REPORT BY THE U.S.

General Accounting Office

Amtrak's Northeast Corridor Trains Operate With A One-Person Locomotive Crew

Since January 1983, Amtrak has operated trains in the Northeast Corridor, between Boston and Washington, D.C., with only one person in the locomotive cab, the engineer. Before, most locomotive crews consisted of two persons, an engineer and a fireman.

This report discusses the safety systems that monitor the alertness of Northeast Corridor engineers and assure that they operate trains within the authorized speeds. The report also discusses engineer work schedules, the safety record for Amtrak trains operating in the corridor during the period from January 1979 through June 1984, the number of injuries to trespassers and Northeast Corridor track maintenance employees since 1979, and the cost to add a second person to each Northeast Corridor locomotive cab.

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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

RESOURCES, COMMUNITY,
AND ECONOMIC DEVELOPMENT
DIVISION

B-197192

The Honorable James J. Florio
Chairman, Subcommittee on Commerce
Transportation and Tourism
Committee on Energy and Commerce
House of Representatives

The Honorable Bruce A. Morrison
House of Representatives

This report answers several specific questions you asked regarding the operation of Amtrak locomotives in the Northeast Corridor with one person in the locomotive cab. As a separate effort, we are also reviewing, at your request, a study of stress among Northeast Corridor locomotive engineers.

As arranged with your offices, after 2 days, we will send copies of this report to interested parties and make it available to others upon request.

Ralph V. Carlone for
J. Dexter Peach
Director

GENERAL ACCOUNTING OFFICE REPORT

AMTRAK'S NORTHEAST CORRIDOR TRAINS OPERATE WITH A ONE-PERSON LOCOMOTIVE CREW

D I G E S T

On January 1, 1983, the National Railroad Passenger Corporation (Amtrak) cut the two-man locomotive cab crews on its Northeast Corridor trains from an engineer and a fireman to an engineer only. (See p. 1.) Amtrak officials stated that the trains could be operated safely with an engineer only; the fireman did not serve a further useful purpose as in the past or add to the safety of the train; and, in fact, a second person in the cab could decrease safety by increasing distraction to the engineer.

On May 4, 1984, the Chairman, Subcommittee on Commerce, Transportation, and Tourism, House Committee on Energy and Commerce, and Representative Bruce A. Morrison requested GAO to review various aspects of operating the trains with only one person in the locomotive cab: the operation and effectiveness of the safety systems, including the signal system; the effect of changes to engineer work schedules; safety records (including injuries to trespassers and track maintenance personnel), problems of vandalism, and engineer health problems; and the cost of stationing an additional person in each cab.

As agreed with the requestors' offices, GAO did not attempt to conclude whether a second person in the locomotive cab is needed for safety.

SAFETY SYSTEMS DESIGNED TO STOP TRAIN IN CERTAIN CIRCUMSTANCES

Amtrak has equipped its Northeast Corridor locomotives with three safety systems to aid engineers in the safe operation of the trains--the electronic alertness control (alerter), cab signals (which operate in conjunction with the automatic block signal system, a system railroads use to safely control train movements), and the overspeed control. Should an engineer become incapacitated or exceed the authorized speed, these systems are designed to automatically stop the train. Amtrak tests these systems daily to assure they are operating properly. (See p. 6.)

Alerter system

The alerter system electronically monitors the engineer's actions to assure alertness. (See p. 6.) It requires the engineer to make and break physical contact ("touch off") with the throttle or some other control or metal surface in the cab every 20 seconds or press the alerter reset button. If these actions are not performed for 20 seconds, an alarm will sound and flash for 6 to 8 seconds. If the alerter is not reset before the end of the alarm period, the brakes will be automatically applied and the train will be stopped.

If the engineer becomes incapacitated and slumps over in the chair or falls out of the chair, the alerter would trigger an automatic braking sequence within about 26 to 28 seconds. (See p. 7.)

Cab signals

Signals in the locomotive cab largely duplicate the signals along the track (wayside signals) that tell engineers the maximum speed at which they can safely operate their trains. The signals have four different indications (aspects) that tell the engineer to proceed normally or proceed slowly at three different speeds. The wayside signals tell the engineer when to stop. (See pp. 8 and 9.)

The cab signal display unit is mounted inside the locomotive cab within the engineer's field of vision. Cab signals and wayside signals operate in conjunction with the automatic block system, which directs each engineer whether to move the train into the next stretch of track, or block.

If the cab signals direct the engineer to slow the train down to a certain speed, the engineer has 6 seconds in which to acknowledge the signals and begin applying the brakes. If the engineer does not take action within this time, the automatic braking system will be activated. (See pp. 9, 10, and 11.)

Overspeed control

The overspeed control protects the locomotive engine or motor from damage caused by excessive speeds and promotes safety by not allowing the engineer to operate the train above authorized speeds. If the train exceeds the

overspeed control's set speed, the device will activate a warning light and sound an alarm. After the alarms are activated, the engineer has about 6 seconds to begin slowing down the train to within the speed set for the overspeed control device, otherwise the automatic braking system will be activated. (See p. 11.)

Reliability

Amtrak believes these systems are reliable because they have malfunctioned on only 13 occasions from January 1979 to June 1984. In the event of malfunction during a trip, Amtrak procedures require that, depending on the type of malfunction, either an extra person ride in the cab to assure that the engineer remains alert or the train be operated at slower speeds. (See pp. 7, 10, and 12.)

