushions (see figures 16 and 17). A number of seats had been dislodged altogether in the seventh car (see figure 18). Postaccident inspections revealed that the emergency windows in the 11th car, a rebuilt Heritage-class coach, could not be pulled inward as designed because the inside framing around them was too wide. Of the 45 passengers who were interviewed or who responded to questionnaires, 20 reproted they were struck by luggage falling from overhead racks; additionally, 8 of the 45 passengers reported they had difficulty in evacuating becuase of fallen luggage in the aisles.

Figure 15. Microwave oven and other pantry material blocking the aisle of the rear car of train 94, the food service car.

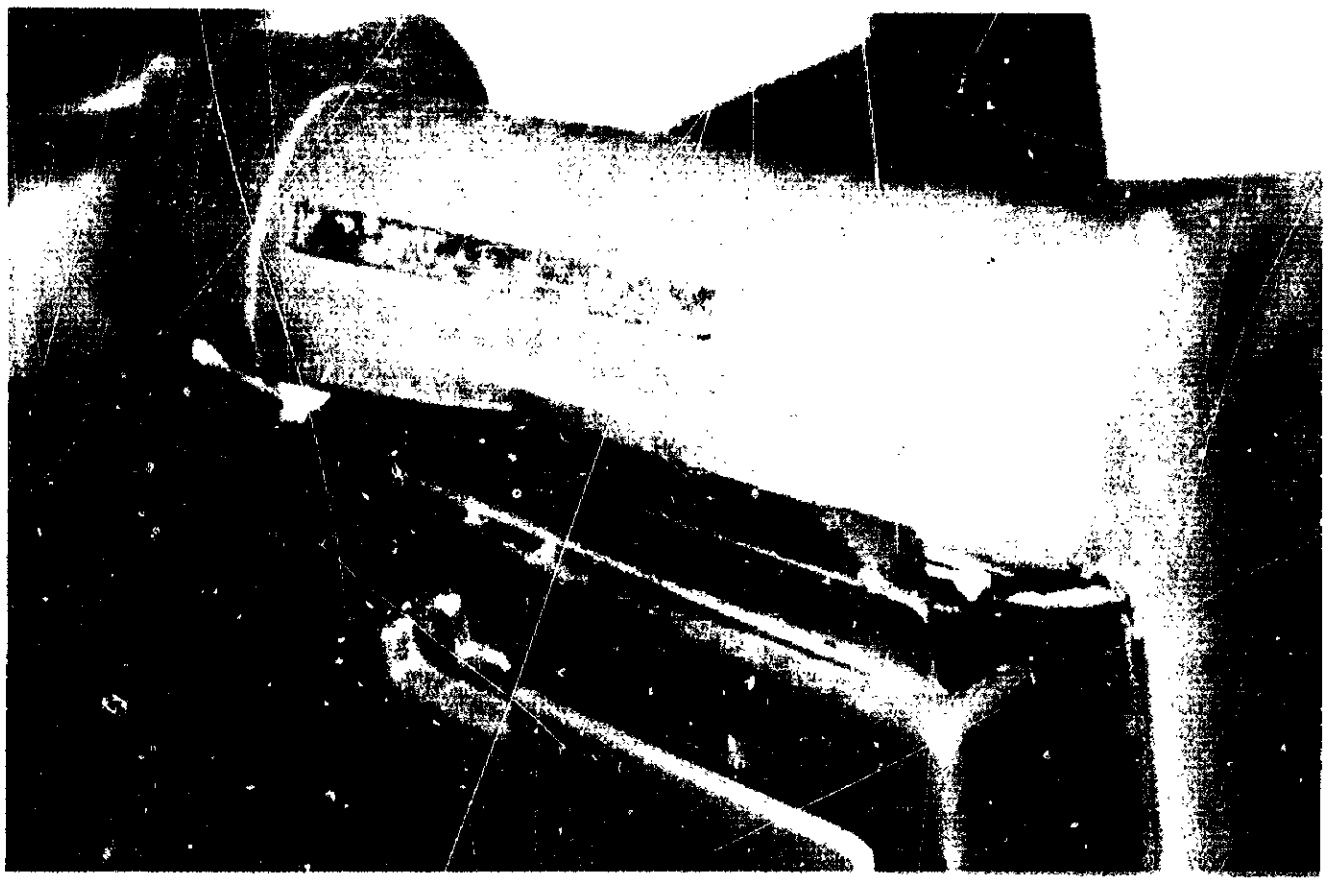


Figure 16. Edges of sheetmetal seatback frames exposed by displacement of the cushions.

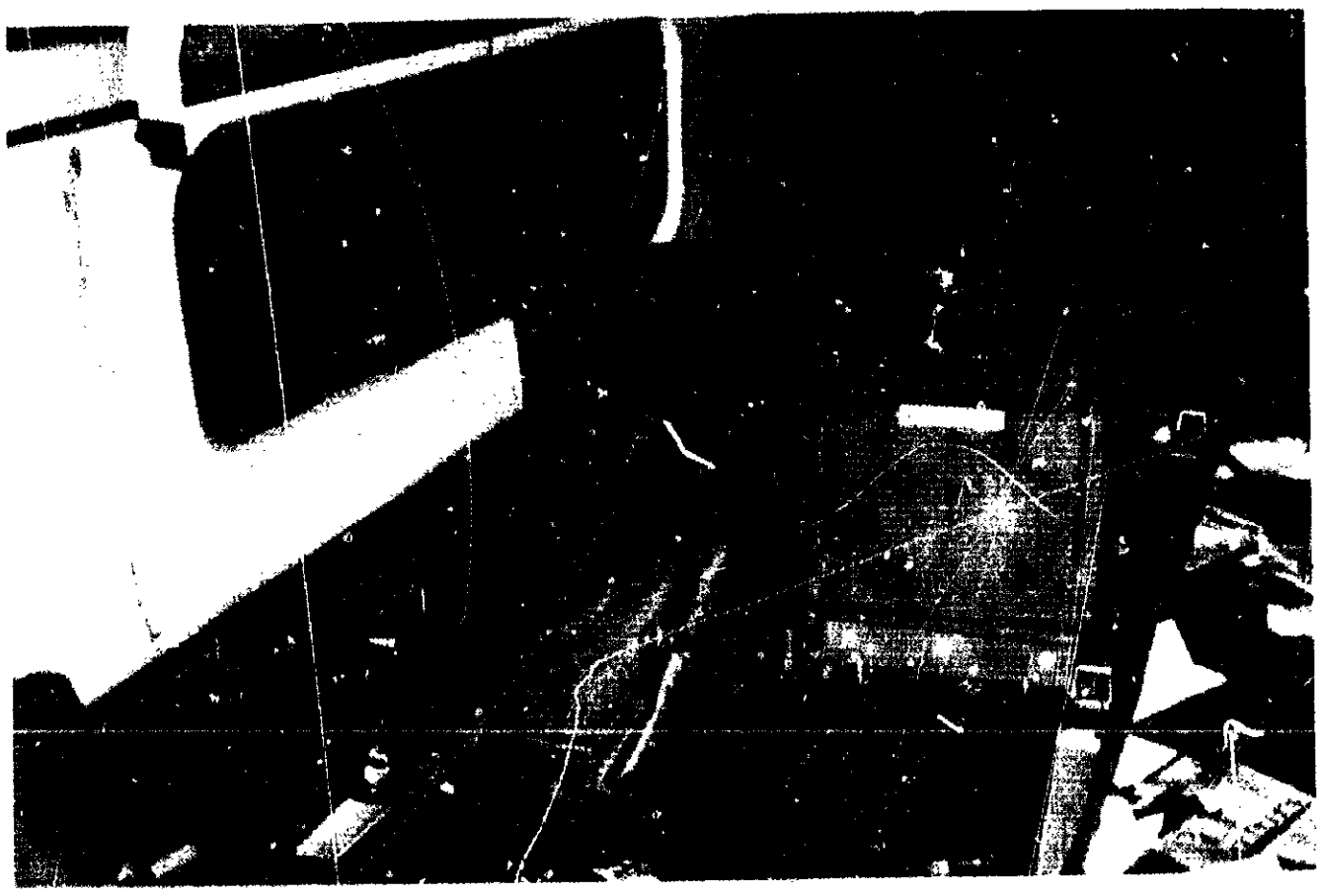


Figure 17. Missing seatback cushions and exposed sheetmetal seatback frames in a coach.

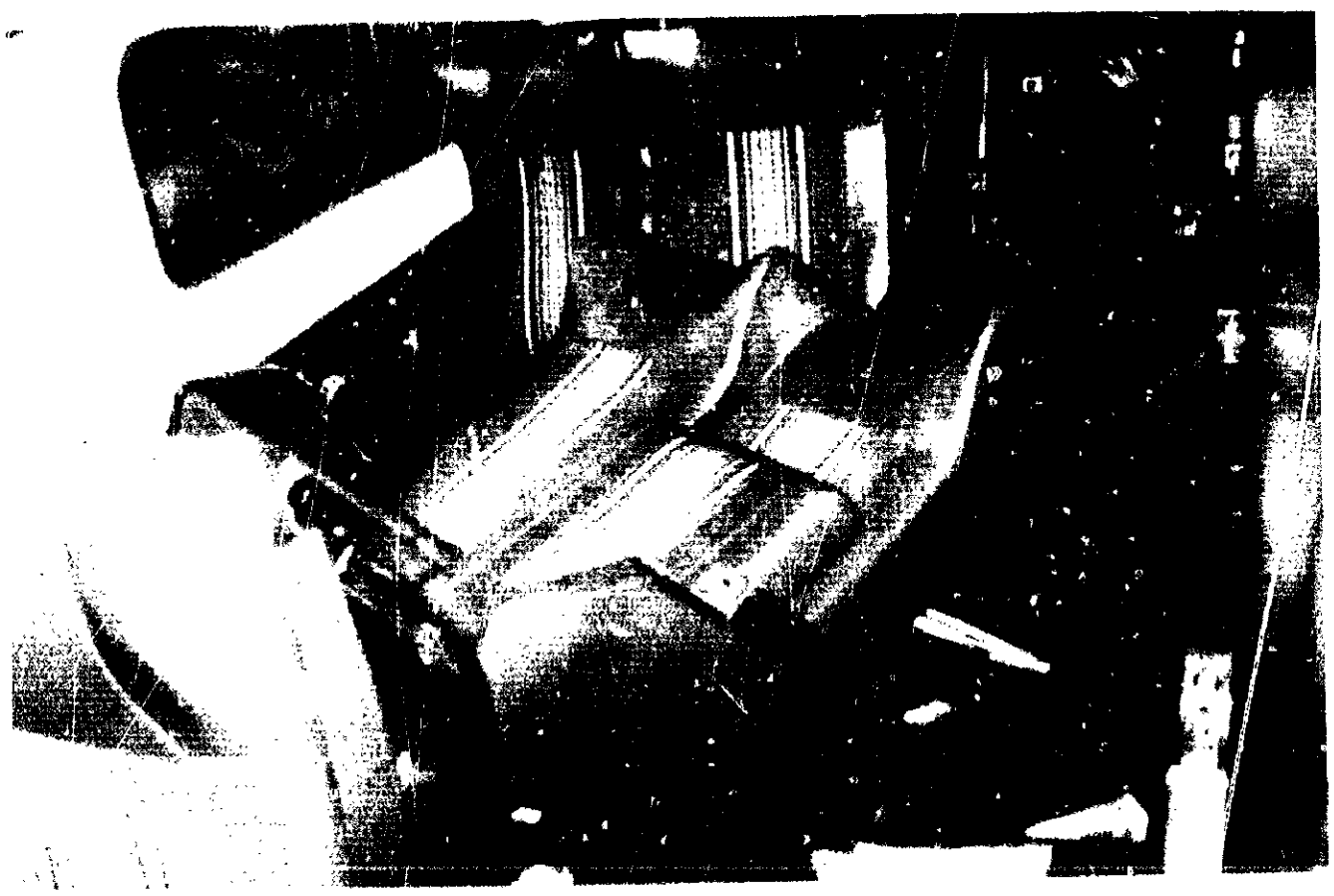


Figure 18. Seats separated from pedestals in the seventh car of train 94.

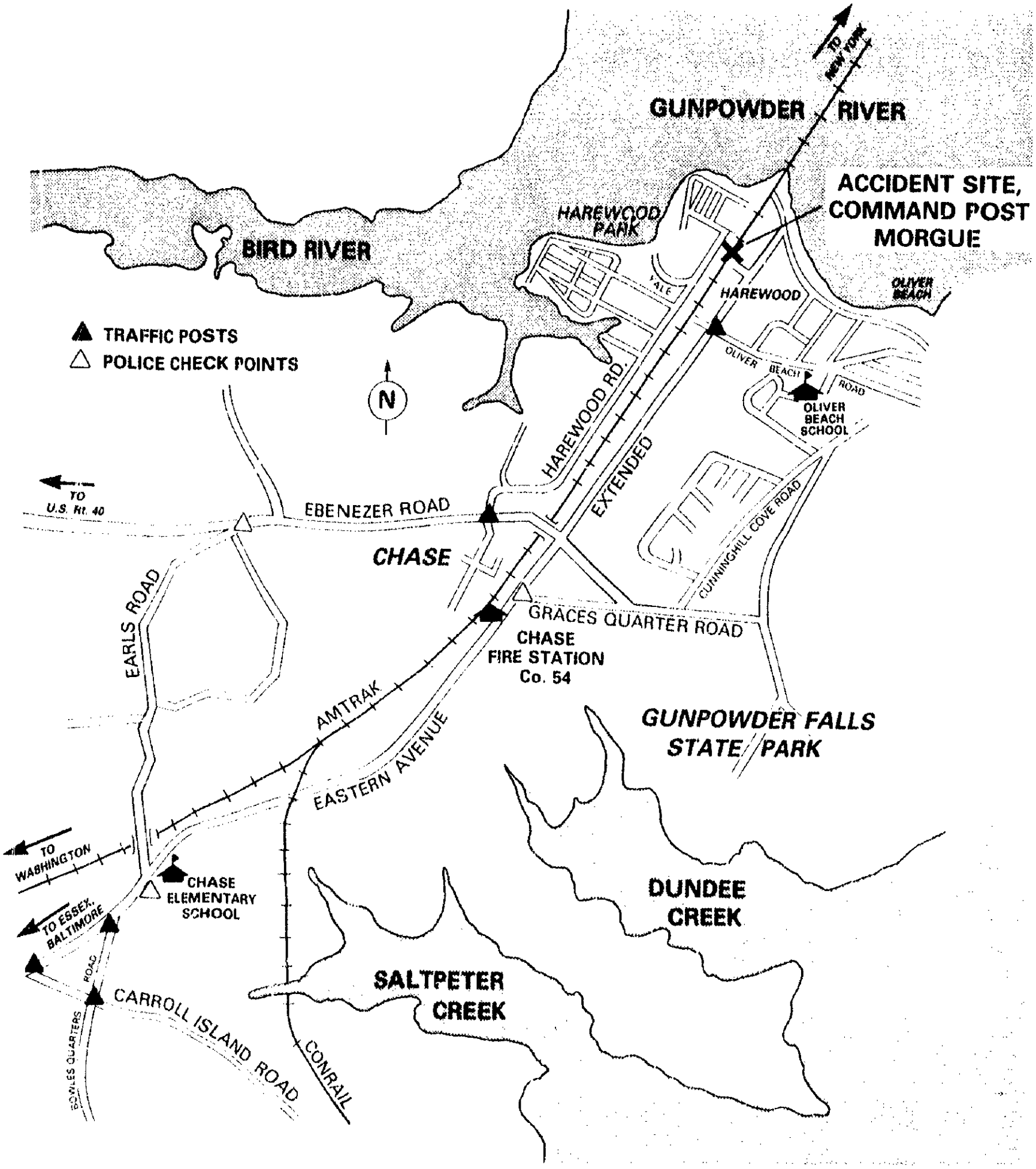


Figure 19. Plan of the Chase area showing access roads and the facilities that were used in response to the accident.

Conrail Train ENS-121.--The rear two locomotive units of train ENS-121 absorbed much of the impact energy, and damage to the lead unit was minimal. Nevertheless, the lead locomotive unit was driven forward about 900 feet. The brakeman said he alighted from the unit and was able to flee from the tracks before the collision. The engineer said that he stayed on the lead unit until after the collision. One eyewitness said that he saw a man dressed similar to the engineer alight and run clear of the tracks before the collision. Another eyewitness said he saw two men on the ground at the south end of the locomotive before the collision. In any event, the engineer escaped without serious injury.

Emergency Response

Chase, Maryland, is located in the extreme eastern part of Baltimore County on an isolated peninsula bounded on the north by the Bird and Gunpowder Rivers, on the east by the Chesapeake Bay, and on the south by the Middle River. (See figure 19.) It is made up entirely of residential neighborhoods separated by undeveloped woodlots and marshes. The total population of the area is about 7,000.

Access to the area is limited to two paved two-lane roads. The principal road is Eastern Avenue that closely parallels the NEC line to the east and runs southwest to Martin State Airport, the Baltimore beltway, and downtown Baltimore. The second access route is Ebenezer Road, a narrow and winding two-lane road intersecting with Eastern Avenue about 1 mile south of the accident site and extending west to U.S. Route 40. The latter is a major four-lane trunk highway that also parallels the corridor line and extends into downtown Baltimore. Harewood Road runs along the west side of the corridor from Ebenezer Road to the accident site. The distance from the accident site to U.S. 40 via either Eastern Avenue or Harewood Road and Ebenezer Road is about 5 miles.

There are continuous rows of houses along both sides of Eastern Avenue from the accident site south, but there are only a few houses along Harewood Road. The area immediately west of the accident site is a wooded marsh. Behind the residences east of the tracks is a wooded park. Farther east is Oliver Park elementary school, and there are two community center buildings in the immediate area. The park was used as a primary triage area for injured passengers; the buildings ultimately served as shelters for uninjured passengers from train 94.

The nearest fire station was the No. 54 Chase station located on Eastern Avenue 1.4 miles south of the accident site. The Chase station was equipped with an engine, a four-wheel drive brush truck and a medic unit/ambulance. At the time of the

accident, the engine was manned by two officers, a driver-firefighter, and a firefighter. The medic unit crew consisted of a paramedic-cardiac rescue technician and a driver-emergency medical technician. The Chase station was about 3 years old and had four large drive-through bays. It was staffed entirely with full-time career personnel. Two years before the accident, some of the station personnel had received Amtrak training in dealing with their train equipment in an emergency.

According to the fire department, the county's emergency force training had concentrated on freight train derailments involving the release of hazardous materials. In 1983, the National Safety Council had provided the fire department with enough copies of Amtrak's booklet, "Emergency Evacuation Procedures," for one to be placed in each fire station. Although this booklet contained diagrams of Amtrak's cars, there were no skeletal diagrams for determining where jacks, cribbing, and air bags could be used to stabilize the cars. In any event, no one at the accident scene on January 4 had one of the booklets.

Farther south on Eastern Avenue were the Chase elementary school and the Maryland Air National Guard facility at Martin State Airport, 3 and 4.8 miles from the accident site, respectively. (See figure 19.) The nearest hospital, Franklin Square, was about 8 miles southwest of the accident site by either the Eastern Avenue or the Ebenezer Road-Route 40 routes. The accident occurred on a Sunday afternoon, and most people living in the area were at home, the schools were unoccupied, and the Air National Guard was in an on-duty status. Several large Huey helicopters assigned to the Martin State base were engaged in an exercise on the north side of the Bird River about 2 miles north of the accident site.

At the time of the accident, Baltimore County had 32 career and 31 volunteer fire companies, 16 career and 17 volunteer medic units, 9 heavy rescue/floodlight units, and numerous auxiliary units to serve the county's 610 square miles and 675,000 residents. All were mobilized after the accident; 34 fire companies, 6 heavy rescue units, 34 auxiliary units, and 13 medic units were dispatched to the site. Under mutual aid agreements, 4 fire companies, 3 rescue units, 18 medic units, and 3 auxiliary units were dispatched from Baltimore City and adjoining counties. Two aircraft crash trucks were sent to the site by the Air National Guard. In addition to the 31 medic units, 14 private ambulances responded to the emergency. Four Air National Guard Huey helicopters and five Maryland State Police helicopters were used in the response.

An area disaster plan had been implemented in 1984; this plan was formulated largely on the experience of Washington, D.C.-area emergency forces in dealing with the crash of an Air Florida airplane and a subway accident on January 3, 1982. The Baltimore County forces participated in annual simulated disaster drills, most recently on June 8, 1986.

According to the report of the Baltimore County Fire Department, the county's emergency communications center received two emergency calls reporting a "big explosion on Eastern Avenue" at 1:29:47 p.m. and 1:29:49 p.m. On the basis of these calls, the Chase station units, three additional engine companies, a ladder truck, two heavy rescue trucks, a three-piece hazardous materials unit, a battalion chief, and a paramedic field supervisor were dispatched to the scene at 1:31:46 p.m. The Chase units arrived at the scene at 1:37 p.m., but while en route, the medic unit made a "heavy smoke showing" report at 1:36 p.m. and requested that four additional medic units be dispatched. At this time the paramedic field supervisor, while en route to the accident site, upgraded the request to eight medic units. This initiated the "major medical command mode" portion of the fire department's emergency plan, mobilizing the remaining medic companies in the county. Four additional fire companies, an air unit, and a mobile command post were dispatched at 1:42 to the Harewood Road area on the west side of the tracks. Also at 1:42 a battalion chief arrived and took overall command at the site. At 1:49, the "major command mode" of the fire department's emergency plan was implemented mobilizing all remaining county volunteer units.

When the first emergency response units arrived, they found diesel fuel burning along the right-of-way east of the tracks, as well as under the trailing Amtrak locomotive and the three forward passenger cars. There was adequate water available from nearby hydrants, but it was ultimately necessary to send for additional foam from the Chase station. The firefighters had to take great care in putting out the fires in the wreckage to prevent scalding or drowning the passengers trapped or injured in the cars, particularly the crushed food service car that the firefighters assumed to be occupied. Considerable time passed before the firefighters were told that no one had been riding in the food service car. Emergency rescue personnel also decided to stabilize the second and third cars with jacks and air bags before extricating passengers trapped in the cars. The firefighters were hampered in their rescue efforts because they had no skeletal diagrams of the cars and were unsure where supports should be placed.

Many nearby residents immediately responded by assisting passengers in evacuating the train, by providing them with blankets, and by taking them into their homes. Medic units set up primary triage sites in the small park east of the tracks and on the Harewood Road side. As fast as the less-seriously injured

persons could be examined and tagged, they were shuttled to the Chase station where the equipment bays were used as a secondary triage and treatment center. Uninjured passengers were taken to a shelter at the community center buildings and the Oliver Park school. Many passengers wandered off and could not be accounted for. Some passengers reportedly walked south on the tracks and boarded train 112 before it was pulled back to Baltimore.

Initially, the 10 Air National Guard and State Police helicopters evacuated the seriously injured from the Chase station parking lot. Because of growing congestion at the fire station and on Eastern Avenue, the air operations were shifted to the Oliver Park school which was much closer to the accident site. In all, the helicopters made 17 flights transporting 28 injured persons to the 6 area hospitals that could accommodate the aircraft. They were also used to bring in personnel and medical supplies, including plasma, and to make traffic surveys and searches for passengers thought to have wandered into nearby wooded lots and marshes.

An additional 156 persons were transported by ambulances and private vehicles to 11 hospitals located 8 to 35 miles from the accident site. According to the fire department report, the existing county communications system was "insufficiently flexible" for adequate communications between the accident site and the hospitals which resulted in the hospitals' receiving "insufficient status information on incoming patients."

Around 4:00 p.m., after the fires were out and the second and third cars had been stabilized against movement, rescue teams succeeded in removing the injured but untrapped passengers from those cars. According to the fire department report, there were still eight known surviving passengers trapped in the cars; the work of extricating them proved to be exceedingly slow and difficult.

The saws and Hurst "jaws of life" tools used by the rescue units were relatively ineffective against the heavy-gauge stainless steel of the car bodies. The saws would not cut through the steel; even cutting torches were not effective. The tips and hydraulic seals of the Hurst tools broke and ruptured. The manufacturer sent technicians and parts from Pennsylvania, but they were not able to arrive until late in the evening.

While rescue teams toiled, medical technicians said they did all they could to care for and comfort the trapped passengers. One passenger in the second car was trapped from the waist down, but was upright and easily accessible. At 7:45 p.m., paramedics were about to administer an intravenous line to him when the cars shifted slightly and all personnel were ordered to

clear the wreckage until the cars could be restabilized. The passenger was clearly upset over being left alone, and although paramedics later succeeded in administering the IV line, the man died. According to the fire department report, a "mood of disappointment and frustration overtook the rescue personnel as a result." The last surviving passenger was removed from the cars at 11:45 p.m. and was flown to a hospital where she subsequently died.

Shortly after the accident, crowds of curious onlookers gathered at the site and mingled with the passengers. These crowds hampered and slowed the efforts of medic units and other emergency personnel to identify, classify, marshal the passengers, and direct them to triage sites, staging areas, or shelters. The fire department report further asserted that medical personnel at the triage sites had difficulty in determining which were patients and bystanders.

The first county police vehicle reportedly arrived at the accident site at 1:33 p.m., and at least one Amtrak policeman, who was aboard train 112, was on hand early. At 2:17 p.m., the county police asked Maryland State Police to block the access roads, but a request to block the outer perimeter, including the intersection of Ebenezer Road and U.S. Route 40, was not made until 7:21 p.m.

Baltimore County police established an on-scene command post at 2:50 p.m., and assumed overall command of the response; subsequently the police devoted considerable resources to the response. By the morning of January 5, Amtrak had nearly 40 police officers at the site. But, referring to the critical hours following the accident, the fire department report stated:

> Access to the incident by unauthorized personnel and vehicles was not controlled. Police officers in some cases were unwilling or unable to confront the situation and gain control of the unauthorized access problem. Access roads on both sides of the incident became needlessly blocked by private and emergency vehicles [and made] it difficult for medic units to access the roads.

Disposition of noninjured passengers was significantly delayed. The police continued to attempt to identify all the passengers who had been on the train well into the evening, and they did not release the passengers' luggage and other personal baggage until 10 p.m. By this time, many passengers had left the area. At 8:45 p.m., 95 persons were transported from various shelters to the Chase school after a downtown Baltimore hotel had made 200 rooms available for out-of-town passengers. About 25 passengers were actually transported to the hotel; another 30 to 40 were picked up by friends and relatives. Ultimately, Amtrak provided buses to accommodate more than 100 passengers who chose to proceed to New York City rather than remain in Baltimore.

Tests and Research

On-Site Inspections and Tests.--About 10 p.m. on January 4, a Safety Board investigator boarded the lead Conrail unit and observed the throttle in the number 8 position, the reverser in reverse, the locomotive brake fully applied, the automatic brake valve in emergency, the dynamic brake in the "off" position, and the battery knife switch open. On closing the battery switch, the "restricted" aspect of the cab signals was illuminated. Subsequently, the investigator removed the cover of the cab signal box and noted that the bulb for the "approach" aspect was missing.

The day after the accident, various tests were performed on the lead Conrail unit in the presence of the Safety Board's vehicle factors investigative group which included Safety Board and FRA investigators as well as Amtrak and Conrail maintenance of equipment officers. A test of the airbrake system was performed and no defects were found. It was noted that maximum brake cylinder pressure was attained 8 seconds after the brakes were applied in emergency and that sand was automatically discharged against the rails for 30 seconds after the emergency application was initiated.

A cab signal test was also performed after a bulb was inserted in the "approach" aspect. All aspects illuminated as required. During the test it was established that because the whistle port was taped, the cab signal alerter whistle made no audible sound that could be heard when the engine of an adjacent unit was idling.

Sight and Stopping Distance Tests.--On January 12, 1987, sight and stopping distance tests were performed approaching Gunpow interlocking from the south on track 1. Conrail B36-7 locomotive units of the same class and with the same equipment that made up train ENS-121 were used. The test train was operated by a Conrail road foreman of engines; Safety Board investigators and observers from Amtrak, Conrail, FRA, and other parties to the Safety Board's investigation were also aboard. The Safety Board investigator observed that the road foreman of engines was able to maintain the train's speed at 60 mph without difficulty.

Sight distance tests of signals 816-1 and 1N were made between 1 p.m. and 1:20 p.m. with an overcast sky. About 1:25 p.m. the sky cleared completely, and the tests were repeated in bright sunlight. It was observed that the signal aspects could be seen in dull light at distances of 300 to 500 feet greater than they could be seen in bright sunlight.

An "approach" aspect displayed by signal 816-1, which is approached through a left-hand curve, could be seen from the left side of the locomotive cab at a distance of 2,118 feet in bright sunlight. The signal could not be seen from the right side of the cab until the locomotive was 1,278 feet from the signal because of the obstruction of the overhead catenary wire in the curve. In bright sunlight, a "stop" aspect displayed by signal 1N could be seen from both sides of the cab at a point 5,181 feet to the south. The location was in the exit spiral of a left-hand curve at the Ebenezer Road overpass. South of that point, the view was obscured by the west abutment of the overpass.

Three stopping distance tests were performed--the first two by applying the independent or locomotive airbrake when signal 1N could first be seen. In the first test, braking was initiated from 60 mph using 66 psi of brake cylinder pressure reduced to 55 psi. This action stopped the train in 2,100 feet leaving 3,081 feet to signal 1N and 3,430 feet to switch 12. In the second test, braking was initiated from 62 mph using the same brake cylinder pressure values as in the first test. This action stopped the train in 2,395 feet leaving 2,786 feet to signal 1N and 3,135 feet to switch 12.

In the third test, independent braking was begun at cab signal code change point CS 806, 4,450 feet south of signal 1N at a speed of 65 mph. Brake cylinder pressure was maintained at 50 pounds psi. The train stopped in 2,502 feet, leaving 1,948 feet to signal 1N and 2,248 feet to switch 12.

All of the stopping tests were performed on a clear and dry day and were witnessed by the parties who witnessed the sight distance tests. The speeds were established with a radar speed gun situated at lineside locations. The radar equipment was calibrated before the tests. Emergency braking was not used nor was sand applied to the rails before or during the tests.

Signal Tests.--The signal system was of "fail-safe" design that was substantially modified during 1985. In-depth modification of reliability tests were performed following these changes and no fault was found in the system. Amtrak records indicate that no report of signal malfunction was made between the time of testing and the accident.

Amtrak signal engineers and FRA signal inspectors performed complete tests of the signal system at Gunpow interlocking from January 4 to 7, 1987. These tests were observed by a Safety Board investigator.

Inspection of the aspect lights in signals 816-1, 816-2, 1N, and 2N determined that none of the bulbs were missing or inoperative. Meggering tests (measurement of insulation resistance to ground and other wires) were performed on the following elements of the system:

1. the lighting cable at signal 816;
2. the signal cables from the central instrument house to the northbound distant and home signals;
3. the track wiring at signal 816, code change location CS 806, an the northbound home signals; and
4. the relays at the central instrument house, signal 816, code change location CS 806, and the northbound home signals for train movements on tracks 1 and 2.

In addition, circuit breakdown tests were performed on signal 816, code change location CS 806, the home signals, and the central instrument house; in each instance the tests were performed on both tracks 1 and 2. Track circuits on tracks 1 and 2 were checked for code rates, current adjustment, and for track circuit interference at all three signal locations. None of the tests revealed any defects; the signal systems for tracks 1 and 2 were within design specifications. It was further established that with the interlocking arranged for through northbound train movement on track 2, the track circuit code generated would have resulted in the display of the proper wayside and cab signal aspects.

After switch 12 was restored to service on January 9, 1987, Amtrak and FRA personnel checked the complete route locking, indicator locking, and time locking with aspects and code rates from signals 1N and 2N to their respective distant signals and code change location CS 806. During these tests the signal system functioned as designed. In addition, investigators were unsuccessful in their attempts to recreate the combination of signal aspects that the engineer of train ENS-121 said he had observed.

Gunpow Signal Event Recorder.--Following the accident, the computerized event recorder in the central instrument house at Gunpow was shunt checked for relay position and current changes that were recorded before the accident. The following events were determined to have been recorded:

Event	Time*
1. Last route setting by Edgewood operator from track 1 to track 2	10:34:04.8
2. Last change of signal 1N aspect	10:37:14.5
3. Last change of signal 2N aspect before accident	12:44:28.8
4. Edgewood operator set route for train 94 and requested that signal 2N be displayed	1:29:44.0

* The indicated times were estimated to be about 4 minutes faster than standard time, but the lapsed times between the events were established to be precise.

Event	Time*
5. Signal 2N displayed "clear" aspect	1:29:45.8
6. Conrail ENS-121 on approach to signal 816-1	1:30:31.0
7. Train 94 on approach to automatic signal 836-2 (20,830 feet south of home signal 2N)	1:31:45.1
8. Train ENS-121 entered 2T track circuit at signal 1N	1:33:24.7
9. Signal 2N displayed "stop" aspect:	1:33:26.7
10. Train ENS-121 reversed position to switch 12 from normal and entered track 2	1:33:31.6
11. Interlocking track circuits indicated as occupied as a result of loss Hz signal power	1:33:47.5

* The indicated times were estimated to be about 4 minutes faster than standard time, but the elapsed times between the events were established to be precise.

Using the loss of 100 Hz power event as a reference, train ENS-121 passed under home signal 1N and then reversed the position of No. 12 switch 20.8 and 15.9 seconds, respectively, before the accident. Tests conducted following the accident established that it took 1.9 seconds for the relay to pick up and 4.7 seconds for clearing signal 1N when a train entered the track 2T circuit. On this basis, it was established that train ENS-121 was moving at 30.1 mph when it passed under signal 1N.

Locomotive Speed Indicators and Recorders.--Following the accident, the speed recorders and their tapes were recovered from the Amtrak locomotives and the speed indicators and event recorder data packs were recovered from the Conrail locomotive units. The speed indicators in the lead end of the lead Amtrak locomotive were not located after the accident.

Calibration of the speed indicator removed from the cab of the lead Conrail unit indicated speed at slightly less than actual speed. The deviation was 1/2 mph under actual speed at 10, 40, 50, and 70 mph; it was 1 mph under at 20, 30, and 60 mph.

The data packs from the Pulse event recorders aboard the Conrail locomotive units were taken to the manufacturer's plant for playback/readout on strip charts. Calibration for accuracy of the speed data was performed during the playback procedure on the basis of pertinent wheel measurements. Data generated on the strip charts were digitized and recorded using the Safety Board's optical reading station. The Safety Board's computer facilities were then used to plot these data in graphic form (see figure 20).

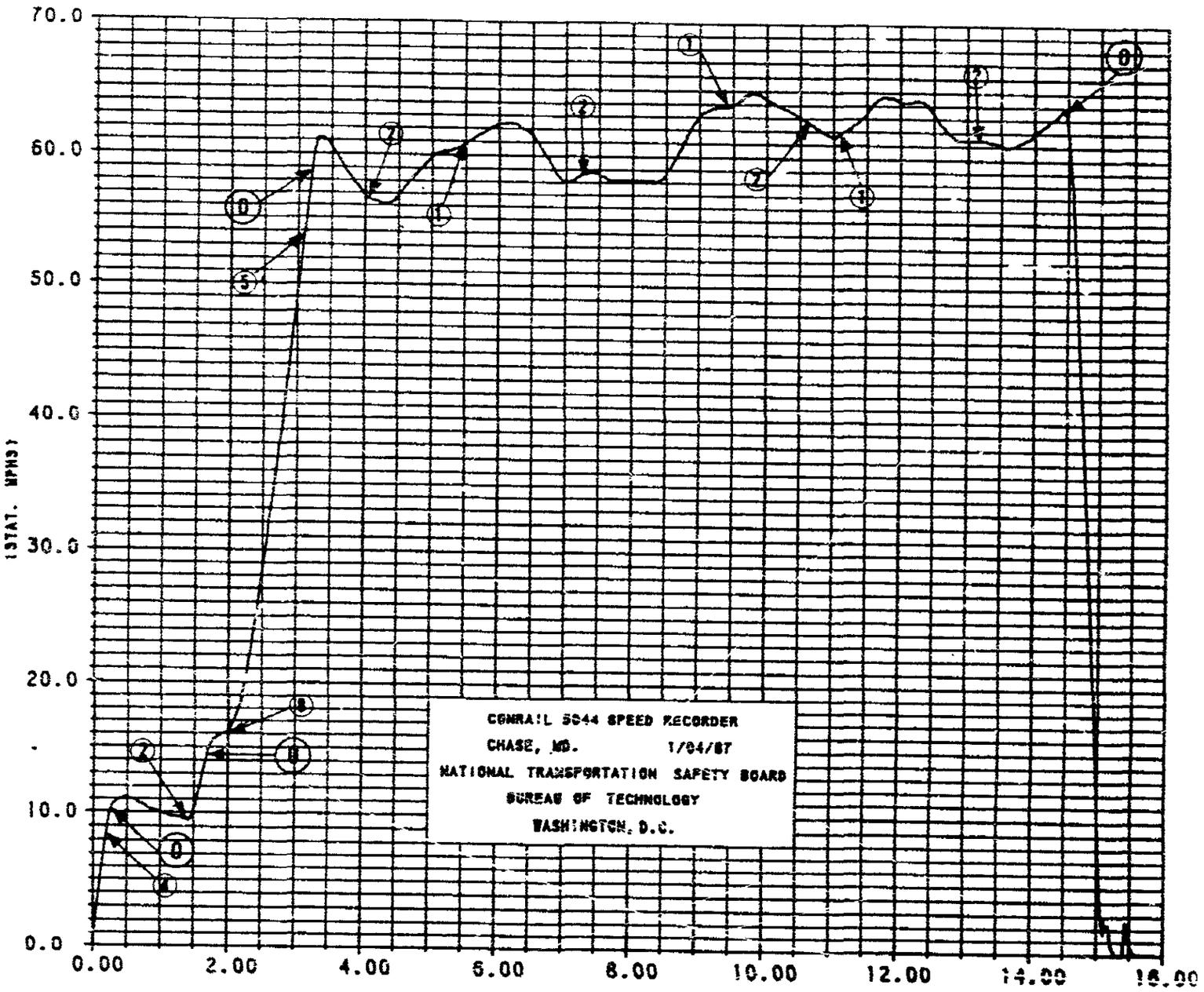


Figure 20: Speed data from the event recorder on Conrail locomotive 5044, the lead unit of train ENS-121, as reproduced in enhanced graphic form. The locations of changes in the throttle setting have been plotted on the graph. Throttle settings are 0 (idle) through 8 (fully open).

The data from the lead unit's recorder indicated that 15 minutes 15 seconds passed between the time train ENS-121 left the vicinity of Bay View yard office and the time it stopped at Gunpow. The times 1:15:15 and 1:30:30 were used as reference points for the start and stop times. At 1:17:15, 2 minutes after the start, the throttle was opened to the eighth or full throttle position; at the time, the train was moving at about 15.5 mph. At 1:18:20 and 5[illegible] mph, the throttle was reduced from the eighth to the fifth position, and 10 seconds later, at 57 mph, the throttle was reduced to idle. Acceleration ceased and deceleration began at about 60 mph; at about 56 mph, the throttle was opened to the second position.

Thereafter, speed was maintained between 56 and 65 mph in 4 cycles or swings with the first two considerably wider than the last two. On the upside of the swings, the throttle was reduced from the second to first position; on the downside, it was opened to the second position. On the last upswing, with the throttle advanced to the second position, speed increased from about 61 to 64 mph when emergency braking was initiated from the automatic brake valve.

In the 55- to 65-mph range, the speeds shown for the middle and trailing units were slower than those recorded for the lead unit--about 1 mph in the case of the middle unit and 4 mph for the trailing unit. 26/ Speed data during deceleration following the emergency application were continuously recorded on the lead and trailing units. On the middle unit, the deceleration sequence was recorded only between 15 and 0 mph. 27/

According to the printout of the lead unit's data pack, the stop was achieved 48 seconds after the brakes were applied in emergency. While the train was still moving at 2 mph, the brakes were released; this brake release was indicated as occurring 42 seconds after the brakes had been applied. The printout further indicated that the locomotive brake was applied 38 seconds after the emergency application had been released. The printouts for the other two units, however, indicated that the locomotive brake was applied continuously from the time the emergency application was made.

26/ The discrepancy in recorded speeds was attributed to incorrect wheel measurements for the trailing unit.

27/ Neither the indicator nor the recorder receive a speed signal when the axle that generates the signal is not turning. When the locomotive unit is moving and no speed signal is being generated, the wheels of the axle are sliding on the rails.

The event recorders yielded data that indicated when and where the crewmembers of train ENS-121 moved the locomotive units before their departure from Bay View. After the brakes were released about 12:45 p.m., the units remained stationary for 7 1/2 minutes. By 12:55 p.m., the units had been moved to the yard office where they remained standing for about 7 minutes. From 1:02 p.m. to 1:05 p.m., the units were moved from the yard office to the cab signal test rack on the "lawn" track where they were stationary for 3 1/2 minutes. From 1:09 p.m. to 1:15 p.m., the train moved from the test rack to the Amtrak connection and waited for a permissive signal to enter the Amtrak line.

The units of train ENS-121 were not moved during the time they were at the test rack. In addition, the printouts yielded no brake application data that would indicate that the required standing load test of the locomotive brake, the predeparture initial terminal airbrake test, or a running application and release airbrake test were performed after the crewmembers took charge of the train.

Following the accident, the event recorder on the lead Conrail unit remained in operation until 2:03 p.m., when its battery power source was cut off. Three minutes earlier, the automatic brake valve of the locomotive had been changed from release to full-service position, the reverser had been placed in reverse position, and the unit's engine was shut down.

A furloughed Conrail engineer who lived close to the accident site subsequently testified that he boarded the lead unit shortly after the accident. According to the furloughed engineer, he shut the engine down, turned off the panel switches, and applied the handbrake. He said he noticed that the reverser was in reverse, but insisted he did not put it in that position. An off-duty Conrail conductor, who also lived nearby, stated that he boarded the lead Conrail unit and pulled the battery switches. At the time, he said, the engine was already shut down.

The Aeroquip/Barco speed recorders were removed from the two Amtrak locomotive units after the accident. Both were damaged and had to be repaired before they could be calibrated. On January 16, 1987, calibration tests were performed at Amtrak's Wilmington, Delaware, shop. These tests were observed by representatives of Amtrak, the FRA, and the manufacturer. No tests were made below 40 mph, and speeds were not measured in consecutive increments to determine constancy of digression from actual speed. Following the tests, Amtrak reported that both recorders recorded speed approximately 5 mph faster than actual speed at levels above 100 mph. Precise calibration was not possible because of damage to the recorders.

The tapes removed from the recorders of train 94 indicated that the train was traveling 123 to 125 mph between the stops made at New Carrollton and Baltimore. The tapes indicated that the train accelerated to 120 mph after leaving Baltimore, decelerated to 110 to 112 mph, and then reaccelerated to a maximum of 128 mph approaching Gunpow. Both tapes showed speed as being 125 mph when braking was initiated and about 107 mph when the trains collided.

Computer Simulations.--Following the accident, Conrail made a Train Operations Simulator (TOS) simulation that indicated train ENS-121, traveling 64 mph, would be stopped in 40 seconds and 2,054 feet with an emergency application of the automatic airbrake.

On March 13, 1987, at the request of Safety Board investigators, a TOS simulation was made for stopping distances of train 94 at Conrail's Philadelphia headquarters. This simulation revealed that traveling 105 mph, the train would be stopped in 5,100 feet with a full-service brake application and 3,448 feet with an emergency brake application. At a speed of 122 mph, the stopping distances were 6,470 feet for a full-service brake application and 4,382 feet for an emergency brake application.

Radio Tests.--At the time the on-site airbrake and cab signal tests were made, the console radio on the lead Conrail locomotive unit was also subjected to a transmission test. A transmission from the radio was audible on a Conrail unit about 50 yards away, but the communication was described as weak and broken by static. At the time, it was also noted that the wires used to connect the radio to the console were short, making it difficult to disconnect or connect the helical multiprong plugs of the wires.

On January 11, 1987, the radio was tested by Conrail at its Enola, Pennsylvania, facility with an FRA electronics engineer present. The tests indicated that the cab roof antenna and the antenna cable were properly installed and in working order. A transmission made from the radio over a distance of 28 miles was "loud and clear." Bench testing at this time established that one of the radio's power cables was loosely twist-spliced and the splice was not taped. It was also reported that during a vibration test, "the radio failed due to a fatigued metal spring on a fuseholder." Records were produced to show that the radio had been last checked at the Enola radio shop on December 22, 1986.

On January 7, 1987, a test was performed on the portable radio used by the crew of train ENS-121. This test established that the radio's battery was fully charged; no defects were

found in the radio or the battery. At the time the tests were made, it transmitted properly over a short distance. As far as the Safety Board was able to determine, no tests were performed to establish the maximum transmitting range of the radio.

Other Tests and Research.--On January 5, 1987, Conrail reported that it tested the cab signal test rack at Bay View Yard using a cab signal-equipped Conrail locomotive. All meter readings were within limits, the cab signals of the locomotive functioned properly, and no defects were found in the test equipment.

Following the accident, the cab signal whistle from the lead Conrail unit and the tape used to mute it were examined by the Federal Bureau of Investigation (FBI) at the Safety Board's request. No latent fingerprints were found on the tape. The FBI estimated that the tape had been applied to the whistle for "some time" but was unable to determine the age of the tape.

Other Information

Before World War II, all track now operated by Amtrak as a part of the Washington-New York section of the NEC was equipped with the track circuitry needed for ACS and ATC, and by the time Amtrak took over the operation of the corridor, all locomotives operating on the corridor between Washington and New York were equipped with ACS and ATC. For more details on the history of safety backup devices on the NEC, see appendix L.

In 1978, as a result of a collision between a Conrail commuter train and an Amtrak passenger train at Seabrook, Maryland, 28/ the Safety Board issued Safety Recommendation R-78-39 to Amtrak that required all trains that operate on the NEC be equipped with an ATC device. However, by 1981 Conrail had retired all of its ATC-equipped E-44 and GG-1 electric locmotives and replaced them with diesel-electric locomotives that were equipped with ACS but not ATC or ATS.

According to the FRA, Conrail was free to replace the ATC-equipped electric locomotives it used on the corridor with nonequipped diesel-electric locomotives at any time, because neither the Interstate Commerce Commission or the FRA had mandated automatic backup systems on the corridor and there was no Federal regulation requiring ATS or ATC where an ACS system was used. Moreover, the FRA could require such backup systems where it found that to do so was in the public interest; promulgate rules, standards, and instructions for the installation, inspection, and maintenance of such systems; and inspect and test such systems.

28/ Railroad Accident Report--"Rear End Collision of Conrail Commuter Tain No. 400 and Amtrak Passenger Train No. 60, Seabrook Maryland, June 9, 1978" (NTSB/RAR-79/03).

At the time Conrail replaced its ATC-equipped locomotives with non-ATC-equipped locomotives and at the time of the accident, FRA regulation 49 CFR 236.566 was in force and stated:

> The locomotive from which brakes are controlled, or each train operating in automatic train stop, train control, or cab signal territory shall be equipped with apparatus responsive to the roadway equipment installed on all or any part of the route traversed, and such apparatus shall be in operative condition. 29/

In 1979, Amtrak submitted its proposal BS-Ap-No. 1588 to the FRA for future high-speed operations on the corridor. The proposal included a provision that all trains operating on the corridor would have to be ATC-equipped, except those "for which specific relief had been granted." The FRA approved this proposal in December 1980, with the condition that relief from 49 CFR 236.566 would be cancelled. 30/ The approval also noted that the regulation prohibited the use of nonequipped locomotives.

On January 15, 1987, the Safety Board issued Safety Recommendations R-87-1 through -3 to Amtrak as a result of the Safety Board's preliminary investigation of the Chase, Maryland, accident.

R-87-1

> Immediately initiate a program which will assure that all locomotives operating on the high speed passenger train trackage of the Northeast Corridor are equipped with a device which will control the train automatically as required by the signal if the engineer fails to do so.

29/ During its investigation, Safety Board investigators asked FRA officials to provide an FRA interpretation of whether 49 CFR 236.566 permitted Amtrak to allow Conrail to replace its ATC-equipped locomotives with non-ATC-equipped locomotives. Although the FRA officials stated they would do so, the Safety Board has not received this interpretation to date.

30/ The ATS, ATC, and ACS systems referred to in the regulation all functioned with the track circuitry that was in place on the corridor. It is unclear whether the FRA interpreted the regulation as requiring locomotives to be equipped with either the ATS or ATC automatic backup devices.

In its response of April 7, 1987, Amtrak indicated that it agreed with the intent of the Safety Board's recommendation and had taken action to install a system on all its work equipment that had not been so equipped, and it had initiated negotiations with the commuter and freight railroads concerning the installation of this equipment and the timetable for completing this installation. Amtrak further stated, however, that it believed that this installation could only be accomplished in a reasonable time if required by law or FRA regulations. While the Safety Board stated in its letter of October 13, 1987, to Amtrak, that it was classifying Safety Recommendation R-87-1 "Open--Acceptable Action," it pointed out that the lack of a final FRA rule should not hamper implementation of the project.

On December 10, 1987, Amtrak responded to the Safety Board's letter of October 13, 1987, stating that ATC equipment for Amtrak's non-ATC-equipped locomotives was being received and installed. Amtrak also stated that funds had been appropriated by SEPTA and NJDOT to purchase ATC equipment and that Conrail was testing equipment, with the D&H and the Providence and Worcester awaiting the outcome of the Conrail tests before ordering equipment. However, Amtrak further stated that it is up to the FRA to require freight and commuter trains using the section of track between Philadelphia and Harrisburg to be equipped with ATC. FRA's proposed amendment to the final rule addresses not only this section of track, but also all connecting lines.

The Safety Board also recommended that Amtrak:

R-87-2

Pending the installation of the automatic train control devices or an equivalent positive control system on the high speed passenger train trackage of the Northeast Corridor, require that the operators of locomotives and trains not equipped with such devices to stop before entry onto the high speed tracks regardless of signal aspect, and to request and receive permission before proceeding.

Amtrak indicated in its response of April 7, 1987, that implementation of this recommendation would be neither effective nor practical. Amtrak did indicate, however, that it had taken some interim measures pending installation of the ATC system including a procedure that limits all freight traffic (including light engines) to 30 mph between 6 a.m. and 10 p.m., and bulletin order instructions regarding maximum speeds depending on the functioning of speed control and train stop equipment on locomotives. In its October 13, 1987, response to Amtrak, the Safety Board stated that it was not convinced these interim measures would provide the requisite protection since engineers who would disregard restrictive signals would be likely to

disregard speed limitations as well. Pending a more adequate response, the Safety Board classified Safety Recommendation R-87-2 "Open--Unacceptable Action."

In its letter of December 10, 1987, Amtrak restated its position that requiring all non-ATC-equipped locomotives to stop and receive permission before entering the high-speed track was not effective and could be a detriment to safety because requiring a train to stop if the tracks were clear could cause trains to part, ladings to shift, or derailments.

During the Safety Board's public hearing, Conrail's senior vice president of operations testified that Conrail was considering retrofitting its locomotive units with some form of ATS or ATC and was studying the various types of safety backup devices used around the world. He also stated that Conrail was also considering replacing the air-operated ACS alerter whistle with an electronic "warbling" device that was less irritating and could not be nullified. After the public hearing, Conrail provided the Safety Board with formal proposed findings and safety recommendations which included the proposed retrofitting of its locomotive units with ATS and the electronic alerting device to be started on July 1, 1987, with 809 units scheduled for modification in 1987 and the remaining units to be modified by mid-1988. According to the report, Conrail had also contracted with two companies to furnish eight prototype ATC designs by October 15, 1987; both suppliers had furnished prototypes that were in test service by that date. Ultimately, Conrail intended to install one form of ATC or the other on about 100 locomotive units which were to be used exclusively in its Corridor freight operations.

As of December 8, 1987, Conrail reported that it had installed ATS and the electronic alerters on 841 of the 1,583 road locomotive units it had in service and was continuing the retrofit program at the rate of about 6 units per day.

On May 20, 1987, the DOT proposed that all trains operating on the NEC between Washington and Boston be fitted with ATC. The necessary ATC receiver apparatus for locomotives and selfpropelled cars was to be ordered by the carriers by January 15, 1988, and the installation was to be completed by January 1, 1990. The proposal was adopted under FRA Order Docket 87-2, Notice No. 2, on November 19, 1987.

Another safety recommendation issued to Amtrak recommended that:

R-87-3

Require all locomotives allowed to enter and operate on the high speed passenger train trackage of the Northeast Corridor to be equipped with an operable radio capable of train-to-train and train-to-fixed station communications.

Amtrak indicated in its response of April 7, 1987, that it had no objection to the intent of the recommendation and that its own equipment has been in compliance as a result of a previous Safety Board recommendation. By bulletin order, Amtrak issued instructions requiring that all trains entering Amtrak territory be equipped with an operable radio. The Safety Board, in its October 13, 1987, response, indicated that the issuance of this bulletin order was in line with the intent of the recommendation. The Safety Board further requested it be informed if the goal of train-to-train and train-to-fixed station communications has been achieved and if Amtrak has verified that the railroads have complied with the bulletin order. Pending a further response, the Safety Board classified Safety Recommendation R-87-3 "Open--Acceptable Action." In its December 10, 1987, letter, Amtrak stated that its monitoring of the bulletin order indicated that the railroads were complying with the requirement.

ANALYSIS

Summary of the Accident

About 1:16 p.m., northbound Conrail train ENS-121 departed Bay View Yard at Baltimore; almost simultaneously, northbound Amtrak train 94 departed Pennsylvania Station in Baltimore. At this time, switch 12 at Gunpow interlocking was lined for normal (straight through) movement for train traffic on track 2, on which Amtrak train 94 was operating. Conrail train ENS-121 was operating on track 1. The signal system provided the primary protection against collision; it was necessary for the Conrail engineer to comply with signal aspects and stop his train short of switch 12 at Gunpow to prevent the collision. If he failed to do so, there was no automatic backup device that would have stopped the train.

The investigation determined that the signal system was working properly; therefore, after the Edgewood operator's request at 1:23 p.m., the wayside signal aspects displayed for train 94 approaching Gunpow on track 2 were "clear" at both the

distant (816-2) and home (2N) signal locations, and the wayside signal aspects displayed for train ENS-121 on track 1 was "approach" at distant signal 816-1 and "stop" at the home signal 1N.

The ACS in both trains should have displayed aspects corresponding to those of the wayside signals, except that the ACS in train ENS-121 would have displayed a "restricting" aspect rather than a "stop" aspect beginning at a point 4,450 feet south of signal 1N. Also, because a bulb may have been missing from the ACS display on train ENS-121, the "approach" aspect at wayside signal 816-1 may not have displayed in the cab. The engineer of train ENS-121 failed to respond, as required, to the "approach" aspect of wayside signal 816-1 and responded too late to the "stop" aspect of wayside signal 1N. The Safety Board believes that the alerter whistle, which should have warned the engineer of train ENS-121 that he was not complying with the more restrictive aspects of the signal system, could not be heard by the engineer because it was taped. Train ENS-121 ran through switch 12 onto track 2 causing the switch to realign for movement from track 1 to track 2. When train ENS-121 entered switch 12, the aspect of signal 2N for track 2 changed from "clear" to "stop." When the engineer of train 94 apparently recognized that the aspect of signal 2N was "stop" and put his train into emergency braking, the train, which was traveling between 120 and 125 mph, 31/ could not be stopped before colliding with train ENS-121.

The Conrail engineer stated under oath that wayside signal 816-1 displayed an "approach limited" aspect. The Conrail brakeman, also under oath, said that he was preparing his lunch and did not see wayside signal 816-1; he said that he saw an "approach medium" aspect on the ACS. Both aspects would have indicated that switch 12 at Gunpow was aligned for movement from track 1 to track 2 (which was not the case). The "approach medium" aspect would have limited the train to 30 mph through the switch and the "approach limited" aspect would have limited the train to 40 mph through the switch. Because "approach medium" was the more restrictive aspect, the rules required that the engineer comply with that aspect. The signal rules for both aspects did not require that speed be reduced until the train reached the switch.

31/ The speed tapes indicated that braking was initiated at 125 mph; however, Amtrak reported that the speed recorders were recording speeds at 5 mph above the actual speed. Because of damage to the speed recording devices, precise calibration was not possible.

The postaccident tests conducted on the distant and home signals at Gunpow and analysis of the signal event recorder data for these signals indicated there were no malfunctions of these signals. According to Amtrak there have been no reports of "false clear" aspects displayed by these signals. Further, investigators were unable to replicate the combination of signal aspects that the engineer of train ENS-121 told investigators he had encountered. Based on this and the testimony of the Amtrak safety supervisor (and four other witnesses) that the engineer had told him at the scene of the accident that "he ran a couple of signals," the Safety Board concludes that the wayside signals at Gunpow were working properly at the time of the accident. Therefore, a false "approach limited" aspect could not have been displayed at wayside signal 816-1 with switch 12 aligned for through movement on track 2. The only aspect that could have been displayed when the block ahead was clear was an "approach" aspect. The "approach" aspect required the engineer of train ENS-121, immediately on sighting the signal, to reduce speed to 30 mph, to pass the signal at a speed no greater than 30 mph and to be prepared to stop at the next signal. The locomotive event recorder data from train ENS-121 did not indicate that braking was initiated or that speed was reduced as the train passed signal 816-1.

Postaccident tests demonstrated that even bright sunshine would not have prevented the crewmembers from seeing the "stop" aspect displayed by wayside signal 1N when they were still more than 5,000 feet south of it. Postaccident testing determined that the engineer should have been able to stop train ENS-121 in much less than 5,000 feet even without using emergency braking. The Safety Board concludes that the crewmembers were not looking ahead to see signal 1N, although they were entering the section of tangent track leading to the switch and should have been alerted to this by the Ebenezer Road overpass they had just passed under. This overpass was a dependable landmark by day or night, and it should have provided the crewmembers an excellent reference as to their location.

Beyond the overpass, the ACS aspect should have changed to "restricting" and should have caused the alerter whistle to sound at code change location CS-806, 4,450 feet south of wayside signal 1N. The crewmembers could not have heard the alerter and they apparently did not observe the restricting ACS aspect that required them to reduce speed to at least 20 mph. When the engineer finally observed the "stop" aspect at signal 1N and placed the brakes in emergency, the train was traveling at 64 mph. The train could not be stopped before it passed the signal 1N and entered switch 12.

According to the data from the signal event recorder, train 94 reached wayside signal 836-2 about 101.6 seconds before home signal 2N changed to "stop" and about 122.4 seconds before the collision occurred; signal 836-2 was 20,830 feet south of home signal 2N at Gunpow.

However, with train 94 continuing to travel at between 120 and 125 mph, it would have been less than 3,000 feet from the turnout when the home signal changed to "stop." At this time, the home signal would have been well within the engineer's sight distance. Assuming the engineer could have detected, interpreted, and reacted to the signal change in only 3 seconds, 32/ there would be only about 2,500 feet remaining to switch 12. Even with emergency braking this would have been more than 1,500 feet less than the computed minimum stopping distance from 122 mph.

The Safety Board's investigation of this accident focused on a number of issues relating to the safety of train operations on Amtrak's NEC. Among these issues are:

1. the performance of the trains' crewmembers, including their predeparture tests and their operation of the trains and the possible impairment from the use of drugs of the Conrail train crew;

2. the adequacy of the signal and safety backup systems;

3. Amtrak's dispatching and management concern with on-time performance;

4. the compatibility of freight trains with high-speed passenger trains in a high-density train environment;

5. the quality of Amtrak and Conrail supervisory oversight of corridor operations;

6. the FRA's oversight of the corridor improvements, the operating practices of Amtrak and Conrail, and the implementation of the drug and alcohol testing rules and other safety regulations;

7. the adequacy of the emergency response; and

8. the crashworthiness of Amtrak's passenger-car interiors.

32/ Response to a master caution light on a cockpit panel of caution lights by pushing the master caution light button took between 1 and 4 1/2 seconds with a meantime of 2.4 seconds. (Van Cott, H. and Kinbade, R., "Human Engineering Guide to Equipment Design," Rrissued Edition; American Institute for Research, Washington, D.C., 1972, P. 304.) The time to perceive danger and react to it can take between 4 and 9 seconds for unimpaired individuals. (Zeller, A. F., "Human Reaction Time," U.S.A.F. Safety Journal, May 1983, p. 8 and 9.)

Predeparture Testing

The Conrail engineer and brakeman reported for duty at Bay View Yard 1 hour before they departed with train ENS-121. Twice they went to the yard office and had face-to-face encounters with the on-duty trainmaster. The trainmaster said he observed nothing out of the ordinary in their manner and appearance. Even though the trainmaster knew the men and had received some training in the detection of impaired persons, the Safety Board believes that it would have been difficult for him to detect that the crew had used marijuana because it does not produce the outwardly noticeable effects of some substances such as alcohol.

Although the crewmembers went to the trouble to remove a radio from the trailing unit and install it on the lead unit, they apparently had trouble reconnecting it. This radio unit had apparently functioned properly when the units were used on a train that had operated from Chicago to Baltimore. The engineer who operated the unit on the final leg the night before the accident said he had no problem with the radio. It functioned very weakly when tested after the accident at the site. Subsequent tests showed that one of the radio's power cables had been poorly spliced. The crewmembers of train ENS-121 may not have known how to reconnect the radio or they may have had difficulty reconnecting it because of the short connecting wires and had given up trying to reconnect it. As far as could be determined, the crewmembers made no effort to secure another console radio unit or to seek help in connecting the radio they had. Instead, they checked out a portable radio with a relatively short transmitting range.

The Safety Board was unable to establish with any certainty whether the ACS apparatus of the Conrail locomotives was tested before it left Bay View. There was no maintenance of equipment employee on duty when the locomotive arrived during the previous night, and the one such employee on duty during the morning shift was called away before he could inspect and test the locomotive. Under these circumstances, the rules required that the crewmembers of train ENS-121 perform the tests. The crewmembers said they made the ACS test on both ends of the locomotive as required, but evaluation of the locomotive event recorder indicated that the locomotive had not been moved on the test circuit as was required to properly test both ends. Therefore, the Safety Board does not believe the test requirements were complied with as claimed. The event recorder also indicated that the crew failed to perform any of the required predeparture brake tests before departing from Bay View

It could not be determined who applied the duct tape to the alerter whistle or for how long the whistle had been muted. Because it was necessary for the whistle to be heard above the sound of the engine, its loud, shrill sound could at times, be

irritating. The Safety Board was unable to confirm or eliminate the possibility that one or both crewmembers of train ENS-121 muted the alerter whistle before or after leaving Bay View. The whistle could be easily and quickly accessed by unsnapping the back panel of the brake stand. Applying a strip of tape over the whistle port and replacing the cover could be accomplished in a few minutes; the crewmembers had plenty of time to do this before or after they left Bay View. However, if the crewmembers did not mute the whistle and did test the lead unit's ACS system, they should have recognized, when they tested the whistle that the whistle was inoperative and would not have alerted them to restrictive signal aspects.

The engineer stated that he manipulated the acknowledgement pedal at the start of the test, and when the whistle failed to sound, he assumed the ACS system was cut out. He said he then cut the ACS system back in, after which the whistle emitted a slight sound. According to the engineer, he then completed the test and all the ACS aspects were displayed.

Postaccident testing revealed that the whistle could not be heard above the sound of the idling engine of an adjacent locomotive. Moreover, an inspection revealed that the lead unit's ACS cut-out cock was sealed in the "in" or open position; therefore, it was not possible for the engineer to have changed the position as he said he did. However, the deadman control cut-out cock in the nose compartment was unsealed in the "out" or closed position. It is conceivable that the engineer may have cut out the deadman control if he erroneously assumed it was the ACS cut-out cock.

Inasmuch as the ACS cut-out cock in Conrail's GM units is located in the nose compartment, the engineer may have assumed that the deadman control cut-out cock in the nose compartment of his GE unit was also the ACS cut-out. Even though the deadman and ACS cut-out cocks are shaped differently, the engineer may not have had an occasion to look for the ACS cut-out on a GE unit.

The Safety Board is concerned about the locations of the ACS alerter whistle and the cut-out cocks for the deadman safety control and ACS systems on Conrail locomotives. Important safety backup devices and the controls for nullifying them should not be located where they can be easily accessed without crewmembers leaving the locomotive cabs. There is a similarly unsatisfactory situation with the safety systems' cut-out cocks in Amtrak's AEM-7 locomotives.

If the engineer actually did turn the deadman control cut-out in error, then it is probable that he assumed he had activated the ACS system. Having made that assumption, it is possible that he saw no need for further testing and unknowingly left Bay View with a muted alerter whistle.

The crew of train ENS-121 may also have left the yard without a bulb for the "approach" aspect of the ACS. The Safety Board was not able to determine when the missing bulb was removed. The bulb could have been removed after the accident when Amtrak and Conrail left the units unattended. It may also have been removed at any time between December 16, 1986, when the last known test of the unit's ACS apparatus was made, and the day of the accident. If the bulb was missing before the accident, the engineer could not have completed the ACS test without realizing that the "approach" aspect could not be displayed.

However these events occurred, it is clear that the crew of train ENS-121 left Bay View Yard without having performed a complete and proper test of the ACS system, without the required working console radio, without having performed the required brake test, with the alerter whistle muted, with the deadman pedal inoperative, and possibly with a bulb missing from the ACS system.

Operation of Train ENS-121

The event recorders of train ENS-121 indicated that after leaving Bay View and entering Amtrak's track 1, the train traveled the 12.2 miles to Gunpow in 13 1/2 to 14 minutes averaging between 52 1/2 and 55 mph. Once it was fully under way, the engineer operated the train between 56 and 65 mph and attempted to maintain speed at about 60 mph by changing throttle position. His speed indicator was accurate; at 60 mph, its indication was only 1 mph under actual speed.

It appears from the event recorder that the engineer was late in changing the throttle position which resulted in the rather wide speed changes. However, the changes in speed became less pronounced as the train proceeded, but during this time (about 8 minutes) the engineer operated the train continuously above 60 mph. Although control of speed with a "light" locomotive consist is somewhat more difficult than with a train of cars even on relatively level track and the engineer was accustomed to operating with cars rather than without them, the variation in the train's speed was greater than the 1- to 2-mph deviations that would be expected from an alert engineer and that were observed by the Safety Board on the trip to Gunpow before the brake and sight distance tests were performed on January 12, 1987.

As they approached Gunpow, the Conrail crewmembers had "clear" aspects on their ACS and on the wayside signals until they reached distant signal 816-1 for Gunpow. The signal event recorder data showed that switch 12 at Gunpow was aligned for through movement on track 2 for nearly 3 hours before the accident. The Safety Board concludes that signal 816-1 displayed an "approach" aspect requiring the engineer to immediately slow train ENS-121 to 30 mph and be prepared to stop at the next

signal. Because the Conrail engineer had an unobstructed view of the signal for only 1,278 feet, he had about 14.5 seconds to observe the aspect of signal 816-1 when traveling 60 mph. The ACS aspect should have changed from "clear" to "approach" at this point, and as a result, the ACS alerter whistle should have sounded. However, it did not because it had been taped. Further, the engineer may have been inattentive or distracted and failed to see signal 816-1; if he was unaware that the whistle was muted, he may have been relying on it to alert him to ACS aspect changes. If the bulb for the ACS "approach" aspect was missing at the time, that aspect would not have been displayed. The Safety Board believes that since the whistle had been taped, and thus did not alert the crew, they probably never looked at the ACS nor observed wayside signal 816-1 because they were inattentive or distracted; thus, the engineer did not slow his train.

Further, the Safety Board concludes that the crew of ENS-121 was not monitoring the ACS display after passing signal 816-1 and did not observe the "stop" aspect until it was too late to prevent the train from going through switch 12 and onto track 2. The Safety Board believes the engineer applied the emergency brakes of train ENS-121 when it was less than 2,000 feet from signal 1N. The Safety Board calculated that had the train been traveling at 55 mph or less, it would nave stopped short of the turnout.

The two crewmembers of Conrail train ENS-121 were able to observe the tracks ahead and the wayside and cab signal aspects. The Amtrak operating rules required that they perform this function diligently. However, they failed to dischage their duty. In the case of the Conrail brakeman, it was his only responsibility once his train was en route. The Safety Board concludes that the crew was either inattentive to or distracted from their duties, and thus failed to obey the signal system.

Eyewitnesses to the accident indicated that before the collision, as train ENS-121 was coming to a stop (or had stopped), one or two persons alighted from the train, and may have gone to the rear of the units. Because the locomotive's reverser was found in reverse after the accident, it is possible that the crew may have considered attempting to back the train out of the interlocking. However, data from the train's event recorder indicate that the reverser was not placed in reverse until 2 p.m., almost 1/2 hour after the accident. Because of the short time between the train's incursion into the switch and the collision, and because of the forcing open of the switch points the Safety Board believes that it would not have been possible for the crew of ENS-121 to have backed the train out of the way of train 94.

Human Performance

All of the crewmembers of the trains involved in the accident had been on duty less than 2 hours when the accident occurred. The conductor of Amtrak train 94 stated that he and the other members of the crew were "100 percent" when they reported for work. Although the conductor was in charge, his duties kept him busy inside the train. He had little contact with the other crewmembers once the train was en route.

The two crewmembers of train ENS-121 and the engineer of train 94 were of nearly the same age (32 to 35) and had been working on the corridor for about the same length of time. With well over 10 years of service each, they were experienced enough to know the operating rules and their job responsibilities. Moreover, both engineers should have been familiar with the physical aspects of this part of the corridor.

The two engineers and the Conrail brakeman had undergone company physical examinations during the year preceding the accident, and as far as could be determined, were in reasonably good health. All had uncorrected 20/20 vision and unimpaired hearing, all should have been at or near their prime with respect to their other sensory perceptions and human faculties, at least from the standpoint of age.

Both engineers had undergone and completed Penn Central's engineer training program. Until 1983, both worked for Conrail in freight service out of Baltimore. The recorded on-the-job performance of the two engineers did not indicate that either man had any significant performance problems. Both were considered to be skilled and knowledgeble, and both apparently had a thorough knowledge of the operating rules, as they had passed Amtrak's 1986 rules examinations with perfect scores. The Conrail engineer had also passed the Conrail rules test with a very high mark. The Amtrak engineer had been twice reprimanded for operating at excessive speed in the 8 years preceding the accident, but he had never been formally disciplined. The Conrail engineer had been suspended for a week in 1984 for threatening a crew dispatcher and for a month in 1974 for passing a "stop" signal. The last suspension occurred while he was a fireman, and according to Conrail, the engineer was primarily responsibile for the incident. However, perhaps a better indicator of the engineers' concern for and compliance with safety rules governing the operation of powered vehicles was the 11 speeding citations the Amtrak engineer had received between 1969 and 1984 and the 13 traffic citations the Conrail engineer had received between 1972 and 1987, including his December 1986 citation for DWI.

The Amtrak engineer had been working a regular 5-day-a week schedule operating passenger trains, primarily during daylight hours. Typically, his workday was 8 to 10 hours long, including a layover in New York City. Since he continued to live in

Baltimore, he spent about 3 hours a day commuting to and from work. Hence, since transferring from Conrail to Amtrak the nature of his working life had become regimented and predictable. Not only was operating a passenger train different from operating a freight train, it required operating on fixed schedules. Since the Amtrak engineer worked on scheduled passenger trains, it was imperative that he was available for duty at fixed times. He was not subject to the variable and irregular work patterns that are characteristic of freight train operations.

Despite being a promoted engineer for more than 10 years, the Conrail engineer had insufficient seniority to hold a regular assignment for very long. When he did so, it was usually on a yard assignment. Otherwise, he was relegated to the extra list and was used only sparingly and irregularly on road freight assignments in relief of regular engineers. During the first 4 1/2 months of 1986, he was used primarily as a fireman and only rarely as an engineer. Conrail records indicated that during 1986 the engineer worked 148 days and been paid for an additional 24 days on which he had deadheaded to or from an assignment. On 99 days, he worked on road freight assignments, but he was the engineer of a train operated through Gunpow on only 36 of these days. During the last 7 1/2 months of 1986, he operated a northbound train through Gunpow on the average of three times a month; in the month preceding the accident, he operated a northbound train only twice. Since Conrail tried to operate most of its corridor freight trains when no Amtrak trains were running, most of the engineer's other trips north from Baltimore were made at night.

The Conrail engineer might have received more work had he not been prone to lay off. In 1986, he did not report to work on 51 days, 31 days of which were due to "sickness," a large number of days for a man of his age who was apparently in good health He laid off 8 days to take his annual rules examinations. An additional 12 days were lost for lack of a car, although he lived relatively close to his workplace.

The Conrail brakeman had more than 13 years of service with Conrail and its predecessor, and he had been qualified as a conductor for more than 10 years. With his seniority, he probably could have held a regular job with Amtrak. Nevertheless, he elected to stay with Conrail where he was virtually a part-time employee working only 56 days during 1986. He could have had more work, but he apparently preferred working at Bay View yard, near his home, and he often laid off whenever Conrail wanted to use him elsewhere. During 1986, the brakeman had 29 road freight assignments north of Baltimore, and had been the conductor on more than half of these. It is conceivable that during the year preceding the accident, he had not worked on many trips north of Baltimore during which he was required to be on the lead locomotive unit and to observe and communicate signal aspects.

The operation of the three light locomotive units from Bay View was an extra movement ordered by Conrail's central power director at Philadelphia and was precipitated by a need for locomotive units at Harrisburg. Hence, it was not a movement the employees assigned to the Bay View extra board might anticipate. The crew had only to ferry the units to Harrisburg; no cars would have to be picked up or other work performed en route. After their arrival at Harrisburg, they would be sent back to Bay View by taxicab. According to Conrail, the round trip would have taken about 6 hours, and the crew would have been paid at the equivalent hourly rate of about $40 for the engineer and $32 for the brakeman--a well-paid assignment for the engineer and brakeman.

Since Conrail scheduled its freight trains in and out of Baltimore at night and the running of the locomotive units to Harrisburg was not a scheduled event, it is probable that the engineer and brakeman did not expect to be called to work on the day of the accident. As a result, they may not have been fully rested and fit when they were called. The Safety Board's investigation determined that both men had been drinking alcoholic beverages the night before; the engineer had also been drinking alcoholic beverages in a tavern the night before that. The previous month he had been arrested for DWI after leaving a tavern in the early morning hours. Furthermore, the engineer voluntarily entered a chemical dependency program after the accident. The Safety Board concludes that the Conrail engineer may have been addicted to alcohol and this may have been related to his propensity for laying off from work. According to the American Medical Association, there is a well-established relationship between alcoholism and work absenteeism. 33/

The Conrail brakeman's work record strongly suggested that he would not hesitate to lay off from work when it suited him to do so. Because of the relatively little work he and the engineer had received the previous year, they may not have wanted to pass up well-paid and relatively easy assignment even if they were not fully rested and fit or disinclined to work for some other reason.

Toxicology

In light of the CAMI forensic laboratory's inaccurate procedures as disclosed by DOT's investigation of the CAMI facility, the Safety Board did not have sufficient confidence in the validity of the CAMI tests to use them as evidence in this analysis. The Board thus assessed the pharmacological effects from the toxicological findings provided by CHT.

33/ "Manual on Alcoholism," American Medical Association, Third Edition, 1977.

CHT reported that its tests of the samples from the Amtrak dispatcher, flagman, and regular assistant conductor taken several days after the accident were negative for alcohol and drugs. The conductor's samples were negative for alcohol and illicit drugs, but his urine tested positive for the a muscle relaxant administered after the accident as a result of injuries. The delay in the provision of the samples negates the value of the tests in determining if alcohol and certain drugs were present at the time of the accident.

The time lapse between the accident and the collection of blood and urine samples from the Conrail engineer and brakeman also precluded precise interpretation of the test results. Furthermore, since CAMI had exhausted most of the Conrail engineer's blood serum specimen in its test procedures, it was not possible for CHT to accurately determine the level of psychoactive cannabinoids (delta-9-THC) that may have been present in his blood sample.

Nonetheless, the Safety Board believes that the test results provided by CHT were sufficient along with known research findings to permit an analysis of the toxicological factors in the accident.

Of the more than 400 compounds that have been isolated from cannabis, the only known psychoactive cannabinoids are delta-9-THC and the hydroxy metabolite derivative (THC-OH). It appears that THC is responsible for the large majority of psychoactive effects of marijuana. Delta-9-THC is rapidly converted to the carboxy metabolite (THC-COOH) in the blood. This metabolite is not psychoactive and is one of the major metabolites found in urine and blood after marijuana use. 34/

Despite a large number of studies, there are numerous factors that complicate the pharmacokinetics of marijuana. First, the blood concentrations of THC and THC-COOH do not appear to follow a single, first order kinetic process of metabolism and elimination. Second, the metabolic rate and elimination are believed to be dependent on frequency of use--the infrequent user demonstrates a different metabolic and elimination rate than the frequent user. Third, there appears to be significant variability between the cannabinoid concentrations obtained with different subjects smoking identical cigarettes in the same way. These factors make it difficult to calculate with any degree of certainty the blood concentration of THC or its metabolites at an earlier time. Finally, the correlation of blood THC concentration with the degree of impairment 35/ has not been established with the degree of certainty that exists for alcohol related impairment.

34/ McBay, A.J. and Mason, A.P.,"Marijuana and Driving: What is the Significance of Cannabinoid Concentrations?" Office of the Chief Medical Examiner and the University of North Carolina.

35/ Any decrement in the level of human vigilence, detection, cognition, or reaction.

Despite these pharmacokinetic limitations, some conclusions can be made regarding the use of marijuana by the two Conrail crewmembers based on studies of the blood and urine concentrations of THC and its metabolites in volunteer subjects. 36/

Almost 9 hours after the accident, the brakeman had a metabolite (THC-COOH) serum concentration of 23 ng/ml, a reported THC of 0, and a urine metabolite concentration of 80 ng/ml. Analysis of the second sample gave a urine concentration of 109 ng/ml. Assuming the brakeman did not use marijuana between the accident and the time of sampling, this information fits the profile of a frequent user. Assuming that the brakeman was a frequent user, then it can be concluded that he used marijuana within 2 days of blood sampling and that use could have occurred within 24 hours of the sampling time or within the 15-hour period before the accident.

The brakeman also had 45 ng/ml of PCP in his urine. In a human volunteer study, PCP was shown to have a half-life of about 17 hours, although in two individuals it was as long as 2 days, and in one subject, it was as short as 7 hours. Since blood concentrations are not available, the Safety Board could not determine when the brakeman ingested PCP or its effect on his performance at the time of the accident. If the marijuana and the PCP had been taken at the same time, the finding of PCP in the urine sample and the half-life of PCP would support an assessment that marijuana was used within 24 hours of the time the samples were provided.

From the engineer's second set of urine and blood specimens, CHT obtained THC-COOH values of 212 ng/ml and 52 ng/ml, respectively. Urine concentrations of THC-COOH vary greatly and are not definitive in establishing the time of use. Comparison of the results of the blood analysis with those reported by Peat 37/ suggests marijuana use within 24 hours before the samples were taken if the engineer is characterized as a heavy user. A blood value of 52 ng/ml clearly indicates that the engineer was a frequent user. A frequent user having a carboxy metabolite blood level of 52 ng/ml would be expected to have had a THC concentration in the range of 1.0 to 10 ng/ml. Since values above 3 ng/ml would probably have been detected by the CHT analysis, it is reasonable to assume that THC concentration in the engineer's blood would have been less than 3 ng/ml at the time the specimens were given. The THC concentration at the time of the accident would have been considerably greater.

36/ Peat, Michael A., McGinnis, K. M., et al, "The Disposition of 9-Tetrahydrocannabinol, 11-Hydroxy-9-Tetrahydrocannabinol, and 11-Nor-9-Carboxylic-9-Tetrahydrocannabinol in Frequent and Infrequent Marijuana Users," submitted to Journal of Clinical Pharmacology and Experimental Therapeutics.
37/ Ibid.

Mason and McBay have suggested that 5 ng/ml of THC in blood be used as a conservative limit for the presumption of a significant degree of a marijuana-induced effect. 38/ According to Peat, data for both light and heavy users indicate blood THC concentrations are less than 5 ng/ml 1 hour after smoking one marijuana cigarette. Behavioral studies suggest, however, that pharmacological effects due to marijuana use persist longer than 1 hour.

A number of studies have determined the effects of marijuana use on a variety of performance tasks including driving an automobile and flying an aircraft simulator. One of these studies shows that performance decrement occurred up to 7 hours after smoking a marijuana cigarette depending on the performance parameter measured. 39/ The THC concentration correlated with the performance decrement. Another study using a flight simulator showed a decrement for up to 24 hours after use of a marijuana cigarette. 40/ A third study looked at the combined effects of marijuana and alcohol and reported that the combined effect was more than the expected additive effects of the individual drugs. 41/

The above studies on marijuana use and performance appear to agree that there is a measurable decrement in performance for a period that is dependent on type and complexity of the performance function that is measured. The concentration profile of the engineer is well within the limits of the above studies since 5 hours after the accident he had a blood acid metabolite value of 52 ng/ml.

The 5-hour delay in obtaining the engineer's blood and urine samples negates the ability of the tests to determine the presence of a BAC level of about 0.06 percent or less at the time of the accident. It is known that the engineer had used alcohol on 2 successive nights before the day of the accident. The fact that he had pleaded guilty to a charge of driving while intoxicated during the early morning hours about 2 weeks before the accident and had voluntarily admitted himself into a hospital-administered chemical dependency program after the accident substantiates his frequent use of alcohol.

38/ Mason, A. P. and McBay, A. J., "Ethanol, Marijuana, and Other Drug Use in 600 Drivers Killed in Single-Vehicle Crashes in North Carolina, 1976-1981," Journal of Forensic Sciences, 1984.
39/ Bennett, Gene, Licko, V., and Thompson, Travis, "Behavioral Pharmacokinetics of Marijuana," Psychopharmacology, Vol. 85, 1985.
40/ Yesavage, Jerome A., et al, "Carry-Over Effects of Marijuana Intoxication on Aircraft Pilot Performance: A Preliminary Report," American Journal of Psychiatry, Vol. 142, 1985.
41/ Sutton, Lawrence R., "The Effects of Alcohol, Marijuana and Their Combination on Driving Ability," Journal of Studies on Alcohol, Vol. 44, 1983.

In his study, Sutton had found significant driving impairment when marijuana and alcohol equivalent to a 0.06 percent BAC were used in combination. If the Conrail engineer metabolized ethanol at the average rate of 0.015 percent per hour (conservative for a heavy drinker), then the ethanol in his blood would not have been detectable when he gave a blood sample 5 hours after the accident if he had a BAC of 0.06 percent at the time of the accident.

The literature cited previously supports the finding that the engineer's performance may have been impaired from the use of marijuana. Further, this could have been exacerbated if ethanol had also been present in the engineer's blood or if he had been suffering from alcohol abuse the night before.

The Safety Board believes that there were a significant number of manifestations of less than satisfactory performance by the Conrail crewmembers--the most evident of which was their failure to respond to restrictive signal aspects. The other manifestations of impaired performance include: their failures to resolve the console radio problem and to make the required predeparture brake tests; their failure to properly test the ACS system including the alerter whistle; the engineer's possible mistaking of the deadman cutout for the ACS cutout lock, and the engineer's delayed throttle responses. The Safety Board concludes that, based on this accumulation of manifestations of degraded performance and on the results of the toxicological testing, that the crewmembers of train ENS-121 were impaired at the time of the accident from the effects of marijuana possibly combined with the effects of the use of alcohol the night before the accident.