CHANGES TO ENGINEER WORK SCHEDULES

Under the October 1982 labor agreement between Amtrak and the Brotherhood of Locomotive Engineers, the number of round trips that many Northeast Corridor engineers make each month increased. By the end of 1985, these engineers will be making six or seven more round trips per month than they were making at the end of 1982. (See p. 13)

Although many engineers are now required to make more round trips each month, the number of hours in an engineer's work day and the average daily time an engineer is operating the train basically have not changed under the new labor agreement. GAO examined the daily work schedules of Northeast Corridor engineers in use before and after January 1, 1983, and noticed no basic change in their daily work schedules. The work schedules covered the time the employee signed on the job to the time the employee signed off the job. (See p. 14.)

AMTRAK'S NORTHEAST CORRIDOR SAFETY RECORD SINCE JANUARY 1979

Amtrak records show that during the period January 1979 to June 1984, engineers did not have any health problems while at work that affected their ability to operate the trains. Also during this period, there were five instances of vandalism to a moving train that resulted in an injury to the engineer or fireman. (See pp. 16 and 17.)

As shown in the following table, during this same 5-1/2 year period, the number of deaths to trespassers and Amtrak track maintenance employees on the Northeast Corridor right-of-way did not change significantly. However, there was a decline in the number of injuries in both categories. (See pp. 17 and 18.)

	Deaths		Injuries	
Years	Trespassers	Amtrak employees	Trespassers	Amtrak employees
1979	27	1	16	1,111
1980	14	2	17	1,028
1981	20	1	23	769
1982	26	2	20	603
1983[a]	26	3	7	513
1984 (through June 30)	10	0	6	272

[a]Trains began operating with one person in the locomotive cab on January 1, 1983.

COST OF ADDING A PERSON TO CABS OF NORTHEAST CORRIDOR LOCOMOTIVES

On the basis of discussions with Amtrak officials and a review of the costs incurred by Amtrak for its Northeast Corridor engineers during 1983, GAO estimates that placing a second person in each Northeast Corridor locomotive cab would cost $16.5 million annually. (See pp. 19 and 20.)

AGENCY COMMENTS

Amtrak agreed that the report fairly describes the various safety systems in effect to ensure that trains are operated within authorized speeds in the Northeast Corridor.

Amtrak also noted that many trains operated with one person in the cab in the Northeast Corridor prior to January 1983. Examples are the self-propelled Metroliner cars, which do not need locomotives, and electrified commuter trains. The Metroliner trains were instituted by Penn Central in 1969 when it still owned and operated the Northeast Corridor, and the commuter trains have used one person in the

cab since the 1920's. Amtrak moved the Metroliner equipment to its Harrisburg-Philadelphia-New York service in 1981 and continues to operate it with one person in the cab.

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ABBREVIATIONS

Amtrak	National Railroad Passenger Corporation
Conrail	Consolidated Rail Corporation
FRA	Federal Railroad Administration
GAO	General Accounting Office

CHAPTER 1

INTRODUCTION

On April 1, 1976, the National Railroad Passenger Corporation (Amtrak)[1] acquired the rail lines in the Northeast Corridor as part of the regional rail reorganization that also formed the Consolidated Rail Corporation (Conrail). The property comprised 456 route-miles from Boston to Washington, D.C.; 62 miles from New Haven, Connecticut, to Springfield, Massachusetts; and 103 miles from Philadelphia to Harrisburg, Pennsylvania, for a total of 621 route-miles, most of which is electrified.

An average of 960 trains a day operate in the Northeast Corridor, which include over 120 Amtrak passenger trains, nearly 660 commuter trains operated by regional and local transportation authorities, and more than 125 Conrail freight trains.

From April 1976 to January 1983, Conrail provided Amtrak's Northeast Corridor train crews under a contract with Amtrak. However, as part of the Northeast Rail Service Act of 1981, Amtrak assumed the responsibility of hiring its own employees to operate its trains in the Northeast Corridor, and on January 1, 1983, Northeast Corridor train crews became Amtrak employees. Amtrak provides passenger service nation-wide and owns its train equipment. Outside the Northeast Corridor, however, it contracts with 19 other railroads that provide and are totally responsible for the crews and own the tracks, or "rights-of-way," over which the Amtrak trains operate.

On October 26, 1982, Amtrak and the Brotherhood of Locomotive Engineers reached an agreement on employment, wages, and hours for passenger locomotive engineers operating trains in the Northeast Corridor covering the period January 1, 1983, to December 31, 1985. The contract included an increase in the minimum number of trips per month an engineer must run.

Until January 1983, two Conrail employees--an engineer and a fireman--were present in the locomotive cab of most Amtrak trains in the Northeast Corridor. However, Amtrak decided not to include a fireman in the locomotive cab as part of the engine crew for Amtrak passenger trains operating in the Northeast Corridor.

In commenting on a draft of this report (see app. I), Amtrak pointed out that many trains in the Northeast Corridor operated with only one person in the cab prior to January 1983. The Metroliner trains are a notable example. Penn Central instituted these trains in 1969 when it still owned and operated the Northeast

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[1]Amtrak was established by the Rail Passenger Service Act of 1970 to administer the operation of rail passenger service throughout the United States. Amtrak began service on May 1, 1971, and assumed responsibility for managing intercity passenger train service over 23,000 route-miles.

Corridor. The trains consist of electric, self-propelled cars and do not include a locomotive. The engineer operates the train from a section in the front car designed for this purpose. This equipment was designed for speeds of up to 150 miles per hour and, in 1981, was moved to Amtrak's Harrisburg-Philadelphia-New York service, where it still operates with only one person in the cab. Electrified commuter trains in the Northeast Corridor have used only one person in the cab since the 1920's.

The traditional role for firemen was to shovel coal into the boilers of steam locomotives. Since the advent of the diesel-electric locomotive, however, the railroads attempted to discontinue the fireman job category. In the Diesel Agreement of 1950 with the organizations representing the firemen, the railroads consented to keep firemen in the cab, but only for locomotives of 90,000 pounds or more. In 1972 the railroads, which were in generally poor financial condition, again attempted to do away with firemen altogether. An agreement was struck whereby the firemen were to be eliminated through a process of attrition and early severance payments known in the railroad industry as Award 282. This resulted in the elimination of many, but not all, firemen and achieved some job protection for those remaining.

In early Amtrak operations, no incentive existed to discontinue the fireman job classification for three reasons. First, the fireman skill was regarded as good training for individuals wanting to become engineers. Second, the railroads providing Amtrak train crews had to employ some firemen under their collective bargaining agreements. Third, and most important, Amtrak used equipment requiring a second person. Earlier passenger coaches did not use electrical power directly from the locomotive. Instead, they used a special steam generator to supply steam for heat and power and a second person to operate it. Amtrak modernized its fleet and purchased and converted coaches that could use electricity directly from the locomotives for heat and other purposes, so the person to operate the steam generator was no longer needed.

Amtrak operates its Northeast Corridor trains at speeds of up to 120 miles per hour. When traveling at high speeds, the trains cannot be stopped or even slowed appreciably in a short distance if someone or something is on the railroad tracks. Basically, the only action the engineer can take is to sound the horn to warn of the approaching train. Even if the train could be stopped abruptly to avoid an accident, numerous passengers onboard the train could be injured. (These trains often carry hundreds of passengers.)

Amtrak officials stated that its Northeast Corridor trains could be safely operated with the engineer only in the locomotive cab. They said that firemen really serve no useful purpose under present circumstances and do not add to the safety of operating the train. Amtrak officials stated that a second person in the locomotive cab might decrease safety because the two might engage in conversation and not be fully concentrating on operating the train.

The number of Northeast Corridor engineers varies throughout the year; as of March 16, 1984, there were 295. Besides engineers, Amtrak Northeast Corridor trains operate with conductors and on-board service personnel who perform such functions as providing food service for passengers. The number of conductors and on-board service personnel vary with the size of the train. For example, a train consisting of six cars generally utilizes one conductor, one assistant conductor, and two or three on-board service personnel.

OBJECTIVES, SCOPE, AND METHODOLOGY

Because of concern over the safe operation of Amtrak passenger service in the Northeast Corridor, the Chairman, Subcommittee on Commerce, Transportation, and Tourism, House Committee on Energy and Commerce, and Representative Bruce A. Morrison requested us to study the safety implications of stationing only one person in the locomotive cab of Amtrak passenger trains operating in the Northeast Corridor. We were asked to review

- --the operation of safety systems installed in the Northeast Corridor and designed to stop the train in case of an emergency or if the engineer becomes incapacitated or exceeds the authorized speed, including the operation of the signal system, which tells engineers the maximum speeds at which they can operate their trains and when to stop them, especially under adverse weather conditions;

- --the safety record of passenger service in the Northeast Corridor, including injury to trespassers and workmen on the railroad right-of-way, problems of vandalism to moving trains, and various health problems engineers may incur while operating their trains; and

- --the changes in the work schedules of Northeast Corridor engineers as a result of the October 26, 1982, labor agreement between Amtrak and the Brotherhood of Locomotive Engineers.

In addition, we were asked to estimate the cost of stationing an additional person in the locomotive cab of each Amtrak Northeast Corridor passenger train. As agreed with the requestors' offices, we did not draw any conclusions concerning whether a second person in Amtrak Northeast Corridor locomotive cabs is needed for safe operations. On December 21, 1984, however, the requestors asked that we consider a study of engineer stress performed for the Brotherhood of Locomotive Engineers. The study found that Northeast Corridor engineers showed signs of considerable stress associated with their work. We agreed to review that study as a separate effort because work on this report was nearly complete.

We reviewed literature describing the function and operation of the Northeast Corridor safety systems (the alerter, which makes sure the engineer stays alert; cab signals, which tell the engineer the maximum speed at which he may proceed; and overspeed

control, which is designed to prevent excessive speed, are described on pp. 6-12). We discussed their operation, maintenance, and inspection with Amtrak officials. We also rode in the locomotive cab with an engineer from Washington, D.C., to Philadelphia, Pennsylvania, and back on two separate occasions to observe the operation of the three systems while the trains were operating with passengers aboard.

We visited Amtrak's repair and storage facilities near Union Station in Washington, D.C., to observe the testing of the three safety systems. We also reviewed Amtrak's test records relating to 75 locomotives for 3 months in 1984 to determine how often Amtrak inspected and tested the systems and how often the systems were not functioning properly. We reviewed Amtrak's operating manuals to determine what steps are to be taken when any of the three systems is not working prior to the start of a trip or during the trip.

To determine the changes in the work schedules of Northeast Corridor engineers, we reviewed Amtrak's current wage and hours agreement with the Brotherhood of Locomotive Engineers and reviewed all the standard engineer work schedules in effect before and after January 1, 1983. We examined the seven daily engineer work schedules which, when linked together, cover the entire Northeast Corridor operation.