The Safety Board concludes that the ENS-121 crew's use of marijuana led to their inattention to their primary duties of operating the locomotive in a safe manner.

Adequacy of the Signal and Safety Backup Systems

Because Amtrak was operating with the existing system of tracks and interlockings and was attempting to fulfill the intent of Congress to implement and to expand the high-speed passenger train service, Amtrak needed a signal and safety backup system to minimize the hazards of its two-track operations and converging interlockings. It had a good, time-tested system of both wayside signals and ACS. Before the maximum operating speed was increased to 125 mph on the high-speed tracks approaching Gunpow, Amtrak had made various track changes in the interlocking, and the signals were revamped to provide increased stopping distances.

Amtrak had performed a field test in 1980 at one location on the corridor. This test, using a single AEM-7 locomotive and six empty Amfleet cars, established that such a train could be stopped from 120 mph with full-service blended braking in less than 6,900 feet and in 7,200 feet with full-service airbraking. Since no tests were performed using emergency braking, Amtrak did not establish minimum stopping distances.

In 1985, changes were made to the signal system that provided more than 15,000 feet of stopping distance from the point where a northbound train on track 2 would first receive an "approach" aspect on the cab signal from code change location CS 826 when home signal 2N at Gunpow was displaying a "stop" aspect. Similarly, wayside signal 816-2, about 10,300 feet south of the home signal, would also have displayed an "approach" aspect if home signal 2N was displaying a "stop" aspect.

The stopping distance provided by CS 826 for a train approaching Gunpow from the south on track 2 was more than twice what was needed for the train to be stopped using full-service braking. The stopping distance was also long enough to stop short of the home signal with less than full-service braking. This would be true even if the home signal did not change from "clear" to "stop" until the train reached signal 816-2, at which time the ACS aspect would be "approach." Thus, even if the view of the wayside signal was totally obscured, the engineer would still have sufficient warning from the ACS.

If the engineer of a train traveling at 125 mph relied solely on his ACS and he first realized the home signal displayed a "stop" aspect when the ACS changed to an "approach" aspect and the cab signal alerter sounded, he could take up to 6 seconds to perceive and respond to the aspect and stop the train with full-service braking in about 8,000 to 8,500 feet. If the ACS had changed at signal 816-2, the head end of the train would stop at least 1,800 feet south of the home signal. In the event the engineer failed to respond to the cab signals and alerter, the ATC apparatus would initiate full-service braking within 6 to 8 seconds. Even if application of the ATC system was delayed the full 8 seconds, it would take less than an additional 400 feet to the distance required to stop. Thus, the changes made to the signal system at Gunpow provided adequate protection for following trains operating on track 2 and even for a train operating on track 2 when a train operating on track 1 encroached onto track 2 under certain conditions.

However, if a train on track 1 ran through switch 12 causing the aspect of signal 2N to change from "clear" to "stop" after a train traveling on track 2 at 125 mph passed signal 816-2, the location of the 125-mph train relative to the home signal becomes critical. The brake application would have to occur before the 125-mph train was within 5,500 to 6,500 feet of the home signal, depending on the number of effective brakes in the train. For a train traveling 105 mph, the calculated minimum braking distance would be 4,300 to 5,000 feet. To stop safely in such minimum distances, the engineer would have to place the train's brakes in emergency in 6 seconds or less after the ACS changed to "approach." If the engineer failed to act and a full-

service brake application was initiated by the ATC system, the distance required to stop short of a collision at 125 mph could be as long as 9,000 feet. Therefore, if the aspect of signal 2N changed because a train on track 1 entered switch 12 after a train traveling 125 mph on track 2 had moved 1,500 feet or more past signal 816-2, the 125-mph train could not be stopped in time to avoid a collision.

Thus, at converging interlockings such as Gunpow, where freight trains or Amtrak work trains normally enter high-speed tracks, there are locations beyond which there is insufficient braking distance to prevent a collision when a freight or work train overruns a "stop" signal and encroaches onto the track in front of a high-speed passenger train. The faster the speed of the passenger trains, the longer these hazard zones become. Obviously no signal system can be devised to eliminate this problem, and the potential danger increases dramatically as the speed of the train increases. Proper research by Amtrak should have revealed the dangers of these hazard zones to the safe operation of trains at 125 mph or more. Amtrak should have recognized that it could not safely operate trains at 125 mph without requiring all trains operating on the NEC to be equipped with ATC.

The vulnerability of high-speed trains to the incursion of other trains at converging interlockings was virtually nonexistent when Amtrak took over the NEC. This hazard was created when Amtrak and FRA acquiesced and allowed the operation of locomotives on the corridor that lacked ATC (and even ATS). The hazard was further exacerbated by the steady buildup of high-speed Amtrak trains and by FRA's certification of 125-mph train speeds without addressing the potential for collision.

Once the ACS track circuitry was installed, locomotives required relatively simple modifications to provide continuous ATS and ATC protection. For years, all passenger locomotives, all electric multiple-unit commuter trains, and all electric-freight locomotives operated on the Pennsylvania's electrified territory north of Washington were equipped with such protection. That situation existed when Amtrak took over the corridor and Conrail was formed in the Penn Central reorganization.

However, after Amtrak took over the corridor, Conrail began using trains with locomotives that were equipped with ACS but not with ATS or ATC. Since the late 1970s, the Safety Board has repeatedly recommended that Amtrak require all trains operating on the corridor to use locomotives equipped with ATC apparatus. Amtrak responded that the Safety Board's recommendations were not warranted and began implementing alternative courses of action.

In January 1982, the Safety Board once again reiterated its concerns about the use of locomotives on the NEC without safety backup devices. Amtrak wrote the Safety Board on February 10, 1982, stating that all Amtrak-powered equipment used outside of yards on the corridor was ATC-equipped, that all tenant-owned passenger equipment on the corridor was at least ATS-equipped, and that timetable rule 1562-A.1, which required non-ATC equipped locomotives to stop and get permission or wait 3 minutes before entering corridor, would be an effective control when non-ATC equipment encountered "stop and proceed" signals. Based on this, the Safety Board classified Safety Recommendation R-78-39 "Closed-Acceptable Alternate Action" on September 30, 1982.

In 1982, Amtrak submitted a new corridor proposal to the FRA to supersede the proposal the FRA had approved in 1980. The original requirement that all corridor trains be ATC-protected was dropped, ostensibly because of funding changes. As with the original proposal, there was no plan to eliminate the converging interlockings by adding tracks to the two-track sections. FRA conditionally approved the new proposal on August 31, 1983.

In addition, timetable rule 1562-A.1 was subsequently modified so that trains equipped with ATS but not ATC were no longer required to get permission to pass "stop and proceed" signals. The Safety Board was never notified of the change, although the rule was no longer responsive to Safety Recommendation R-78-40 and could in no way be considered an adequate alternative to the mandatory ATC operation recommended in Safety Recommendation R-78-39. (See appendix L for a more detailed discussion of the history of the Safety Board's recommendations to Amtrak, Amtrak's responses, and FRA's positions on this issue.)

Amtrak's failure to prevent Conrail from replacing locomotives equipped with devices that would automatically comply with the restrictive signal aspects with locomotives not so equipped helped to create the situation in which, when the engineer of train ENS-121 failed to comply with signal 816-1 and delayed in complying with signal 1N, there was no safety backup device to prevent this accident. Conrail also contributed by replacing its ATC-equipped locomotives with non-ATC-equipped locomotives.

Following this accident, the Safety Board issued recommendations to Amtrak recommending that it require the use of devices on all locomotives operating on the NEC to automatically control the train as required by the signal and until this was accomplished, require operators of locomotives not so equipped to stop and receive permission before proceeding onto the high-speed passenger tracks of the corridor. Amtrak agreed, in general, that locomotives operating on the corridor should be so equipped

so equipped and began the process of complying, in part, with the Safety Board's recommendation. However, Amtrak has not agreed with the Safety Board's recommendation to have all locomotives not so equipped to stop and receive permission before entering the high-speed tracks. Amtrak has indicated that it has restricted all freight train operations on the corridor to 30 mph between 6 a.m. and 10 p.m. The Safety Board notes the recent FRA rule requiring all trains operating on the corridor to be equipped with ATC devices by January 1, 1990. The Safety Board is concerned that even this date might not be met fully and believes that the process needs to be expedited.

During the Safety Board's investigation of the Chase accident, it was revealed that the non-ATS- or ATC-equipped Amtrak diesel locomotive units and/or its replacements were not confined to "yard" service as Amtrak had represented, but were used to pull work trains on the corridor (see appendix M). As of December 10, 1987, Amtrak reported it is beginning to modify these units with ATC, but in the meantime, it continues to use the unmodified units. The Safety Board believes that Amtrak should immediately discontinue the use of these non-ATC-equipped locomotives on the NEC.

The Pennsylvania Railroad had significantly advanced the state-of-the-art in railway signals when it designed and adopted the position-light signal system in the early 1920s. A few years later, it initiated another important signal advancement in its development and introduction of ACS. By 1931, both position-light wayside signals and ACS were in service on the corridor between Washington and New York. ACS supplemented the wayside signals by alerting engineers to the condition of the tracks ahead even when they could not see the wayside signals. Moreover, ACS informed them of changed conditions ahead after they passed a wayside signal.

When the ACS system was fully functional, it made the wayside signal system appear to be redundant. The Safety Board believes that many engineers may have become dependent on the ACS aspects, particularly since the cab signal whistle alerted them whenever the ACS changed to a more restrictive aspect. However, the operating rules still require engineers and other crewmembers to observe, respond, and communicate the aspects of both wayside signals and ACS. As long as wayside signals are used, it is imperative that they be observed and identified as far in advance as possible, particularly when trains are operated at high speeds. The ACS system is merely a backup to the wayside signal system and an aid to the locomotive crew when visibility is poor.

However, the Safety Board believes the use of the same color in all the aspects is a weakness in the position-light signal used on the corridor. At great distances, it is difficult to distinguish one aspect from another. The amber lights can be seen best at night and in overcast daylight; bright

sunlight illuminates the black backgrounds and reduces the definition between the backgrounds and the lights. This was evident in the Safety Board's postaccident sight distance tests. Overhead catenary wires often prevent a full view of signal aspects in curves, somewhat diminishing the value of the position indication. This problem is aggravated by all the aspect lights being the same color.

The color red is universally recognized as a warning of danger. When locomotive crewmembers watch for the amber aspects of a signal on the NEC, they must first detect this display and then decide, based on the position of the display, what action the aspect requires. However, if the "stop" aspect lenses were red, the engineer would know that on detection of the color red, he would be required to stop. This would save the time otherwise required to perceive the position of the aspect lights. It may be necessary to use a bulb of greater intensity for the red aspect to enable the engineer to detect it from the same or greater distance needed to detect the amber, but this should not present a problem.

In American railway practice, red has always signified danger, and restrictive interlocking signal aspects include the color red virtually everywhere except on the NEC. Norfolk and Western and Conrail recognized the value of modifying their Pennsylvania-type position-light signals by replacing the amber lenses in the horizontal aspect with red ones. This modification had also been proposed for the NEC as part of an improvement project, but according to Amtrak's chief signal officer, it had been set aside because of budget restrictions. The Safety Board is not convinced, however, that the expense of such a project outweighs the probable safety benefits of such a relatively easy way to enhance the effectiveness of the wayside signal system. It cannot be eliminated as a possibility that had the "stop" aspect of signal 1N been red and of p per intensity, the engineer may have detected and reacted to it in sufficient time to prevent the accident or reduce its severity.

Dispatching Procedures

Although classed by Amtrak as a conventional train, train 94 was ordinarily permitted to operate at maximum authorized speeds of up to 125 mph because it was powered by AEM-7 locomotives and consisted of Amfleet-type cars. On January 4, 1987, however, train 94 included more cars than usual to accommodate the heavy holiday weekend traffic. One of the extra cars was an older Heritage-type car that was restricted to 105 mph, a fact established in the timetable.

Amtrak officials testified that the 105-mph speed restriction on the Heritage-type cars was imposed only because of ride quality and maintenance considerations, and they asserted that these cars could be operated safely at 125 mph. However, at 125 mph, the conventional trucks of these cars were beyond their

lateral stability and curve performance limits; this could result in truck hunting and inadequate ability to negotiate curves--situations that could result in derailment. The Safety Board believes that these safety-related performance limitations probably were a factor in Amtrak's decision to restrict the speed of trains with Heritage cars.

The conductor stated he understood his train was restricted to 105 mph and had so informed the engineer before train 94 left Washington. Amtrak's top corridor operating officers testified that the conductor was required to inform the dispatcher of the speed restriction. However, the conductor did not inform the dispatcher, and therefore, the dispatcher was unaware of the fact that train 94 was restricted to a maximum of 105 mph. The Safety Board was unable to establish whether the conductor failed to perform an absolute and thoroughly-understood requirement or had simply followed a customary practice of assuming that the dispatchers already knew when trains were restricted. However, Amtrak has not provided the Safety Board with any written procedures establishing a process by which conductors notify dispatchers of such restrictions. Further, for the conductor to notify all six dispatchers on the corridor between Washington and New York, he would have had to telephone them before leaving Washington. If the dispatchers' shift changed while the train was en route, the information would have had to have been passed on to the dispatchers coming on duty.

This action places a substantial burden on the conductors. It would be preferable to have a supervisor at Washington or New York provide the conductor and the dispatcher with the train manifest detailing speed restrictions. To the extent that multiple dispatchers are responsible for the movement of a restricted train, a procedure should require that each dispatcher is informed before the train enters his assigned territory. Given the density of train operations and the stress placed on the on-time performance on the corridor, the Safety Board believes that Amtrak should have a formal procedure through which personnel involved in the operation of restricted trains are provided written notice of speed restrictions.

Unaware of train 94's restriction, the dispatcher put the train out of Washington just ahead of the late 125-mph Metroliner 112, despite the fact that train 94 had to make a stop en route to Baltimore and the Metroliner did not. Train 94 was operated at 125 mph, yet it failed to make up any of the time it was already behind schedule. Both trains 94 and 112 were in the station at Baltimore simultaneously, but again train 94 was allowed to leave ahead of the Metroliner. Had the dispatcher been aware that train 94 was a 105-mph train, he probably would have allowed the Metroliner to leave first; failing to do that, he could have run train 94 on track 1 and allowed the Metroliner to run around train 94 on track 2. In such an event, the

dispatcher probably would have decided to hold Conrail train ENS-121 at Bay View to follow the two northbound passenger trains. Holding the Conrail train at Bay View would have delayed it about 10 minutes at the most. Most of this delay was unavoidable anyway; if advanced to Gunpow ahead of the passenger trains, the Conrail train would have had to wait there.

Both train 94 and Metroliner 112 were routed through on track 2 with the Metroliner running only 4 minutes behind train 94. This procedure was to be continued for at least 32 miles, to Perryville and probably beyond. The dispatcher and the block station operators at Edgewood and Perryville were concerned with "double-barrelling" the two southbound Amtrak trains down the 7.7-mile 2-track section between Bush and Gunpow after the northbound passenger trains cleared that section. If trains 94 and 112 could maintain maximum speed and were not delayed, they would be past Bush well before the southbound trains arrived. With this strategy, the southbound trains would not be stopped or slowed, and they could continue to Baltimore.

In contrast, not much planning was done regarding train ENS-121. Based on the Edgewood operator's suggestion, the dispatcher decided to move train ENS-121 from Gunpow to Magnolia Siding, about midway along the 2-track section, after trains 94 and 112 passed. Had the Conrail train followed trains 94 and 112 from Bay View instead, it could have made the run to Magnolia nonstop and arrived sooner than if it had been moved to Gunpow and held there until train 112 passed. In any event, train ENS-121 could not leave Magnolia until the southbound train using track 2 passed that point.

Since the Conrail train did not have ATC, running it to the converging interlocking ahead of the passenger trains created a potential conflict between the trains and set the stage for the accident. Nonetheless, the Conrail train was dispatched from Bay View as train 94 was leaving the Baltimore station, only 3.8 miles to the south.

Although the dispatcher's decision was not a violation of Amtrak rules, the Safety Board believes it was not as well planned as it might have been. Amtrak needs to provide sufficient procedures and training for its dispatchers to recognize the desirability of dispatching trains not equipped with safety backup devices to avoid their conflicting with high-speed passenger trains at interlockings.

Speed Restrictions

Amtrak's timetable indicated that 70 mph was the maximum authorized speed for Conrail's 5000-5059 series locomotive units on the corridor. For "light" multiple-unit diesel-electric locomotive units of this series without cars, the maximum speed was 60 mph. However, according to Amtrak's corridor timetable No. 4, the maximum track speed for freight trains on track 1 was

50 mph. The Amtrak general superintendent testified at the Safety Board's public hearing that he considered the 60-mph light-locomotive restriction to supersede the 50-mph track speed, although he also testified that he considered train ENS-121 to be a freight train. This testimony was contradicted later by the statement of the Amtrak general manager-transportation that train ENS-121 was not a freight train and was subject to passenger train track speeds and could operate as fast as 60 mph. Because of the confusion and complexity of these rules, the Safety Board does not believe it is reasonable to expect engineers to determine the proper speed restrictions when two senior Amtrak operating officials cannot agree on their interpretation. The Safety Board believes that all rules, especially those of such importance as speed restrictions, must be understandable to those to whom they apply and must not be subject to differing interpretations.

Conrail's timetable rules also limited a light locomotive consist to 60 mph, but included a provision that maximum track speed "must not be exceeded;" Amtrak had no such provision in its timetable. Although the Conrail engineer apparently believed that the 60-mph limit applied on the corridor, he operated his train at 65 mph between Bay View Yard and Gunpow, a clear violation of the speed restriction according to the timetable and to Amtrak management.

As far as the Safety Board has been able to determine, the engineer of train 94 had not been given an order to exceed the train's 105-mph limit, and it was his responsibility to comply with the speed restrictions. It could not be established if the engineer decided deliberately to operate train 94 as he normally would (when it did not contain a Heritage-class car) because he assumed that the dispatcher had put his train ahead of the late Metroliner and wanted him to operate at the maximum speeds, or if he had failed to notice that his train included a Heritage-class car which restricted his speed, or if he, indeed, had been informed of the speed restriction by the conductor. Once he left Baltimore, he again began exceeding the authorized speed for his train. Approaching Gunpow, the speed recorder tapes indicated that the train reached 128 mph and had already made up 4 minutes on his schedule. If the engineer had checked his indicated speed against the marked mile posts north of Washington, as required by Amtrak rules, he should have been aware of the actual speed of his train thereafter.

Had train 94 slowed to 105 mph at signal 836.2, it would have traveled 15,646 feet in the 101.6 seconds that elapsed before home signal 2N changed to "stop" and its ACS changed to "approach" when train ENS-121 passed home signal 1N. This would have left 5,183 feet to signal 2N and 5,508 feet to switch 12. According to the TOS computer simulation, train 94, traveling 105 mph, required 3,448 feet to stop with an emergency application. Allowing 6 seconds for perception and reaction, the train would have stopped more than 1,000 feet short of a collision.

If train 94 had been where it actually was when signal 2N changed to "stop," but slowed to 105 mph, the collision could not have been avoided, but the impact speed would have been greatly reduced. As it was, train 94 struck train ENS-121 at about its maximum authorized speed of 105 mph adding to the severity of the accident.

Mixing Freight and Passenger Trains on the Corridor

The corridor had always been used by freight and commuter trains. When Amtrak acquired the line, Congress recognized the need of regional commuter authorities and newly-created Conrail to operate their trains over the line. Conrail acquired parallel lines north of Philadelphia that had not been part of predecessor Penn Central and was able to divert much of its freight traffic from the corridor to them. A certain number of freight trains still had to be operated, however, to serve industries located on this part of the corridor.

However, south of Philadelphia the corridor was a primary west-south as well as north-south freight route. The only parallel line (now part of the CSX System) actively competed for this freight traffic. Even if its managers were willing to accommodate trains diverted from the corridor, the line's capacity would have had to have been increased at great expense in order to accommodate the diversion. Moreover, Conrail would have had to spend large sums to construct connecting tracks, to build new bridges, or to enlarge existing bridges to accommodate more tracks. But even if all this could have been accomplished, some freight trains would still have had to be operated to serve industries on the corridor and on branch lines connected to it. Hence, there would always be some risk of a freight train derailing alongside or in front of a fast-moving passenger train on an adjacent track. Although that had not happened on the New York-Washington corridor since 1929 (see appendix L), the probability of it happening again could be reduced even further by operating as many freight trains as possible during the hours when passenger trains were not running. However, Conrail's ability to do this diminished as Amtrak began running more passenger train , and there were correspondingly shorter times when Conrail had exclusive use of the corridor.

Aside from the necessity of operating them on parallel tracks, the mix of freight and passenger trains on the corridor had another serious deficiency in that it was not possible to dedicate specific tracks for exclusive use by freight or passenger trains over great distances. This deficiency was particularly acute between Baltimore and Perryville where the line varied from two to three to four tracks. The two-track segments, necessitated by long bridges crossing the Gunpowder, Bush, and Susquehanna rivers were built-in bottlenecks that frequently interrupted the smooth flow of train traffic. The problem was exacerbated by the growing number of trains operated by Amtrak.

Wherever a larger number of tracks converged to only two tracks as at Gunpow, passenger trains routinely encountered freight trains that had to yield the right of way to them. The possibility that a freight train might fail to stop and enter the intersection in such a situation should have been recognized by Amtrak as the most potentially serious operational safety hazard on the corridor. This should have motivated Amtrak to require the use of ATC, the highest possible level of protection given the situation.

Supervision and Management

Because train ENS-121 was operating on Amtrak's line it was operating under Amtrak rules. Further, Amtrak had the responsibility for the management and supervision of all operations on the corridor.

Conrail's Supervisory Management.--Conrail had a substantial supervisory force to oversee its operations at Baltimore and between Washington and Perryville. Three road foremen of engines headquartered at Baltimore and Washington supervised the 60 engineers who worked over this territory, and there were two trainmasters at Baltimore, as well. All were required to make at least 250 efficiency checks monthly, including compliance with the signal and radio rules and speed restrictions.

The Safety Board determined that Conrail management had also required its supervisors to make frequent employee fitness-for-duty checks at reporting points such as Bay View where supervisors were on duty day and night. The Safety Board has long been concerned about the railroads providing adequate supervisory oversight where train crews report for duty. In its investigation of a Conrail collision at Royersford, Pennsylvania, in 1979, 42/ the Safety Board determined that a crewmember, operating one of the trains involved in the accident, was under the influence of marijuana. He and the other members of his crew had reported to a location where no supervisors were on duty and supervisory checks of crews were rarely made. As a result of its investigation, the Safety Board recommended that Conrail:

R-80-5

Provide adequate supervision of night train operations and include in supervisory efficiency checks, periodic checks of train crewmembers' fitness for duty at reporting points and on trains en route.

42/ Railroad Accident Report--"Rear End Collision of Consolidated Rail Corporation Freight Trains ALPG-2 and APJ-2 Near Royersford, Pennsylvania, October 1, 1979" (NTSB/RAR-80/02).

Following its investigation of a collision of two Missouri Pacific freight trains near Possum Grape, Arkansas, in 1982, 43/ the Safety Board recommended to member railroads of the Association of American Railroads:

R-83-60

Establish supervisory procedures at crew-change terminals to insure that all operating department employees coming on duty at any hour of the day are physically fit and capable of complying with all pertinent operating rules.

According to Conrail's manager of rules, these safety recommendations and others of a similar nature were instrumental in the development of Conrail's system-wide program for intensifying supervisory oversight and rules enforcement.

Conrail's Oversight of the Traincrew.--Conrail reported it had intensified its supervisory oversight and it had at least two supervisors at Bay View Yard on January 4, 1987. Nevertheless, the supervisors did not recognize that the crew of train ENS-121 failed to make a proper and complete ACS test, failed to secure a proper radio (although the trainmaster had reason to be concerned that they may not have had a proper radio), and failed to make a predeparture brake test. If the supervisors recognized these failures, they failed to take any action to correct the situation. Instead, the crew took train ENS-121 out on the NEC where they would be operating on tracks with high-speed passenger trains.

Despite the fact that the engineer of train ENS-121 consistently scored high in the annual rules examinations and was considered to be competent in his work, there were indications that he did not fit well into an organization that depended on individual reliability and ability to perform without close supervision. These characteristics should have been apparent to management. One supervisor described the engineer as "overconfident and surly," and he intimated that he was resistant to supervisory guidance. The engineer also had been disciplined for belligerence and threatening a crew dispatcher. Although co-workers had described him as outgoing and friendly, one barmaid described him as occassionally "displaying a temper and obnoxious behavior" when drinking. The engineer's propensity for laying off was a matter of record. His frequent infractions of motor vehicle regulations when he was off work were also a matter of record, but these records were not as readily available to

43/ Railroad Accident Report--"Side Collision of two Missouri Pacific Railroad Company Freight Trains Near Possum Grape, Arkansas, October 3, 1982" (NTSB/RAR-83/06).

the engineer's supervisors. The engineer's propensity to lay off should have been an indication to the engineer's supervisor that the engineer might have had serious problems that could affect his job performance.

In 1986, FRA had issued its "Field Manual on Drug and Alcohol Use" to assist the railroads in implementing Federal regulations (49 CFR 219.19) on alcohol and drug use by railroad employees. According to Conrail's manager of rules, this manual had been distributed in 1986 to supervisors as part of Conrail's Management Awareness Program. The manual cited "key criteria" for "early identification of work performance problems," including increased absenteeism and sick days, frequent mood changes or swings, decreased ability to receive constructive criticism, increased aggressiveness or defensiveness, incidents of hostility toward fellow workers, and encounters with police. The Safety Board believes that the engineer's absenteeism and rules violation should have alerted his supervisors to a potential employee problem and should have caused them to do some additional checking on the engineer which may have enabled them to learn of the engineer's motor vehicle violations and his chemical dependency.

Further, had Conrail had reasonable-cause testing as a part of its drug and alcohol program, the engineer's record of absenteeism would probably have qualified as reasonable cause for testing and his chemical dependency may have been uncovered. Unfortunately Conrail did not have such a provision in its drug and alcohol program. Further, it appears that because of a decreasing amount of work for its train crews in this area, the engineer's supervisors were probably not overly concerned about the engineer's record of absenteeism and never checked further to determine if the engineer had other problems.

The Safety Board previously expressed concern about the need for organizations that provide public transportation to monitor properly the performance of operating employees, including off-duty indicators of potential performance problems. After investigations of accidents involving air carriers and operators of intercity bus lines, 44/ the Safety Board has suggested that the driving records of operating employees be monitored (this may require the permission of the employees) through State departments of motor vehicles (which have access to the National Driver Register (NDR) operated by the National Highway Traffic Administration, DOT) to learn of serious motor

---

44/ Highway Accident Report--"Intercity Tour Bus Loss of Control and Rollover Into the West Walker River, Walker, California, May 30, 1986" (NTSB/HAR-87/04); and Aircraft Accident Report--"Simmons Airlines Flight 1746, Embraer Banderante, EMB-110P1, N1356P, Near Alpena, Michigan, March 13, 1986" (NTSB/AAR-87/02).

vehicle operating violations, including driving while intoxicated or using drugs. These indicators should then be used as a part of a supervision program of the employees that would include taking appropriate actions when early signs of problems appear.

Currently, there are no systematic means for rail employers to gain access to driving records. In fact, current law governing the NDR strictly limits dissemination of information from that multijurisdictional data base.

The Safety Board believes that this is a deficiency in the current system and that rail employers should have access to the NDR. This type of data can be essential to an accurate assessment of an individual's fitness to operate a train. Access to driving records on an individual State basis may not provide complete information, as drivers often commit traffic offenses in multiple jurisdictions.

On June 22, 1987, the DOT proposed the enactment of legislation that would provide access to the NDR by other transportation employers (rail and air). On November 5, 1987, the Senate passed a major railroad safety bill that included access to the NDR by rail employers and the FRA. Similar legislation has been proposed in the House of Representatives.

The Safety Board believes that Conrail should do more to ascertain facts about employees who are in safety critical positions so that Conrail can be alerted to early warnings of potential performance-related problems. Conrail should develop a policy that would provide supervisors with criteria regarding the employees' driving record, absenteeism, on-the-job violations, and other factors. These criteria should require specific actions including supervisory discussions with the employee, counselling, or suspensions when the combination of such warning signs reach predetermined levels.

Conrail's Equipment Inspection.--Based on documents provided by Conrail and the testimony of Conrail's superintendent of motive power-east, the lead locomotive unit of train ENS-121 repeatedly passed through the 51st Street enginehouse at Chicago without receiving the required ACS test when it was the rearmost unit of an outbound locomotive. Because this location presented the last opportunity for this test before a "relayed" through-train passed into ACS territory, it was imperative that the employees responsible for the maintenance of equipment at Chicago perform the test properly.

The Safety Board is convinced that shortcomings in performing the ACS tests should have been discovered by the responsible maintenance-of-equipment supervisors since they had access to the inspection reports. These reports provided proof that the testing was not being done properly. Conrail should take the necessary steps to correct this inadequacy at Chicago and other locations where the ACS tests are performed.

Further, the Safety Board believes that Conrail's supervisory oversight of its operating employees and its equipment was inadequate to discover that some of the ACS alerter whistles were being muted. Conrail action to prevent the whistles from being muted may have prevented this accident. The Safety Board believes that Conrail should revise its procedures to require that the ACS alerter whistles, the cut-out cocks of the ACS, and deadman safety control systems are properly and thoroughly inspected at appropriate intervals.

Amtrak's Supervisory Management.--The Safety Board's investigation revealed that, unlike Conrail, Amtrak had only a limited program of supervisory oversight of its corridor train service employees. Safety Recommendation R-83-60, previously mentioned, had been addressed to Amtrak as well as other railroads in 1982, recommending improved supervisory oversight at crew-change terminals. Nevertheless, Amtrak's vice president of operations and maintenance testified at the public hearing that Amtrak's conductors, not its supervisors, were responsible for checking employees' fitness for duty.

The Safety Board has repeatedly pointed out the deficiencies in a policy of relying on train crewmembers to police their performance and fitness, even when trains carry freight (not passengers), are operated at moderate speeds, and are separated by substantial distances. The Safety Board believes that this policy does not provide an acceptable level of protection for railroad employees and the public traveling on the corridor, where Amtrak trains are scheduled as frequently as every 1/2 hour, may be operated only a few minutes apart, are often crowded with people, and are operated at high speeds. Proper supervisory oversight is heightened by the fact that engineers on Amtrak corridor trains are alone on their locomotives, isolated from other crewmembers, and can defeat the action of the safety backup systems. The Safety Board believes that Amtrak must provide more effective supervisory oversight of its employees.

The Amtrak vice president testified that transfering the responsibility for checking fitness from the conductors to the supervisors would require the addition of 150 supervisors "nationwide." If that were a valid argument, the cost of remedying the problem could be high.

However, in the high-speed territory on the corridor between New York and Washington over which Amtrak has complete responsibility, Amtrak traincrews report to fewer than 12 locations. To properly supervise these locations and the territory between them would require a fraction of the number of supervisors cited by the vice president. Moreover, the Safety Board is not satisfied that Amtrak lacks an adequate operational supervisory force to carry out the Safety Board's recommendation,

but rather the Safety Board is convinced that deficiencies in Amtrak's supervisory oversight policies and procedures are the reason it has not done what the Safety Board has asked. This conclusion is supported by the large number of senior Amtrak supervisors who were on hand at Chase in a relatively short time after the accident, but who failed to take a number of appropriate actions.

At the time of the accident, Amtrak had a safety department headed by a director of safety who reported to Amtrak's vice president of operations and maintenance. This organizational structure should have enabled Amtrak's safety department to be equal to and not subordinate (as it was) to Amtrak's line departments, including transportation, maintenance-of-way, and maintenance-of-equipment, which were also under the vice president of operations and maintenance. Further, under such an organizational structure, the safety department should have been able to provide safety input to the policies, methods, and procedures employed by the line departments and into all facets of Amtrak's operations including accident and injury prevention, job safety analysis, employee training, rules enforcement, train operations, equipment design and modification, and passenger safety. To be effective, safety department personnel should have appropriate backgrounds and expertise. They should also have authority at least equal to that of their counterparts in the other departments and would have to develop close working relationships with tnose individuals. Thus to succeed, a broad-based organization-wide approach to safety requires the establishment of firm policies by the vice president of operations and maintenance to whom the various departments were responsible.

According to the general superintendent of the Philadelphia division involved in this accident, the division had its own independent safety program. Safety supervisors from Amtrak's safety department were assigned to this program. He described the program as the whole safety "package" that covered everything from "A to Z." The safety supervisor assigned to the division, who was on site shortly after the accident, testified that before 1985, he had been a substation electrician. There was no evidence that he had received training or experience in safety work in general, or operational safety in particular. According to the safety supervisor, he had no involvement in train operations, efficiency testing, operating rules training, or observing the fitness of Conrail crews on the corridor. Subsequently, the division general superintendent testified that he thought that anything related to safety was the safety supervisor's responsibility and also that compliance with signals was a safety matter. However, he also stated that compliance with operating rules, speed restrictions, and signal aspects were the responsibility of the transportation department and not the safety department. The Safety Board believes that a safety department should be concerned with such aspects of the railroad's operation and that its safety supervisors should be qualified to address such issues.

The Safety Board's investigation left little doubt that Amtrak's safety department was primarily involved in preventing employee injuries and implementing emergency response and other educational programs with outside organizations. Although these are important issues, Amtrak's safety department should have also been concerned with promoting operational safety. The Safety Board also believes that the effectiveness of safety personnel can often be greatly enhanced when they report to a director of safety and not to division transportation officers.

The Safety Board's experience with Amtrak since its formation and again in connection with the investigation of this accident suggests that safety has not had sufficient management support, and thus, it has not had the impact it should have on train operations, passenger safety, enforcement of operating rules and restrictions, or the purchase and maintenance of train equipment. The Safety Board believes that, if Amtrak management had been more sensitive to safety, it would have been more responsive to past Safety Board safety recommendations, particularly those that addressed the need for automatic safety backup devices on corridor trains and the elimination of the injury-producing features of its cars.

Amtrak's Oversight of the Traincrews.--The Safety Board found little evidence that even Amtrak's transportation department supervisors actively monitored crew compliance with signal aspects and speed restrictions. There was no record that Amtrak performed operational efficiency checks on the engineer of train ENS-121. Despite the fact that the engineer of train 94 worked a round trip over the corridor daily, Amtrak's records indicated he had been subjected to operational checks on the average of only four times annually during the 2 years preceding the accident; only half the checks included speed checks. In 1985, he had been checked twice on his compliance with a "clear" signal aspect, but during that year and 1986, he was never checked on his compliance with a restrictive signal aspect. The Safety Board believes that compliance with a "clear" signal aspect is not a meaningful signal check.

In its 1984 safety assessment of corridor operations, FRA found that operational efficiency checking appeared to be "nonexistent" and that Amtrak imposed no efficiency checking requirements on its operating officers. The FRA report also stated that efficiency checks that would interfere with schedule requirements were not conducted, and some Amtrak supervisors stated they believed they would be disciplined if checks delayed a train. In 1985, Amtrak responded to this evaluation by stating that it intended to increase efficiency checks, but would not require that a specific number of checks be conducted in a fixed period of time. It was about this time, according to Conrail, that Amtrak relaxed its opposition to Conrail efficiency checks on the corridor.

According to Amtrak's records, operational efficiency checks of the Conrail engineer were made on July 24 and October 24, 1985. However, its records indicate that the engineer was not checked for compliance with signal, speed, or radio rules on either date. Further, on October 24, 1985, the engineer took his annual examination on Amtrak's rules and was not in service on that day (he did not operate a train on that day). The Safety Board does not know how Amtrak could have performed an operational efficiency check on an engineer who was not operating a train.

At the time of the Safety Board's public hearing, the Philadelphia division general superintendent stated that he was requiring his operating supervisors to perform one speed check and one signal check monthly. It is not known if this requirement was in force at the time of the accident. Since Amtrak continues to deny Conrail permission to make restrictive signal checks, the Safety Board believes that the required Amtrak supervisory signal checks are probably of the "clear" aspect type.

The Safety Board's investigation developed substantial evidence that Amtrak placed great emphasis on maintaining the corridor passenger schedules because of its competition with air carriers for the New York-Washington passenger traffic. By the time of the Chase accident, Amtrak had greatly increased its share of passengers. According to Amtrak's vice president of operations and maintenance, that share was then one out of every three passengers. The consistent adherence to schedules certainly contributed to Amtrak's success. However, to meet schedules, the fastest Metroliners had to average 80 mph, including four stops, to make the 169-minute schedule between Washington and New York. Until late in 1986, this was only 4 minutes more than the computed minimum running time between those points. Yet, according to the Philadelphia general superintendent, at the time of the accident, trains on his part of the corridor were running "on time" more than 85 percent of the time.

Amtrak officials who testified before the Safety Board insisted that train 94 could have made its normal schedule even if it had not exceeded 105 mph at any time. The Safety Board believes this would have been very difficult if not impossible to accomplish. With one fewer car the day before the accident, the engineer was able to make up only 1 of the 30 minutes it was behind in its schedule, although the train was permitted to run as fast as 125 mph. On the day of the accident, the engineer had actually lost time running between Washington and Baltimore, although the train was operated well over 105 mph whenever track speeds permitted.

Train 94 was dispatched from the Baltimore station ahead of Metroliner 112. Both trains were in the station simultaneously, and train 94 was not routed onto track 1 so it could be overtaken by the Metroliner which was behind schedule. Thus, it is very likely that the engineer of train 94 understood he was going to be running ahead of the Metroliner. In the 32 miles between Bay View and Perryville, train 94 had a 19-minute schedule, the same as most of the 125-mph Metroliners, and had to average 101.3 mph to meet it. Considering that this portion of the corridor included 80- and 90-mph restricted sections, it would have been difficult for a train traveling 105 mph or less to meet this schedule.

As for supervisory speed testing, FRA's 1984 assessment reported that Amtrak corridor trains were operated in excess of allowable speeds before the assessment was begun. But, even while the assessment was in progress and it was general knowledge that FRA inspectors were making radar speed checks on the corridor, some engineers continued to speed. While the assessment was in progress, the B of LE president complained to Amtrak that corridor engineers were being pressured and hassled by supervisors to maintain schedules. While this was denied by Amtrak's president, the Safety Board believes that Amtrak's operating supervisors may have been overly concerned with assuring that Amtrak trains meet their schedules, even when, in some cases, the schedules may have been somewhat unrealistic. The Amtrak general superintendent's interpretation that equipment speed restrictions superseded track speeds, the ambiguous nature of Amtrak's timetable speed restrictions, and Amtrak's failure to inform dispatchers when trains were restricted to less than their normal speed also support the conclusion that on the corridor, speed and schedules were paramount, perhaps even above safety.

The Safety Board understands and supports the need of transportation companies to provide dependable, on-time service for the traveling public. However, it can be extremely harmful to the traveling public if safety considerations become subjugated to meeting schedules. The Safety Board believes that this may have happened to Amtrak in its otherwise commendable efforts to provide such service to the traveling public.

Even if Amtrak subsequently relaxed its emphasis on speed, and if track speeds were increased without reducing running times late in 1986, which made it easier for engineers to meet schedules without speeding, the Safety Board believes it is possible that a mindset (of the importance of meeting schedules) had been established in the transportation department that could not be changed easily. Additionally, the Safety Board believes that it is possible that such a mindset may have motivated the engineer of train 94 to operate his train above its permitted speed just before the accident.

Supervision of Toxicological Testing.--At the time of this accident, Federal regulations required all train crewmembers, dispatchers, operators, and other employees subject to the Federal Hours of Service Act to submit specimens for toxicological testing "as soon as possible" after a major accident that resulted in fatalities and in which they had direct involvement. The regulations required that the railroads make "every reasonable effort to assure that samples are provided" for testing. Amtrak and Conrail had included this testing requirement in their operating rules and had instructed supervisors and employees on its provisions and the proper use of the testing equipment. All Amtrak and Conrail crewmembers as well as the dispatcher and block station operators were required to be tested, and they stated that they expected to be tested.

Amtrak's safety supervisor and assistant vice president of transportation arrived at the site 30 minutes and 1 hour 25 minutes after the accident, respectively. Three Amtrak superintendents were there by 3:30 p.m., and the general superintendent arrived an hour later. Conrail's superintendent at Baltimore testified at the public hearing that he was on the scene 50 minutes after the accident. Shortly afterward, he was joined by a trainmaster and a road foreman of engines. Still later, a Conrail police captain and another trainmaster arrived. Thus, within 3 hours of the accident, at least six Amtrak and five Conrail supervisors were on the scene.

Amtrak officials testified at the public hearing that because the accident occurred on Amtrak and all involved were subject to Amtrak rules and supervision, it was Amtrak's responsibility to enforce the testing requirement. From the time the first supervisors arrived at the scene, each crewmember should have been monitored and taken promptly to provide specimens for testing.

Of the seven Amtrak employees who were subject to the testing requirements, only the Edgewood block station operator was taken to a hospital by a supervisor for testing. Amtrak officials did not accompany the other employees to hospitals to ensure that specimens were furnished. One Amtrak assistant conductor did have a urine specimen taken that was forwarded to CAMI for testing, although the stipulated procedures were not followed.

Although a fire department official testified that he detected a strong odor of alcohol on the breath of the flagman of train 94 not long after the accident, he observed nothing else about the flagman that might have indicated he was intoxicated. Further, no other crewmembers or passengers corroborated the fire department official's testimony and some stated the flagman showed no signs of being under the influence of alcohol. In the event the conductor was incapacitated, the flagman would have been in charge of the crew of train 94. In that position, he

would have had the responsibility for the train's passengers. Because of the importance of the position the flagman may have held and because he was a crewmember aboard a train involved in an accident, the Safety Board believes that testing of the flagman was particularly important. Because specimens for testing were not taken until several days after the accident, it is not possible to prove or disprove the testimony of the fire official concerning the flagman's condition.