We limited our review of the safety record of passenger service to the the Northeast Corridor and to the three problems identified in the request. Specifically, we reviewed Amtrak daily reports on (1) injuries and deaths to trespassers and maintenance-of-way employees, (2) vandalism to moving trains, and (3)incidents of illness to engineers while operating the trains in the Northeast Corridor for the period from January 1979 through June 1984 to determine whether such occurrences have increased or decreased since Amtrak began employing only one person in the locomotive cab. We chose this time period because (1) we believe it was adequate for our purposes and (2) Amtrak records for periods prior to 1979 were not readily available.

We met with Amtrak officials to discuss the method by which we could estimate the cost for Amtrak to station a second person in the cab. To make this estimate, we obtained information on the total costs for all of its Northeast Corridor engineers during 1983.

We met with officials of the Federal Railroad Administration (FRA), National Transportation Safety Board, Office of Technology Assessment, Amtrak, and the two unions representing the engineers and firemen--the Brotherhood of Locomotive Engineers and the United Transportation Union, respectively. The purpose of the meetings was to discuss the results of our review and elicit their comments and suggestions concerning our work. We have considered their comments and suggestions in writing this report.

During 1984 two accidents occurred to Amtrak trains operating in the Northeast Corridor that received widespread attention; one

occurred during our review and one occurred after we had concluded our review. On June 8, 1984, an Amtrak train derailed the rear six of its nine cars in Philadelphia while traveling at 70 miles per hour. Twenty-nine persons were injured as a result of the derailment. The accident was attributed to a kinked rail caused by the hot weather. On July 23, 1984, two Amtrak passenger trains collided on a viaduct in Queens, New York. One passenger was killed and 125 were injured in the accident.

Investigations of the causes of these two accidents had not been completed when we finished our work. Since their causes had not been clearly determined, we did not consider them within the scope of our review.

Our review was performed in accordance with generally accepted government auditing standards and was done primarily during the period from April through June 1984.

CHAPTER 2

SAFETY SYSTEMS DESIGNED TO STOP THE TRAIN IN CERTAIN CIRCUMSTANCES

All Amtrak trains in the Northeast Corridor have been operating with only one person--the engineer--in the locomotive cab since January 1, 1983.

To aid in safe operation of the trains, Amtrak equipped its Northeast Corridor locomotives with three safety systems--an electronic alertness control (alerter) to make sure the engineer stays alert; cab signals, which work with other devices to tell the engineer the maximum speed at which he may proceed; and overspeed control, which is designed to prevent excessive speed. Amtrak tests these systems daily to assure that they are operating properly. Should an engineer become incapacitated, get too close to another train on the same track, or exceed the authorized speed, these systems are designed to automatically stop the train.

Amtrak runs about 120 passenger trains daily through the Northeast Corridor. Our review of Amtrak records shows that the safety systems have malfunctioned 13 times in a 5-1/2 year period. Amtrak believes these systems are reliable, but has procedures requiring the use of slower speeds or extra personnel in the event of an in-route malfunction.

The following section discuss how the systems work as well as Amtrak's operating procedures relating to these systems.

ALERTER SYSTEM

As the name implies, the alerter system is designed to make sure the engineer is alert to operate the train by electronically monitoring the engineer's actions. The alerter cannot be turned off by the engineer without breaking a shop-installed seal on the alerter switch. The switch (or "cut-out cock," as it is called) is located in the locomotive engine compartment behind the cab. Once the train is in route, the engineer must adjust some train control, press the alerter reset button, or touch a metal surface in the cab every 20 seconds. If this is not done, an alarm (flashing light and siren) will activate for 6 to 8 seconds, after which a brake application will be initiated. Until the alerter triggers the automatic braking system--a period of about 26 to 28 seconds--the engineer can perform any one of the following to reset the alerter cycle: press the alerter reset button, touch off (grasp and release) a metal surface in the locomotive cab, touch off the locomotive engine control lever (while sitting in the seat), sound the horn, or ring the bell.[1] Once the automatic braking system is activated, the train must come to a complete stop before it can proceed again. Thirty of the 47 Northeast

[1]Each action restarts the 20-second cycle, but two repetitive actions do not increase the 20-second cycle to 40 seconds.

Corridor-based locomotives come equipped with alerters programmed for a fixed 20-second reset time, known as a "window." Seventeen locomotives are equipped with variable windows in which reset times decrease as speed increases and increase as speed decreases. We observed variable window alerters on our trips.

The alerter system uses a radio transmitter and antenna attached to the engineer's seat and a timer that monitors the time elasped since the last reset. By sitting in the seat when operating the train, the engineer is in the radio signal's path. When the engineer moves any train control or touches any metal, the radio signal changes, and the 20-second cycle restarts. Should the engineer not touch off any control for more than 20 seconds, the warning light and horn cycle starts, and the alerter will have to be reset to prevent the automatic braking system from stopping the train. For example, if the engineer slumped over in the chair while grasping some train control, the alerter would trigger the automatic braking system within 26 to 28 seconds, and the train would stop because the control was not released within the specified time. The same would occur if the engineer fell from his seat or released his grip from any control.

If the alerter should fail during a trip, the automatic braking system would be activated and the train would be brought to a complete stop. Then, according to Amtrak's operating procedures, the engineer would have to radio the train dispatcher and tell him or her that the alerter had failed and request permission to break the seals on the electric and air circuits so that the automatic braking system could be released. Also, according to Amtrak's procedures, the train would not be allowed to proceed without another member of the train crew riding in the locomotive cab. Therefore, a conductor or other crew member would have to come up from the back of the train and ride with the engineer until the malfunctioning locomotive could be removed and another one substituted.