Similarly, the Safety Board could not establish if the other crewmembers of train 94 and the dispatcher were free of alcohol and drugs because Amtrak's ranking officials at the accident site decided their performance had no bearing on the accident. The Amtrak assistant vice president of transportation circumvented his own company's rule and the Federal regulations when he decided not to have these persons submit to testing.

Following the accident, the Conrail engineer remained at the site and talked with many people including the Conrail terminal superintendent who, about an hour after the accident, ordered the engineer to be put in an ambulance to transport him to a hospital. However, since no supervisor escorted the engineer to the hospital, the engineer was able to leave the ambulance undetected. Valuable time was lost because the Conrail trainmaster at the accident site did not escort the engineer to the hospital for testing.

The Safety Board determined that neither the Conrail terminal superintendent nor the Amtrak assistant vice-president of transportation attempted to learn where the engineer had been taken and to instruct a supervisor to take samples. About 2 1/2 hours after the accident, it was discovered that the engineer was still on the site and the Conrail trainmaster was told to accompany him to a hospital. Another 2 hours passed before a blood specimen was drawn for FRA testing, although the engineer had been at the hospital with the trainmaster for more than 1 1/2 hours.

The brakeman did not provide specimens until 8 hours 45 minutes after the accident. His whereabouts were unknown to Amtrak and Conrail officials for more than 6 hours.

The Safety Board is deeply concerned about the failure of Amtrak and Conrail supervisors to comply with the intent of the FRA regulations for postaccident toxicological testing and about FRA's inability to achieve timely compliance with its regulations by these two railroads in this accident. The Safety Board is pleased that both railroads have now implemented all parts of the FRA's regulations, including reasonable cause testing. However, the Safety Board is not convinced that the compliance deficiencies that occurred in this accident will not reoccur.

The failures to obtain, on a timely basis, specimens for toxicological testing from all employees who may have had a role in this and in other recent accidents such as the derailment of the Norfolk and Western Railway Company passenger excursion steam train near Suffolk, Virginia, and the collision of the two Southern Pacific Transportation Company trains near Yuma, Arizona, on June 15, 1987, suggest there may be a need for improvements in the FRA alcohol and drug rules.

As a result, the Safety Board has undertaken an assessment of the implementation of the FRA rules on alcohol and drug use in the railroad industry. The Safety Board has been reviewing the results of the FRA program and the specific components of the rules that may need to be strengthened. Postaccident testing and reasonable-cause testing is being monitored and evaluated. The Safety Board believes that the reasonable-cause testing provision, for example, may provide the greatest deterrence to illegal alcohol and drug use. Therefore, the Safety Board is evaluating the extent to which railroads are voluntarily implementing this section. Additionally, the Safety Board is reviewing the reporting criteria and the number of tests actually undertaken under the FRA rules. Further, the Safety Board is reviewing the programs of several major railroads to identify those that have been successful in combating this serious safety issue.

FRA Oversight of the Northeast Corridor

The Safety Board has often expressed its belief to the FRA that all trains operating on mainline passenger train tracks should be equipped with devices that will automatically comply with the wayside signal system if the engineer fails to do so. The FRA has had a special responsibility in its oversight of the NEC as the current corridor system has resulted from Federal legislation and regulations. When Amtrak presented to the FRA its original plan for the implementation of its high-speed passenger service on the NEC and also when Amtrak sought permission from the FRA to modify its signal system and interlockings, the FRA should have recognized the need for all trains operating on the NEC to be equipped with automatic safety backup devices. The FRA should have taken action to implement regulations requiring all trains operating on the NEC to be equipped with automatic safety backup devices; it should have prevented Amtrak from permitting Conrail to replace its locomotives which were equipped with safety back up devices with locomotives not so equipped, thereby decreasing the level of safety on the NEC.

The FRA has not clarified its interpretation of 49 CFR 236.566--a request made by the Safety Board during the investigation of this accident. Therefore, the Safety Board does not know if the FRA believes (or did believe) that this regulation permits (or permitted) Amtrak to have allowed Conrail to replace its ATC-equipped locomotives with non-ATC locomotives. (However, when in December 1980, the FRA approved Amtrak's

proposal for the future high-speed operation of the corridor, it did so on the condition that relief from 49 CFR 235.566 would be cancelled and then noted that the regulation prohibited the use of non-equipped locomotives). If the FRA did believe that 49 CFR 236.566 permitted this replacement, the Safety Board believes the FRA should have amended the regulation to have prevented it. If the FRA did not believe the regulation permitted this action, it should have prevented Amtrak from allowing Conrail to take the action.

In any event, the Safety Board believes that the FRA should have recognized the dangers of permitting non-ATC-equipped locomotives to be used on the corridor and should have taken action to prevent this from happening. In failing to do so, the FRA helped to create the conditions that led to this accident.

The Safety Board is also concerned that FRA did not exercise sufficient oversight over the management and supervision of the corridor by Amtrak. As was pointed out in its 1984 safety assessment, the FRA found inadequacies in Amtrak's supervision of its engineers (insufficient operating efficiency checks), indications of operation of trains in excess of speed restrictions, and other indications that Amtrak was not exercising sufficient supervision of its employees resulting in the operation of trains at excessive speeds. The Safety Board believes that the FRA was slow to act, and this may have contributed to Amtrak's supervisory deficiencies.

The FRA has also failed to support adequately, the Safety Board's efforts to have Amtrak improve the crashworthiness of its passenger car interiors. The Safety Board believes that FRA could have persuaded Amtrak to accept and implement the numerous recommendations it made to Amtrak for car interior improvements. If the FRA was unable to accomplish this through persuasion, it could have required this through regulation.

The promotion of compliance with its alcohol and drug regulations is another area in which the FRA has not exercised sufficient oversight of the railroads. The FRA must do more in advance of accidents to set the stage for prompt and complete compliance with the postaccident toxicological testing provisions of its regulations, and it must do considerably more at the scene of an accident to obtain compliance. Through on-scene staff and if necessary, through senior management, the FRA should have made it very clear to both Amtrak and Conrail shortly after the accident of the need to have all Amtrak and Conrail employees involved in this accident supervised and taken promptly to appropriate facilities to provide toxicological specimens for testing. The Safety Board recognizes that the FRA cited Amtrak following the accident for its failure to comply fully with the regulations. However, the Safety Board believes that the FRA should have taken sufficient action before the accident and at the scene of the accident to have achieved full and timely compliance with the regulations, thereby avoiding the need to cite Amtrak after the accident.

Response to the Emergency

The emergency response forces of Baltimore County and its neighboring jurisdictions responded promptly and in appropriate strength to the emergency. Because of the relative isolation of the accident location and the very limited access to it, it was inevitable that the access routes would be congested with emergency vehicles. However, more timely action by the county police could have prevented the gridlock that was caused mostly by curious motorists. This unnecessary congestion severely hampered access to the site by emergency vehicles for as long as 6 to 7 hours after the accident.

The county police also failed to prevent access to the site by crowds of onlookers and others who were not directly involved in the rescue operation. This failure interfered with emergency treatment personnel who were attempting to identify and treat injured passengers. The civil police devoted some of their resources to assisting Amtrak in determining who had been on the train. This effort should have been left to Amtrak police and supervisors who were on the scene permitting the civil police to control access to the area.

Rescue forces were hampered by extrication tools that proved inadequate to deal with the structure of the Amfleet cars. As a result, some passengers were not extricated until after temperatures dropped below freezing. It appears that at least one person may have died as a result of hypothermia while awaiting rescue and not solely from the injuries received in the accident. In its future liaison with local emergency forces especially along the corridor, Amtrak should provide them with structural diagrams for the cars and information relating to the types of tools (even if new tools must be designed and developed) that can be used effectively to free persons trapped in railroad car wreckage.

The State of Maryland contributed important resources, including National Guard and State police units. These resources greatly benefited the ability of the emergency response personnel to quickly evacuate the seriously injured.

Survival Aspects

Most of the impact force of the collision was absorbed by the rear Conrail locomotive unit and the locomotive units and head three cars of train 94. Assuming that the Amtrak engineer had perceived and reacted to signal 2N changing to a "stop" aspect in 6 seconds, there was only 15 seconds for the engineer to reach the rear cab, the only part of the lead locomotive unit's superstructure that was not destroyed. To reach the rear cab, the engineer would have had to work through the narrow passageway and open the doors on both ends.

The lead car of train 94 was so thoroughly crushed that had the car been occupied, almost none aboard could have survived the crash. Fortunately, the car served as a buffer much as a baggage car would. It was also fortunate that there were only 25 passengers aboard the second car, which had 84 seats. More than half the passengers in this car were fatally injured, and the emergency response personnel had great difficulty in extricating injured passengers. Had the car been filled to capacity, as were most of the cars to the rear, the toll of fatally-injured passengers would have been much higher. More than 450 people aboard train 94 were not injured.

The effect of the collision and rapid deceleration of train 94 were progressively less severe toward the rear of the train because the cars' tightlock couplers resisted disengagement of the cars through the worst of the derailment sequence. The jackknifing of cars that did occur was not severe, and none of the rear nine cars were struck in the sides. As a result, these cars retained their structural integrity.

Nevertheless, the Safety Board believes that many passengers aboard the train were injured unnecessarily because not all of the seats were adequately secured against undesired rotation, many seatbacks became detached exposing their sheetmetal frames, luggage was stowed in open luggage racks above the seats of the coaches, and unsecured equipment was thrown into the aisles in the food service cars.

Most Amtrak corridor trains, including the Metroliners and some of the conventional trains such as train 94, were operated without baggage cars because this type of car was restricted to 105 mph. The Amfleet cars and rebuilt Heritage coaches had no provision for storing luggage except for the open overhead racks above the seats. There were no restraints to prevent luggage from falling on to passengers, particularly in cars that were jackknifed and/or tilted.

Even before the formation of Amtrak in 1971, the Safety Board recognized the potential for unrestrained luggage and inadequately designed and secured seats in railroad passenger cars to cause serious injuries to passengers in a high-speed derailment. In its investigation of a 1969 derailment of a conventional Penn Central passenger train on the corridor north of Washington, 45/ the Safety Board noted that although the cars of the train had remained in line with and on the track structure, many tipped over causing seats to rotate and luggage to be launched from overhead racks. The Safety Board concluded that most of injuries received by the 144 persons injured "resulted from persons being thrown from their seats and from flying luggage and loose objects." The Safety Board's report stated:

45/ Railroad Accident Report--"Penn Central Company Train Second 115 (Silver Star) Derailment at Glenn Dale, Maryland, June 28, 1969" (NTSB/RAR-70/01).

> Two interesting and important questions are raised by this accident. . .control of loose furniture and luggage on high-speed trains and. . .the availability of some means of restraining passengers in their seats. In the aviation field, luggage retention. . . [is] required by regulations.

As a result of its investigation, the Safety Board issued a recommendation to FRA:

> R-70-10
>
> Initiate studies to determine the relationship between rail passenger car design and passenger injury, and, where practical, take action for correction in the design of future high-speed and rapid transit cars.

Safety Recommendation R-70-10 was reiterated in the Safety Board's report of a 1970 Richmond, Fredericksburg & Potomac passenger train derailment in Virginia. 46/ In this report, the Safety Board concluded that "most of the passengers were injured by being thrown from their seats or by luggage dislodged from overhead baggage racks." The Safety Board also issued a recommendation to the FRA:

> R-71-6
>
> Institute immediate regulations requiring the equipment of all future, new, and rebuilt passenger cars with secured seats and luggage retention devices.

FRA responded to Safety Recommendation R-70-10 in 1974, stating that it had a study in progress regarding passenger car crashworthiness and was planning crash testing during fiscal 1976 as part of the design and development function for new equipment. On the basis of this response, the Safety Board classified the recommendation "Closed--Acceptable Action." The Safety Board classified Safety Recommendation R-71-6 "Open" pending the results of FRA's crash testing and evaluation.

On June 10, 1971, the Safety Board investigated a major train accident in which passengers were fatally injured 47/ and subsequently issued Safety Recommendation R-72-34 recommending that Amtrak correct the injury-causing features of its passenger cars as they were rebuilt and establish specifications for the interior designs of new cars that would minimize impact-type injuries. This recommendation was subsequently classified

---

46/ Railroad Accident Report "Richmond, Fredericksburg and Potomac Railroad Company Train No. 10/76, Derailment at Franconia, Virginia, January 27, 1970" (NTSB/RAR-71/01).
47/ "Railroad Accident Report--"Derailment of Amtrak Train No. 1 While Operating on the Illinois Central Railroad, near Salem, Illinois, June 10, 1971" (NTSB/RAR-72/05).

"Closed--Acceptable Action" after Amtrak informed the Safety Board that it was requiring improved safety features for new passenger cars, including the Amfleet-type cars and was improving existing cars to reduce injury-causing interior features.

Following its investigation of a 1974 passenger train derailment in Kansas, 48/ the Safety Board issued Safety Recommendation R-75-5 recommending that Amtrak "...require the installation of the latest practical crashworthiness features when rolling stock is renovated or when new cars and locomotives are purchased." Amtrak responded on July 21, 1976, informing the Safety Board that the new cars it would be acquiring in the next several years would have the latest crashworthiness features.

Amtrak's new Amfleet-type coaches and food service cars, delivery of which began in 1977, were among those Amtrak was referring to in its 1976 response to the Safety Board. However, these new cars, which had no luggage compartments, were designed for maximum seating capacity. Despite Amtrak's assurances to the contrary, the recommendations that the Safety Board had made to FRA and Amtrak relating to unsecured luggage had not been addressed in the design of the new cars. The only provision for stowage of carry-on baggage was open racks above the seats.

After the original Amfleet cars were delivered, the 1978 FRA crashworthiness study identified seat rotation as a major cause of passenger injuries and recommended the seats be equipped with positive locks to prevent undesired rotation. In subsequent investigations of accidents involving Amfleet cars, the Safety Board found that the coach seats rotated causing passengers to be thrown from them.

Following a 1979 collision on the corridor in New Jersey, 49/, the Safety Board found that seats in the 84-passenger Amfleet coaches were not securely locked and were rotated by the collision forces. As a result of this investigation, the Safety Board issued Safety Recommendation R-79-22 to Amtrak "to insure that the seats are locked securely in place." Amtrak notified the Safety Board on April 15, 1980, that it had developed a device to prevent seat rotation in Amfleet cars and would shortly begin installing it. As a result, the Safety Board classified Safety Recommendation R-79-22 "Closed--Acceptable Action."

48/ Railroad Accident Report--"Derailment of an Amtrak Train on the Tracks of the Atchison, Topeka and Santa Fe Railway Company at Melvern, Kansas, July 5, 1974" (NTSB/RAR-75/01).
49/ Railroad Accident Report--"National Railroad Passenger Corporation (Amtrak) Head-end Collision of Train No. 111 and Plasser Track Machine Equipment, Edison, New Jersey, April 20, 1979" (NTSB/RAR-79/10).

On October 10, 1980, Congress enacted Public Law 96-423, the Federal Railroad Safety Authorization Act of 1980, which mandated that the Secretary of the DOT issue initial rules, regulations, orders, and standards relating to rail passenger equipment. As amended in 1982, 45 USC 431 (h)(1)(A), reads, in part:

> The Secretary shall, within one year after January 14, 1983, issue such initial rules, regulations, orders, and standards as may be necessary to insure that the construction, maintenance, and operation of railroad passenger equipment maximize safety to rail passengers. The Secretary shall, as a part of any such rulemaking, consider comparable Federal regulations and procedures which apply to other modes of transportation, especially those administered by the Federal Aviation Administration. The Secretary shall periodically review any such rules, regulations, orders, and standards and shall, after a hearing...make such revisions...as may be necessary.

The amended subsection also required a report to Congress by January 13, 1984, covering such rules, regulations, and standards as had been issued. The FRA submitted such a report to Congress in January 1984; this report indicated that the interior of passenger cars merited additional study with regard to design and securement of seats, luggage retention, interior contouring, and other features. Nevertheless, the FRA has never issued standards or rules in these areas of concern.

Following the Congressional mandate to the DOT, there were other Amtrak accidents that continued to demonstrate car interior deficiencies. In its report of the investigation of a 1983 derailment of a train consisting of Amfleet cars in Illinois, 50/ the Safety Board observed that passengers were injured by heavy luggage falling from open overhead racks, by being ejected from seats that had rotated as much as 90°, by improperly secured seat cushions, and by unsecured microwave ovens and other equipment breaking loose in a food service car. The Safety Board's report stated:

50/ Railroad/Highway Accident Report--"Collision of Amtrak Passenger Train No. 301 on Illinois Central Gulf Railroad with Marquette Motor Service Terminals, Inc. Delivery Truck, Wilmington, Illinois, July 28, 1983" (NTSB/RHR-84/02).

> Equipment designers and crashworthiness experts have known for years how to protect passengers from injuries attributed to all of these causes. Safety analyses by competent passenger car designers can provide cost-effective corrections to deal with inadequately secured seats, unsecured luggage in overhead racks, and inadequately secured dining car equipment.

In connection with this report, the Safety Board issued a recommendation to Amtrak:

> R-84-40
>
> Correct the identified design deficiencies in the interior features of existing and new passenger cars, which can cause injuries in accidents, including the baggage retention capabilities of overhead luggage racks, inadequately secured seats, and inadequately secured equipment in food service cars.

The Safety Board also issued a recommendation to the FRA:

> R-84-46
>
> Expedite the studies on the interior design of passenger cars, described in the January 1984 Report to Congress, and publish recommended guidelines for securing seats and for luggage retention devices.

With the issuance of these recommendations, the Safety Board classified Safety Recommendations R-71-6 and R-75-5 "Closed--Superseded."

On June 3, 1985, the FRA responded to Safety Recommendation R-84-46 by stating:

> The FRA has discussed with Amtrak and other operators of passenger equipment the subjects of passenger car seat design, existing securement devices, luggage and equipment retention in meetings addressing passenger car interior design. Based on these discussions, the FRA does not feel Federal regulations providing recommended guidelines concerning these areas are required or justified at this time. Since we do not plan further action on Recommendation R-84-46, it should be closed.

The Safety Board wrote the FRA on August 19, 1985, expressing disappointment over the FRA's response and strongly urged the FRA to reconsider its position. At that time, the Safety Board advised the FRA it was classifying Safety

Recommendation R-84-46 "Open--Unacceptable Action." The Safety Board has received no further response to the recommendation from the FRA, even though the Safety Board has recently reiterated this recommendation as a result of an accident investigation 51/ which again revealed similar interior design deficiencies.

Safety Recommendation R-84-40 was reiterated to Amtrak on February 4, 1985, following the Safety Board's investigation of an Amtrak passenger train derailment in Texas on November 12, 1983, 52/ and on May 14, 1985, in connection with the head-on collision of Amtrak passenger trains at Hell Gate (Queens), New York, on July 3, 1984. 53/ As a result of its investigation of the latter accident, the Safety Board also issued a recommendation to Amtrak:

R-85-81

Modify the coach seats used in Amfleet equipment so that seatback cushions cannot become dislodged when struck and expose surfaces which can cause injuries in accidents.

Amtrak responded to Safety Recommendation R-85-81 on November 4, 1985, reporting that it was reinforcing the securement of the headrest part of Amfleet seatback cushions to prevent their being dislodged under impact. Amtrak also reported that it had completed the modification in 125 Amfleet cars as part of a 6-year overhaul program. On the basis of the response, the Safety Board classified Safety Recommendation R-85-81 "Closed--Acceptable Action."

During its investigation of an Amtrak derailment in Vermont on July 7, 1984, 54/ the Safety Board again found that coach seats had rotated, seat mounts had torn loose (In this accident Heritage class cars were involved; and many passengers were injured when struck by articles thrown from open overhead luggage

---

51/ Railroad Accident Report--"Rear-End Collision Between Boston and Maine Corporation Commuter Train No. 5324 and Consolidated Rail Corporation Train TV-14, Brighton, Massachusetts, May 7, 1986" (NTSB/RAR-87/02).
52/ Railroad Accident Report--"Derailment of Amtrak Train No.21 (The Eagle) on the Missouri Pacific Railroad, Woodlawn, Texas, November 12, 1983" (NTSB/RAR-85/01).
53/ Railroad Accident Report--"Head-on Collision of Amtrak Passenger Trains Nos. 151 and 168, Astoria, Queens, New York, July 23, 1984" (NTSB/RAR-85/09).
54/ Railroad Accident Report--"Derailment of Amtrak Passenger Train No. 60, The Montrealer, on the Central Vermont Railway Near Essex Junction, Vermont, July 7, 1984" (NTSB/RAR-85/14).

racks. Consequently, Safety Recommendation R-85-127 was issued to Amtrak addressing seats in this type car. Also, as in earlier derailments, unsecured microwave ovens and food containers had injured persons and blocked aisles when thrown from counter/pantry areas in Amfleet food service cars. Previously, in an Amtrak derailment in Pennsylvania on May 29, 1984, 55/ passengers told Safety Board investigators that personal belongings and baggage "were flying everywhere." One passenger reported she had been repeatedly struck by baggage and was literally buried under suitcases that fell from an overhead rack. Evacuation was difficult because aisles were full of fallen luggage.

Amtrak responded to Safety Recommendation R-84-40 on March 13, 1985, reporting that positive seat locking devices were being installed on its coaches as they were overhauled. As for unsecured food service car equipment, Amtrak advised that it was installing a steel bar across the tops of microwave and convection ovens to prevent their displacement. According to Amtrak, this modification was also being implemented when the cars underwent overhaul and 120-day maintenance work. Amtrak also reported that it had designed a web-type retention device to be applied to luggage racks on a new type of sleeping car then under order. However, Amtrak reported at that time that it had no plans to retrofit existing cars with baggage retention devices.

In view of Amtrak's position on luggage retention modifications, the Safety Board informed Amtrak on July 29, 1985, that it had classified Safety Recommendation R-84-40 "Closed--Unacceptable Action/Superseded." In connection with the previously mentioned Essex Junction accident, Safety Recommendation R-85-128 was issued to Amtrak to address specifically luggage retention devices:

> R-85-128
>
> Develop and install effective retention devices on its overhead luggage racks to prevent the dislodging of luggage and other articles in a collision and/or derailment.

55/ Railroad Accident/Incident Summary Report-"Derailment of Amtrak Passenger Train, The Capital Limited, near Connellsville, Pennsylvania, May 29, 1984" (NTSB/RAR-85/01/SUM).

In response, Amtrak notified the Safety Board on June 30, 1986, that it was investigating the use of vertical dividers spaced at intervals along the overhead racks to restrain luggage from moving longitudinally during rapid deceleration. The design also included a longitudinal restraint that somewhat increased retention against lateral movement. On March 19, 1987, Amtrak advised it was testing a prototype of the new restraint system.

On September 22, 1987, Amtrak informed the Safety Board that "test luggage restraints have been installed on three car sets. Luggage restraints have been approved by Federal agencies. Material has been ordered and will be delivered by October 31 with installation to begin thereafter. We estimate installation will take 6 years to complete." In view of these responses, the Safety Board classified the recommendation "Open--Acceptable Action," even though the Safety Board is not convinced of the need for 6 years to make the modifications. Further, the test luggage restraints have sharp protruding edges; and the Safety Board believes that additional testing and design changes may be necessary.

In the Chase accident, the fixtures in the food service cars had not been modified to retain them in place. Unsecured microwave ovens in the Amfleet food service cars were thrown to the floor blocking the aisle in the counter/pantry area. None of the coaches had the modified luggage racks. Of the 45 passengers who were interviewed or who responded to questionnaires sent by the Safety Board, 20 passengers voluntarily reported they were struck and injured by luggage falling from overhead racks; additionally 8 of the 45 passengers reported they had difficulty in evacuating because of fallen luggage in the aisles. One difficulty in assessing the extent of these injuries is that many passengers were not willing to discuss their injuries with investigators. Nonetheless, this accident clearly demonstrates that unsecured equipment and luggage continues to be a source of injury and an impediment to egress for passengers aboard Amtrak trains involved in accidents. A number of seats, including those in cars near the rear of the train, were dislodged, rotated, and/or had their seat back frames exposed due to cushions being dislodged.

Safety Board investigators at an Amtrak derailment near Joliet, Illinois, on June 26, 1987, 56/ found 17 rows of seats in two Amfleet cars in various angles of rotation because of seat-lock failures. Two rows of seats were separated from their attachments.

During the past 18 years, neither repeated Safety Board recommendations based on overwhelming and well-documented evidence nor Congressional mandate have convinced FRA to do all it should to eliminate these injury-producing interior features

---

56/ Field Investigation Report--"Collision Between Amtrak Passenger Train No. 311 and a Spee Dee Disposal truck, on the Chicago, Missouri and Western Railroad near Joliet, Illinois, June 26, 1987" (NTSB/CHI-8//MR-015).

of passenger cars. For nearly as long and for as long as Amtrak has existed, the Safety Board has repeatedly called on its management to improve these same areas when new cars were designed and older cars were retrofitted.

These efforts have resulted in some tangible progress. Amtrak has developed a program to correct the deficiency in the headrest portion of the Amfleet seatback cushions and has modified 125 Amfleet cars under a 6-year program. However, much remains to be done. The Safety Board has investigated accidents in which headrests that have not yet been modified have become dislodged. Amtrak needs to expedite the modification of its unmodified Amfleet cars. Further, securement of the seat locking mechanism remains a problem and seats continue to rotate in accidents. Finally, the luggage retention problem remains to be completely corrected.

The Amfleet designs that make up the bulk of Amtrak's car fleet were developed, and many hundreds of cars built with public funds, apparently without consideration of the passenger injuries that could result from the use of outmoded open overhead luggage racks, poorly assembled and secured seats, and unrestrained equipment in food service cars. The Safety Board believes that the designers of the Amfleet cars have been motivated principally by the desire to provide maximum seating capacity. They failed to heed past accidents and act on a number of outstanding Safety Board recommendations. This was an especially critical failure because it was understood that these new cars would be used in high-speed service.

Even when retrofitting older Heritage cars in the 1980s, Amtrak apparently was motivated by the desire for more seating capacity at the expense of the luggage storage compartments that were in these cars and which had become standard in passenger coaches built in the postwar period. The luggage situation is most critical on the NEC; in most cases the overhead racks are the only place where luggage and personal articles can be carried. Since Amtrak has no baggage cars that may be operated faster than 110 mph, the Metroliners do not include baggage cars. Amtrak has no high-speed cars with separate compartments for luggage storage, such as are used on British Railway's 125-mph HST intercity trains. The Safety Board believes that Amtrak must correct these deficiencies in its existing car fleet and must not purchase new cars that have these same deficiencies.

CONCLUSIONS

Findings

1. The signal system at Gunpow performed as designed, and it was not possible for signal 816-1 to display an "approach limited" aspect as stated by the engineer of train ENS-121.

2. The crewmembers of train ENS-121 either failed to observe the "approach" aspect of signal 816-1, or having observed it, failed to comply with it. Since the locomotive had no automatic backup system, the train could proceed without being slowed to the prescribed speed.

3. If the crewmembers had observed the ACS change to "restricting" at code change location CS-806 and responded properly, the engineer could have stopped train ENS-121 short of home signal 1N.

4. With train ENS-121 traveling at 64 mph, when the engineer finally noticed the "stop" aspect displayed by home signal 1N, he was unable to stop the train before it had passed through switch 12 onto track 2.

5. Operating at speeds between 120 and 125 mph, train 94 was less than 3,000 feet south of switch 12 when the Conrail train entered it. This was 2,300 feet less than the necessary stopping distance, and the collision could not be avoided. Had train 94 been operating at its maximum restricted speed of 105 mph, it was still too late to avoid the collision, but the impact speed and force would have been substantially lower, probably resulting in fewer fatal and serious injuries.

6. The crew of train ENS-121 failed to obtain a properly working console radio on their lead unit. They either did not know how to connect the console radio, or they decided it was too difficult a task. Instead, they elected to rely on a small portable radio--reliance on which violated both Conrail and Amtrak rules.

7. The Conrail crewmembers failed to make a proper test of the ACS before leaving Bay View. The engineer may have inadvertently cut out the "deadman" control in an effort to restore the ACS to operation. If so, he did not perform the ACS test afterward.

8. The Conrail engineer stated that he knew that the whistle did not sound properly; if he knew this, he apparently elected to leave Bay View Yard with the whistle inoperative in violation of Amtrak and Conrail rules. However, since he did not perform the ACS test fully, he may not have known that the whistle had been muted.

9. The cut-out cocks for the ACS and deadman control systems on Conrail locomotives are located where they can be easily accessed to nullify their operation.

10. The engineer appeared to be late in changing the throttle position in attempting to maintain 60 mph. The speed excursions were greater than what would be expected for an alert engineer.

11. Because the whistle had been taped, it did not alert the crew to the restrictive signals; the crew probably did not monitor the ACS or the wayside signals because they were inattentive to or distracted from their duties.

12. Neither the engineer nor the brakeman of train ENS-121 had impaired eyesight or hearing. From the standpoint of age, both men should have been at or near their prime with respect to their other human faculties.

13. The Conrail engineer worked on an irregular basis and was prone to lay off work regularly because of "sickness" and/or car problems. There may have been a relationship between his absenteeism and the dependency on alcohol for which the engineer was treated after the accident.

14. The Conrail brakeman had worked even less than the engineer and preferred to work in Bay View Yard. He worked only 29 road assignments during 1986, more than half of which he worked as the conductor. It was conceivable that the brakeman had seldom been required to observe and communicate signals on the lead locomotive unit of a train.

15. The operation of train ENS-121 was not a scheduled event, and it is not likely that either of the crewmembers expected to be called to work during the day since most Conrail trains were operated at night. Both men had been drinking alcoholic beverages the night before, and it is possible they were not fully rested and physically fit when called to work.

16. There were several manifestations of degraded performance by the crew of train ENS-121 before the trains collided that included their failure to resolve the console radio problem, their failure to make the required predeparture tests, their possible mistaking of the deadman cut-out for the ACS cut-out, the engineer's delayed throttle responses, and their failure to respond to restrictive signals.

17. Analyses by CHT of the specimens obtained from the Conrail engineer and brakeman indicated the presence of marijuana metabolites in sufficiently high levels to show that they were heavy or frequent users of marijuana and may have used marijuana within 24 hours before the time they provided the specimens.

18. The prolonged delay in obtaining the engineer's blood specimen and the limited amount of the specimen that was available for reanalysis reduced the ability to detect delta-9-THC.

19. The THC-COOH level in the engineer's blood suggests that the psychoactive THC component should have been present in his blood at the time of sampling. The value would have been even higher at the time of the accident resulting in some degree of impairment. Such impairment would have been exacerbated if alcohol were in the engineer's blood or if he was suffering from alcohol abuse from the night before.

20. The manifestations of degraded performance and the results of the toxicological tests indicates that the crewmembers of train ENS-121 were inattentive or distracted from their duties before the accident because they were impaired from the effects of marijuana and possibly the after effects of the use of alcohol the night before the accident.

21. Because the ACS alerter whistle had been muted, the crewmembers were not alerted to the "restricting" aspect and failed to take the required action to stop the train short of the home signal. Had the locomotive been equipped with automatic backup protection, the train's brakes would have been applied automatically.

22. Although the Safety Board recommended in 1978 that all corridor trains be equipped with ATC, in 1981 Amtrak permitted Conrail to replace its ATC-equipped electric locomotives with non-equipped diesel-electric locomotives on NEC freight trains creating the situation in which train ENS-121 had no safety backup device.

23. Although Conrail's substitution of diesel-electric locomotives without automatic backup protection for ATC-equipped electric locomotives may have been a violation of Federal regulations, the Safety Board could not conclusively determine this because the FRA did not respond to a request for its interpretation of the regulations.

24. Use of red lenses for the stop aspect rather than the amber lens now used for all signal aspects could expedite the response to a "stop" signal. It cannot be eliminated as a possibility that had Amtrak used red instead of amber lights in the "stop" aspect, the Conrail engineer may have recognized the aspect earlier and stopped his train short of switch 12.

25. The conductor of train 94 stated he knew his train was restricted to 105 mph and that he informed the engineer accordingly.

26. The dispatcher was unaware that train 94 was restricted to 105 mph, and he permitted the train to leave Baltimore immediately ahead of a 125-mph Metroliner. Amtrak did not provide the Safety Board with a documented policy for notifying dispatchers when trains include cars that restrict the train to lower than normal speeds.

27. When the dispatcher permitted train ENS-121 to leave Bay View ahead of trains 94 and 112, he violated no rules; however, this created an unnecessary potential conflict between the trains at Gunpow. Had the dispatcher been trained to avoid conflicts between Amtrak and Conrail trains without safety backup systems, he may have held the Conrail train at Bay View until the Amtrak train had passed, preventing the accident.

28. According to Amtrak's general superintendent the 60-mph light-locomotive restriction superseded the 50-mph track speed for freight trains in the timetable, although he also stated that train ENS-121 was a freight train. Amtrak's general manager-transportation defined train ENS-121 as a passenger train and stated that it could operate at 60 mph. The trains' engineer attempted to maintain a speed of 60 mph, but on occasion he permitted his train to reach 65 mph in violation of the speed restriction established by the timetable and Amtrak management.

29. Even if train ENS-121 approached Gunpow in potential conflict with one of the Amtrak passenger trains, emergency braking initiated from 55 mph or lower instead of 64 mph would have stopped the train short of the home signal and a collision would not have occurred. Further, had the engineer applied the brakes when the home signal first became visible, he could have stopped the train short of the home signal even at a speed of 64 mph.

30. Operating just ahead of the Metroliner, the engineer of train 94 may have operated the train at 125 mph in accordance with his normal routine, he may have thought the dispatcher wanted him to operate at 125 mph so that he would not delay the Metroliner, or he may have failed to glance back at his train and recognize that he had a Heritage-class car that restricted his speed to 105 mph.

31. Freight and passenger trains had always been operated over the NEC. Although Conrail had diverted some freight trains, there was no practical way to remove all freight trains from the corridor, particularly between Baltimore and Perryville. The use of the NEC by freight trains was unavoidable; their operation routinely conflicted with passenger trains because of the corridor's numerous interlockings with converging tracks.

32. As long as both freight and passenger trains operating between Baltimore and Perryville had ATC-equipped locomotives, there was little probability of trains colliding at a converging interlocking or when using the same track.

33. The decision of the Amtrak assistant vice president not to require the surviving crewmembers of train 94 and the dispatcher to provide specimens for toxicological testing was contrary to the provisions of Amtrak's rules and FRA regulations.

34. Amtrak officials at the accident location were responsible for ensuring that the Conrail crewmembers submitted specimens for toxicological testing in a timely manner, but they failed to do so and violated the requirement to obtain specimens "as soon as possible" after an accident.

35. Conrail officials ultimately assumed responsibility for and supervised the taking of specimens for testing from the Conrail crewmembers. However, delays in obtaining the samples reduced the value of toxicological testing.

36. Conrail should have better supervised the crewmembers of train ENS-121 during the predeparture tests at Bay View Yard; and Conrail should have discovered that the ACS alerter whistles of its locomotives were being muted.

37. Amtrak failed to establish dispatching procedures on the NEC that would have prohibited the conflicting operation of non-ATC-equipped Conrail trains and high-speed passenger trains at converging interlockings.

38. Amtrak had a very limited program of oversight and supervision of its employees on the corridor. Amtrak's supervisory deficiencies include: 1) its failure to perform restrictive signal aspect efficiency checks; 2) its failure to prohibit Conrail from replacing locomotives that had safety backup devices with locomotives that did not; and 3) its failure to provide training and procedures for dispatchers to reduce or avoid potential conflicts between non-ATC-equipped trains and high-speed passenger trains at converging interlockings. These deficiencies suggest that Amtrak's concern with on-time performance may, at times, have had a detrimental efffect on safety.

39. Although FRA had authority to require ATC on the corridor and concurred in Amtrak's 1979 proposal that all NEC trains have ATC, it accepted a subsequent proposal that did not include such a provision, helping to create the situation in which train ENS-121 was not equipped with a safety backup device.

40. The FRA's oversight of Amtraks' operation and supervision of the NEC were deficient in numerous ways. The FRA failed to prevent Amtrak from allowing the operation on the NEC of trains with locomotives not equipped with safety backup devices that would automatically comply with restrictive signals if the engineer failed to do so. The FRA failed to correct in a timely and adequate manner known deficiencies in Amtrak's supervision of its operating employees, resulting in the operation of trains at excessive speeds. The FRA also failed to encourage or require Amtrak to improve the crashworthiness of its passenger cars. Further, the FRA failed to enforce the complete implementation of the postaccident requirements of its alcohol and drug regulations.

41. The emergency response forces of Baltimore county and its neighboring jurisdictions reacted promptly and in appropriate strength to the emergency.

42. Failure of police to adequately control public access to the accident area and to the site itself hampered the ability of emergency vehicles to travel to and from the site and made it difficult for emergency medical personnel to identify and treat injured passengers.

43. Many persons aboard train 94 were injured because some seats were inadequately secured, many seatbacks became detached exposing their sheetmetal frames, unsecured luggage fell from open tracks above the seats, and unsecured equipment was thrown into the aisles in the food service cars.

44. Fallen luggage in coaches and ejected microwave ovens in the food service cars blocked aisles and made evacuation from the train difficult.

45. Some of the improvements the Safety Board has repeatedly recommended since 1970 have been made. Amtrak has developed a program to modify the problems with the upper seatbacks. However, much remains to be done. The upper seatback program needs to be expedited. Securing of the seat-locking mechanism remains a problem and seats continue to rotate in accidents, and luggage retention remains a serious problem.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure, as a result of impairment from marijuana, of the engineer of Conrail train ENS-121 to stop his train in compliance with home signal 1N before it fouled track 2 at Gunpow, and the failure of the Federal Railroad Administration (FRA) and Amtrak to require and Conrail to use automatic safety backup devices on all trains on the Northeast Corridor.

Contributing to the accident were: 1) the failure of the brakeman of ENS-121 to observe signal aspects and to alert the engineer when they became restrictive; 2) the failure of the crewmembers of train ENS-121 to make the required automatic cab signals (ACS) test; 3) the muting of the ACS alerter whistle on the lead unit of train ENS-121; and 4) the inadequacies of the FRA oversight of Amtrak's and Conrail's supervision of corridor trains.

Operation of Amtrak train 94 at 125 mph, rather than its restricted speed of 105 mph, contributed to the severity of the accident.

RECOMMENDATIONS

Based on its investigation of this accident, the National Transportation Safety Board on January 15, 1987, issued Safety Recommendations R-87-1 through -3 to the National Railroad Passenger Corporation (Amtrak):

> Immediately initiate a program which will assure that all locomotives operating on the high speed passenger train trackage of the northeast corridor are equipped with a device which will control the train automatically as required by the signal if the engineer fails to do so.
>
> Pending the installation of the automatic train control devices or an equivalent positive control system on all locomotives operating on the high speed passenger train trackage of the northeast corridor, require that the operators of locomotives and trains not equipped with such devices to stop before entry onto the high-speed tracks regardless of signal aspect, and to request and receive permission before proceeding.
>
> Require all locomotives allowed to enter and operate on the high speed passenger train trackage of the northeast corridor to be equipped with an operable radio capable of train-to-train and train-to-fixed station communications.

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

--to the National Railroad Passenger Corporation (Amtrak):

Provide procedures and instructions to dispatchers to avoid operating trains not equipped with automatic safety backup devices in a manner that places them in potential conflict with passenger trains at converging interlockings. (Class II, Priority Action)(R-88-1)

Revise the Northeast Corridor timetable to eliminate the possibility of misinterpretation of maximum permissible speed rules. (Class II, Priority Action)(R-88-2)

Expand and intensify supervision and management of train operations on the Northeast Corridor to include mandatory speed and signal compliance checks and regular supervisory crew fitness checks at reporting points and improve enforcement of compliance with the requirements of postaccident testing of employees for alcohol and drugs. (Class II, Priority Action)(R-88-3)

Reassess and restructure its safety program to provide a greater role for safety considerations in all aspects of its operations. (Class II, Priority Action)(R-88-4)

Discontinue immediately the use of non-automatic train control-equipped locomotives in corridor work train service. (Class II, Priority Action)(R-88-5)

Modify the wayside signals so that horizontal (stop) aspects are displayed by red lights. (Class II, Priority Action)(R-88-6)

Provide local emergency forces along the corridor with data on the structural details of locomotive and passenger cars and information on extrication tools that are adequate for use with those cars. (Class II, Priority Action)(R-88-7)

Develop and implement a procedure for the written notification of dispatchers and traincrews when train speeds are restricted. (Class II, Priority Action) (R-88-8)

Modify the emergency exit window sunshade frames inside Heritage cars so that the emergency windows can be removed quickly. (Class II, Priority Action) (R-88-9)

--to the Consolidated Rail Corporation (Conrail):

Expedite the current program for installing automatic safety backup devices on your fleet of locomotives. (Class II, Priority Action) (R-88-10)

Improve its procedures for inspecting and testing automatic cab signal apparatus at Chicago and other initial terminals. (Class II, Priority Action) (R-88-11)

Modify the locomotives so that cut-out cocks for the automatic control system and safety control systems cannot be accessed by traincrews while they are en route. (Class II, Priority Action) (R-88-12)

Improve the methods of identifying employees who abuse alcohol and/or drugs. (Class II, Priority Action) (R-88-13)

--to the Federal Railroad Administration:

Expand and intensify its oversight of Amtrak's operating practices, supervisory efficiency checks, and compliance with Federal safety regulations (including the requirements for postaccident toxicological testing), and periodically provide the Safety Board with its assessment of Amtrak's performance in these areas. (Class II, Priority Action) (R-88-14)

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

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

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ JOSEPH T. NALL
Member

/s/ JAMES L. KOLSTAD
Member

PATRICIA A. GOLDMAN, Vice Chairman, and JOHN K. LAUBER, Member, filed the following dissenting statement:

We respectfully dissent from the majority decision to include the operation of Amtrak train 94 at 125 mph, rather than its restricted speed of 105, as contributory to the severity of the accident. The only reason for the restriction was the inclusion of a Heritage-class car in the consist for train 94; had this car not been present, 125 mph would have been the normal operating speed for this train. It is purely a matter of chance that the car was present, and therefore, that the speed restriction applied. Given this, to hold that train 94's speed contributed to the severity of the accident is simply restating a principle of physics; however, by doing so it is implied that the operating crew of train 94 had a greater burden of responsibility for this accident than we believe is warranted by the facts.