On two separate occasions, we rode inside the locomotive cab with the engineer from Washington, D.C., to Philadelphia and back to observe the operation of the alerter system as well as the cab signals and overspeed control systems discussed later in this chapter. The alerter system seemed highly sensitive and kept the engineer constantly on the alert to prevent the alarm sequence from starting. Because passengers were aboard, the engineer did not deliberately fail to reset the cycle within the specified time; therefore, we did not witness what would have happened. However, we did observe that whenever the engineer did not take any action within 20 seconds, the alerter initiated a flashing light and sounded a horn in the locomotive cab.

FRA[2] safety regulations require that the alerter system of each locomotive in use be inspected and tested each day. Likewise, Amtrak's operating procedures require the alerter system to be checked before each trip. If an alerter malfunction is

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[2]FRA is responsible for railroad safety.

discovered on a locomotive that is ready to depart, it is common practice to replace the locomotive because the malfunction locks the brakes and too much time can be spent repairing the alerter on the spot.

Amtrak has used alerters in their present form in Northeast Corridor trains since the late 1970's. According to Amtrak, the alerters are reliable. We reviewed Amtrak's daily morning reports for the period from January 1979 to June 1984 to determine how often alerters failed. The reports showed that alerters failed on only two occasions during trips in the 5-1/2 year period covered by our review.

CAB SIGNALS AND THE AUTOMATIC BLOCK SYSTEM

Cab signals

Cab signals, which have been used by railroads in the United States since the early 1920's, inform the engineer of the maximum speed at which he may operate the train.

Cab signals operate in conjunction with the automatic block system, used to control the movements of trains in the Northeast Corridor. The cab signal display unit is mounted inside the locomotive cab within the engineer's field of vision. If the cab signals direct the engineer to slow the train down to a certain speed, the engineer has 6 seconds in which to acknowledge the signals and begin applying the brakes. If the engineer does not take action within this time, the automatic braking system will be activated and the train will be stopped.

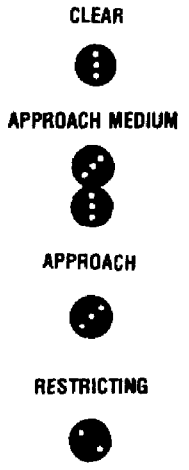
A cab signal aspect is the particular indication on the cab signal display unit that directs the engineer of the maximum permissable speed. In the Northeast Corridor, four different cab signal aspects are used--restricting, approach, approach medium, and clear. The restricting aspect directs the engineer to proceed at the restricted speed of 20 miles per hour or less. The approach aspect directs the engineer not to exceed 30 miles per hour. The approach medium aspect directs the engineer not to exceed 45 miles per hour. The clear aspect informs the engineer that he may operate the train up to the maximum speed allowed for that particular section of track.

The cab signals largely duplicate the wayside signals--the signals displayed above or alongside of the tracks. The wayside signals, however, can give additional indications, such as an indication to stop the train.

The main components of the cab signal system in the locomotive are the cab signal pickup bar and the cab signal display unit. The rails transmit a coded electrical current that differs for each of the four different cab signal aspects. A pickup bar located beneath the front of the locomotive receives signals and then transmits them to the cab signal display unit.

The cab signal aspects are displayed on the cab signal display unit as a series of two or three lights. The lights are grouped in vertical, diagonal, and horizontal rows according to the particular aspect. The action the engineer is to take is determined by which aspect is illuminated. For example, if a diagonal row of three lights is displayed, the signal indication is "approach" and the engineer knows not to exceed 30 miles per hour. The following illustration shows the four different Northeast Corridor cab signal aspects.

Cab Signal Aspects



When the cab signal aspect changes to a more restrictive indication requiring the engineer to operate the train at a lower speed, an audible warning signal sounds, and an overspeed indicator light comes on until the engineer manually acknowledges the signal change by pressing an "acknowledge" switch (or foot pedal in some locomotives). If the engineer does not acknowlege the change in the signal within 6 seconds and begin slowing down the train, the automatic braking system will be activated and the train will be brought to a complete stop. Likewise, if the engineer at any time operates the train faster than the maximum speed authorized for the signal aspect shown, the audible cab alarm will sound and the overspeed indicator will light up informing the engineer that the train is operating too fast. Again, the engineer has 6 seconds in which to acknowledge and begin slowing down the train or the automatic braking system will activate.

Cab signals work in all types of weather even when the tracks are covered with snow. The cab signal display unit shows the engineer the maximum speed at which he may operate the train even if the engineer cannot see the wayside signals because of heavy fog or curves.

The automatic block system

Cab signals operate in conjunction with the automatic block system, which was introduced in the 1870's. The system is based

on the principle that no train is admitted into a block, or stretch of track, without proper signal indication (usually stop and proceed) while another train occupies it.

The automatic block system operates in the following manner. As a train enters a block, it interrupts the aforementioned electrical signal traveling in the rails at its entrance. Trackside monitors detect that a train's steel wheels and axles have created an interruption, or short circuit, between the rails. When the short circuit occurs, the wayside and cab signals are changed for the block the train is in and for at least one additional block behind to direct any following trains to slow down or to stop. If the engineer enters a block and does not obey or acknowledge whatever signal is displayed in 6 seconds, the automatic braking system will be activated. This action is due to the fact that the wayside signal change activates a cab signal change that must be acknowledged. According to Amtrak officials, the automatic block system allows railroads to run trains faster and closer together in adjacent blocks without sacrificing safety because engineers know if another train is on the tracks ahead.