In all other respects, we concur with the majority decision.

January 20, 1988

APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

Investigation

The Safety Board was notified of the accident at 2:10 p.m., on January 4, 1987, and immediately dispatched an investigator from the New York field office to the scene. A Safety Board member, the investigator-in-charge, and other members of the investigative team were also dispatched from Washington, D.C. Investigative groups were established for operational, track and signal, vehicle, human performance, survival and emergency response, data recording, toxicological, weather, and radio factors.

Hearing

The Safety Board convened a 4-day public hearing as part of its investigation on March 30, 1987, at Baltimore, Maryland. Parties to the hearing included the National Railroad Passenger Corporation (Amtrak), the Consolidated Rail Corporation (Conrail), the State of Maryland, Baltimore County, United Transportation Union, Brotherhood of Locomotive Engineers, and the Federal Railroad Administration. Testimony was taken from 33 witnesses, and 57 exhibits were entered into the record.

APPENDIX B

PERSONNEL INFORMATION

Conrail Employees

Engineer Ricky Lynn Gates

Engineer Ricky Lynn Gates, 32, was employed as a brakeman by Penn Central Transportation Company on March 19, 1973, and transferred to the position of fireman on January 24, 1974. Mr. Gates entered Penn Central's engineer training program on October 13, 1975, and completed this training on March 16, 1976. He was promoted to engineer on May 1, 1976.

On July 22, 1986, the engineer completed the biennial airbrake operation training and passed the annual rules examinations. He also passed the annual Amtrak rules examination on July 24, 1986. The engineer's last physical examination on July 11, 1985, indicated that he had 20/20 vision and normal hearing. No drug screen was performed as part of the examination.

According to his service record, in December 1974, the engineer, while he was a fireman, was assessed a 30-day suspension for passing a stop signal. In November 1984, the engineer was suspended for 7 days after speaking to a crew dispatcher in a "belligerent and threatening manner." He was again reprimanded in March 1986 for engaging in an "apparent unauthorized work stoppage.

Conrail records also indicated the engineer submitted to proficiency, fitness, and other supervisory checks on June 23, 1986, and December 13, 1986. The engineer's performance was rated as acceptable without failures on both occasions.

Brakeman Edward Walter Cromwell

Brakeman Edward Walter Cromwell, 33, was employed as a freight brakeman by Penn Central Transportation Company on April 3, 1973. He was promoted to freight conductor on April 1, 1976. The brakeman passed the annual Conrail and Amtrak rules examination on June 6, 1986, and August 12, 1986. His last physical examination on June 10, 1986, revealed 20/20 vision and normal hearing; there was no drug screen performed.

His service record indicated a reprimand for failure to report to an assignment in 1982. The brakeman was subjected to nine supervisory checks in June 1986. None of the checks was of the on-board evaluation type. He was not charged with any failures during any of the checks.

Amtrak Employees

Conductor Donald Edward Keasey

Conductor Donald Edward Keasey, 44, was employed as a freight brakeman by the Penn Central Transportation Company on October 6, 1966. He was promoted to freight conductor on October 5, 1968. Mr. Keasey was qualified as a passenger conductor by Conrail in March 1981, and he transferred from Conrail to Amtrak on January 1, 1983. He last passed an Amtrak physical examination on July 24, 1986, and the annual Amtrak rules examination on July 31, 1986. Mr. Keasey has had no entries on his discipline record since 1968. According to Amtrak records, Mr. Keasey was subjected to efficiency testing twice during 1986 and once during 1985.

Engineer Jerome E. Evans

Engineer Jerome E. Evans, 35, was employed by Penn Central as a fireman on November 14, 1972. He entered the Penn Central engineer training program on October 8, 1973; he completed the program and was promoted to engineer on January 8, 1974. Mr. Evans transferred from Conrail to Amtrak on October 1, 1983. His service record indicated his last biennial physical examination was on April 26, 1986. At that time, he had uncorrected 20/20 vision in both eyes and normal hearing. A urine screen for drugs was negative. He last passed an examination on the rules and timetable on June 24, 1986. The engineer had been reprimanded by Conrail in 1978 for a violation of restricted speed and by Amtrak in 1984 for a 5-mph violation of a curve-speed restriction.

Assistant Conductor/Flagman Sterling Alfonso Spivey

Assistant conductor Sterling Alfonso Spivey, 37, was employed as a freight brakeman by Penn Central on March 9, 1973. He was promoted to flagman on June 15, 1973, and to freight conductor on March 9, 1974. Mr. Spivey transferred from Conrail to Amtrak on April 19, 1983. According to his service record, he last passed a company physical examination on January 24, 1983, and the Amtrak rules examination on February 5, 1986. There were no disciplinary entries in his service record. According to Amtrak records, Mr. Spivey was not subjected to any efficiency checks from 1985 through 1986.

Assistant Conductor Michael Allen Frederick

Assistant conductor Michael Allen Frederick, 38, was employed by Penn Central as a freight brakeman on June 11, 1973. He was promoted to flagman on November 3, 1973, and to freight

conductor on November 14, 1974. Mr. Frederick transferred from Conrail to Amtrak service in August 1986. According to his Amtrak service record, he passed the Amtrak rules examination on May 20, 1986, and he last passed a company physical on May 23, 1983. Conrail records indicated Mr. Frederick had been suspended for 60 days in 1980 for destroying a company radio. Amtrak records indicated he had not been subjected to efficiency testing from 1985 through 1986. At the time of the accident, Mr. Frederick was regularly assigned to train 94 on Sundays.

Extra Assistant Conductor Richard Lynn Evans

Assistant conductor Richard Lynn Evans, 45, was employed by Penn Central as a freight brakeman on July 24, 1973. He was promoted to freight conductor on October 18, 1974, and transferred from Conrail to Amtrak on November 2, 1986. Mr. Evans passed an Amtrak physical examination on November 17, 1986, and he passed an examination on Amtrak operating rules on November 18, 1986. His discipline record was clear of infractions; Amtrak records indicated he was not subjected to efficiency testing during 1985 and 1986. At the time of the accident, Mr. Evans was assigned to the extra board.

Train Dispatcher John F. Akins, Jr.

Train dispatcher John F. Akins, Jr., 28, was employed by Amtrak as a block operator on September 8, 1980. He was qualified as a train dispatcher on January 2, 1984, and was qualified specifically on the territory between Washington, D.C. and Ragan, Delaware, on February 3, 1985. As a block operator, he worked from 1980 to 1984 at Bay block station at Baltimore. In 1980, he also worked briefly at Edgewood block station. Mr. Akins last passed an Amtrak physical examination on September 3, 1984, and he last passed the Amtrak rules examination on January 21, 1986. His discipline record indicated that he was reprimanded for failing to issue instructions to an operator that resulted in delaying a train on August 26, 1986. At the time of the accident, Mr. Akins was assigned to the dispatcher's extra board.

Block Operator Richard Herbert Hafer

Block operator Richard Herbert Hafer, 33, was employed by Penn Central as a ticket clerk on April 3, 1972, and was made a block operator on February 21, 1973. In April 1977, he was promoted to train dispatcher and held this position until October 1985 when he resigned it and resumed working as a block operator. Mr. Hafer was originally qualified at Edgewood block station in 1973 and was requalified there in 1985. He was regularly assigned there since September 1986. Mr. Hafer passed an Amtrak physical examination on February 26, 1986, and he passed an Amtrak rules examination with a perfect score on May 30, 1986. The only entry in his discipline record was a reprimand for failing to properly arrange switches resulting in delaying a passenger train on April 5, 1977.

APPENDIX C

EXCERPTS FROM AMTRAK AND CONRAIL OPERATING RULES

AMTRAK

GENERAL RULES

A. Employees whose duties are prescribed by these rules will be provided with a copy. Employees must maintain their copy and have it with them while on duty.

Employees whose duties are in any way affected by the Timetable must have the current Timetable with them while on duty.

In Special Instructions, General Orders, Bulletin Orders, General Notices and all other instructions for conducting transportation, reference to rules by letter or number only shall be restricted to rules contained in the Book of Operating Rules.

B. Employees must be conversant with and obey all Rules and Special Instructions.

C. Employees must pass the required examinations. Employees whose duties require them to be qualified on the Operating Rules and Timetable must pass an examination within six months after entering service.

Employees must be re-examined annually or as required by proper authority.

When reporting for examination, they must present their copy of the Book of Operating Rules, Timetable, and other instructions for inspection as required.

D. Employees must devote themselves exclusively to the Company's service while on duty. They must obey the rules and Special Instructions and promptly report to the proper officer any violation thereof.

To remain in service, employees must refrain from conduct which adversely affects the performance of their duties, other employees, or the public. They must refrain from conduct which brings discredit upon the Company.

Any act of insubordination, hostility, or willful disregard of the Company's interest will not be condoned.

E. Gambling, card, playing, fighting, or participating in any illegal, immoral, or unauthorized activity while on duty or on Company property is prohibited.

Reading of other than Company instructions while performing service is prohibited.

Sleeping or assuming an attitude of sleep while on duty is prohibited. The use or possession of television or radio other than those furnished for railroad operations is prohibited while performing service.

G. Employees subject to duty, reporting for duty, or while on duty are prohibited from possessing, using, or being under the influence of alcoholic beverages, intoxicants, or narcotics, including medication whose use may cause drowsiness or impair the employee's responsiveness.

T. Employees must report for duty at the required time.

Employees subject to call must not absent themselves from their usual calling place without notice to those required to call them.

Employees will not absent themselves from duty or engage a substitute to perform their duties without permission of a Division Officer.

Employees must give immediate written notice of change in residence or telephone number to a Division Officer.

DEFINITIONS

ABSOLUTE BLOCK—A block in which a train or engine is not permitted to enter while it is occupied by another train or engine except as prescribed by the rules.

AUTOMATIC BLOCK SIGNAL SYSTEM (ABS)—A block signal system wherein the use of each block is governed by an automatic block signal, cab signal, or both.

BLOCK—A length of track of defined limits, the use of which by trains and engines is governed by block signals, cab signals, or cab signals and block signals.

BLOCK SIGNAL—A fixed signal, or hand signal in the absence of a fixed signal, at the entrance of a block to govern trains and engines in entering and using that block.

BLOCK STATION—A place provided for the blocking of trains by block signals or other means.

BULLETIN ORDER—A form issued by authority and over the signature of the General Superintendent which contains instructions directly affecting the movement of trains and engines.

CAB SIGNAL—A signal located in the engine control compartment or cab indicating a condition affecting the movement of a train and used in conjunction with interlocking signals and in conjunction with or in lieu of block signals.

COMMUTER TRAIN—A short-haul passenger train operating within an urban, suburban, or metropolitan area.

CONTROLLED SIDING—A siding the use of which is governed by signals under the control of a Train Dispatcher or Operator.

CURRENT OF TRAFFIC—The assigned direction of a main track as specified in the Timetable.

DISTANT SIGNAL—A fixed signal used to govern the approach to an interlocking signal.

DIVISION—That portion of the railroad assigned to the supervision of a General Superintendent.

ENGINE—A unit propelled by any form of energy or a combination of such units operated from a single control, used in train or yard service.

EXTRA TRAIN—A train not authorized by a Timetable Schedule. It may be designated as:

EXTRA—for any extra train except passenger extra or work extra;

PASSENGER EXTRA—for passenger train extra;

WORK EXTRA—for work train assigned to perform Maintenance of Way service.

FIXED SIGNAL—A signal of fixed location including such signals as switch target, train order, block, interlocking, speed signs, stop signs, or other means for indicating a condition affecting the movement of a train or engine.

GENERAL NOTICE—A form issued by the authority and over the signature of the General Superintendent which contains instructions which do not directly affect the movement of trains and engines.

GENERAL ORDER—Order issued by authority and over the signature of the Assistant Vice President-Transportation which contains changes in the Timetable, the Operating Rules, or other instructions as prescribed.

HOME SIGNAL—A fixed signal governing entrance to an interlocking.

INTERLOCKING—An arrangement of signals and signal appliances so interconnected that their movements must succeed each other in proper sequence and for which Interlocking Rules are in effect.

INTERLOCKING LIMITS—The tracks between the opposing home signals of an interlocking.

INTERLOCKING SIGNALS—The fixed signals of an interlocking.

INTERLOCKING STATION—A place from which an interlocking is operated.

MAIN TRACK—A track designated by Timetable upon which train movements are governed by Automatic Block Signal System or Manual Block Signal System Rules.

MANUAL BLOCK SIGNAL SYSTEM (MBS)—A block signal system wherein the use of each block is governed by block signals controlled manually upon information by telephone or other means of communication.

MU—Electric self propelled pasenger carrying cars operated singly or in multiple.

PILOT—An employee assigned to a train when the Engineer, Conductor, 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.

REGULAR TRAIN—A train authorized by a Timetable Schedule.

ROUTE—The course or way which is or is to be traveled.

RUNNING TRACK—A track designated by Timetable upon which movements may be made as prescribed by Rule 112.

SCHEDULE—That part of a Timetable which prescribes direction, number, frequency and times for movement of regular trains.

SIDING—A track auxiliary to a main track for meeting or passing trains.

SIGNAL ASPECT—The appearance of a fixed signal conveying an indication as viewed from the direction of an approaching train; the appearance of a cab signal conveying an indication as viewed by an observer in the engine control compartment.

Aspects shall be shown by the position of semaphore blades, color of lights, position of lights, flashing of lights or any combination thereof, except the diagonal alignment of lights of color light signals with respect to the signal mast does not modify the signal indication. They may be qualified by marker plate, number plate, letter plate, marker light, shape of semaphore blade, or any combination thereof.

SIGNAL INDICATION—The information conveyed by the aspect of a signal.

SINGLE TRACK—A single main track between two points upon which trains are operated in either direction.

SPEED CONTROL—A device which will automatically apply the brakes on the train or engine unless the speed conforms to the cab signal indication.

SPEEDS:

Normal Speed—The maximum authorized speed.

Limited Speed—For passenger trains, not exceeding 45 MPH; for freight trains, not exceeding 40 MPH.

Medium Speed—Not exceeding 30 MPH

Slow Speed—Not exceeding 15 MPH.

Restricted Speed—Prepared to stop short of train, obstruction, or switch not properly lined, looking out for broken rail, but not exceeding 20 MPH outside interlocking limits, 15 MPH within interlocking limits.

NOTE: Speed applies to entire movement

STATION—A place designated in the Timetable by name.

TIMETABLE—The authority for the movement of regular trains subject to the Operating Rules. It contains classified Schedules and Special Instructions relating to the movement of trains and engines.

TRAIN—An engine, or more than one engine coupled, with or without cars and displaying marking device.

TRAIN ORDER—A Form 19 issued in the proper format when applicable and as prescribed by the rules, which affects train movements.

YARD—A system of tracks used for the making up of trains and storing of cars, upon which movements may be made at Restricted Speed, subject to applicable rules and special instructions.

34. Employees located in the operating compartment of an engine must communicate to each other in an audible and clear manner the indication by name of each signal affecting movement of their train or engine as soon as the signal is clearly visible or audible. It is the responsibility of the Engineer to have each employee comply with these requirements, including himself.

It is the Engineer's responsibility to have each employee located in the operating compartment maintain a vigilant lookout for signals and conditions along the track which affect the movement of the engine or train.

If a crew member becomes aware that the Engineer has become incapacitated or should the Engineer fail to operate or control the engine or train in accordance with the signal indications or other conditions requiring speed to be reduced, other members of the crew must communicate with the Engineer at once and if he fails to properly control the speed of the train or engine, other members of the crew must take action necessary to ensure safety including operating the emergency valve.

An employee controlling the movement of a train from a location other than the operating cab of an engine must, when practicable, communicate to other employees involved the indication by name of each signal affecting the movement.

After the name of a signal has been communicated to other employees involved, it must continue to be observed until passed and any change of indication communicated in the required manner.

136. Employees are prohibited from altering, nullifying, or in any manner restricting or interfering with the normal intended function of any instruction, or of any device or equipment on engines, cars, or other railroad property.

In case of failure, seals may be broken or devices altered as provided by applicable rules or Special Instructions. When such action is necessary or when seals are found to be broken, missing, or tampered with, it must be reported on the prescribed form.

Should the engine Safety Control Feature, commonly known as the "deadman feature," be cut out for any reason or become inoperative after dispatchment, the Engineer must at the first opportunity that will not result in delay to his train, so advise the Train Dispatcher and/or Yardmaster and also complete prescribed form. These instructions also include engines working in yard service.

MOVEMENT AND PROTECTION OF TRAINS

80. The Train Dispatcher must be advised in advance of any known condition that will delay a train or prevent it from making normal speed.

SIGNAL RULES

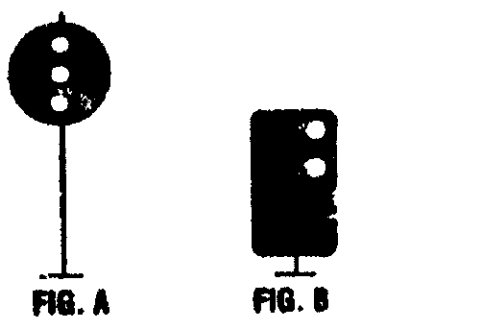
Movement of Trains by Block Signals

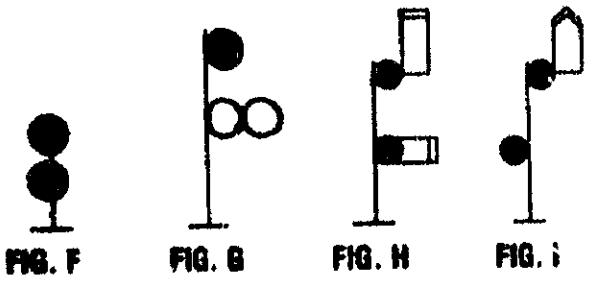
251. On designated tracks specified in the Timetable, signal indication will be authority for trains to operate with the current of traffic.

261. On designated tracks specified in the Timetable, signal indication will be authority for trains to operate in either direction on the same track.

NORTHEAST CORRIDOR SIGNALS

Rule 261



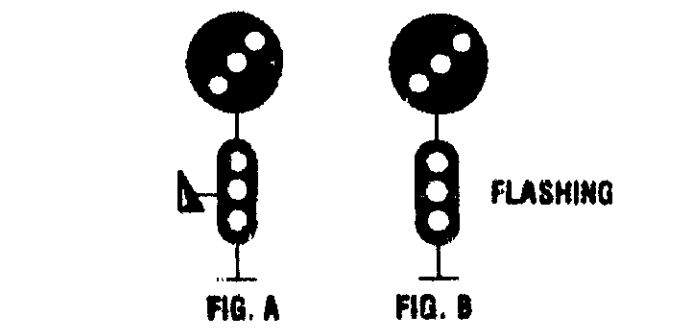


IN CAB SIGNAL TERRITORY CAB SIGNAL WILL DISPLAY CLEAR

NAME: Clear
INDICATION: Proceed

NORTHEAST CORRIDOR SIGNALS

Rule 261(B)



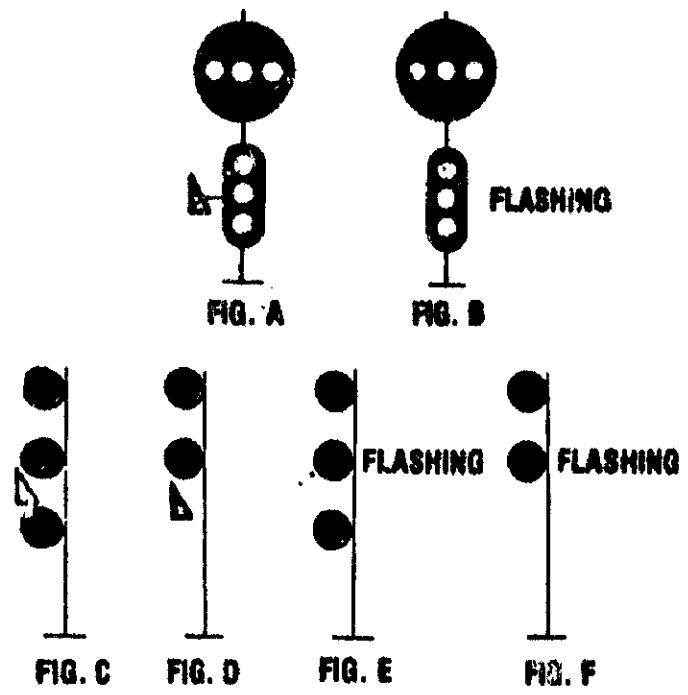
IN CAB SIGNAL TERRITORY CAB SIGNAL WILL DISPLAY APPROACH MEDIUM

AND FIXED SIGNAL INDICATION WILL GOVERN

NAME: Approach Limited
INDICATION: Proceed approaching next signal at Limited speed.

NORTHEAST CORRIDOR SIGNALS

Rule 281(C)



IN CAB SIGNAL TERRITORY
CAB SIGNAL WILL DISPLAY
APPROACH MEDIUM

AND FIXED SIGNAL INDICATION WILL GOVERN

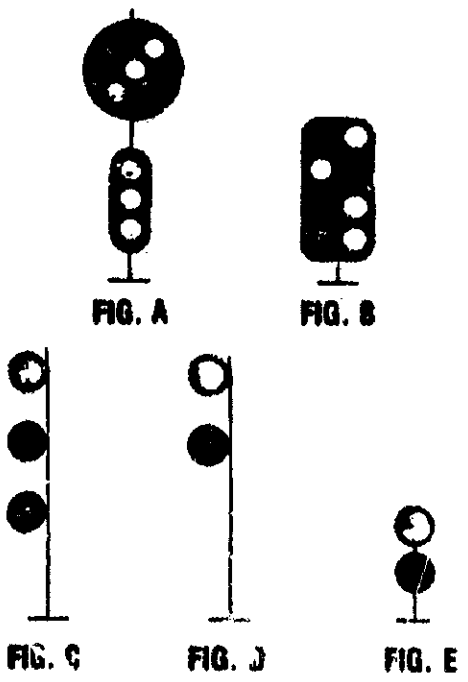
NAME: Limited Clear

INDICATION: Proceed; Limited speed within interlocking limits.

NOTE: In cab signal territory with fixed automatic blocks signals, trains with cab signals not in operative condition, or not equipped with cab signals, must approach next signal at Medium Speed.

NORTHEAST CORRIDOR SIGNALS

Rule 282

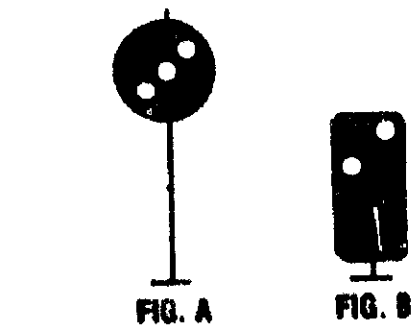


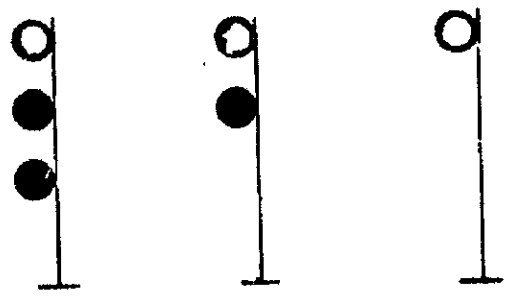
IN CAB SIGNAL TERRITORY
CAB SIGNAL WILL DISPLAY
APPROACH MEDIUM

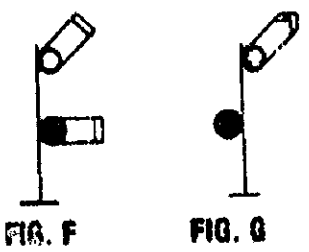
NAME: Approach Medium.

INDICATION: Proceed approaching next signal at Medium speed.

NORTHEAST CORRIDOR SIGNALS
Rule 285





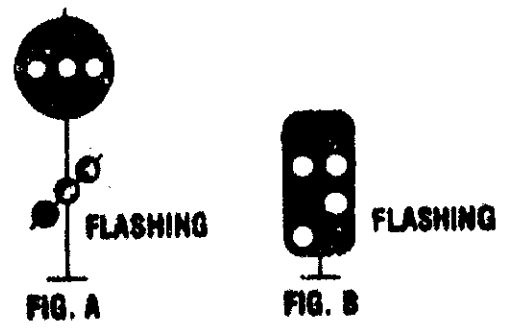


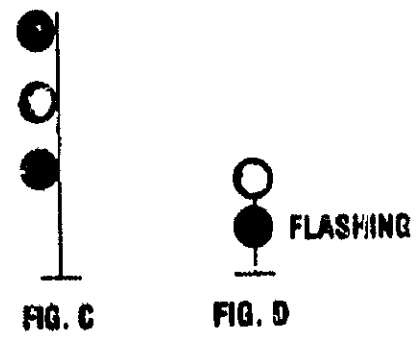
IN CAB SIGNAL TERRITORY CAB SIGNAL WILL DISPLAY APPROACH

NAME: Approach
INDICATION: Proceed prepared to stop at next signal. Train exceeding Medium speed must at once reduce to that speed.

1-47

NORTHEAST CORRIDOR SIGNALS
Rule 286





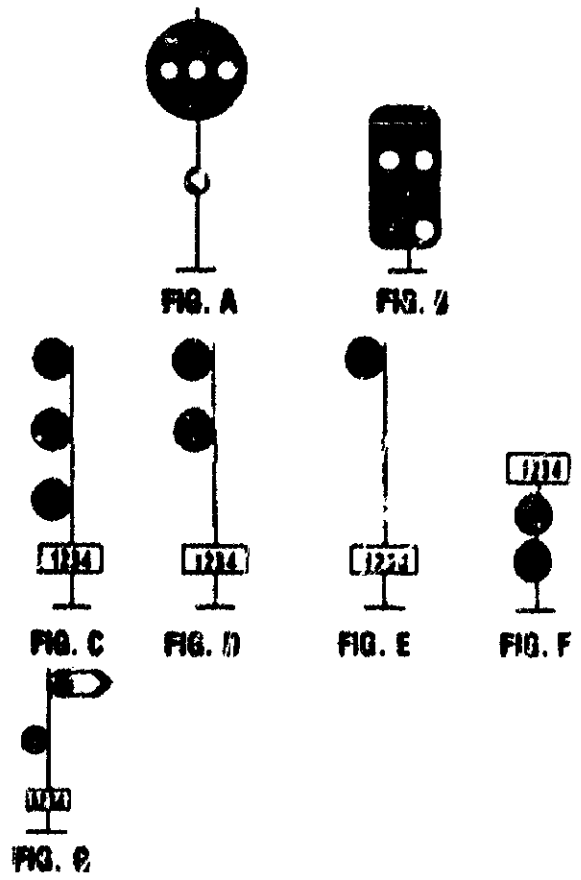
IN CAB SIGNAL TERRITORY CAB SIGNAL WILL DISPLAY APPROACH

AND FIXED SIGNAL INDICATION WILL GOVERN

NAME: Medium Approach.
INDICATION: Proceed at Medium speed preparing to stop at next signal. Train exceeding Medium speed must at once reduce to that speed.

1-49

NORTHEAST CORRIDOR SIGNALS
Rule 291

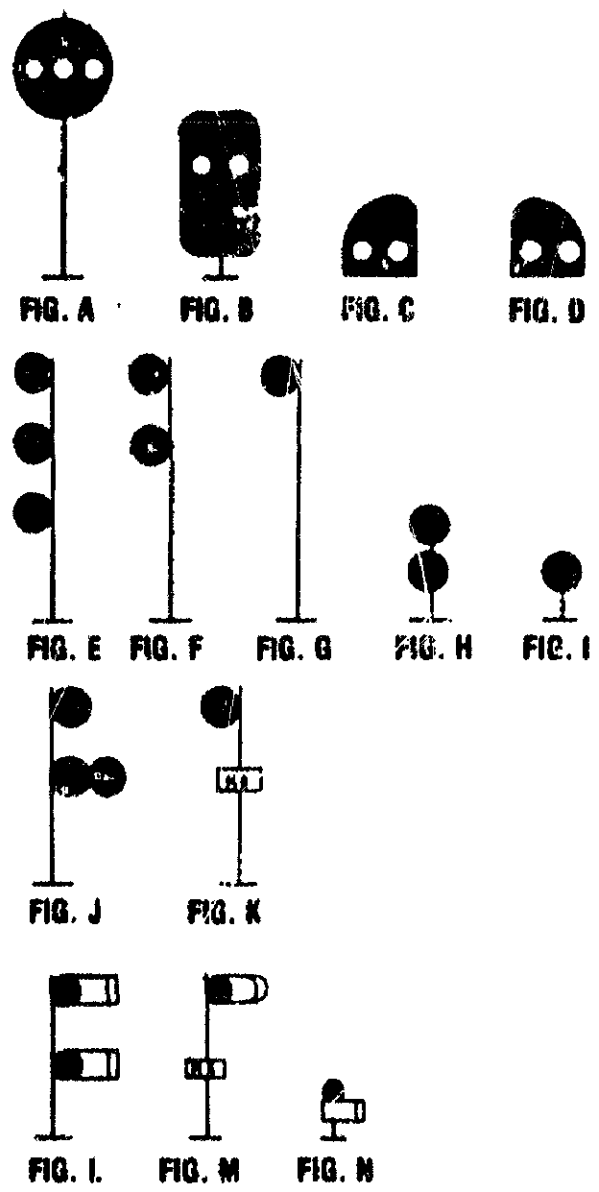


IN CAB SIGNAL TERRITORY
CAB SIGNAL WILL DISPLAY
RESTRICTING

AND FIXED SIGNAL INDICATION WILL GOVERN

NAME: Stop and proceed
INDICATION: Stop; then proceed at Restricted speed.
NOTE: Where in addition to the number plate a letter G, Grade Marker, is displayed as part of these aspects, freight trains may proceed as though a restricting signal were displayed.

NORTHEAST CORRIDOR SIGNALS
Rule 292



IN CAB SIGNAL TERRITORY
CAB SIGNAL WILL DISPLAY
RESTRICTING

AND FIXED SIGNAL INDICATION WILL GOVERN

NAME: Stop Signal
INDICATION: Stop

CAB SIGNAL SYSTEM

NOTE: Rules 550 to 563, inclusive, will not be in effect except by Special Instructions.

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 cut out or de-energized after departure test has been made, it must be tested again prior to entering equipped territory. Engines dispatched from points in Cab Signal territory to points where test circuits are not provided must have Cab Signal apparatus cut in for the entire trip. Testing sections at locations other than terminals will be specified in the Timetable Special Instructions.

When test of Cab Signal System apparatus is made by an employee other than the Engineer, the prescribed form stating that the Cab Signal System apparatus has been tested must be filled out in its entirety and must accompany the engine to its final terminal. The Engineer, after taking charge of the engine, must assure himself that Cab Signal System apparatus is energized and that the audible indicator will sound when 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 Engineer 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 is required as follows:

(a) On single unit engine equipped for operation in both directions, test must be made from both ends.
(b) On engine consisting of two or more units, test must be made from front end of leading unit and rear end of trailing unit.
(c) When test equipment is not available at a point where an intermediate unit will be required to become a lead unit, this unit must be tested at the initial terminal and the prescribed form filled out and placed on the engine.

When a departure test cannot be made due to failure of test equipment, engine may be dispatched 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 the proper record made. The prescribed form must be used and signed by the Enginehouse Foreman or his representative who must also verbally notify the Engineer of the details.

When necessary enroute to operate from an equipped unit or end that had not been given a departure test, the Cab Signals must be considered inoperative, and Rule 554 must be observed.

551. The Cab Signal System is interconnected with the fixed signal system so that the Cab Signal must conform with the fixed signal 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 Engineer will be governed as follows:

(a) When Cab Signal and fixed signal conform when entering the block, a change of cab signal aspect will indicate conditions affecting movement of train in the block, and cab signal will govern.
(b) When Cab Signal changes from Clear to Approach Medium between fixed signal locations, trains exceeding Medium Speed must at once begin reduction to that speed, unless otherwise authorized by next fixed signal indication.
(c) When Cab Signal aspect changes to Restricting, the Engineer must take action at once to reduce train to Restricted Speed.
(d) When Cab Signal aspect changes from Restricting to a more favorable aspect, speed must not be increased until train has run its length.
(e) If the Cab Signal and fixed signal do not conform when train enters the block, the more restrictive signal will govern. The Engineer will notify the Train Dispatcher or Operator by radio or by message as soon as possible without delaying the train, giving location and track on which non-conformity occurred.
(f) When Cab Signal aspect "flips" (momentarily changing aspect and then returning to original aspect), Engineer will, by radio or as soon as possible without delaying the train, forward a message in the following form to the Train Dispatcher:
Cab Signal flipped from *(state aspect)* to *(state aspect)* on No. ___ track at *(signal bridge or MP no.)*; or between *(designate points if multiple occurrence)*.
When the "flip" holds for a duration which required Cab Signals be acknowledged, Engineer must so state when reporting occurrence.
(g) The Cab Signal apparatus will be considered as having failed when:
(1) The audible indicator fails to sound when Cab Signal changes to a more restrictive aspect.
(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.

Engineer 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 Engineer, 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.

(h) 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 notify the Engineer and designate the limits of the area affected by such malfunction. Movements within the designated limits shall be made as prescribed by Rule 557. The Speed Control System of the engine must be cut-out, but the Cab Signal Apparatus must remain cut-in.

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, the Engineer must contact the AMTRAK Train Dispatcher or Operator, who will control movement, before entering onto the Northeast Corridor. The Engineer 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 aspect 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.

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 Restricted Speed and be governed by fixed signal indication. When authorized by the Train Dispatcher the train may proceed as provided for in Rule 557.

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 aspect unless authorized by the Train Dispatcher to do so.

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 Engineer 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. Engineer, in addition to verbally reporting flips, 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 Engineer 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 enroute, the Engineer must notify the 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. Engineer will report failure of Train Control or Speed Control to Train Dispatcher or Operator by radio. Report must also 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 Engineer immediately if the audible indicator sounds for longer than six seconds.

CONRAIL

34. Employees qualified on the operating rules and located on the leading engine or car must observe and then communicate to each other in an audible and clear manner the name of each signal affecting the movement of their train as soon as the signal becomes clearly visible. After the name of a signal has been communicated, it must continue to be observed until passed and any change communicated in the required manner.

When a train is two (2) miles from a temporary restriction, qualified employees located on the leading engine or car must immediately communicate with the engineer and confirm the requirements of the restriction.

If train is not operated in accordance with the requirements of the signal indication or restriction, qualified employees located on the leading engine or car must communicate with the engineer at once, and, if necessary, stop the train.

132. Employees are prohibited from altering, nullifying, or in any manner restricting or interfering with the normal intended function of any device or equipment on engines, cars or other railroad property.

In case of failure, or where seals are found to be tampered with, broken or missing, report must be made immediately to the train dispatcher.

CAB SIGNAL SYSTEM

NOTE: Rules 550 to 561 inclusive will be effective in territory designated by Timetable Special Instructions.

550. The Cab Signal System apparatus on the engine 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 cut-out or deenergized after departure test has been made, it must be tested again prior to entering equipped territory.

When test of the Cab Signal System apparatus is made by an employee other than the engineer, the prescribed form stating that engine has been tested must be filled out in its entirety and accompany engine to its final terminal. The engineer, when taking charge, must assure himself that Cab Signal System apparatus is energized and that the audible indicator will sound when acknowledging device is operated. If the Cab Signal System has been deenergized or audible indicator fails to sound when the acknowledging device is operated, the engineer must inform the train dispatcher and must not enter equipped territory.

When departure test cannot be made due to failure of test equipment, engine may be dispatched, provided the inbound operating test indicated that Cab Signals were functioning properly, and that defects which existed, if any, have been corrected and the proper record made. The prescribed form will then be used and signed by the enginehouse foreman or his representative who must also notify the outbound engineer of the complete details.

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

(a) On single unit engine equipped for operation in both directions, test must be made for operation in each direction.

(b) On engine consisting of two or more units, test must be made from front end of leading unit and rear end of trailing unit.

(c) When test equipment is not available at a point where an intermediate unit will be required to become a lead unit, such unit must be tested at the initial terminal and the prescribed form completed by an authorized employee and placed on the engine.

When circumstances make it necessary to operate an equipped unit from an end that had not been given a departure test, the Cab Signals must be considered as not in operation, and Rule 554 must be observed.

551. The Cab Signal System is interconnected with the block signal system so that the Cab Signal must conform with the fixed signal indication within eight seconds after the engine passes fixed signal governing the entrance into the block in the direction for which the track and engine are equipped. Engineer 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 engineer must take immediate action to operate train at Restricted Speed.

(c) When Cab Signal indication changes from Restricting to a more favorable indication, speed must not be increased until train has moved a distance equal to its length.

(d) If Cab Signal indication authorizes a speed different from that authorized by the fixed signal when the train entered the block, the lower speed will govern. The engineer must notify the train dispatcher or operator by radio or by message as soon as possible without delaying the train, giving location and track on which nonconformity occurred.

(e) When Cab Signal indication "flips" (momentarily changing indication and then returning to original indication), engineer will by radio, or as soon as possible without delaying the train, forward a message in the following form to the train dispatcher.

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

When the "flip" holds indication for a duration which required Cab Signals be acknowledged, engineer 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 the Cab Signals change to a more restrictive indication.

(2) The audible indicator continues to sound although the Cab Signal change was acknowledged and speed of train has been reduced to speed required by the Cab Signal indication.

(3) The Cab Signal fails to conform at two fixed signal locations in succession.

(4) The Cab Signal displays "Restricting" while approaching a fixed signal displaying "Approach" or more favorable aspect, and the Cab Signal fails to conform after passing fixed signal.

(5) Damage or fault occurs to any part of the Cab Signal apparatus.

When Cab Signal apparatus has failed, or has authorized a speed greater than authorized by the fixed signal, the train will proceed governed by Rule 554. The engineer must notify the train dispatcher or operator by radio; when unable to report by radio, details must be rendered at first point of communication where stop can be made without excessive delay. Upon arrival at the engine terminal, the engineer must advise the foreman or his representative and make written report on the prescribed form.

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 movements and is running backward.

552. When the Cab Signal portion of the wayside signal system is inoperative, the train dispatcher or operator when authorized by the train dispatcher must so notify the engineer and designate the limits of the area affected. The Cab Signal apparatus of the engine must not be deenergized or cut-out during movement through designated limits. Movement shall be governed by fixed signal indications, but not exceeding 40 miles per hour, unless authorized to proceed as provided in Rule 556.

Normal operation may be resumed only after engineer 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 to have failed, and Rule 554 must be observed.

553. When a train from another division or a connecting railroad has been given authority to operate non-equipped, the engineer must advise the train dispatcher or operator who controls movements before that train enters a new division.

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 initial terminal. The train may then operate at a speed not exceeding 40 miles per hour, governed by fixed signal indications. The train dispatcher must be advised as soon as practicable.

When instructed by the train dispatcher, or operator when authorized by the train dispatcher, the train will proceed as provided in Rule 556.

555. The movement of a train not equipped with Cab Signals is prohibited except at locations listed in Timetable Special Instructions.

The movement of a train not equipped with Cab Signals may be made at a speed which will permit stopping with one-half the range of vision, but not exceeding 20 miles per hour, and must be governed by fixed signal indications. When instructed by the train dispatcher, or operator when authorized by the train dispatcher, the train may proceed as provided in Rule 556.

556. As prescribed in Rule 554 or 555, when instructed by the train dispatcher, or operator when authorized by the train dispatcher, as prescribed by Rule 706 or 723, a train may proceed at Normal Speed, not exceeding 79 miles per hour, and governed by fixed signal indications. Before authorization can be granted, the train dispatcher must know that the route is clear to the next interlocking and that no train has been given permission or a signal to enter or foul that track. Absolute block must be established in advance of the train between each interlocking or open block station.

557. When the Cab Signal System apparatus has failed, the apparatus shall be considered inoperative until repaired. Train dispatcher must notify dispatchers of adjacent territories, divisions or other railroads that train is moving with inoperative Cab Signals.

558. Train dispatcher must record on the record of train movements, the movement of trains with inoperative Cab Signals and the movement of any train that is not equipped with Cab Signals. Where Cab Signal System rules are in effect, operators must make a record of all such moves on the station record of train movements and indicate those movements given authority to operate as provided in Rule 556.

In the application of Rule 552, the train dispatcher and operators involved must record the limits of the affected area and indicate those movements authorized to operate as provided in Rule 556.

APPENDIX D

EXCERPTS FROM AMTRAK NORTHEAST CORRIDOR TIMETABLE

NATIONAL RAILROAD PASSENGER CORPORATION

Amtrak

TIMETABLE No. 4

(SCHEDULES and SPECIAL INSTRUCTIONS)
In effect 12.01 A.M., Eastern Standard Time
Sunday, April 27, 1986

★ ★ ★

NORTHEAST CORRIDOR

D. F. SULLIVAN
VICE PRESIDENT OPERATIONS-MAINTENANCE

R. C. VANDERCLUTE
ASSISTANT VICE PRESIDENT-TRANSPORTATION

General Superintendents:	Divisions:
D. J. BEATTY	BOSTON
R. A. HERMAN	NEW YORK
C. C. BROWN	PHILADELPHIA

★ ★ ★

FOR THE GOVERNMENT OF EMPLOYEES ONLY

MAIN LINE—PHILADELPHIA TO WASHINGTON (Continued)

Interlocking	Interlocking Station	Block Station and Train Order Office	STATIONS	Mile Post	Sidings Assigned Direction Car Capacity 50 ft. Cars			Note
					East or North	West or South	Both	
....	....	....	CRUM LYNNE	11.2	....	....	....	....
X	....	....	BALDWIN	11.7	....	....	....	....
....	....	....	EDDYSTONE	12.3	....	....	....	....
....	....	....	CHESTER	13.4	....	....	....	....
....	....	....	LAMOKIN ST	14.4	....	....	....	....
....	....	....	HIGHLAND AVE.	15.5	....	....	....	....
X	X	X-★	HOOK	16.8	....	....	....	....
....	....	....	MARCUS HOOK	17.1	....	....	....	....
....	....	....	PA.-DELAWARE STATE LINE	18.2	....	....	....	....
....	....	....	CLAYMONT	19.6	....	....	....	....
X	....	....	HOLLY R-Bell	20.3	....	....	....	....
X	X	X-★	BELL	22.5	....	....	....	....
....	....	....	EDGE MOOR	24.0	....	....	....	....
X	....	....	LANDLITH R-Wilmington	25.4	....	....	....	....
X	....	....	WINE R-Wilmington	26.6	....	....	....	....
....	X	X-★	WILMINGTON	26.8	....	....	....	....
X	....	....	BRANDY R-Wilmington	26.9	....	....	....	4
X	....	....	YARD R-Wilmington	28.2	....	....	....	4
X	....	....	RAGAN (Shellpot Branch—Conrail) R-Wilmington	29.7	....	....	....	....
....	....	....	NEWPORT	30.6	....	....	....	....
X	X	X-★	DAVIS (Delmarva Secondary Track—Conrail)	38.4	....	....	....	....
....	....	....	NEWARK	38.9	....	....	....	....
....	....	....	DELAWARE-MD. STATE LINE	41.4	....	....	....	....
X	....	....	IRON R-Davis	41.5	....	....	....	1
....	....	....	ELKTON	44.9	....	....	....	....
X	....	....	BACON R-Davis	51.0	....	....	....	....
....	....	....	NORTHEAST	51.3	....	....	....	....
....	....	....	CHARLESTOWN	54.0	....	....	....	....
X	....	....	PRINCE R-Perry	57.3	....	....	....	....
X	X	X-★	PERRY (Port Road Branch—Conrail)	59.5	....	....	....	....
....	....	....	SUSQUEHANNA RIVER MOVABLE BRIDGE	60.2	....	....	....	....
X	....	....	GRACE R-Perry	60.7	....	....	....	....
X	....	....	OAK R-Perry	62.9	....	....	....	....
....	....	....	ABERDEEN	65.5	....	....	....	....
X	....	....	POPLAR R-Perry	67.4	....	....	....	2
....	....	....	PERRYMAN	69.0	....	....	....	....
X	....	....	BUSH (Movable Bridge) R-Edgewood	71.6	....	....	....	....
X	X	X-★	EDGEWOOD	75.3	....	139	....	....
X	....	....	MAGNOLIA R-Edgewood	76.9	139	....	....	....
X	....	....	GUNPOW R-Edgewood	79.3	....	....	....	....
....	....	....	CHASE	81.9	....	....	....	....
....	....	....	STEMMER'S RUN	87.0	....	....	....	....
X	....	....	RIVER R-Bay	89.3	....	....	....	....
X	....	....	POINT R-Bay	90.1	....	....	....	....
X	X	X-★	BAY	91.9	....	....	....	6
X	....	....	CANTON R-Bay	92.9	....	....	....	....

MAIN LINE—PHILADELPHIA TO WASHINGTON (Continued)

Interlocking	Interlocking Station	Block Station and Train Order Office	STATIONS	Mile Post	Sidings Assigned Direction Car Capacity 50 ft. Cars			Note
					West or North	East or South	Both	
....	....	....	BIDDLE ST.	94.3	....	....	....	....
X	X	X-★	UNION JUNCTION	95.5	....	....	....	....
....	....	....	BALTIMORE	95.7	....	....	....	....
X	X	X-★	B. & P. JUNCTION	95.9	....	....	....	....
X	....	....	FULTON R-B & P Junction	97.7	....	....	....	....
X	....	....	BRIDGE R-B&P Junction	98.2	....	....	....	
....	....	....	EDMONDSON	98.3	....	....	....	....
....	....	....	WEST BALTIMORE	98.5	....	....	....	....
....	....	....	GWYNN	99.3	....	....	....	....
....	....	....	FREDERICK ROAD	99.9	....	....	....	....
....	....	....	HALETHORPE	103.0	....	....	....	....
X	....	....	WINANS R-B & P Jct.	103.4	....	....	....	3
....	....	....	B.W.I.	106.3	....	....	....	
....	....	....	VERN	111.4	....	....	....	....
X	X	X-★	GROVE	112.4	....	....	....	....
....	....	....	ODENTON	113.6	....	....	....	....
....	....	....	ARUNDEL	118.2	....	....	....	....
....	....	....	JERICHO PARK	119.4	....	....	....	....
X	X	X ★	BOWIE (Popes Creek Secondary Track—Conrail)	120.5	....	....	....	....
....	....	....	GLENNDALE	123.1	....	....	....	....
....	....	....	SEABROOK	124.7	....	....	....	....
X	....	....	CARROLL R-Landover	127.0	....	....	....	4
....	....	....	NEW CARROLLTON	127.0	....	....	....	....
X	X	X-★	LANDOVER (Main Line—Landover to RO—C.R.C.)	128.8	....	....	....	....
....	....	....	CHEVERLY	130.4	....	....	....	....
....	....	....	MARYLAND-D.C. STATE LINE	131.6	....	....	....	....
....	....	....	DIVISION POST (Wash. Div.)	134.9	....	....	....	....
....	....	....	NEW YORK AVE. (Wash. Div.)	135.0	....	....	....	....
X	X	X	K TOWER (Wash. Div.)	135.9	....	....	....	....
....	....	....	WASHINGTON	136.0	....	....	....	....

The direction from Zoo to Washington is southward.

Note 1. Interlocking Rules apply on Track A and No. 1 track only.
Note 2. Interlocking Rules apply on No. 3 and No. 4 tracks only.
Note 3. Interlocking Rules apply on Track A, No. 1 and No. 2 only.
Note 4. Interlocking Rules apply on No. 1 and No. 2 tracks only.
Note 5. Interlocking Rules apply on Amtrak No. 4 and No. 5 tracks only.
Note 6. Interlocking Rules and Block Stations do not apply on No. 2 and No. 3 tracks.

MAIN LINE—MILL RIVER TO SPRINGFIELD (Boston Division)

Interlocking	Interlocking Station	Block Station and Train Order Office	STATIONS	Mile Post	Sidings Assigned Direction Car Capacity 50 ft. Cars			Note
					East or North	West or South	Both	
X	....	....	MILL RIVER (Main Line Boston to New Haven) R-New Haven	*1.6	....	....	....	....
....	....	....	AIR LINE JCT R-New Haven	2.2	....	....	....	....
....	....	....	NORTH HAVEN (DEVINE ST.)	6.4	....	....	....	....
X	....	....	NORTH HAVEN JCT (North Haven Thorotare C.R.C.) R-New Haven	7.0	....	....	....	....
....	....	....	WALLINGFORD	12.6	....	....	....	....
....	....	....	WALL	13.4	....	....	....	....
....	....	....	MERIDEN	18.6	....	....	....	....
....	....	....	CAMP	19.0	....	....	....	....
....	....	....	QUARRY JCT	20.3	84	76	....	....
....	....	....	SO. BERLIN	25.6	....	....	....	....
....	....	R-★	BERLIN (Berlin Sec. Trk. B&M RR)	25.9	....	....	....	1
....	....	....	NO. BERLIN	26.3	....	....	....	....

Cont'd on next Page.

WASHINGTON TO PHILADELPHIA

STATIONS	86	8224	e20	□ 108	174	8226
	Daily	Daily Ex. Sunday	Daily	Daily Ex. Sat & Sun	Daily	Daily
	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.
WASHINGTON	$ 9.30		$ 9.25	$10.00	$10.30	
NEW YORK AVE. (NY)	9.33		9.29	10.03	10.34	
LANDOVER	9.39		9.34	10.08	10.39	
NEW CARROLLTON	$ 9.40			C10.10	$10.41	
SEABROOK						
BOWIE	9.45		9.39	10.16	10.46	
JERICHO PARK						
ODENTON						
GROVE	9.49		9.45	10.20	10.52	
BWI	$ 9.55					
HALETHORPE						
WEST BALTIMORE						
BALTIMORE Ar			D10.03		$11.[illegible]	
BALTIMORE Lv	$10.11		10.13	$10.36	#11.10	
BAY	10.20		10.23	10.43	11.19	
GUNPOW	10.27		10.33	10.51	11.26	
EDGEWOOD	10.29		10.36	10.53	11.29	
ABERDEEN						
PERRYVILLE	10.38		10.46	11.02	11.37	
BACON	10.44		10.53	11.07	11.43	
ELKTON						
NEWARK						
DAVIS	10.50		11.01	11.14	11.50	
RAGAN	10.56		11.08	11.19	11.55	
WILMINGTON	$11.01		D11.14	$11.23	$12.00	
EDGEMOOR						
BELL	11.05	MU	11.19	11.27	12.04	MU
CLAYMONT						
MARCUS HOOK	11.08	$10.58	11.23	11.30	12.08	$11.58
HOOK		10.59				11.59
HIGHLAND AVE.		$11.02				$12.02
LAMOKIN ST.		$11.04				$12.04
CHESTER		$11.06				$12.06
EDDYSTONE	11.11	$11.08	11.26	11.34	12.11	$12.08
BALDWIN		11.09				12.09
CRUM LYNNE		$11.10				$12.10
RIDLEY PARK		$11.12				$12.12
PROSPECT PARK		$11.14				$12.14
NORWOOD		$11.15				$12.15
GLENOLDEN		$11.17				$12.17
FOLCROFT		$11.18				$12.18
SHARON HILL		$11.20				$12.20
CURTIS PARK		$11.21				$12.21
DARBY	11.17	$11.23	11.32	11.39	12.16	$12.23
PHIL		11.26				12.26
30th ST. Lower Lev	$11.22	$11.33	D11.37		$12.21	$12.33
30th ST. Upper Lev	#11.25		11.47	$11.45	#12.26	
PENN CENTER STA		$11.38				$12.38
	A.M.	A.M.	A.M.	A.M.	P.M.	P.M.

HOLIDAY NOTES:

Train #108 will not run 11/27, 12/25, 1/1 and 2/16
Will run 11:30, 12/28 and 1/14.

NORTHWARD

	□ 119	140	132	8228	□ 112	8230	94
	Daily Ex. Sat. & Sun.	Daily Ex. Sat.	Saturday Only	◇ Daily Ex. Sunday	Daily Ex. Saturday	Daily	Daily
	A.M.	A.M.	A.M.	P.M.	NOON	P.M.	P.M.
	$11.00	$11.30	$11.30		$12.00		$12.30
	11.03	11.33	11.33		12.03		12.34
	11.08	11.38	11.38		12.08		12.39
		$11.40	$11.40				$12.41
	11.13	11.45	11.45		12.13		12.40
	11.17	11.49	11.49		12.17		12.54
		$11.55	$11.55				
	$11.33	$12.11	$12.11		$12.33		$ 1.11
	11.40	12.20	12.20		12.40		1.21
	11.47	12.27	12.27		12.48		1.29
	11.50	12.29	12.29		12.50		1.31
	11.59	12.38	12.38		12.58		1.40
	12.04	12.44	12.44		1.00		1.46
	12.11	12.50	12.50		1.10		1.52
	12.16	12.56	12.56		1.15		1.58
	$12.20	$ 1.02	$ 1.02		$ 1.19		$ 2.03
	12.24	1.06	1.06		1.23	MU	2.07
	12.27	1.09	1.09	$12.58	1.26	$ 1.58	2.11
				12.59		1.59	
				1.02		2.02	
				1.04		2.04	
				1.06		2.06	
	12.30	1.12	1.12	$ 1.08	1.30	$ 2.08	2.14
				1.09		2.09	
				1.10		2.20	
				1.12		2.12	
				1.14		2.14	
				$ 1.15		$ 2.15	
				1.17		2.17	
				1.18		2.18	
				1.20		2.20	
				1.21		2.21	
	12.36	1.18	1.18	$ 1.23	1.35	$ 2.23	2.20
				1.26		2.26	
		$ 1.23	$ 1.23				$ 2.25
	$12.42	# 1.25	# 1.25	$ 1.33	$ 1.40	$ 2.33	# 2.27
				$ 1.38		$ 2.38	
	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.	P.M.

HOLIDAY NOTES:

Train #110 will not run 11/27, 11/28, 12/25, 12/26, 1/1, 1/2 and 2/16.
Will run 11/30, 12/28 and 1/4.

Train #112 will not run 11/27, 12/25 and 1/1.

100G-A1. ALCOHOL AND DRUG TESTING—EMPLOYEES COVERED BY THE FEDERAL HOURS OF SERVICE ACT—Under Federal Railroad Administration (FRA) safety regulations, you may be required to provide a urine sample after certain accidents and incidents or at any time the company reasonably suspects that you are under the influence of, or impaired by, drugs or alcohol while on duty. Because of its sensitivity, the urine test may reveal whether or not you have used certain drugs within the recent past (In a rare case, up to sixty days before the sample is collected). As a general matter, the test cannot distinguish between recent use off the job and current impairment. However, the Federal regulations provide that if only the urine test is available, a positive finding on that test will support a presumption that you were impaired at the time the sample was taken.

You can avoid this presumption of impairment by demanding to provide a blood sample for testing at the same time the urine sample is collected. The company will ensure that you are taken to an independent medical facility to have the necessary samples taken and will designate the independent facilities at which testing of the samples will be performed. The blood test will provide information pertinent to current impairment. Regardless of the outcome of the blood test, if you provide a blood sample there will be no presumption of impairment from a positive urine test.

If you have used any drug off the job (other than a medication that you possessed lawfully and used in the recommended dosage for a medical problem) in the prior sixty days, it may be in your interest to provide a blood sample. If you have not made unauthorized use of any drug in the prior sixty days, you can expect that the urine test will be negative; and you may not wish to provide a blood sample.

You are not required to provide a blood sample at any time, except in the case of certain accidents and incidents subject to Federal post-accident testing requirements. If you refuse to cooperate in providing a blood or urine sample following an accident (specificed in 49 CFR Part 219 Subpart C), you shall be removed from service, are subject to dismissal, and may not under any circumstances be employed in a position covered by the Hours of Service Act for a period of at least 9 months.

If you test positive for drugs but are not shown to be in possession of, using, or impaired by such drugs while on duty or subject to duty, you shall be removed or withheld from service. You shall be disqualified for service until you achieve a negative test result, and shall, as a condition of being returned to service after a negative test result, be subject to testing for drugs by urine sample for a period of two years. You must, within 30 days after the initial positive test result, be retested or enter the EAP program if eligible. In no event will you be entitled to be retested more than twice, and if you have three successive positive test results, you will be subject to dismissal.

1157-A1. SPEED TABLE

Time per Mile		Miles per Hour	Time per Mile		Miles per Hour
Min.	Sec.		Min.	Sec.	
0	28	125	1	00	60
0	30	120	1	05	55
0	31	115	1	12	50
0	33	110	1	20	45
0	34	105	1	30	40
0	36	100	1	43	35
0	38	95	2	00	30
0	40	90	2	24	25
0	42	85	3	00	20
0	45	80	4	00	15
0	48	75	6	00	10
0	51	70	12	00	5
0	55	65			

SPEEDOMETERS—CHECKING

1157-A2.

White marker posts are installed on opposite side of track from Mile Posts at the following locations for the purpose of checking speedometers.

Engineer on each trip shall check the speed indicated on speedometer against lapse of time while equipment is being operated at constant speed, and report inaccuracies on EL-106-a or MAP 100.

Between	Location
BOSTON DIVISION	
Main Line—Boston to New Haven:	
Mile Post 78 and Mile Post 79	East of Shore Line Jct
Mile Post 89 and Mile Post 90	East of Guilford
Mile Post 164 and Mile Post 165	West of Wickford Jct
Mile Post 192 and Mile Post 193	East of State Line
Mile Post 200 and Mile Post 201	East of Attleboro
Mile Post 222 and Mile Post 223	West of Morton St
Main Line—Mill River to Springfield:	
Mile Post 15 and Mile Post 16	North of Wallingford
Mile Post 57 and Mile Post 58	North of Enfield
NEW YORK DIVISION	
Main Line—New York to Philadelphia:	
Mile Post 4 and Mile Post 5	East of Portal
Mile Post 30 and Mile Post 31	East of New Brunswick
Mile Post 45 and Mile Post 46	East of Nassau
Mile Post 53 and Mile Post 54	East of Fair
Mile Post 63 and Mile Post 64	East of Grundy
Mile Post 73 and Mile Post 74	East of Torresdale
PHILADELPHIA DIVISION	
Main Line—Philadelphia to Washington:	
Mile Post 8 and Mile Post 9	South of Folcroft
Mile Post 20 and Mile Post 21	South of Claymont
Mile Post 34 and Mile Post 35	North of Davis
Mile Post 123 and Mile Post 122	North of Glendale
Mile Post 130 and Mile Post 131	South of Landover
Main Line—Philadelphia to Harrisburg:	
Mile Post 14 and Mile Post 15	West of St. Davids
Mile Post 24 and Mile Post 25	West of Frazer
Mile Post 41 and Mile Post 42	West of Coatesville
Mile Post 100 and Mile Post 101	East of Slate

PASSENGER TRAINS AND FREIGHT TRAINS

1157-C1. MAXIMUM SPEEDS AND SPEED RESTRICTIONS
Unless otherwise restricted by Special Instruction 1157-G1.

NOTE 1: Where two speeds separated by a diagonal line are shown, the higher speed applies to equipment authorized to exceed 90 MPH, and the lower speed applies to equipment not authorized to exceed 90 MPH.

NOTE 2: Where the maximum speed of a track changes at an interlocking and the specific point where the change occurs is not specified, the lower speed will apply through the entire interlocking.

BOSTON DIVISION

Main Line—Boston to New Haven Between:	Other Tracks		No. 1 Track		No. 2 Track		No. 3 Track		No. 4 Track	
	Pass.	Frt.	Pass.	Frt.	Pass.	Frt.	Pass.	Frt.	Pass.	Frt.
Maximum Speeds										
Boston & Tower 1 Intlg. Limits	10	10	....	....	....	....	....	....	....	....
South Bay Intlg. Limits	....	....	25	25	25	25	....	....	....	....
South Bay & Readville Transfer	....	....	60	40	60	40	....	....	....	....
Readville Transfer & Route 128	....	....	95	50	100	50	....	....	....	....
Route 128 & MP 213.8	....	....	95	50	95	50	....	....	....	....
MP 213.8 & MP 213.0 (canton Jct. Viaduct)	....	....	80	50	80	50	....	....	....	....
MP 213.0 & MP 205.0	....	....	95	50	95	50	....	....	....	....
MP 205 & MP 200	....	....	100	50	100	50	....	....	....	....
MP 200 & Holden	....	....	95	50	100	50	....	....	....	....
Holden & Attleboro	....	....	95	50	100	50	....	....	60	40
Attleboro & Thatcher	....	....	95	50	100	50	30	30	60	40
Thatcher & MP 195	....	....	95	50	100	50	....	....	60	40
MP 195 & Hebronville	....	....	100	50	95	50	....	....	60	40
Hebronville & MP 190	....	....	100	50	95	50	....	....	....	....
MP 190 & Providence	....	....	50	35	50	35	....	....	....	....
Providence & Cranston	....	....	50	40	50	40	....	....	....	....
Cranston & MP 180	....	....	90	50	90	50	....	....	....	....
MP 180 & MP 178	....	....	110	50	90	50	....	....	....	....
MP 178 & MP 176	....	....	110	50	110	50	....	....	....	....
MP 176 & MP 175	....	....	90	50	110	50	....	....	....	....
MP 175 & East Greenwich	....	....	85	50	85	50	....	....	....	....
East Greenwich & Davisville	....	....	90	50	95	50	....	....	....	....
Davisville & MP 166	....	....	100	50	100	50	....	....	....	....
MP 166 & MP 163	....	....	100	50	110	50	....	....	....	....
MP 163 & MP 161	....	....	110	50	100	50	....	....	....	....
MP 161 & Kingston	....	....	100	50	100	50	....	....	....	....
Kingston & MP 155	....	....	100	50	80	50	....	....	....	....
MP 155 & MP 152	....	....	80	50	80	50	....	....	....	....
MP 152 & Bradford	....	....	85	50	85	50	....	....	....	....
Bradford & MP 137	....	....	80	50	80	50	....	....	....	....
MP 137 & Palmers Cove	....	....	70	50	70	50	....	....	....	....

Rev. G.O. 402 8-25-86

1157-C1 (Cont'd)

Main Line—Boston to New Haven Between:	Other Tracks		No. 1 Track		No. 2 Track		No. 3 Track		No. 4 Track	
	Pass.	Frt.	Pass.	Frt.	Pass.	Frt.	Pass.	Frt.	Pass.	Frt.
Maximum Speeds										
Palmers Cove & MP 127	....	....	70	50	70	50	....	....	30	25
MP 127 & Groton	....	....	60	40	60	50	....	....	30	25
Groton & Shaw Cove	....	....	25	25	25	25	....	....	....	....
Shaw Cove & Nan	....	....	60	40	60	40	....	....	....	....
Nan & Conn	....	....	79/70	50	79/70	50	....	....	....	....
Conn & Old Saybrook	....	....	90	50	90	50	....	....	....	....
Old Saybrook & Brook	....	....	90	50	90	50	....	....	25	25
Brook & MP 101	....	....	90	50	90	50	....	....	....	....
MP 101 & MP 95	....	....	85	50	85	50	....	....	....	....
MP 95 & MP 82	....	....	90	50	80	50	....	....	....	....
MP 82 & Mill River	....	....	70	50	70	50	....	....	....	....
Mill River & Division Post (Metro. Reg.)	....	....	35	35	35	35	35	35	35	35
Speed Restrictions										
Fort Point Channel Bridge MP 227.0	5	5	10	10	10	10	....	....	....	....
Route 128 Station Platforms	....	....	60	50	60	50	....	....	....	....
Canton Jct. Sta. Platform	....	....	80	40	80	40	....	....	....	....
Except during the hours 7.30 AM to 9:01 AM and 4:01 PM to 5:00 PM Mon. thru Fri.	....	....	60	....	50	....	....	....	....	....
Curve between MP 194.5 and MP 193.7	....	....	90	50	90	50	....	....	30	30
Curve between MP 190.4 and MP 190.0	....	....	60	50	60	50	....	....	....	....
Curves between MP 186.5 and MP 186.1	....	....	40	35	50	35	....	....	....	....
Curve between MP 186.1 and MP 185.1	....	....	25	25	25	25	....	....	....	....
First Curve East of MP 185.5 Smith St. OH Bridge	....	....	45	30	45	30	....	....	....	....
First Curve East and First West of Providence Sta. including Station Platforms	....	....	25	....	25	....	....	....	....	....
Curves between MP 184.7 and MP 184.3	....	....	40	....	40	....	....	....	....	....
Curve between MP 160.5 and MP 159.7	....	....	90	50	....	....	....	....	....	....
Curve between MP 152.6 and MP 151.9	....	....	75	50	75	50	....	....	....	....
Curve between MP 136.4 and MP 135.9	....	....	60	50	60	50	....	....	....	....
Curve between MP 134 and MP 133.6	....	....	60	50	60	50	....	....	....	....
Curve between MP 132.5 and MP 132.0	....	....	55	50	55	50	....	....	....	....
MP 132.0 to 131.9 (Bridge 131.95)	....	....	55	50	55	50	....	....	....	....
Curve between MP 131.9 and MP 131.3	....	....	55	50	....	....	....	....	....	....

Rev. G.O. 402 8-25-86

1157-C1 (Cont'd)										
Main Line—Philadelphia to Washington Between:	No. 4 Track		No. 3 Track		No. 2 Track		No. 1 Track		Other Tracks	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Maximum Speeds									
MP 66 and Bush	120	50	80	50	120	50	...	...	...	...
Through Bush Interlocking	110	50	110	50	110	50	...	...	...	...
Bush and MP 78	...	...	120	50	120	50	...	...	...	...
MP 78 and Gunpow	...	...	110	50	110	50	...	...	...	...
Gunpow and MP 83	...	...	110	50	110	50	110	50	...	...
MP 83 and MP 85	...	...	120	50	110	50	110	50	...	...
MF 85 and River	...	...	110	50	110	50	110	50	...	...
Track A between Gunpow and River	...	...	...	...	...	...	...	...	80	50
River and Point	...	...	110	50	110	50	110	50	...	...
Point and Bay	...	...	100	50	110	50	100	50	...	...
Bay and Union Junction	...	...	60	35	60	40	60	35	...	...
Track A between Bay and Union Junction	...	...	...	...	...	...	...	...	35	35
Through Union Tunnels	...	...	45	30	45	30	45	30	...	...
South Portals of Union Tunnels and Southward limits B&P Junction Intlg	All Tracks 15 MPH									
Southward limits B&P Junction Intlg and Fulton	...	...	30	20	30	20	...	...	...	...
Gauntlet Track (B&P Tunnel)	...	...	...	...	...	...	...	...	30	20
Track A between Bridge and Winans	...	...	...	...	...	...	...	...	80	50
Bridge and Frederick Road	...	...	...	...	...	...	75	50	...	...
Fulton and Frederick Road	...	...	75	50	75	50	...	...	...	...
Frederick Road and MP 101	...	...	100	50	90	50	90	50	...	...
MP 101 and MP 107	...	...	110	50	110	50	110	50	...	...
MP 107 and Grove	...	...	120	50	120	50	110	50	...	...
Grove and MP 120	...	...	120	50	120	50	80	50	...	...
MP 120 and Landover	...	...	110	50	110	50	80	50	...	...
Landover and MP 133	...	...	105	50	105	50	...	...	...	...
MP 133 and Division Post (WT)	...	...	85	50	85	50	...	...	...	...
	Speed Restrictions									
All curves between Zoo Interlocking Sta. and 34th St. overhead Bridge	30	30	...	...	...	...	30	30	...	...
All curves between 34th St OH bridge and Penn Intlg Signal located 1035 ft. south of Spring Garden St OH Bridge	40	30	...	...	...	...	40	30	...	...
All curves South St overhead Bridge to Arsenal Interlocking Station	...	...	50	30	50	30	...	...	...	...

347

1157-C1 (Cont'd)										
Main Line—Philadelphia to Washington Between:	No. 4 Track		No. 3 Track		No. 2 Track		No. 1 Track		Other Tracks	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Speed Restrictions									
Reverse curves between Brill and Sharon Hill	70	50	90	50	80	50	70	50	...	...
Curve under Jumpover north of Bell Nos. 1F and 2F Tracks	...	...	...	...	...	...	...	...	30	30
Through Bell Interlocking No. 1F Track	...	...	...	...	...	...	...	...	10	10
First curve south of Bell	...	...	90	50	90	50	...	...	...	...
Curve north of Wilmington Station	...	...	40	40	40	40	...	...	...	...
Curve at MP 27	...	...	40	40	40	40	40	40	...	...
Davis—Track A switch leading to Delmarva Branch and 780 feet south thereof	...	...	...	...	...	...	...	...	10	10
Curve at MP 50	...	...	90	50	90	50	90	50	...	...
Curve at MP 57, north of Prince	...	...	95	50	95	50	...	...	...	...
North and south legs of Wye, Perry Interlocking	...	...	...	...	...	...	...	...	15	10
First curve South of Grace	...	...	...	...	...	...	90	50	...	...
First curve North of Gunpow Interlocking	...	...	100	50	100	50	...	...	...	...
Reverse curves Bay Interlocking	...	...	50	35	...	...	50	35	...	...
Curve at MP 94	...	...	45	35	45	35	45	35	...	...
Curve at Fulton	...	...	40	40	40	40	...	...	...	...
First curve South of Bridge Track A	...	...	50	50	50	50	50	50	30	30
First curve north of Frederick Road Station Track A	...	...	...	...	70	50	70	50	55	40
First Curve south of Frederick Road Station Track A	...	...	...	...	...	...	...	...	60	40
First curve south of MP 101	...	...	105	50	105	50	105	50	...	...
Curve at Winans	...	...	100	50	100	50	100	50	...	...
Curve south of MP 106	...	...	90	50	90	50	90	50	...	...
Curve at Landover	...	...	100	50	100	50	...	...	...	...
Curve at Division Post (WT)	...	...	30	30	30	30	...	...	...	...
Main Line—Philadelphia to Harrisburg Between:										
Eastward limits Zoo Interlocking and 34th St. OH Bridge	30	10	30	10	30	10	30	10	...	...
34th St OH Bridge and Connection with No. 1 and No. 4 Main Line via 36th St. Tunnel	...	...	30	15	30	15	...	...	...	...
34th St OH Bridge and 44th St OH Bridge	50	20	...	...	30	20	50	20	...	...

348

SPECIAL MAXIMUM SPEEDS, UNLESS OTHERWISE RESTRICTED

ALL DIVISIONS

1157-C2. PASSENGER TRAINS—Passenger trains consisting of more than 30 cars must not exceed 60 MPH.

1157-C3. TV TRAINS—A Trail Van (TV) train is a freight train consisting of multi-level automobile carrying cars, flat cars carrying trailers in piggy-back service, with or without passenger equipment cars and freight cabooses. TV trains consisting of 61 cars or more must not exceed the maximum speed for freight trains. TV trains consisting of 60 or less cars may operate up to but not exceeding 60 MPH where the freight train speed is 50 MPH, at the following locations:

Main Line—New York to Philadelphia
Between:
Automatic Block Signal No. 157/158 and MP 54
East End Delaware River Bridge and MP 76

Main Line—Philadelphia to Washington
Between:
Phil and Baldwin (Southward moves only)
Baldwin and Bell
Bell and Bay (Southward moves only)
Gwynn and Landover

Main Line—Philadelphia to Harrisburg
Between:
Paoli and State

NOTE: When combined with any other freight train, TV trains must operate at freight train speeds.

Rev. G.O. 402 8-25-86

Electric engines coupled with proper pantograph-up arrangement will be operated as follows:

Number of Units	Maximum Permissible Speed
5	80 MPH unless otherwise restricted
6	35 MPH unless otherwise restricted
Over 6	Prohibited

Amtrak-NEC Engine Nos.	Bldr. Model	Speed MPH: Life	Mltp. Life	Single w/Train	Mltp. w/Train	Restriction Column S.I. 1160	Builder
100-144	RS-3	30	50	50	50	3	ALCO
200-400	F40PH	80	80	100	100	4	EMD
480-491	FL-9	50	60	100	100	4	EMD
495-497	E8a	50	60	98	98	4	EMD
550-567	SSB1200	30	45	50	50	1	EMD
575, 577, 581, 582, 588, 591, 596	CF-7	30	60	65	65	3(c)	EMD
578, 579, 580, 583, 586, 590	CF-7	30	60	65	65	3	EMD
600-615★	E60CP	80	80	90	90(a)	6(b)	GE
730-745	SW1	30	45	50	50	1	EMD
764-775	GP9	30	60	65	65	3	EMD
776-783	GP7	30	60	65	65	3	EMD
900-946★	AEM-7	60	80	125	125	6	EMD
950-957 964, 965, 969, 970, 974, 975★	E60CP	80	60	80	80(a)	6(b)	GE

NOTES
★Electric Engines

(a) Trains operated with multiple E60-CP Engines must not exceed 50 MPH between the westward limits of A Interlocking and the Eastward limits of Hudson Interlocking (New York Division)

(b) Class E60-CP engines must be operated in accordance with speed restrictions contained in Special Instruction **1157-B1a** in addition to restrictions in Special Instruction **1160-A1**.

(c) Class CF-7 Nos. 575, 577, 581, 582, 588, 591 & 596 are restricted West of New Haven Interlocking in addition to restriction in Special Instruction **1160-A1**.

Boston & Maine Corp. Engine Nos.	Bldr. Model	Speed MPH: Life	Mltp. Life	With Train	Notes at End of Table	Restriction Column 1160-A1	Builder
1206	NW2	40	40	45	—	2	EMD
1119-1132	SW1	40	40	45	—	1	EMD
200-211	GP38-2	30	60	65	—	3	EMD
300-317,	GP40-2	30	60	65	--	3	EMD
MBTA							
1000-1017	F40PH	50	60	100	—	4	EMD
1100-1112	F-10	40	40	80	—	3	EMD
1150-1153	F10S	40	40	80	—	3	EMD
1900	SW-1	40	40	45	—	1	EMD
1920-1923	GP9	50	50	60	--	3	EMD
MARC (Maryland D.O.T.)							
4900-4903★	AEM 7	60	80	110	—	6	EMD

Rev G.O. 403 10-26-86

1157-G1. Cont'd

NJT Engine Nos.	Bldr. Model	Speed MPH: Lite	Speed MPH: Mltp. Lite	Speed MPH: With Train	Notes at end of Table	Restriction Column 1160-A1	Builder
D&H Engine Nos.							
7314-7325	GP38-2	30	60	65	—	3	EMD
7401-7420	GP39-2	30	60	65	—	3	EMD
7601-7620	GP39	30	60	65	—	3	EMD
417, 418, 420, 423-425	F7A	30	60	80	—	3	EMD
436, 438	SW9	30	45	50	—	2	EMD
958-963, 967, 971-973★	E60CP	80	80	80(a)	—	6(b)	GE
4100-4112	GP40P	30	60	70	—	3	EMD
4113-4139	F40PH-2B	30	60	100	—	4	EMD
4151-4182, (NYMTA) 4183	U34CH	30	60	75	—	5	GE
4246, 4248, 4251, 4253, 4257, 4258, 4267, 4270, 4272, 4285, 4305, 4320-4328, 4330-4335	E8A	50	60	80	—	4	EMD
5681, 5902, 5904-5908, 5910	GP7	30	60	65	—	3	EMD
7000, 7010, 7013, 7016	GP9	30	60	65	—	3	EMD

NOTES.
★Electric Engines

(a) Trains operated with multiple E60-CP Engines must not exceed 50 MPH between the westward limits of A Interlocking and the Eastward limits of Hudson Interlocking (New York Division)

(b) Class E60-CP engines must be operated in accordance with speed restrictions contained in Special Instruction **1157-G1a** in addition to restrictions in Special Instruction **1160-A1**.

Conrail Engine Nos.	Bldr. Model	Speed MPH: Lite	Speed MPH: Mltp. Lite	Speed MPH: With Train	Notes at end of Table	Restriction Column 1160-A1	Builder
1639-1891	F7a	30	60	65	—	3	EMD
1900-2023	B23-7	30	60	70	A	5	GE
2100-2112	GP20	30	60	65	—	3	EMD
2168-2187	GP30	30	60	65	A	3	EMD
2188-2249	GP30	30	60	65	—	3	EMD
2250-2399	GP35	30	60	65	—	3	EMD
2502-2582	U25B	30	60	70	A	3	GE
2583-2596	U25B	30	60	70	A-B-C-D	3	GE
2700-2776	U23B	30	60	70	—	3	GE
2777-2788	U23B	30	60	70	A-B-C	3	GE
2789-2798	U23B	30	60	70	—	3	GE
2800-2816	B23-7	30	60	70	A	5	GE
2830-2863	U30B	30	60	70	—	3	GE
2890-2970	U33B	30	60	70	—	5	GE
2971-2974	U36B	30	60	70	—	5	GE
3000-3274	GP40	30	60	70	—	3	EMD
3275-3279	GP40-2	30	60	70	A-C	5	EMD
3280-3403	GP40-2	30	60	70	—	5	EMD
3620-3692	GP35	30	60	65	A	3	EMD
4020-4022	E8a	50	60	90	—	4	EMD
5000-5059	B36-7	30	60	70	—	5	EMD
5400-5485	RSC	30	60	65	—	3	ALCO
5600-5675	GP7	30	60	65	—	3	EMD

Rev G.O. 403 10-26-86

356

1157-G1. Cont'd

EQUIPMENT	Miles per Hour
Amfleet car series 20000 to 22999, 25000 to 25124, 26002, 26030, 26036, 26045, 26053, 26057, 26063, 26064, 26065, 26067, 28000 to 28024 43000 to 43053, 43300 to 43307, 44000 to 44270, 44800 to 44889, 44909 to 44984, 48117 to 48146, 48211 to 48242, 48900 to 46926 and 46970 ..... (Series 43000, 44000 and 48000 equipped for Push-Pull operation.) With over-inflated air bellows (air springs): (a) Diverting movements over crossovers and turnouts ..... (b) All other movement ..... Note: See Special Instruction **1154-A3.** (c) Movements with defective bolster anchor radius rod ..... Note: See Special Instruction **1154-A5.**	125 15 30 30
AMTRAK passenger car SERIES 1000 through 10613	105
AMTRAK inspection cars 10001 and 10002	125
AMTRAK cabin cars series 14000-14027	45
AMTRAK wheel cars series 15011-15012-15214 .	45
AMTRAK Baggage Cars Nos. 1001 to 1006 ...	105
AMTRAK Material Handling Cars Series MHC 1400 to 1473	105
Conrail Office Car Nos. 1, 2, 3, 4, 8, 9, 10, 11, 12, 20 ..... Nos. 21, 22, 25, 26	105 90

1157-G1a. CLASS E60CP SPEED RESTRICTIONS

MAIN LINE—NEW YORK TO PHILADELPHIA

Between	Tracks 1	2	3	4
F and Eastern Limits C and JO	35	35	35	35
MP 4.6 (Bridge 4.61)	70	70		
MP 4.7 (Bridge 4.76) and MP 4.9 (Bridge 4.95)	45	45		
MP 5.6 (Bridge 5.65) and MP 6.8 (Bridge 6.86)	60	60		
MP 7.8 (Bridge 7.85) and MP 7.9 (Bridge 7.96)	40	40		
MP 26.1 (Bridge 26.23)	70	70	70	70
North Philadelphia: Eastward and Westward Station Tracks 40 MPH No. 1 and No. 4 Station Tracks 40 MPH				

MAIN LINE—PHILADELPHIA TO WASHINGTON

Between	Tracks 1	2	3	4
B&P Jct. and Fulton		25	25	

Rev G.O. 403 10-26-86

359

APPENDIX E

AMTRAK NORTHEAST CORRIDOR BULLETIN ORDERS

Amtrak NORTHEAST CORRIDOR, BULLETIN ORDER NO. 4-36, CONTINUED.

(b) PASSENGER TRAINS AND FREIGHT TRAINS
Maximum speeds and Speed Restrictions, unless otherwise restricted by Special Instruction 1157-G1.

MAIN LINE - PHILADELPHIA TO WASHINGTON

	MAXIMUM SPEEDS									
	No. 4 Track		No. 3 Track		No. 2 Track		No. 1 Track		Other Track	
Between	Psgr	Frt	Psgr	Frt	Psgr	Frt	Psgr	Frt	Psgr	Frt
Yard and Ragan			125	50	125	50				
Ragan and Bacon			125	50	125	50	110	50		
Track A between Davis and Iron									35	35
Bacon and MP 53			125	50	125	50				
MP 53 and Prince			110	50	110	50				
Prince and MP 58	65	50	110	50	110	50	65	50		
MP 58 and southward limits of Perry Interlocking	65	50	125	50	125	50	65	50		
Southward limits of Perry Interlocking and Grace			90	40	90	40				
Grace and Oak	65	50	80	50	80	50	125	50		
Oak and MP 64	125	50	80	50	125	50				
MP 64 and MP 66	110	50	80	50	110	50				
MP 66 and Bush	125	50	80	50	125	50				
Through Bush Interlocking	125	50	125	50	125	50				
Bush and Gunpow			125	50	125	50				
Gunpow and MP 85			125	50	125	50	110	50		
MP 85 and River			110	50	110	50	110	50		
Track A between Gunpow and River									80	50
River and Point			110	50	110	50	110	50		
Point and Bay			100	50	125	50	100	50		
Bay and Union Junction			60	35	60	40	60	35		
Track A between Bay and Union Junction									35	35
Through Union Tunnels			45	30	45	30	45	30		
Southward portals of Union Tunnels and southward limits B&P Junction Interlocking	ALL TRACKS 15 MPH									
Southward limits B&P Junction Interlocking and Fulton	30	20			30	20				
Gauntlet Track (B&P Tunnel)									30	20
Track A between Bridge and Winans									80	50
Bridge and Frederick Road							75	50		
Fulton and Frederick Road			75	50	75	50				
Frederick Road and MP 101			100	50	125	50	90	50		
MP 101 and MP 107			110	50	110	50	110	50		
MP 107 and Grove			125	50	125	50	110	50		
Grove and MP 125			125	50	125	50	80	50		
MP 125 and Landover			110	50	110	50	80	50		
Landover and MP 133			105	50	105	50				
MP 133 and Division Post (W.T)			85	50	85	50				

Amtrak NORTHEAST CORRIDOR, BULLETIN ORDER NO. 4-36, CONTINUED.

SPEED RESTRICTIONS

Between	No. 4 Track Psgr/Frt	No. 3 Track Psgr/Frt	No. 2 Track Psgr/Frt	No. 1 Track Psgr/Frt	Other Track Psgr/Frt
Curve at MP 29		110 50	110 50		
Curve at MP 30		110 50	110 50		
Curve north of MP 33		110 50	110 50		
First curve south of Davis		115 50	110 50		
Curve at MP 47		115 50	115 50		
Curve at MP 49		110 50	110 50		
Curve at MP 50		90 50	90 50	90 50	
Curve at MP 57, north of Prince		95 50	95 50		
First curve south of Grace				90 50	
Curve north of Bush	120 50		120 50		
First curve south of Magnolia		120 50	120 50		
First curve north of Gunpow		100 50	100 50		
Reverse curves May Interlocking		50 35		50 35	
Curve at MP 94		45 35	45 35	45 35	
Curve at Fulton		40 40	40 40		
First curve south of Bridge		50 50	50 50	50 50	
Track A					30 30
First curve north of Frederick Road Station			70 50	70 50	
Track A					55 40
First curve south of Frederick Road Station					
Track A					60 40
First curve south of MP 101		105 50	105 50	105 50	
Curve at Winans		100 50	100 50	100 50	
Curve south of MP 106		90 50	90 50	90 50	
All curves MP 110 to MP 118		120 50	120 50		
Curve south of MP 120		110 50	110 50		
Curve at Landover		100 50	100 50		
Curve at Division Post (W.T.)		45 45	45 45		

Special Instruction 1157-C1, pages 346, 347 and 348 changed.