Since the cab signal system and the wayside signal system are interdependent, Amtrak's operating procedures dictate that the cab signal aspect inside the locomotive must conform with the wayside signal within 3 seconds after the engine passes the wayside signal governing the entrance into the block. Amtrak's procedures and FRA regulations require that if the cab signal and wayside signal aspects do not conform when the locomotive enters the block, the more restrictive signal--the signal requiring a lower speed or a stop--will govern. The engineer must notify the train dispatcher or operator by radio or by message as soon as possible thereafter of the nonconformity. The engineer communicates the exact location on the tracks where the nonconformity occurred. If the cab signal aspect should "flip," that is, momentarily change aspect and then return to the original aspect, the engineer must also report this malfunction.

In the event of a cab signal failure, the cab signal circuit is designed to display the most restricting aspect. Under this circumstance, the operating rules require the engineer to bring the train to a complete stop, and with permission from the train dispatcher, proceed at the restricted speed of 20 miles per hour or less. If the restricting signal aspect is not obeyed, the train is automatically brought to a stop.

According to Amtrak's operating procedures, if the cab signal apparatus fails entirely and no aspect is displayed, the engineer may proceed according to wayside signal indications at speeds not exceeding 40 miles per hour. Trains must not, however, pass a signal displaying a stop and proceed aspect unless the train dispatcher authorizes them to do so. A train dispatcher may authorize a train that is governed by wayside signals to proceed at a speed not exceeding 79 miles per hour. FRA regulations state that at speeds of up to 79 miles per hour, no cab signal apparatus (display unit, pickup bar, etc.) is needed. Therefore, in the

event of cab signal failure, the engineer, with the train dispatcher's permission, can break the seals on the cab signal circuits, switch off the cab signals, and run the train at a speed of up to 79 miles per hour. But he must obey all wayside signals. The engineer can only enter an occupied block with the dispatcher's permission.

According to Amtrak's procedures, the cab signal apparatus is considered to have failed when

--the audible overspeed indicator fails to sound when the cab signal changes to a more restrictive aspect,

--the audible overspeed indicator continues to sound although the cab signal change was acknowledged by reduction of speed to the level required by the cab signal indication,

--the cab signal fails to conform at two wayside signal locations in succession, or

--damage or fault occurs to any part of the cab signal apparatus.

The Amtrak morning reports showed that the cab signals failed 11 times during trips in the 5-1/2 year period covered by our review.

FRA regulations and Amtrak operating procedures require that the cab signal apparatus of locomotives in use be inspected and tested each day. (See p. 12.)

OVERSPEED CONTROL

The overspeed control is a device which serves the dual purpose of (1) protecting the locomotive engine or motor from any damage that might be caused by running above engine or motor design limits and (2) promoting safety by not allowing the engineer to operate the train above the speed set for the overspeed control device. If the engineer should operate the train above this speed for more than 6 seconds, the automatic braking system will activate and stop the train.

The overspeed control in Amtrak's Northeast Corridor locomotives is set by inserting a punched card in the overspeed control mechanism. The punched card carries a record of the maximum speed that an Amtrak train is authorized to travel for the particular route the train is traveling. For example, from Washington, D.C., to Philadelphia, the maximum authorized speed is 120 miles per hour, and a punched card is inserted in the overspeed mechanism with that indication. Amtrak sets the overspeed control at about 123 miles per hour for locomotives operating that route to allow for a 3-mile-per-hour margin for wheel slippage.

If the train exceeds the speed set for the overspeed control device, the device will activate both a warning light and a sound alarm similar to that of the alerter alarm sequence. The engineer

has approximately 6 seconds after the alarms are activated to slow the train down to within the maximum speed authorized, otherwise the automatic braking system will be activated and the train will be brought to a complete stop.

FRA regulations and Amtrak's operating procedures require that the overspeed control of locomotives in use be inspected and tested each day. (See below).

In the event of an overspeed control failure, the cab signal mechanism is expected to provide back-up, since the train's speed would be exceeding the maximum speed for which the "clear" aspect is indicated. If the engineer continues to operate the train faster than the maximum speed for the "clear" aspect, the audible cab alarm will sound and an indicator will light up informing the engineer that the train is operating too fast. The engineer in this case has 6 seconds to acknowledge and begin slowing down the train or else the automatic braking system will activate.

TESTING THE ALERTER, CAB SIGNALS, AND OVERSPEED CONTROL SYSTEMS

FRA regulations and Amtrak's operating procedures require that the alerter, cab signals, and engine overspeed control systems of all Amtrak locomotives in use be inspected and tested at least once every 24 hours or within 24 hours before departure on a trip.

We reviewed Amtrak test records relating to 75 locomotives for 3 months of 1984 to determine how often Amtrak inspected and tested the alerter, cab signals, and engine overspeed control systems and how often the systems were not functioning properly. We found that Amtrak made all of the required inspections and tests of these three systems and all of the systems were reported as functioning properly. Also, our review of Amtrak records of trips from January 1979 to June 1984 (5-1/2 years) showed 13 instances where one of these systems malfunctioned.