(c) MAIN LINE - PHILADELPHIA TO HARRISBURG
ZOO
Facing point, interlocked crossover (No. 39) for eastward movements from No. 1 Track to No. 2 Track, located east of 34th Street OHB, removed from service

(d) MAIN LINE - PHILADELPHIA TO HARRISBURG
ZOO - PAOLI
The following track is temporarily out of service but may be used by Maintenance of Way equipment:
Paoli: Fillout Track
Overbrook: Dump Siding

(e) MAIN LINE - PHILADELPHIA TO HARRISBURG
Cain - Park
No. 4 Track between MP 36.6 and Park Block and Interlocking Station, in service for electrical operation.
Paragraph (ff) and (kk) of General Order 401, annulled.

APPENDIX F

AMTRAK EQUIPMENT CONDITION REPORT

[redacted] NATIONAL RAILROAD PASSENGER CORPORATION

MAP 'X'
(3) TRAIN S / M

(1) EQUIPMENT CONDITION REPORT — CONSIST UNIT NUMBERS: 900 | 903 | | | | | 99

Each locomotive unit, self propelled car and turbotrain shall be inspected in accordance with the Code of Federal Regulations, Title 49, Part 229, Railroad Locomotive Safety Standards and Cab Card MAP 101 signed.

	REPAIRS NEEDED	ENGR. INIT.	REPAIRED BY
4	HAND BRAKE ON, ISOLATED	[illegible]	
5			
6	RADIO MISSING F AND 903		[illegible]
7			
8	FAULT CODES MISSING 900 & 903		
9			
10			
11			
12			
13			
14			
15			
16			

17. CONDITION OF SPEED INDICATOR ok
18. CONDITION OF ST. GEN OR H.E.P. ok
19. BRAKE PIPE PRESSURE 110 LBS
20. MAIN RESERVOIR PRESSURE 140-130 LBS
21. CONDITION OF BRAKES & RIGGING OPERATIVE
22. CONDITION OF DYNAMIC BRAKE "
23. CONDITION OF RADIO "
24. CONDITION OF CROSSING BELL "
25. CONDITION OF SANDERS "

26. CONDITION OF FIRST AID KIT WHERE REQUIRED BY STATE LAW
27. CAB SIGNAL DEPART. TEST FRONT END ok REAR END ok
28. DATE 1-3-87 SIGNATURE [signature] TITLE Elec
29. TIME 9 10 P M LOCATION SBRR
30. CONDITION OF CAB SIG. DURING TRIP ok
31. CONDITION OF SPEED CONTROL
32. CONDITION OF DEADMAN FEATURE OR ALERTOR
33. CONDITION OF HORN
34. CONDITION OF WINDOW WIPER
35. CONDITION OF PUBLIC ADDRESS SYSTEM, INTERCOM, AND ANNUNCIATOR

When Failure Occured ("0" Applicable Number) Elec. Loco. Write In Throttle Position

36 Speed	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	OVER 8
37 Throttle Position	Idle	1	2	3	4	5	6	7	8									
38 Amp. (Motoring)	0	50	100	150	200	250	300	350	400	500	600	700	800	900	1000	1100	1200	
39 Amp (Dyn Brking)	0	50	100	150	200	250	300	350	400	450	500	550	600					
40 Lube Oil Pressure		5	10	15	20	25	30	40	50	60	70	80						
41 Fuel Oil Pressure		5	10	15	20	25	30	40	50	60	70	80						
42 Turbo Pressure		5	10	15	20	25	30	40	50	60	70	80						

	Signature of employee making inspection	Occupation	Place	Date	Time
43	[signature]	Elec.	QC	1/3/87	12:20 PM
44					
45					
46					
47					
48					

49 PREVIOUS INSPECTION DATES

45 Days _____ Location _____ 368 Days _____ Location _____
92 Days _____ Location _____ 736 Days _____ Location _____

THE ABOVE WORK HAS BEEN PERFORMED, EXCEPT AS NOTED, AND THE REPORT IS APPROVED.

SIGNATURE [signature] OCCUPATION Elec. AVAILABLE FOR SERVICE DATE 1-3-87 TIME 12:20 PM

Rev. 6/83

STOCK NO. 013 51

APPENDIX G

CONRAIL EL 106-A AND MP-94 INSPECTION REPORTS

EL 106-A REV 5-84 Printed in USA MU

CONRAIL

FRA No. 2A

Locomotive inspection report

Each locomotive unit shall be inspected in accordance with Rule 203 of the laws, rules, and instructions for inspection and testing of locomotives other than steam.

Train symbol:	Units: 3 Show initial CR	1 5045	2 5052	3 5044	4	5	6
TV22		7	8	9	10	11	12

Consist position	Report code	Electrical problems
_____	11	Trips ground relay in ☐ motoring, ☐ dyn. braking
		How many times did ground relay trip? _____
_____	16	Wheel slip in ☐ motoring, ☐ dyn. braking at _____ mph
_____	20	Dyn. brake not working (no amperage)
_____	20	Dyn. brake too heavy or erratic ☐ Brake warning light comes on
_____	13	Not loading (no amperage)
_____	08	Not loading properly (not enough amps. or drops amps. frequently)
_____	17	Will not make transition at _____ mph.

Consist position	Report code	Engine problems
_____		Engine dies:
	66	☐ Low oil tripped
	57	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	38	☐ No apparent reason
_____	43	Engine makes black smoke or has fire out of stack
_____	30	Engine has unusual noise or vibration
_____	33	Engine hunts badly
_____	15	Engine has hot engine alarm

Consist position	Report code	Miscellaneous defects
_____	24	Radio
_____	78	Speed indicator and/or recorder not working
_____	83	Air brake equipment (explain in "Remarks")
_____	89	Water cooler not working
_____	87	Defective lighting
_____	23	Cab signal (explain in "Remarks")

Cab signal departure test

A end _____ B end _____

Date _____ Time _____

Location REMY

Signature _____

Title _____

Main reservoir pressure 135 lbs. Brake pipe pressure 90 lbs.

Condition of brakes and brake rigging OPERATIVE

Outbound consist tested per MP 751 procedures.

Signature _____ Time _____ Date _____

Signature _____ Time _____ Date _____

Place _____

Other defects and remarks:

1) CLEAN CONSIST WINDOWS
2) CLEAN BOX-STAND PIPES
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)
15)

Repaired by _____

Signature of employee making inspection	Occupation	Place	Date	Time
C. Cordero	Engr.	Bay	12-4-86	1:35 PM

The above work has been performed, except as noted, and the report is approved	Signature	Occupation	Available for service Date	Time	M

EL 1044-A RB 2-86 Printed in USA MU

CONRAIL

FRA No

Locomotive inspection report

Each locomotive unit shall be inspected in accordance with Rule 200 of the laws, rules, and instructions for inspection and testing of locomotives other than steam

Train symbol	Units	1	2	3	4	5	6
TV79	3 Show initial CR	5044	3262	5009			
		7	8	9	10	11	12

Consist position	Report code	Electrical problems
_____	11	Trips ground relay in ☐ motoring, ☐ dyn braking
		How many times did ground relay trip? _____
_____	16	Wheel slip in ☐ motoring, ☐ dyn. braking at _____ mph
_____	20	Dyn brake not working (no amperage)
_____	20	Dyn. brake too heavy or erratic ☐ Brake warning light comes on
_____	13	Not loading (no amperage)
_____	08	Not loading properly (not enough amps or drops amps frequently)
_____	17	Will not make transition at _____ mph.

Consist position	Report code	Engine problems
_____		Engine dies:
	36	☐ Low oil tripped
	57	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	38	☐ No apparent reason
_____	43	Engine makes black smoke or has fire out of stack
_____	30	Engine has unusual noise or vibration
_____	33	Engine hunts badly
_____	15	Engine has hot engine alarm

Consist position	Report code	Miscellaneous defects
_____	24	Radio
_____	78	Speed indicator and/or recorder not working
_____	83	Air brake equipment (explain in "Remarks")
_____	89	Water cooler not working
_____	87	Defective lighting
_____	23	Cab signal (explain in "Remarks")

Cab signal test

A end _____ B end _____

Date _____ Time _____

Location _____

Signature _____

Title _____

Main reservoir pressure 130/140 lbs. Brake pipe pressure 90 lbs.

Condition of brakes and brake rigging Operative

Outbound consist tested per MP 751 procedures.

Signature _____ Time _____ Date _____

Signature _____ Time _____ Date _____

Place _____

Other defects and remarks:

1)
2) No defects Engines fueled to capacity at No Bergen.
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)
15)

Repaired by

Signature of employee making inspection	Occupation	Place	Date	Time
BW Gerhold	Engr.	Selkirk	12-20-86	650a

The above work has been performed except as noted, and the report is approved	Signature	Occupation	Available for service Date	Time	M

6

EL 106-A. R8 2-86 Printed in USA MU

CONRAIL

FRA No. 2A

Locomotive inspection report

Each locomotive unit shall be inspected in accordance with Rule 200 of the laws, rules, and instructions for inspection and testing of locomotives other than steam.

From symbol:	Units: Show initial	1 5545	2	3	4	5	6
		7	8	9	10	11	12

Consist position	Report code	Electrical problems
_____	11	Trips ground relay in ☐ motoring, ☐ dyn. braking
		How many times did ground relay trip? _____
_____	16	Wheel slip in ☐ motoring, ☐ dyn. braking at _____ mph
_____	20	Dyn. brake not working (no amperage)
_____	20	Dyn. brake too heavy or erratic ☐ Brake warning light comes on
_____	13	Not loading (no amperage)
_____	08	Not loading properly (not enough amps or drops amps frequently)
_____	17	Will not make transition at _____ mph.

Consist position	Report code	Engine problems
_____		Engine dies:
	66	☐ Low oil tripped
	67	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	39	☐ No apparent reason
_____	43	Engine makes black smoke or has fire out of stack
_____	30	Engine has unusual noise or vibration
_____	33	Engine hunts badly
_____	15	Engine has hot engine alarm

Consist position	Report code	Miscellaneous defects
_____	24	Radio
_____	78	Speed indicator and/or recorder not working
_____	83	Air brake equipment (explain in "Remarks")
_____	89	Water cooler not working
_____	87	Defective lighting
_____	23	Cab signal (explain in "Remarks")

Cab signal test

A end 5045 B end _____

Date 01-02-87 Time 8:05 AM

Location Enola Yard

Signature _____

Title Elect.

Main reservoir pressure _____ lbs. Brake pipe pressure _____ lbs.

Condition of brakes and brake rigging _____

Outbound consist tested per MP 751 procedures.

Signature _____ Time _____ Date _____

Signature _____ Time _____ Date _____

Place _____

Other defects and remarks:	Repaired by
1)	
2)	
3)	
4)	
5)	
6)	
7)	
8)	
9)	
10)	
11)	
12)	
13)	
14)	
15)	

Signature of employee making inspection	Occupation	Place	Date	Time

The above work has been performed, except as noted, and the report is approved	Signature	Occupation	Available for service Date Time M

3

EL 106-A R8 2-86 Printed in USA MU

CONRAIL

Locomotive inspection report

FRA No

Each locomotive unit shall be inspected in accordance with Rule 203 of the laws, rules, and instructions for inspection and testing of locomotives other than steam.

Train symbol	Units 3 / Show initial CR	1	2 5044	3	4	5	6
TV-13		7	8	9	10	11	12

Electrical problems

Consist position	Report code	Electrical problems
______	11	Trips ground relay in ☐ motoring, ☐ dyn. braking
		How many times did ground relay trip? ______
______	16	Wheel slip in ☐ motoring, ☐ dyn braking at ______ mph
______	20	Dyn brake not working (no amperage)
______	20	Dyn brake too heavy or erratic ☐ Brake warning light comes on
______	13	Not loading (no amperage)
______	03	Not loading properly (not enough amps, or drops amps frequently)
______	17	Will not make transition at ______ mph.

Engine problems

Consist position	Report code	Engine problems
______		Engine dies:
	66	☐ Low oil tripped
	57	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	38	☐ No apparent reason
______	43	Engine makes black smoke or has fire out of stack
______	30	Engine has unusual noise or vibration
______	33	Engine hunts badly
______	15	Engine has hot engine alarm

Miscellaneous defects

Consist position	Report code	Miscellaneous defects
______	24	Radio
______	78	Speed indicator and/or recorder not working
______	80	Air brake equipment (explain in "Remarks")
______	89	Water cooler not working
______	87	Defective lighting
______	23	Cab signal (explain in "Remarks")

Cab signal test

A end ______ B end ______

Date ______ Time ______

Location ______

Signature ______

Title ______

Outbound consist tested per MP 751 procedures.

Signature ______ Time ______ Date ______

Signature ______ Time ______ Date ______

Place ______

Main reservoir pressure ______ lbs Brake pipe pressure ______ lbs.

Condition of brakes and brake rigging ______

Other defects and remarks:

1)
2)
3) SAD 1101.8 [illegible]
4)
5)
6)
7) [illegible]
8)
9)
10)
11)
12) 11-18-86 ALTOONA
13)
14)
15)

Repaired by

Signature of employee making inspection	Occupation	Place	Date	Time
[signature]	Mach	57 ST	1-1-87	

The above work has been performed except as noted and the report is approved	Signature [signature]	Occupation	Available for service Date Time M

4

Daily or trip inspection report—51st Street Engine House

CONRAIL

Location Inspected _____ Unit No. 5044 Date 12-21-86

A. Mechanical (Report Defects Found on EL-106A)	Machinist Signature
1. Inspect for Fuel, Lube Oil and Water Leaks	
2. Test Air Brake in accordance with S.M.R. 1000	
3. Check Safety Control Operation & Seal Cut-Out Cock	
4. Check Level of Water, Lube Oil, Governor Oil & Air Comp. Oil	
5. Inspect Water Fill Pressure Cap for defects & tightness	
6. Check Operation of Low water and Low oil shutdown devices	
7. Inspect running gear	
8. Check any unusual noises	
9. Date and sign EL-107A Cab Card	

B. Electrical (Report Defects Found on EL-106A)	Electrician Signature
1. Inspect Electrical Cabinets, Lighting & Seals	
2. Check for proper Radio Operation	
3. Check for Traction Motor Cut-Out	
4. Inspect for Missing Traction Motor Covers	
5. Check Operation of Alarm Bell, Wheel Slip Indication, Sander Operation, Shutters and Cooling Fans	
6. Make Load Test, Forward and Reverse	
7. Make Cab Signal Test as required and apply Test Sheet in Cab. Time and Date of Test	

C. Sheet Metal Worker (Report Defects Found on EL-106A)	Sheetmetal Worker Signature
1. Check Sanders for proper operation	
2. Clean & Check Water Cooler Operation	
3. Check Toilet Operation	

D. Laborer	Laborer Signature
1. Clean Cab, Windows, Toilet & Nose Compartment	
2. Supply Cab with required Flagging & Emergency Equipment	
3. Supply Drinking Cups & Water Cooler Bottle if out of date	
4. Fill Fuel Tank & Toilet Water Tank	
5. Fill Sand Boxes	

The above work has been performed, except as noted on attached EL-106A, and the report is approved. Time and Date 12-21 5:30A	Supervisor Signature B. Miller

8

Daily or trip inspection report—51st Street Engine House CONRAIL

Location Inspected 51 ST Unit No. 5044 Date 1-1-87

	Machinist Signature
A. Mechanical (Report Defects Found on EL-106A)	
1. Inspect for Fuel, Lube Oil and Water Leaks	[signature]
2. Test Air Brake in accordance with S.M.R. 1000	
3. Check Safety Control Operation & Seal Cut-Out Cock	
4. Check Level of Water, Lube Oil, Governor Oil & Air Comp. Oil	[signature]
5. Inspect Water Fill Pressure Cap for defects & tightness	[signature]
6. Check Operation of Low water and Low oil shutdown devices	[signature]
7. Inspect running gear	[signature]
8. Check any unusual noises	[signature]
9. Date and sign EL-107A Cab Card	[signature]
	Electrician Signature
B. Electrical (Report Defects Found on EL-106A)	
1. Inspect Electrical Cabinets, Lighting & Seals	[signature]
2. Check for proper Radio Operation	
3. Check for Traction Motor Cut-Out	
4. Inspect for Missing Traction Motor Covers	
5. Check Operation of Alarm Bell, Wheel Slip Indication, Sander Operation, Shutters and Cooling Fans	
6. Make Load Test, Forward and Reverse	
7. Make Cab Signal Test as required and apply Test Sheet in Cab. Time and Date of Test	
	Sheetmetal Worker Signature
C. Sheet Metal Worker (Report Defects Found on EL-106A)	
1. Check Sanders for proper operation	
2. Clean & Check Water Cooler Operation	
3. Check Toilet Operation	
	Laborer Signature
D. Laborer	
1. Clean Cab, Windows, Toilet & Nose Compartment	
2. Supply Cat with required Flagging & Emergency Equipment	
3. Supply Drinking Cups & Water Cooler Bottle if out of date	
4. Fill Fuel Tank & Toilet Water Tank	
5. Fill Sand Boxes	

The above work has been performed, except as noted on attached EL-106A, and the report is approved. Time and Date 1/1	Supervisor Signature [signature]

5

SPECIAL MAXIMUM SPEEDS, UNLESS OTHERWISE RESTRICTED

ALL DIVISIONS

1157-C2. PASSENGER TRAINS—Passenger trains consisting of more than 30 cars must not exceed 60 MPH.

1157-C3. TV TRAINS—A Trail Van (TV) train is a freight train consisting of multi-level automobile carrying cars, flat cars carrying trailers in piggy-back service, with or without passenger equipment cars and freight cabooses. TV trains consisting of 61 cars or more must not exceed the maximum speed for freight trains. TV trains consisting of 60 or less cars may operate up to but not exceeding 60 MPH where the freight train speed is 50 MPH, at the following locations:

Main Line—New York to Philadelphia
Between:
Automatic Block Signal No. 157/158 and MP 54
East End Delaware River Bridge and MP 76

Main Line—Philadelphia to Washington
Between:
Phil and Baldwin (Southward moves only)
Baldwin and Bell
Bell and Bay (Southward moves only)
Gwynn and Landover

Main Line—Philadelphia to Harrisburg
Between:
Paoli and State

NOTE: When combined with any other freight train, TV trains must operate at freight train speeds.

Rev. G.O. 402 8-25-86

351

Electric engines coupled with proper pantograph-up arrangement will be operated as follows:

Number of Units	Maximum Permissible Speed
5	50 MPH unless otherwise restricted
6	35 MPH unless otherwise restricted
Over 6	Prohibited

Amtrak-NEC Engine Nos.	Bldr. Model	Speed MPH: Lite	Mltp. Lite	Single w/Train	Mltp. w/Train	Restriction Column S.I. 1150	Builder
100-144	RS-3	30	50	50	50	3	ALCO
200-400	F40PH	60	80	100	100	4	EMD
480-491	FL-9	50	60	100	100	4	EMD
495-497	E9a	50	60	98	98	4	EMD
550-567	SSB1200	30	45	50	50	1	EMD
575, 577, 581, 582, 588, 591, 596	CF-7	30	60	65	65	3(c)	EMD
578, 579, 580, 583, 586, 590	CF-7	30	60	65	65	3	EMD
600-615★	E60CP	80	80	90	90(a)	6(b)	GE
730-745	SW1	30	45	50	50	1	EMD
764-775	GP9	30	60	65	65	3	EMD
776-783	GP7	30	60	65	65	3	EMD
900-946★	AEM-7	60	80	125	125	6	EMD
950-957 964, 965, 969, 970, 974, 975★	E60CP	80	80	80	80(a)	6(b)	GE

NOTES
★Electric Engines

(a) Trains operated with multiple E60-CP Engines must not exceed 50 MPH between the westward limits of A Interlocking and the Eastward limits of Hudson Interlocking (New York Division).

(b) Class E60-CP engines must be operated in accordance with speed restrictio is contained in Special Instruction **1157-B1a** in addition to restrictions in Special Instruction **1160-A1.**

(c) Class CF-7 Nos 575, 577, 581, 582, 588, 591 & 596 are restricted West of New Haven Interlocking in addition to restriction in Special Instruction **1160-A1.**

Boston & Maine Corp. Engine Nos.	Bldr. Model	Speed MPH: Lite	Mltp. Lite	With Train	Notes at End of Table	Restriction Column 1160-A1	Builder
1206	NW2	40	40	45	--	2	EMD
1119-1132	SW1	40	40	45	---	1	EMD
200-211	GP38-2	30	60	65	---	3	EMD
300-317,	GP40-2	30	60	65	---	3	EMD
MBTA							
1000-1017	140PH	50	60	100	---	4	EMD
1100-1112	F-10	40	40	80	---	3	EMD
1150-1153	F10S	40	40	80	---	3	EMD
1900	SW-1	40	40	45	---	1	EMD
1920-1923	GP9	50	50	60	---	3	EMD
MARC (Maryland D.O.T.)							
4900-4903★	AEM-7	60	80	110	--	6	EMD

Rev G O 403 10-26-86

355

1157-G1. Cont'd

AJT Engine Nos. / D&H Engine Nos.	Bldr. Model	Speed MPH: Lite	Speed MPH: Mltp. Lite	Speed MPH: With Train	Notes at end of Table	Restriction Column 1160-A1	Builder
7314-7325	GP38-2	30	60	65	—	3	EMD
7401-7420	GP39-2	30	60	65	—	3	EMD
7601-7620	GP30	30	60	65	—	3	EMD
417, 418, 420, 423-425	F7A	30	60	80	—	3	EMD
436, 438	SW9	30	45	50	—	2	EMD
958-963, 967, 971-973★	E60CP	80	80	80(a)	—	6(b)	GE
4100-4112	GP40P	30	60	70	—	3	EMD
4113-4139	F40PH-2B	30	60	100	—	4	EMD
4151-4182, (NYMTA) 4183	U34CH	30	60	75	—	5	GE
4246, 4248, 4251, 4253, 4257, 4258, 4267, 4270, 4272, 4285, 4305, 4320-4328, 4330-4335	E8A	50	60	80	—	4	EMD
5681, 5902, 5904-5908, 5910	GP7	30	60	65	—	3	EMD
7000, 7010, 7013, 7016	GP9	30	60	65	—	3	EMD

NOTES

★Electric Engines

(a) Trains operated with multiple E60-CP Engines must not exceed 50 MPH between the westward limits of A Interlocking and the Eastward limits of Hudson Interlocking (New York Division)

(b) Class E60-CP engines must be operated in accordance with speed restrictions contained in Special Instruction **1157-G1a** in addition to restrictions in Special Instruction **1160-A1**.

Conrail Engine Nos.	Bldr. Model	Speed MPH: Lite	Speed MPH: Mltp. Lite	Speed MPH: With Train	Notes at end of Table	Restriction Column 1160-A1	Builder
1639-1891	F7a	30	60	65	—	3	EMD
1900-2023	B23-7	30	60	70	A	5	GE
2100-2112	GP20	30	60	65	—	3	EMD
2168-2187	GP30	30	60	65	A	3	EMD
2188-2249	GP30	30	60	65	—	3	EMD
2250-2399	GP35	30	60	65	—	3	EMD
2502-2582	U25B	30	60	70	A	3	GE
2583-2596	U25B	30	60	70	A B C D	3	GE
2700-2776	U23B	30	60	70	—	3	GE
2777-2788	U23B	30	60	70	A-B-C	3	GE
2789-2798	U23B	30	60	70	—	3	GE
2800-2816	B23-7	30	60	70	A	5	GE
2830-2863	U30B	30	60	70	—	3	GE
2890-2970	U33B	30	60	70	—	5	GE
2971-2974	U36B	30	60	70	—	5	GE
3000-3274	GP40	30	60	70	—	3	EMD
3275-3279	GP40-2	30	60	70	A-C	5	EMD
3280-3403	GP40-2	30	60	70	—	5	EMD
3620-3692	GP35	30	60	65	A	3	EMD
4020-4027	E8a	50	60	90	—	4	EMD
5000-5059	B36-7	30	60	70	—	5	EMD
5400-5405	RS3	30	60	65	—	3	ALCO
5600-5675	GP7	30	60	65	—	3	EMD

Rev G U 403 10-26-86

1157-G1. Cont'd

EQUIPMENT	Miles per Hour
Amfleet car series 20000 to 22999, 25000 to 25124, 26002, 26030, 26036, 26045, 26053, 26057, 26063, 26064, 26065, 26067, 28000 to 28024 43000 to 43053, 43300 to 43307, 44000 to 44270, 44800 to 44869, 44909 to 44984, 48117 to 48146, 48211 to 48242, 48900 to 48926 and 48970 (Series 43000, 44000 and 48000 equipped for Push-Pull operation.) With over-inflated air bellows (air springs): (a) Diverting movements over crossovers and turnouts (b) All other movement Note: See Special Instruction **1154-A3**. (c) Movements with defective bolster anchor radius rod Note: See Special Instruction **1154-A5**.	125 15 30 30
AMTRAK passenger car SERIES 1000 through 10613	105
AMTRAK inspection cars 10001 and 10002	125
AMTRAK cabin cars series 14000-14027	45
AMTRAK wheel cars series 15011-15012-15214	45
AMTRAK Baggage Cars Nos. 1001 to 1006	105
AMTRAK Material Handling Cars Series MHC 1400 to 1473	105
Conrail Office Car Nos. 1, 2, 3, 4, 8, 9, 10, 11, 12, 20 Nos. 21, 22, 25, 26	105 90

1157-G1a. CLASS E60CP SPEED RESTRICTIONS

MAIN LINE—NEW YORK TO PHILADELPHIA

Between	Tracks 1	2	3	4
F and Eastern Limits C and JO	35	35	35	35
MP 4.6 (Bridge 4.61)	70	70		
MP 4.7 (Bridge 4.76) and MP 4.9 (Bridge 4.95)	45	45		
MP 5.6 (Bridge 5.65) and MP 6.8 (Bridge 6.86)	60	60		
MP 7.8 (Bridge 7.85) and MP 7.9 (Bridge 7.96)	40	40		
MP 26.1 (Bridge 26.23)	70	70	70	70

North Philadelphia:
Eastward and Westward Station Tracks 40 MPH
No. 1 and No. 4 Station Tracks 40 MPH

MAIN LINE—PHILADELPHIA TO WASHINGTON

Between	Tracks 1	2	3	4
B&P Jct. and Fulton		25	25	

Rev G O 403 10-26-86

APPENDIX E

AMTRAK NORTHEAST CORRIDOR BULLETIN ORDERS

Amtrak NORTHEAST CORRIDOR, BULLETIN ORDER NO. 4-36, CONTINUED.

(b) PASSENGER TRAINS AND FREIGHT TRAINS
Maximum speeds and Speed Restrictions, unless otherwise restricted by Special Instruction 1157-G1.

MAIN LINE - PHILADELPHIA TO WASHINGTON

Between	MAXIMUM SPEEDS No. 4 Track Psgr/Frt	No. 3 Track Psgr/Frt	No. 2 Track Psgr/Frt	No. 1 Track Psgr/Frt	Other Track Psgr/Frt
Yard and Ragan		125 50	125 50		
Ragan and Bacon		125 50	125 50	110 50	
Track A between Davis and Iron					35 35
Bacon and MP 53		125 50	125 50		
MP 53 and Prince		110 50	110 50		
Prince and MP 58	65 50	110 50	110 50	65 50	
MP 58 and southward limits of Perry Interlocking	65 50	125 50	125 50	65 50	
Southward limits of Perry Interlocking and Grace		90 40	90 40		
Grace and Oak	65 50	80 50	80 50	125 50	
Oak and MP 64	125 50	80 50	125 50		
MP 64 and MP 66	110 50	80 50	110 50		
MP 66 and Bush	125 50	80 50	125 50		
Through Bush Interlocking	125 50	125 50	125 50		
Bush and Gunpow		125 50	125 50		
Gunpow and MP 85		125 50	125 50	110 50	
MP 85 and River		110 50	110 50	110 50	
Track A between Gunpow and River					80 50
River and Point		110 50	110 50	110 50	
Point and Bay		100 50	125 50	100 50	
Bay and Union Junction		60 35	60 40	60 35	
Track A between Bay and Union Junction					35 35
Through Union Tunnels		45 30	45 30	45 30	
Southward portals of Union Tunnels and southward limits B&P Junction Interlocking	ALL TRACKS 15 MPH				
Southward limits B&P Junction Interlocking and Fulton		30 20	30 20		
Gauntlet Track (B&P Tunnel)					30 20
Track A between Bridge and Winans					80 50
Bridge and Frederick Road				75 50	
Fulton and Frederick Road		75 50	75 50		
Frederick Road and MP 101		100 50	125 50	90 50	
MP 101 and MP 107		110 50	110 50	110 50	
MP 107 and Grove		125 50	125 50	110 50	
Grove and MP 125		125 50	125 50	80 50	
MP 125 and Landover		110 50	110 50	80 50	
Landover and MP 133		105 50	105 50		
MP 133 and Division Post (W.T)		85 50	85 50		

Amtrak NORTHEAST CORRIDOR, BU ETIN ORDER NO. 4-36, CONTINUED

SPEED RESTRICTIONS

Between	No. 4 Track Pagr/Frt	No. 3 Track Pagr/Frt	No. 2 Track Pagr/Frt	No. 1 Track Pagr/Frt	Other Track Pagr/Frt
Curve at MP 29	110 50	110 50			
Curve at MP 30	110 50	110 50			
Curve north of MP 33	110 50	110 50			
First curve south of Davis	115 50	110 50			
Curve at MP 47	115 50	115 50			
Curve at MP 49	110 50	110 50			
Curve at MP 50	90 50	90 50	90 50		
Curve at MP 57, north of Prince	95 50	95 50			
First curve south of Grace				90 50	
Curve north of Bush	120 50		120 50		
First curve south of Magnolia	120 50	120 50			
First curve north of Gunpow	100 50	100 50			
Reverse curves Bay Interlocking	50 35		50 35		
Curve at MP 94	45 35	45 35	45 35		
Curve at Fulton	40 40	40 40			
First curve south of Bridge	50 50	50 50	50 50		
Track A					30 30
First curve north of Frederick Road Station	70 50	70 50			
Track A					55 40
First curve south of Frederick Road Station					
Track A					60 40
First curve south of MP 101	105 50	105 50	105 50		
Curve at Winans	100 50	100 50	100 50		
Curve south of MP 106	90 50	90 50	90 50		
All curves MP 110 to MP 118	120 50	120 50			
Curve south of MP 120	110 50	110 50			
Curve at Landover	100 50	100 50			
Curve at Division Post (W.T.)	45 45	45 45			

Special Instruction 1157-C1, pages 346, 347 and 348 changed.

(c) MAIN LINE - PHILADELPHIA TO HARRISBURG
ZOO
Facing point, interlocked crossover (No. 39) for eastward movements from No. 1 Track to No. 2 Track, located east of 34th Street CHB, removed from service.

(d) MAIN LINE - PHILADELPHIA TO HARRISBURG
ZOO - PAOLI
The following track is temporarily out of service but may be used by Maintenance of Way equipment:
Paoli: Fillout Track
Overbrook: Dump Siding

(e) MAIN LINE - PHILADELPHIA TO HARRISBURG
Caln - Park
No. 4 Track between MP 36.6 and Park Block and Interlocking Station, in service for AC electrical operation.
Paragraph (ff) and (kk) of General Order 401, annulled.

APPENDIX F

AMTRAK EQUIPMENT CONDITION REPORT

Amtrak

NATIONAL RAILROAD PASSENGER CORPORATION

MAP 10[illegible]

(1) EQUIPMENT CONDITION REPORT

CONSIST UNIT NUMBERS: 900 | 903

(3) TRAIN SYM: 89

Each locomotive unit, self propelled car and turbotrain shall be inspected in accordance with the Code of Federal Regulations. Title 49, Part 229, Railroad Locomotive Safety Standards and Cab Card MAP 101 signed.

	REPAIRS NEEDED	ENGR. INIT.	REPAIRED BY
4	HAND BRAKE ON & ISOLATED	[illegible]	
5			
6	RADIO MISSING F AND 903		[illegible]
7			
8	FAULT CUBES MISSING 900 & 903		
9			
10			
11			
12			
13			
14			
15			
16			

17. CONDITION OF SPEED INDICATOR OK
18. CONDITION OF ST. GEN. OR H.E.P OK
19. BRAKE PIPE PRESSURE 110 LBS
20. MAIN RESERVOIR PRESSURE 140-130 LBS
21. CONDITION OF BRAKES & RIGGING OPERATIVE
22. CONDITION OF DYNAMIC BRAKE "
23. CONDITION OF RADIO "
24. CONDITION OF CROSSING BELL "
25. CONDITION OF SANDERS "
26. CONDITION OF FIRST AID KIT WHERE REQUIRED BY STATE LAW
27. CAB SIGNAL DEPART. TEST FRONT END OK REAR END OK
28. DATE 1-3-87 SIGNATURE [signature] TITLE [illegible]
29. TIME 9 10 PM LOCATION [illegible]
30. CONDITION OF CAB SIG. DURING TRIP OK
31. CONDITION OF SPEED CONTROL
32. CONDITION OF DEADMAN FEATURE OR ALERTOR
33. CONDITION OF HORN
34. CONDITION OF WINDOW WIPER
35. CONDITION OF PUBLIC ADDRESS SYSTEM, INTERCOM, AND ANNUNCIATOR

When Failure Occured ("0" Applicable Number) Elec. Loco. Write In Throttle Position

36 Speed	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	OVER 8[illegible]
37 Throttle Position	Idle	1	2	3	4	5	6	7	8									
38 Amp (Motoring)	0	50	100	150	200	250	300	350	400	500	600	700	800	900	1000	1100	1200	
39 Amp (Dyn Brking)	0	50	100	150	200	250	300	350	400	450	500	550	600					
40 Lube Oil Pressure		5	10	15	20	25	30	40	50	60	70	80						
41 Fuel Oil Pressure		5	10	15	20	25	30	40	50	60	70	80						
42 Turbo Pressure		5	10	15	20	25	30	40	50	60	70	80						

	Signature of employee making inspection	Occupation	Place	Date	Time
43	[signature]	Eng	DC	9 JAN 1987	12:20 Pm
44					
45					
46					
47					
48					

49 PREVIOUS INSPECTION DATES

46 Days ______ Location ______ 368 Days ______ Location ______

92 Days ______ Location ______ 736 Days ______ Location ______

THE ABOVE WORK HAS BEEN PERFORMED, EXCEPT AS NOTED, AND THE REPORT IS APPROVED.	SIGNATURE [signature]	OCCUPATION Foreman	AVAILABLE FOR SERVICE DATE 1-4-87 TIME 12 [illegible]

Rev. 6/83

STOCK NO. 013 51

APPENDIX G

CONRAIL EL 106-A AND MP-94 INSPECTION REPORTS

EL 106-A R7 5-84 Printed in USA MU

CONRAIL

FRA No. 2A

Locomotive inspection report

Each locomotive unit shall be inspected in accordance with Rule 200 of the laws, rules, and instructions for inspection and testing of locomotives other than steam.

Train symbol:	Units: 3	1 5045	2 5052	3 5044	4	5	6
T122	Show initial CR	7	8	9	10	11	12

Consist position	Report code	Electrical problems
_____	11	Trips ground relay in ☐ motoring, ☐ dyn. braking
		How many times did ground relay trip? _____
_____	16	Wheel slip in ☐ motoring, ☐ dyn. braking at _____ mph
_____	30	Dyn. brake not working (no amperage)
_____	20	Dyn. brake too heavy or erratic ☐ Brake warning light comes on
_____	13	Not loading (no amperage)
_____	08	Not loading properly (not enough amps. or drops amps frequently)
_____	17	Will not make transition at _____ mph.

Consist position	Report code	Engine problems
_____		Engine dies:
	66	☐ Low oil tripped
	57	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	38	☐ No apparent reason
_____	43	Engine makes black smoke or has fire out of stack
_____	80	Engine has unusual noise or vibration
_____	33	Engine hunts badly
_____	15	Engine has hot engine alarm

Consist position	Report code	Miscellaneous defects
_____	24	Radio
_____	78	Speed indicator and/or recorder not working
_____	83	Air brake equipment (explain in "Remarks")
_____	89	Water cooler not working
_____	87	Defective lighting
_____	23	Cab signal (explain in "Remarks")

Cab signal departure test

A end _____ B end _____

Date _____ Time _____

Location RELAY

Signature _____

Title _____

Main reservoir pressure 135 lbs. Brake pipe pressure 90 lbs.

Condition of brakes and brake rigging OPERATIVE

Outbound consist tested per MP 751 procedures.

Signature _____ Time _____ Date _____

Signature _____ Time _____ Date _____

Place _____

Other defects and remarks:

1) CLEAN CAB & WINDOWS
2) OPEN AIR-SAND PIPES
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)
15)

Repaired by

Signature of employee making inspection	Occupation	Place	Date	Time
C Coordinator	ENGR	BAY	12-4-86	1:35 PM

The above work has been performed, except as noted, and the report is approved	Signature	Occupation	Available for service Date	Time	AM

9

EL 1C4-A 88 2-86 Printed in USA MU

CONRAIL

FRA No

Locomotive inspection report

Each locomotive unit shall be inspected in accordance with Rule 203 of the laws, rules, and instructions for inspection and testing of locomotives and steam

Train symbol	Units 3 Show initial CR	1 5044	2 3262	3 5009	4	5	6
TV79		7	8	9	10	11	12

Consist position	Report code	Electrical problems
_____	11	Trips ground relay in ☐ motoring, ☐ dyn. braking How many times did ground relay trip? _____.
_____	16	Wheel slip in ☐ motoring, ☐ dyn. braking at _____ mph
_____	20	Dyn. brake not working (no amperage)
_____	20	Dyn. brake too heavy or erratic ☐ Brake warning light comes on
_____	13	Not loading (no amperage)
_____	08	Not loading properly (not enough amps or drops amps frequently)
_____	17	Will not make transition at _____ mph.

Consist position	Report code	Engine problems
_____		Engine dies:
	66	☐ Low oil tripped
	57	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	38	☐ No apparent reason
_____	43	Engine makes black smoke or has fire out of stack
_____	53	Engine has unusual noise or vibration
_____	33	Engine hunts badly
_____	15	Engine has hot engine alarm

Consist position	Report code	Miscellaneous defects
_____	24	Radio
_____	78	Speed indicator and/or recorder not working
_____	83	Air brake equipment (explain in "Remarks")
_____	89	Water cooler not working
_____	87	Defective lighting
_____	23	Cab signal (explain in "Remarks")

Cab signal test

A end _____ B end _____

Date _____ Time _____

Location _____

Signature _____

Title _____

Main reservoir pressure 130/140 lbs. Brake pipe pressure 90 lbs.

Condition of brakes and brake rigging operative

Outbound consist tested per MP 751 procedures.

Signature _____ Time _____ Date _____

Signature _____ Time _____ Date _____

Place _____

Other defects and remarks:

1) 2) No defects Engines fueled to capacity at No Bergen.
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)
15)

Repaired by

Signature of employee making inspection	Occupation	Place	Date	Time
BW Gerhold	Engr.	Selkirk	12-20-86	650a

The above work has been performed except as noted, and the report is approved	Signature	Occupation	Available for service Date Time M

6

SL 109-A RB 2-86 Printed in USA MU

CONRAIL

FRA No. 2A

Locomotive inspection report

Each locomotive unit shall be inspected in accordance with Rule 200 of the laws, rules, and instructions for inspection and testing of locomotives other than steam.

Train symbol:	Units: Show initial	1 5045	2	3	4	5	6
		7	8	9	10	11	12

Consist position	Report code	Electrical problems
_____	11	Trips ground relay, in ☐ motoring, ☐ dyn. braking
		How many times did ground relay trip? _____
_____	16	Wheel slip in ☐ motoring, ☐ dyn. braking at _____ mph
_____	20	Dyn. brake not working (no amperage)
_____	20	Dyn. brake too heavy or erratic ☐ Brake warning light comes on
_____	13	*Not loading (no amperage)*
_____	08	Not loading properly (not enough amps. or drops amps. frequently)
_____	17	Will not make transition at _____ mph.

Consist position	Report code	Engine problems
_____		Engine dies:
	86	☐ Low oil tripped
	87	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	38	☐ No apparent reason
_____	43	Engine makes black smoke or has fire out of stack
_____	70	Engine has unusual noise or vibration
_____	33	Engine hunts badly
_____	15	Engine has hot engine alarm

Consist position	Report code	Miscellaneous defects
_____	24	Radio
_____	78	Speed indicator and/or recorder not working
_____	83	Air brake equipment (explain in "Remarks")
_____	89	Water cooler not working
_____	87	Defective lighting
_____	23	Cab signal (explain in "Remarks")

Cab signal test

A end 5045 B end _____

Date 01-02-87 Time 8:05 AM

Location [illegible] 154 Chgo

Signature [illegible]

Title Elect.

Main reservoir pressure _____ lbs. Brake pipe pressure _____ lbs.

Condition of brakes and brake rigging _____

Outbound consist tested per MP 751 procedures.

Signature _____ Time _____ Date _____

Signature _____ Time _____ Date _____

Place _____

Other defects and remarks:	Repaired by
1)	
2)	
3)	
4)	
5)	
6)	
7)	
8)	
9)	
10)	
11)	
12)	
13)	
14)	
15)	

Signature of employee making inspection	Occupation	Place	Date	Time

The above work has been performed, except as noted, and the report is approved.	Signature	Occupation	Available for service Date Time M

3

EL 106A R8 2-86 Printed in USA MU

CONRAIL

Locomotive inspection report

FRA No

Each locomotive unit shall be inspected in accordance with Rule 203 of the laws, rules, and instructions for inspection and testing of locomotives other than steam.

Train symbol	Units / Show initial						
TV-13	Units 3	1	2 5044	3	4	5	6
	Show initial CR	7	8	9	10	11	12

Electrical problems

Consist position	Report code	Electrical problems
______	11	Trips ground relay in ☐ motoring, ☐ dyn. braking
		How many times did ground relay trip? ______
______	16	Wheel slip in ☐ motoring, ☐ dyn. braking at ______ mph
______	20	Dyn. brake not working (no amperage)
______	20	Dyn. brake too heavy or erratic ☐ Brake warning light comes on
______	13	Not loading (no amperage)
______	08	Not loading properly (not enough amps, or drops amps. frequently)
______	17	Will not make transition at ______ mph.

Engine problems

Consist position	Report code	Engine problems
______		Engine dies:
	66	☐ Low oil tripped
	57	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	38	☐ No apparent reason
______	43	Engine makes black smoke or has fire out of stack
______	30	Engine has unusual noise or vibration
______	33	Engine hunts badly
______	15	Engine has hot engine alarm

Miscellaneous defects

Consist position	Report code	Miscellaneous defects
______	24	Radio
______	78	Speed indicator and/or recorder not working
______	80	Air brake equipment (explain in "Remarks")
______	89	Water cooler not working
______	87	Defective lighting
______	23	Cab signal (explain in "Remarks")

Cab signal test

A end ______ B end ______

Date ______ Time ______

Location ______

Signature ______

Title ______

Main reservoir pressure ______ lbs Brake pipe pressure ______ lbs.

Condition of brakes and brake rigging ______

Outbound consist tested per MP 751 procedures.

Signature ______ Time ______ Date ______

Signature ______ Time ______ Date ______

Place ______

Other defects and remarks: | **Repaired by**

1)
2) SAO 1101.8 ___
3)
4)
5)
6) Pilot 20
7)
8)
9)
10)
11)
12) 11-18-86 ALTOONA
13)
14)
15)

Signature of employee making inspection	Occupation	Place	Date	Time
[signature]	mach	57 ST	1-1-87	

The above work has been performed except as noted and the report is approved	Signature	Occupation	Available for service
	[signature]		Date ______ Time ______ M

Daily or trip inspection report—51st Street Engine House

CONRAIL

Location Inspected _____ Unit No. 5044 Date 12-21-16

A. Mechanical (Report Defects Found on EL-106A)	Machinist Signature
1. Inspect for Fuel, Lube Oil and Water Leaks	
2. Test Air Brake in accordance with S.M.R. 1000	
3. Check Safety Control Operation & Seal Cut-Out Cock	
4. Check Level of Water, Lube Oil, Governor Oil & Air Comp. Oil	
5. Inspect Water Fill Pressure Cap for defects & tightness	
6. Check Operation of Low water and Low oil shutdown devices	
7. Inspect running gear	
8. Check any unusual noises	
9. Date and sign EL-107A Cab Card	
B. Electrical (Report Defects Found on EL-106A)	**Electrician Signature**
1. Inspect Electrical Cabinets, Lighting & Seals	
2. Check for proper Radio Operation	
3. Check for Traction Motor Cut-Out	
4. Inspect for Missing Traction Motor Covers	
5. Check Operation of Alarm Bell, Wheel Slip Indication, Sander Operation, Shutters and Cooling Fans	
6. Make Load Test, Forward and Reverse	
7. Make Cab Signal Test as required and apply Test Sheet in Cab. Time and Date of Test	
C. Sheet Metal Worker (Report Defects Found on EL-106A)	**Sheetmetal Worker Signature**
1. Check Sanders for proper operation	
2. Clean & Check Water Cooler Operation	
3. Check Toilet Operation	
D. Laborer	**Laborer Signature**
1. Clean Cab, Windows, Toilet & Nose Compartment	
2. Supply Cab with required Flagging & Emergency Equipment	
3. Supply Drinking Cups & Water Cooler Bottle if out of date	
4. Fill Fuel Tank & Toilet Water Tank	
5. Fill Sand Boxes	

The above work has been performed, except as noted on attached EL-106A, and the report is approved. Time and Date 12-21 5PM	Supervisor Signature B. Mitchell

8

Daily or trip inspection report—61st Street Engine House CONRAIL

Location Inspected 51 ST Unit No. 5044 Date 2-1-87

	Machinist Signature
A. Mechanical (Report Defects Found on EL-106A)	
1. Inspect for Fuel, Lube Oil and Water Leaks	
2. Test Air Brake in accordance with S.H.R. 1000	
3. Check Safety Control Operation & Seal Cut-Out Cock	
4. Check Level of Water, Lube Oil, Governor Oil & Air Comp. Oil	
5. Inspect Water Fill Pressure Cap for defects & tightness	
6. Check Operation of Low water and Low oil shutdown devices	
7. Inspect running gear	
8. Check any unusual noises	
9. Date and sign EL-107A Cab Card	
B. Electrical (Report Defects Found on EL-106A)	Electrician Signature
1. Inspect Electrical Cabinets, Lighting & Seals	
2. Check for proper Radio Operation	
3. Check for Traction Motor Cut-Out	
4. Inspect for Missing Traction Motor Covers	
5. Check Operation of Alarm Bell, Wheel Slip Indication, Sander Operation, Shutters and Cooling Fans	
6. Make Load Test, Forward and Reverse	
7. Make Cab Signal Test as required and apply Test Sheet in Cab. Time and Date of Test	
C. Sheet Metal Worker (Report Defects Found on EL-106A)	Sheetmetal Worker Signature
1. Check Sanders for proper operation	
2. Clean & Check Water Cooler Operation	
3. Check Toilet Operation	
D. Laborer	Laborer Signature
1. Clean Cab, Windows, Toilet & Nose Compartment	
2. Supply Cab with required Flagging & Emergency Equipment	
3. Supply Drinking Cups & Water Cooler Bottle if out of date	
4. Fill Fuel Tank & Toilet Water Tank	
5. Fill Sand Boxes	

The above work has been performed, except as noted on attached EL-106A, and the report is approved. Time and Date / /	Supervisor Signature

EL-105-A RD 2-86 Printed in USA MU

CONRAIL

FRA No.

Locomotive inspection report

Each locomotive unit shall be inspected in accordance with Rule 203 of the laws, rules, and instructions for inspection and testing of locomotives o... than steam

Train symbol	Units — Show initial	1 5014	2	3	4	5	6
		7	8	9	10	11	12

Consist position	Report code	Electrical problems
_____	11	Trips ground relay in ☐ motoring, ☐ dyn. braking
		How many times did ground relay trip? _____
_____	16	Wheel slip in ☐ motoring, ☐ dyn. braking at _____ mph
_____	20	Dyn. brake not working (no amperage)
_____	20	Dyn. brake too heavy or erratic ☐ Brake warning light comes on
_____	13	Not loading (no amperage)
_____	08	Not loading properly (not enough amps. or drops amps. frequently)
_____	17	Will not make transition at _____ mph.

Consist position	Report code	Engine problems
_____		Engine dies:
	66	☐ Low oil tripped
	57	☐ Low water tripped
	37	☐ Crankcase pressure tripped
	44	☐ Overspeed tripped
	38	☐ No apparent reason
_____	43	Engine makes black smoke or has fire out of stack
_____	30	Engine has unusual noise or vibration
_____	33	Engine hunts badly
_____	15	Engine has hot engine alarm

Consist position	Report code	Miscellaneous defects
_____	24	Radio
_____	78	Speed indicator and/or recorder not working
_____	83	Air brake equipment (explain in "Remarks")
_____	89	Water cooler not working
_____	87	Defective lighting
_____	23	Cab signal (explain in "Remarks")

Cab signal test

A end _____ B end _____

Date _____ Time _____

Location _____

Signature _____

Title _____

Main reservoir pressure _____ lbs Brake pipe pressure _____ lbs.

Condition of brakes and brake rigging _____

Outbound consist tested per MP 751 procedures.

Signature _____ Time _____ Date _____

Signature _____ Time _____ Date _____

Place _____

Other defects and remarks: — **Repaired by**

1) 2) 3) 4) 5) 6) 7) 8) 9) 10) 11) 12) 13) 14) 15)

Signature of employee making inspection	Occupation	Place	Date	Time

The above work has been performed except as noted and the report is approved	Signature	Occupation	Available for service
			Date Time

7

APPENDIX H

BROTHERHOOD OF LOCOMOTIVE ENGINEERS' LETTER TO AMTRAK

Brotherhood of Locomotive Engineers

B. OF L. E. BUILDING
CLEVELAND, OHIO 44114

JOHN F. SYTSMA
President

August 14, 1984

Mr. George F. Daniels
Vice President - Labor Relations
Amtrak
400 North Capitol Street, N. W.
Washington, D. C. 20001

Dear Mr. Daniels:

It has come to my attention, mainly as a result of the recent head-on collision near Hell Gate, that operating practices by Amtrak leave something to be desired. Many of the engineers represented by my union have complained to BLE representatives that they are being encouraged by Amtrak officials to make the schedule running time of their trains which carries strong implications and a definite inference to overlook the permissible timetable speed limits.

During the House Sub-Committee hearings on Amtrak Safety held in the forepart of August, BLE National Legislative Representative and Vice President E. L. McCulloch was advised by Mr. Joseph Walsh, Administrator of Safety - Federal Railroad Administration, that the FRA was clocking trains and engineers in the corridor and that over speed would not be tolerated. He also advised that certain Amtrak officials were encouraging and pressuring locomotive engineers to make the schedule running time of their trains.

Upon receipt of this information, I had Mr. Walsh contacted by my office and he was advised that the BLE representatives on Amtrak were being notified to tell their constituents to comply with Amtrak's train speed limits. Mr. Walsh was again informed that in the past our people had been encouraged and pressured to make schedule running times, and he advised that he was aware of this and stated that certain officials having jurisdiction over locomotive engineers, notably Road Foreman of Engines Gene Connors, did in fact encourage engineers in this practice.

In view of the adverse media publicity against Amtrak, it certainly is a very inappropriate time for Amtrak officials to be following such a policy.

Let me assure you - I repeat - let me assure you that in the event Amtrak officials continue to encourage, hassle, or pressure locomotive engineers to exceed the authorized timetable speeds so as to make the schedule running times of their trains, the BLE through its General Committee of Adjustment will take the appropriate action necessary to protect its locomotive engineers. We insist and demand that the officials responsible for this "double standard syndrome" be instructed that locomotive engineers are not to be intimidated by this practice any longer, and as to which I shall await your reply.

With best wishes and warm regards, I am

Very truly yours,

President

cc: M. G. Clayton, Jr., Chr.&Pres.-National
Railroad Passenger Corp.
E. L. McCulloch, VP&NLR
J. P. Carberry, VP
D. F. Miley, GC-Conrail

APPENDIX I

AMTRAK RESPONSE TO BROTHERHOOD OF LOCOMOTIVE ENGINEERS' LETTER

Amtrak

W GRAHAM CLAYTOR JR
PRESIDENT

August 31, 1984

Mr. John F. Sytsma
President
Brotherhood of Locomotive Engineers
1110 Engineers Building
1365 Ontario Street
Cleveland, Ohio 44114

Dear John:

I appreciate your bringing to our attention, in your letter of August 14, 1984 to George Daniels, copy to me, allegations that some of our management people have improperly pressured our passenger engineers represented by your organization to make scheduled running times of their trains, with the implication or inference that they should overlook permissible speed limits. This is a matter of such importance that I am answering it personally.

As you are aware, Amtrak is committed to maintaining and improving the quality of its service to the public. This commitment includes both the attainment of on-time performance and safety goals, as well as other objectives related to operating an efficient and safe intercity rail passenger service.

Because the scheduled running times normally comprehend known delays to trains, passenger engineers are not only encouraged but are expected to meet scheduled running times, unless there are circumstances beyond their control which would hinder their performance. Although certain minimal speed tolerances are allowed based on physical characteristics and train operating dynamics, I assure you that it is a clear violation of

National Railroad Passenger Corporation 400 North Capitol Street N W Washington D C 20001
Telephone (202) 383-3960

both our rules and our management policy for anyone on Amtrak to encourage or condone the violation of timetable speed limits. While I have not been aware of any specific instances where this has occurred, several important steps have now been taken to make certain that there can be no violation of this policy or misunderstanding about it anywhere in our company.

First of all, I have given notice in unmistakable terms to all of our operating officers that I will personally not tolerate any direct or indirect effort by any of our management to hassle, pressure or permit our engineers to violate authorized timetable speed limits, and disciplinary action against such officers will be taken if this occurs.

Second, between August 1 and 3, 1984, Amtrak's management team has specifically addressed this subject by directly speaking to or telephoning each of its passenger engineers and conveying to them Amtrak's policy in an attempt to eliminate any confusion in this regard.

Third, on August 10, 1984, our Chief Operating Officer, Tom Hackney, and Vice President Operations, Frank Abate, met with representatives of the FRA, including Joe Walsh, for the purpose of thoroughly reviewing Amtrak's procedures for policing adherence to authorized speed limits. It was agreed that FRA and Amtrak would make detailed field checks for compliance, and these are now being made. We will not only not pressure or authorize our engineers to exceed speed limits but will take disciplinary action if they are found doing this -- and even more severe disciplinary action against any supervisor who directs, authorizes or condones such action.

Again, I appreciate your letter and the opportunity to let you know of these recently instituted measures,

which I believe will eliminate your concerns and any confusion as to Amtrak's policy. It is always a pleasure to be able to work with your organization on matters of common interest, such as this.

With warmest good wishes,

Sincerely,

Graham Claytor

APPENDIX J

STATEMENTS OF AMTRAK ASSISTANT VICE PRESIDENT OF TRANSPORTATION
AND FRA ASSOCIATE ADMINISTRATOR FOR SAFETY
TO SAFETY BOARD MEMBER JOSEPH NALL

Conference with Robert VanderClute
1/6/87 at 8:45 pm at NS Crossing,
witnessed by Peter Cannito, by Joe Nall.

"The conductor had gone to the hospital unknown to us. The other 3 crew members were at a nearby home. They had not gone to a hospital. They were in shock. We took them to a gathering point. We could not find them after this. No fox tests were done on them."

"I talked to Joe Walsh of the Fed RR Admin. and told him, 'We're running out of time.' This was during the night, before John Pike arrived. I said, 'They are really not involved. We'd like done with that,' referring to the fox test. 'We do not want to put these people through more. It would not prove anything.'

"Joe said, 'yes, I understand and I agree.' We then dropped it.

These two pages were
Prepared by Joseph T. Wall
and witnessed by Peter
Cannito. Copies given to Mr. Cannito.

Joseph T. Wall

Peter J. Cannito

APPENDIX K

TOXICOLOGICAL ANALYSIS REPORTS
FROM THE CENTER FOR HUMAN TOXICOLOGY

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH - 36 SKAGGS HALL • SALT LAKE CITY, UTAH 84112 • (801) 581-5117

CONSULTANT CASE CC-0015-87
January 29, 1987

I. REFERENCE INFORMATION — Ricky L. Gates
Agency #ATCR 87-004-MD03

TYPE EVIDENCE EXAMINED: Urine

REQUESTING AGENCY: National Transportation Safety Board
Washington, D.C.

II. EVIDENCE AND SOURCE — The sample was submitted by Frances Sherertz/Merritt Birky on January 16, 1987.

III. PURPOSE OF EXAMINATION — It was requested that the sample submitted be analyzed for the presence of cannabinoids.

IV. RESULTS AND CONCLUSIONS — The urine was found to contain 182 ng/ml of the carboxylic acid metabolite of delta-9-tetrahydrocannabinol.

V. DISPOSITION OF EVIDENCE — The sample will be retained at the Center for Human Toxicology awaiting further instructions.

Dennis J. Crouch
Assistant Director

Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

/job
Enclosure

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH - 38 SKAGGS HALL • SALT LAKE CITY, UTAH 84112 • (801) 581-5117

CONSULTANT CASE CC-0014-87
January 29, 1987

I. REFERENCE INFORMATION — Edward W. Cromwell
Agency #ATCR 87-004-MD04

TYPE EVIDENCE EXAMINED: — Serum/Plasma & Urine

REQUESTING AGENCY: — National Transportation Safety Board
Washington, D.C.

II. EVIDENCE AND SOURCE — The sample was submitted by Frances Sherertz/Merritt Birky on January 16, 1987.

III. PURPOSE OF EXAMINATION — It was requested that the sample submitted be analyzed for the presence of cannabinoids.

IV. RESULTS AND CONCLUSIONS — The serum/plasma was found to contain 23 ng/ml of the carboxylic acid metabolite of delta-^{9}-tetrahydrocannabinol. No parent delta-^{9}-tetrahydrocannabinol was detected.

The urine was found to contain 80 ng/ml of the carboxylic acid metabolite of delta-^{9}-tetrahydrocannabinol.

V. DISPOSITION OF EVIDENCE — The sample will be retained at the Center for Human Toxicology awaiting further instructions.

Dennis J. Crouch
Dennis J. Crouch
Assistant Director

Douglas E. Rollins
Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

/job
Enclosure

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH • SALT LAKE CITY, UTAH 84112 (801) 581-5117

CONSULTANT CASE CC-0014-87
March 9, 1987

Preliminary Report

I. REFERENCE INFORMATION — Edward W. Cromwell
Agency #ATCR 87-004-MD04

TYPE EVIDENCE EXAMINED: Serum/Plasma & Urine

REQUESTING AGENCY: National Transportation Safety Board
Washington, D.C.

II. EVIDENCE AND SOURCE — The sample was submitted by Frances Sherertz/Merritt Birky on January 16, 1987.

III. PURPOSE OF EXAMINATION — It was requested that the sample submitted be analyzed for the presence of drugs.

IV. RESULTS AND CONCLUSIONS — The serum/plasma was found to contain 23 ng/ml of the carboxylic acid metabolite of delta-9-tetrahydrocannabinol. No parent delta-9-tetrahydrocannabinol was detected.

The urine was found to contain 80 ng/ml of the carboxylic acid metabolite of delta-9-tetrahydrocannabinol.

A total screen has not been completed on this case.

V. DISPOSITION OF EVIDENCE — The sample will be retained at the Center for Human Toxicology awaiting further instructions.

Dennis J. Crouch
Assistant Director

Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

/sp

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH • SALT LAKE CITY, UTAH 84112 (801) 581-5117

CONSULTANT CASE CC-0015-87
March 9, 1987

I. REFERENCE INFORMATION — Ricky L. Gates
Agency #ATCR 87-004-MD03

TYPE EVIDENCE EXAMINED: Urine

REQUESTING AGENCY: National Transportation Safety Board
Washington, D.C.

II. EVIDENCE AND SOURCE — The sample was submitted by Frances Sherertz/Merritt Birky on January 16, 1987.

III. PURPOSE OF EXAMINATION — It was requested that the sample submitted be analyzed for the presence of drugs.

IV. RESULTS AND CONCLUSIONS — The urine was found to contain 182 ng/ml of the carboxylic acid metabolite of delta-9-tetrahydrocannabinol, and acetaminophen was found to be present.

V. DISPOSITION OF EVIDENCE — The sample will be retained at the Center for Human Toxicology awaiting further instructions.

Dennis J. Crouch
Assistant Director

Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

/sp

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH • SALT LAKE CITY, UTAH 84112 (801) 581-5117

CONSULTANT CASE CC-0017-87
March 9, 1987

I. REFERENCE INFORMATION — Sterling Spivey
Agency # 246-84-9801

TYPE EVIDENCE EXAMINED: Urine

REQUESTING AGENCY: National Transportation Safety Board
Washington, D.C.

II. EVIDENCE AND SOURCE — The sample was submitted by Frances Sherertz/Merritt Birky on January 16, 1987.

III. PURPOSE OF EXAMINATION — It was requested that the sample submitted be analyzed for the presence of drugs.

IV. RESULTS AND CONCLUSIONS — No drugs were detected.

V. DISPOSITION OF EVIDENCE — The sample will be retained at the Center for Human Toxicology awaiting further instructions.

Dennis J. Crouch
Assistant Director

Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

/sp
Encl.

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH • SALT LAKE CITY, UTAH 84112 (801) 581-5117

CONSULTANT CASE DD-0013-87
March 9, 1987

I. REFERENCE INFORMATION — John Akins
Agency # 212-76-3569

TYPE EVIDENCE EXAMINED: Blood and Urine

REQUESTING AGENCY: National Transportation Safety Board
Washington, D.C.

II. EVIDENCE AND SOURCE — The sample was submitted by Frances Sherertz/Merritt Birky on January 16, 1987.

III. PURPOSE OF EXAMINATION — It was requested that the sample submitted be analyzed for the presence of drugs.

IV. RESULTS AND CONCLUSIONS — No drugs were detected.

V. DISPOSITION OF EVIDENCE — The sample will be retained at the Center for Human Toxicology awaiting further instructions.

Dennis J. Crouch
Assistant Director

Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

/sp
Encl.

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH • SALT LAKE CITY, UTAH 84112 (801) 581-5117

CONSULTANT CASE CC-0019-87

March 9, 1987

Preliminary Report

I. REFERENCE INFORMATION — Don Edward Keasey
Agency # 210-32-5473

TYPE EVIDENCE EXAMINED: — Blood and Urine

REQUESTING AGENCY: — National Transportation Safety Board
Washington, D.C.

II. EVIDENCE AND SOURCE — The sample was submitted by Frances Sherertz/Merritt Birky on January 16, 1987.

III. PURPOSE OF EXAMINATION — It was requested that the sample submitted be analyzed for the presence of drugs.

IV. RESULTS AND CONCLUSIONS — The sample is found to be presumptively positive for Amitriptyline, Nortriptyline, Meperidine, and Salicylates.

Dennis J. Crouch
Assistant Director

Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH • SALT LAKE CITY, UTAH 84112 (801) 581-5117

CONSULTANT CASE CC-0020-87
March 9, 1987

I. REFERENCE INFORMATION — Michael Fredrick
Agency # 216-52-5160

TYPE EVIDENCE EXAMINED: Blood and urine

REQUESTING AGENCY: National Transportation Safety Board
Washington, D.C.

II. EVIDENCE AND SOURCE — The sample was submitted by Frances Sherertz/Merritt Birky on January 16, 1987.

III. PURPOSE OF EXAMINATION — It was requested that the sample submitted be analyzed for the presence of drugs.

IV. RESULTS AND CONCLUSIONS — No drugs were detected.

V. DISPOSITION OF EVIDENCE — The sample will be retained at the Center for Human Toxicology awaiting further instructions.

Dennis J. Crouch
Assistant Director

Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

/sp

Encl.

CENTER FOR HUMAN TOXICOLOGY
UNIVERSITY OF UTAH • 38 SKAGGS HALL • SALT LAKE CITY, UTAH 84112 • (801) 581-5117

CONSULTANT CASE CC-0094-87
August 18, 1987

I. REFERENCE INFORMATION — Case F87-01C – R. Ortes and
Case F87-01D – E. W. Cromwell

TYPE EVIDENCE EXAMINED: Blood and Urine

REQUESTING AGENCY: National Transportation Safety Board
Washington, D.C.
via
CAMI Laboratories

II. EVIDENCE AND SOURCE — The samples were submitted by Merritt M. Birky, Ph.D. (NTSB) via CAMI Laboratories on April 3, 1987.

III. PURPOSE OF EXAMINATION — It was requested by the National Transportation Safety Board that the samples submitted be analyzed for the presence of cannabinoids and phencyclidine.

IV. RESULTS AND CONCLUSIONS — Case F87-01C: The carboxylic acid metabolite of delta-^{9}-tetrahydrocannabinol was detected in the blood at a concentration of 52 ng/ml and in the urine at a concentration of 212 ng/ml. No parent delta-^{9}-tetrahydrocannabinol was detected. No phencyclidine was detected in either the blood or urine specimens.

Case F87-01D: The carboxylic acid metabolite of delta-^{9}-tetrahydrocannabinol was detected in the urine at a concentration of 109 ng/ml and in the blood at a concentration of 15 ng/ml. No parent delta-^{9}-tetrahydrocannabinol was detected. The urine was found to contain 64 ng/ml of phencyclidine and no phencyclidine was detected in the blood.

V. DISPOSITION OF EVIDENCE — The samples will be retained at the Center for Human Toxicology awaiting further instructions.

Dennis J. Crouch
Assistant Director

Douglas E. Rollins, M.D., Ph.D.
Director
Associate Professor of Medicine
and Pharmacology

/job

APPENDIX L

HISTORY OF SAFETY BACKUP DEVICES ON THE NORTHEAST CORRIDOR

In 1910, Congress passed the Accident Report Act which compelled the railroads to report their train accidents to the Interstate Commerce Commission (ICC). During the first decade the Act was in effect, the railroads reported more than 16,500 head-on and rear-end collisions that resulted in 3,089 deaths and 44,000 serious injuries. 1/ As a result, in 1920 Congress authorized the ICC to require the railroads to install some type of automatic backup safety system on all or part of the lines they operated. On January 10, 1922, the ICC ordered (ICC Order 13413) the major railroad systems to install such backup systems on at least one operating division over which they operated passenger trains. Most of these installations were of the intermittent inductive ATS type with track inductors located adjacent to the wayside block signals. When the wayside signal displayed a restrictive aspect, such as "approach" or "stop," the inductor was open-circuited. Locomotives were equipped with a receiver that initiated a "penalty" full-service brake application after it passed over an open-circuited inductor. The brake application could be forestalled if the engineer acknowledged the restrictive signal by manually opening a valve. With some ATC systems, the engineer and fireman had to open simultaneously acknowledging valves on their respective sides of the locomotive cab. If acknowledgement was not made within a prescribed time, the brake application could not be released until after the train had stopped. 2/ Just as there was no protection between block signals, there was no protection between the inductors of intermittent ATC. Once a train passed an unrestricted signal, the engineer had no way of knowing if another train had entered or fouled the track ahead. Also, the system depended on the engineer taking the necessary action to stop his train after he acknowledged a restrictive signal.

In compliance with Order 13413, the Pennsylvania railroad (PRR) installed ATS on its mainline between Philadelphia and Pittsburgh. In July 1923, it also began the test operation of a three-speed continuous ATC system on a branch line. This system included speed control and ACS with continuous track circuitry that provided protection after the locomotive passed an unrestricted wayside signal. It also regulated speed in accordance with signal aspects when the engineer failed to do so. 3/ A modified system was later installed on the PRR between Harrisburg and Baltimore. This also included continuous track

---

1/ FRA, "History of ATC in the Northeast Corridor, 1987."
2/ Oppelt, J.H., "Nickel Plate First to Install Union Intermittent Train Stop," Railway Age, May 15, 1926.
3/ Warner Paul T., "Improvements on the Pennsyvlania Railroad," Baldwin Locomotives Magazine, July 1930

circuitry and ACS, but the ATC system was replaced by an ATS with a forestalling or acknowledging feature. As long as the engineer acknowledged a more restrictive aspect, the brakes were not automatically applied as was the case with the PRR ATC system.

By the end of the 1920s, PRR was convinced that continuous ACS without ATS or ATC provided ample protection for its trains. PRR management contended that its engineers were responsible for controlling its trains, and it proceeded on this basis. 4/ Thereafter, PRR continued to install ACS on its lines, but did not equip its locomotives with ATS or ATC apparatus.

In January 1929, a mail train ran into the rear end of a freight train about 13 miles north of Gunpow. Fog reportedly obscured the view of the wayside signals. Wreckage fouled an adjacent track, and it was struck by a 70-mph express passenger train. As a result of this double accident, PRR began installing ACS on the corridor. By 1930, this feature was in service between Washington and New York, and in 1931 the ICC authorized PRR to operate locomotives not equipped with ATS over the territory mandated for ATS operation under Order 13413. By this time, PRR had installed ACS on its mainline from Philadelphia to Indianapolis, Indiana, in addition to the Washington-New York segment of the present corridor.

PRR began to electrify the Washington-New York line corridor in 1926; this work was finished as far as Wilmington, Delaware, in 1928 and in Washington, D.C., in 1934. By 1938, the entire line was electrified, as was the case with PRR's lines from Harrisburg to Philadelphia and Perryville. The original equipment for the electrification consisted of 92 class P5a electric locomotives, 34 of which were geared for freight service. Between 1934 and 1943, the P5a locomotives were supplemented by 139 class GG-1 electric locomotives. When the last GGs were acquired, there were 97 electric passenger locomotives and 134 electric freight locomotives on the New York-Washington corridor and Harrisburg lines.

According to FRA, all the electric locomotives were originally equipped only with ACS. Later, however, they were modified with ATC as were diesel-electric passenger locomotives which began to be used on the corridor after World War II. Between 1960 and 1963 most of the P5a locomotives were replaced by 66 new E-44 electric freight locomotives. Some GG-1s were regeared to supplement E-44s in freight service after the Metroliner high-speed multiple-unit (MU) cars and E60CP locomotives went into NEC service. All the E-44, E60CP, and Metroliner units were equipped with ACS and ATC from the time of

4/ Ibid.

their delivery. The remaining GG-1s in both freight and passenger service were similarly equipped. Most of the 30 GG-1 locomotives acquired by Amtrak in 1973 were retired after the AEM-7 locomotives were delivered. The E-44 locomotives were conveyed to Conrail at the time of its formation in 1976. In 1981, Conrail retired all its E-44 and remaining GG-1 electric locomotives and replaced them with diesel-electric locomotives that were ACS-equipped but lacked ATS or ATC. Later, it removed the overhead catenary wires on the Harrisburg-Perryville line and the NEC line between Landover, Maryland, and Potomac Yard, Virginia, as well as at Bay View and other yards where it connected with Amtrak NEC trackage.

APPENDIX M

SAFETY BOARD SAFETY RECOMMENDATIONS FOR AUTOMATIC TRAIN CONTROL INSTALLATION ON THE NORTHEAST CORRIDOR

In 1978, a MARC commuter train operated by Conrail between Washington and Baltimore, struck the rear of a standing Amtrak passenger train on the corridor near Seabrook, Maryland. 1/ The commuter train consisted of self-propelled electric MU cars leased by Amtrak from NJDOT and sub-leased to MARC. The cars were equipped with ACS and ATS, but not ATC. The Safety Board's investigation established that the ACS of the lead car was defective due to a design flaw. After the commuter train entered the block occupied by the Amtrak train on "stop and proceed" wayside signal and "restricting" ACS aspects, the ACS aspect changed to "approach" and the engineer of the commuter train increased speed accordingly. As a result, he failed to stop his train short of the Amtrak train that was still standing in the block.

Based on its investigation of the Seabrook accident, the Safety Board issued recommendations to Amtrak:

R-78-39

Require all trains that operate on the Northeast Corridor be equipped with an automatic train control apparatus.

R-78-40

Until an automatic train control system can be implemented on all trains, require that all "stop and proceed" signals on the Northeast Corridor be regarded as "stop and stay" signals by all trains equipped with locomotives and by self-propelled cars not equipped with automatic train control systems. If circumstances require such a train to enter an occupied signal block, the train dispatcher should be required to authorize the movement.

Amtrak responded to Safety Recommendation R-78-40 by issuing a bulletin order on June 29, 1978, that stated:

1/ Railroad Accident Report--"Rear End Collision of Conrail Commuter Train No. 400 and Amtrak Passenger TrainNo. 60, Seabrook, Maryland, June 9, 1978" (NTSB/RAR-79/03).

> A train not equipped with speed control system or with speed control system not in operative condition must not pass a stop and proceed (Rule 291) signal, unless authorized by verbal permission through operator by authority of train dispatcher after train has been stopped.

The bulletin fulfilled the intent of the recommendation, and on October 3, 1978, the Safety Board classified Safety Recommendation R-78-40 "Closed--Acceptable Action."

In contrast to its prompt response to Safety Recommendation R-78-40, Amtrak did not comment on or take any action on Safety Recommendation R-78-39. In a November 14, 1979, letter to the president of Amtrak, the Safety Board noted this and advised that the recommendation was classified "Open" pending action from Amtrak. In its letter, the Safety Board stated, "...we believe that an automatic train control system offers superior operational safety, especially in the high-density, high-speed territory of the Northeast Corridor."

In 1979, Amtrak made a formal proposal to the FRA that provided for various corridor changes and improvements leading ultimately to train operation at 150 mph. The proposal provided that all trains using the NEC be ATC-equipped. All tenant users of the NEC objected to the proposal because of the costs involved. Conrail also argued that equipping its freight locomotives with ATC posed the risk of derailments caused by heavy braking action. At the time the proposal was made, all Conrail electric freight locomotives in use on the NEC were ATC-equipped. The FRA approved the proposal in December 1980 with the proviso that ATC on freight locomotives be modified to delay automatic brake application for 30 to 50 seconds and forestalled altogether if a full-service brake application was made within that time frame. Another FRA condition was the cancellation of any relief from 49 CFR 236.566 that required that locomotives operating over ATS, ATC, or ACS territory to be equipped to respond to the system over such territory. Amtrak subsequently replaced the proposal with one that excluded the ATC requirement.

On May 16, 1980, nearly 2 years after the Safety Board issued Safety Recommendation R-78-39, the president of Amtrak responded by reporting that, "All Amtrak motive power operated on the Northeast Corridor is now equipped with one of two forms of Automatic Train Control." According to the letter, diesel-electric units and self-propelled electric MU commuter cars had ATC, whereas the latter was applied to electric locomotives and high-speed Metroliner MU cars had ATC. No reference was made to the equipment used on the NEC by tenant commuter operators,

although Amtrak should certainly have been aware that the NJDOT MU cars had only ATS since these cars were involved in the Seabrook accident and were still being used by MARC. These cars were also used on the NEC in New Jersey. Moreover, in the nearly 2 years since Safety Recommendation R-78-39 had been made, Amtrak should have been able to learn that SEPTA's MU cars also had only ATS. As for Conrail, Amtrak's response included a comment that not all Conrail locomotives were equipped with one of the two forms of "automatic train control" and that some Conrail locomotives had only ACS.

In light of Amtrak's response, the Safety Board wrote Amtrak on October 8, 1980, and classified Safety Recommendation R-78-39 "Open--Unacceptable Action" because, "The description of your cab signal system does not comply with the intent of this recommendation. The systems described were in operation before the accident and in our opinion do not provide the necessary level of protection."

On November 18, 1980, Amtrak informed the Safety Board that, in response to Safety Recommendation R-78-39, it had issued new timetable rule 1562-A.1. As described in the letter, the new rule formalized the bulletin order issued by Amtrak on June 29, 1978. A significant change in the rule permitted non-ATC-equipped trains to proceed after being stopped for 3 minutes in the event the conductor or engineman was unable to communicate with the dispatcher or operator. As in the case of the 1978 bulletin, timetable rule 1562-A.1 applied to ATS-equipped trains as well as to trains that had neither ATS nor ATC. Amtrak's letter included no substantive response either to Safety Recommendation R-78-39 or to the concerns detailed in the Safety Board's letter of October 8, 1980.

On June 26, 1981, the Safety Board again notified Amtrak that Safety Recommendation R-78-39 was still classified "Open--Unacceptable Action" because the Safety Board did not consider timetable rule 1562.A.1 responsive to the intent of the recommendation. In its letter, the Safety Board pointed out that the rule did not provide the necessary protection for a nonequipped train in the event the engineer failed to take required action in response to restrictive signals. The letter further stated:

> The point of the recommendation is to have a fail-safe backup system that will control a train in the event of human error. ATC systems are common, and their effectiveness is well established. The Board feels strongly that Amtrak should require their use in order to enhance safe train operations on the Northeast Corridor.

The Safety Board believes that Amtrak either failed to comprehend the thrust of Safety Recommendation R-78-39 or may have chosen to ignore it despite its 1979 proposal to FRA that was responsive to the recommendation. At no time did Amtrak refer to the proposal in its responses to the Safety Board. In the meantime, in 1981 Conrail retired all its ATC-equipped electric freight locomotives on the NEC and replaced them with diesel-electric locomotives that were ACS-equipped but lacked ATS or ATC. Later, Conrail removed the overhead catenary wires on the Harrisburg-Perryville (Port Road Branch) and Landover-Potomac Yard lines, as well as at yards and on branches that connected with the NEC. These changes made it possible for Conrail to use its freight locomotive fleet on all parts of its system with substantial cost benefits.

Because virtually all locomotives and self-propelled MU cars on the former Pennsylvania railroad portion of the NEC between Washington and New York were equipped with either ATS or ATC, the action of Conrail in substituting locomotives lacking one system or the other on NEC trains may have been a violation of FRA regulation 49 CFR 236.566. Since the nonequipped Conrail locomotives would not be operating over the NEC with its heavy density of high-speed passenger trains, FRA should have interpreted the regulation in the strictest possible manner. The Safety Board was unable to determine if FRA had waived the regulation in the case of Conrail, but in any event, FRA took no action to require Conrail to equip its diesel-electric locomotives with a backup system after the motive power change took place.

On August 7, 1981, Amtrak responded to the Safety Board's June 29, 1981, letter and provided a list of NEC tenant operators and the general types of powered equipment used on the NEC; the numbers of units each tenant operated was not given. The only mention of Conrail was that it operated freight locomotives on the NEC. According to the letter, Amtrak still did not know whether or not any of the tenant-operated equipment had ACS and/or ATC protection, but the letter stated Amtrak had written to each tenant to develop this information.

According to Amtrak, all its electric and diesel-electric locomotives, electric MU cars, and leased diesel rail cars were ACS- and ATC-equipped. An unspecified number of Model RS-3 and SW-1 diesel-electric locomotives were listed; the RS-3 units were shown as ACS-equipped and the SW-1 units were shown as not equipped with ACS or ATC (these two classes of locomotives were restricted to yard service). Amtrak still leased the NJDOT MU cars being used in MARC service; these cars were equipped only with ACS.

Amtrak's only response to the concerns expressed in the Safety Board's June 29, 1981, letter was that Amtrak was aware that some of the tenant-owned equipment in use on the NEC was not ATC-equipped, but it performed, "...extensive commuter service throughout the corridor and to prohibit its use or restrict it beyond the provisions of Amtrak Timetable Rule 1562-A.1, could significantly disrupt this service." Amtrak did not indicate that it was aware that Conrail had replaced its ATC-equipped electric freight locomotives with nonequipped diesel-electric locomotives on the NEC. Amtrak's letter closed by stating that the Safety Board would be advised as soon as Amtrak determined the scope of noncompliance with Safety Recommendation R-78-39.

On January 12, 1982, the Safety Board made yet another attempt to apprise Amtrak of its concerns, and it restated its conviction that, despite the protection afforded by timetable rule 1562-A.1, the rule did not satisfy the recommendation's objective, especially in the high-density, high-speed NEC.

Amtrak wrote the Safety Board on February 10, 1982, providing the results of its survey of tenant-owned equipment used on the NEC. The equipment was classified as ACS-equipped only; ACS- and ATS-equipped; and ACS-, ATS-, and ATC-equipped. Except for 10 RS-3 diesel units shown as ACS-equipped only and 2 SW-1 units without ACS, ATS, or ATC, all Amtrak-owned equipment was ACS-, ATS, and ATC-equipped. As in the August 1981 response, these units were shown as "yard only." Conrail had six diesel units with ACS and ATS and unspecified number identified as "FRA Diesel N.A." ("N.A." was apparently an abbreviation for "not available" and referred to the number of units being used on the corridor.)

The survey indicated that NJDOT had 58 locomotives, all ACS- and ATC-equipped, and 300 electric MU cars that were ACS-and ATS-equipped. SEPTA had 62 electric MU cars assigned to the NEC that were also ACS- and ATS-equipped. There were 244 electric MU cars, ACS- and ATC-equipped, used on the NEC east of New York City. In total, there were 12 Amtrak "yard" diesels, 362 MU commuter cars, and an unspecified number of Conrail freight locomotives being used between New York and Washington that were not equipped with ATC. Moreover, the Amtrak report revealed that Amtrak work train locomotives and most Conrail diesels lacked ATS as well.

Amtrak concluded its report by asserting that "...service on the corridor would be disrupted significantly were Amtrak to further prohibit...vehicles which are not equipped with ATC," and by asking the Safety Board to reconsider the "utility of this approach in meeting the intent of Recommendation R-78-39."

In light of the assurances that all Amtrak-powered equipment used outside of yards on the NEC was ATC-equipped, that all tenant-owned passenger equipment on the NEC was at least ATS-equipped, and that timetable rule 1562-A.1 would be made an effective control when non-ATC equipment encountered "stop and proceed" signals, the Safety Board classified Safety Recommendation R-78-39 "Closed--Acceptable Alternate Action" on September 30, 1982.

In 1982, Amtrak submitted a new NEC proposal to the FRA to supersede the proposal the FRA had approved in 1980. The original requirement that all NEC trains be ATC-protected was dropped, ostensibly because of funding changes. As with the original proposal, there was no plan to eliminate the converging interlocking by adding tracks to the two-track sections. The FRA conditionally approved the new proposal on August 31, 1983.

In addition, timetable rule 1562-A.1 was subsequently modified so that trains equipped with ATS but not ATC were no longer required to get permission to pass "stop and proceed" signals. The Safety Board was never notified of the change, although the rule was no longer responsible to Safety Recommendation R-78-40 and could in no way be considered an adequate alternative to the mandatory ATC operation recommended in Safety Recommendation R-78-39. The Safety Board believes that this action on Amtrak's part was a strong indication of a management policy that placed maximum emphasis on expedited train operation and minimum emphasis on train safety. As modified, the rule was identified as timetable rule 1291-A.1 in the timetable that was in force at the time of the Chase accident (see appendix D).

* U. S. GOVERNMENT PRINTING OFFICE: 1988-201-610:60064