We also visited Amtrak's repair and storage facilities near Union Station in Washington, D.C., to observe the testing of the three safety systems. We saw the locomotive test stand--where a locomotive's electrical, mechanical, and safety systems are tested--and watched Amtrak technicians conducting a complete check of a locomotive about to enter revenue (passenger-carrying) service. On the basis of our observations, we believe that Amtrak possesses and employs adequate and thorough inspection and test procedures to check out its locomotives.

AGENCY COMMENTS

In commenting on a draft of this report (see app. I), Amtrak agreed that it fairly describes the various safety systems in effect to ensure that trains are operated within authorized speeds in the Northeast Corridor.

CHAPTER 3

CHANGES TO ENGINEER WORK SCHEDULES

On October 26, 1982, Amtrak and the Brotherhood of Locomotive Engineers signed a new labor agreement revising the work schedules of engineers operating trains in the Northeast Corridor to increase the number of hours an engineer works each month. The increase in work hours was accomplished by requiring an engineer to operate the train on more round trips each month.

We found that although more round trips were being run each month, the number of hours an engineer works each day and average time at the throttle have remained basically unchanged from when the engineers were Conrail employees.

NORTHEAST CORRIDOR ENGINEER WORK SCHEDULES UNDER NEW LABOR AGREEMENT

The October 26, 1982, labor agreement between Amtrak and the Brotherhood of Locomotive Engineers established two separate groups of engineers--those regularly assigned to Amtrak's New York to Washington service (including service to Harrisburg, Pennsylvania, from Philadelphia) and those regularly assigned to Amtrak's Boston to New Haven service (including service to Springfield, Massachusetts, and New York City)--in order to establish seniority districts. In 1982, the last year that Northeast Corridor passenger engineers were Conrail employees, engineers in New York to Washington service averaged about 10 round trips per month. Engineers in Boston to New Haven service averaged 13 trips per month.

Under the agreement put into effect on January 1, 1983, the number of round trips will increase for many engineers. Minimums were established at 13 for New York to Washington and 15 for Boston to New Haven. As shown in the following table, these will increase by two for each year of the agreement from the end of 1983 through 1985.

	Number of round trips each month			
	Actual average	Minimums under new agreement		
Location of service	1982	1983	1984	1985
New York to Washington	10	13	15	17
Boston to New Haven	13	15	17	19

Some Northeast Corridor engineers work less under the new agreement and some will work the same amount as they did before. For example, engineers in the New York to New Haven service work less and engineers in the New York to Philadelphia service work the same.

Under the Hours of Service Act (Public Law 91-169), an engineer cannot work more than 12 continuous hours. To determine the

impact that increased round trips had on the schedules, we reviewed the daily work schedules of engineers operating Northeast Corridor passenger trains before and after January 1, 1983, and noticed no change in their daily work schedules.

A group of seven daily engineer schedules, when linked together, cover the entire Northeast Corridor operation. These schedules basically did not change on January 1, 1983, when the new labor agreement went into effect. What did change was the number of days each month that many engineers had to work and the number of round trips many engineers had to make.

The following are examples of typical schedules for Northeast Corridor passenger engineers under the new labor agreement. Selection was based on no particular criterion except to show typical numbers of hours the engineers are at the throttle and on layover between trips. As shown on these schedules, engineers spend 5 to 7 hours each workday running trains and work 3 or 4 days a week.

TYPICAL ENGINEER WORK SCHEDULES

Washington to New York, Engineer
Based in Washington

First Week - Monday, Tuesday, Friday, Sunday
Second Week - Wednesday, Thursday, Saturday

		(Hours)	(Minutes)	
Sign up	5:15 a.m.		45	Sign up[a]
Depart Washington	6:00 a.m.			
Arrive New York	8:55 a.m.	2	55	Running time
		1	35	Layover[a]
Depart New York	10:30 a.m.			
Arrive Washington	1:37 p.m.	3	07	Running time
Sign off	2:22 p.m.	—	45	Sign off[a]
		9	07	Total time

[a]Nonoperating time.

Source: Amtrak.

New York to Washington, Engineer
Based in New York

First Week - Monday, Wednesday, Friday, Saturday
Second Week - Tuesday, Thursday, Sunday

		(Hours)	(Minutes)	
Sign up	6:00 a.m.		30	Sign up[a]
Depart New York	6:30 a.m.			
Arrive Washington	10:19 a.m.	3	49	Running time
		7	41	Layover[ab]
Depart Washington	6:00 p.m.			
Arrive New York	8:55 p.m.	2	55	Running time
Sign off	9:05 p.m.	___	10	Sign off[a]
		15	05	Total time

[a]Nonoperating time.

[b]Amtrak provides the engineer a hotel room in Washington.

Source: Amtrak.

Boston to New Haven, Engineer
Based in Boston

Tuesday, Wednesday, Thursday, Saturday

		(Hours)	(Minutes)	
Sign up	6:49 a.m.		30	Sign up[a]
Depart Boston	7:19 a.m.			
Arrive New Haven	9:51 a.m.	2	32	Running time
		3	47	Layover[a]
Depart New Haven	1:38 p.m.			
Arrive Boston	4:15 p.m.	2	37	Running time
Sign off	4:25 p.m.	___	10	Sign off[a]
		9	36	Total time

[a]Nonoperating time.

Source: Amtrak.

CHAPTER 4

AMTRAK'S NORTHEAST CORRIDOR SAFETY RECORD SINCE JANUARY 1979

To determine the safety record of Amtrak's passenger service in the Northeast Corridor, including injury to trespassers and track maintenance employees on the railroad right-of-way, problems of vandalism to moving trains, and various health problems engineers may incur while operating the train, we reviewed safety reports relating to such incidents from January 1979 through June 1984. We found few instances of vandalism to moving trains resulting in injury to the engineers or firemen or acute health problems experienced by firemen or engineers for Amtrak's Northeast Corridor operations. Also, the number of deaths and injuries to trespassers and the number of Amtrak maintenance-of-way (track maintenance) employees killed on the Northeast Corridor right-of-way had not changed significantly during the past 5-1/2 years and since January 1983. However, a significant decline took place in the number of injuries to Amtrak's maintenance-of-way employees on the Northeast Corridor right-of-way since 1979.

We did not evaluate Northeast Corridor safety records for periods before and after elimination of firemen because there is insufficient information to draw conclusions about the effect of removing firemen.

SAFETY REPORTS

Amtrak publishes a daily "morning report," which includes information on safety-related incidents. We reviewed the morning reports from January 1979 through June 1984 for safety-related incidents occurring in the Northeast Corridor other than deaths and injuries to trespassers and maintenance-of-way employees. With Amtrak's assistance, we looked for incidents where the safe operation of the train could have been affected.

We categorized the safety incidents culled from the morning reports into the following general groupings:

--Train stopped in emergency (regardless of reason, except "struck debris," which is listed below).

--Struck debris and did not stop.

--Struck debris and stopped in emergency.

--"Penalty application" (automatic application of the brakes by the alerter, cab signals, or engine overspeed control systems).

--Malfunctioning alerter and/or cab signals.

--Vandalism to moving trains resulting in injury to the engineer and/or fireman (second person in the locomotive cab prior to January 1983).

--Misreading of wayside or cab signals leading to accident, damage, or injury.

--Engineer health problems of an acute nature while operating the train.

--Health problems for fireman of an acute nature while in the locomotive cab. (Through the end of 1982 when Amtrak discontinued the second person in the locomotive cab.)

As shown in the following table, few safety-related incidents took place during the past 5-1/2 years. For example, during this period, the engineers in the Northeast Corridor did not have any health problems of an acute nature while operating trains. One fireman suffered an electrical shock while working on the locomotive engine. Only five instances of vandalism to a moving train resulted in injury to the engineer or fireman.

Incidents Per 1 Billion Northeast Corridor Passenger Miles

Type of incident	Year 1979	1980	1981	1982	1983	1984[b]
Emergency stop	5.3	5.1	4.7	4.7	4.7	4.3
Struck debris, did not stop	7.9	6.0	1.9	4.7	.0	10.8
Struck debris, stopped	1.8	1.7	.9	.0	1.9	6.5
Penalty application	.0	.0	.0	.0	.0	.0
Malfunctioning alerter and/or cab signals	.9	.0	2.8	4.7	2.8	2.2
Vandalism	.0	.0	.9	1.9	1.9	.0
Misreading signals	1.8	.0	.0	.0	.0	.0
Engineer health problems	.0	.0	.0	.0	.0	.0
Fireman health problems	.0	.0	.0	.9	[a]	[a]
Total	17.7	12.8	11.2	16.9	11.3	23.8

[a]Firemen not employed in Northeast Corridor locomotive cab after 1982.

[b]Six months.

DEATHS AND INJURIES TO TRESPASSERS AND MAINTENANCE-OF-WAY EMPLOYEES

We obtained Amtrak data relating to the number of deaths and injuries to trespassers and Amtrak employees working on the Northeast Corridor rail right-of-way from January 1979 through June 1984. The following table shows that no significant change has taken place in the number of deaths and injuries to trespassers on the Northeast Corridor right-of-way except for 1983, when the number of injuries other than at highway grade crossings dropped by 65 percent, from 20 to 7 injuries.

Deaths and Injuries to Trespassers

Years	Deaths		Injuries	
	At grade crossings[a]	Elsewhere	At grade crossings	Elsewhere
1979	2	25	0	16
1980	1	13	0	17
1981	5	15	3	20
1982	1	25	0	20
1983	2	24	0	7
1984 (through June 30)	0	10	0	6

[a]Grade crossings are places where the railroad tracks cross a highway or road with no overpass or underpass. As of November 1984, all grade crossings between New Haven and Washington had been eliminated.

Amtrak data showed that the number of injuries to Amtrak maintenance-of-way employees on the Northeast Corridor right-of-way has gone down since 1979 while the number of deaths of these employees has remained relatively stable.

Amtrak Maintenance-of-Way Employees

Year	Killed	Injured
1979	1	1,111
1980	2	1,028
1981	1	769
1982	2	603
1983	3	513
1984 (through June 30)	0	272

CHAPTER 5

COST OF ADDING A SECOND PERSON TO AMTRAK NORTHEAST CORRIDOR LOCOMOTIVE CABS

To determine the cost of stationing a second person in the locomotive cab of each Amtrak train in Northeast Corridor service, we interviewed Amtrak officials and reviewed cost information they provided us. On the basis of this information, we estimated that the additional 1984 cost of placing a second person in each Northeast Corridor locomotive would be approximately $16.5 million annually. This chapter discusses the methodology and types of cost data we used to prepare the cost estimate as well as the estimate itself.

After meeting with Amtrak officials to discuss our methodology for estimating the cost of an additional person in each Northeast Corridor locomotive, we decided to compare the cost for the second person in the cab in Amtrak's Auto-Train service[1] (called an assistant engineer instead of a fireman) with the cost of the engineer in Auto-Train service and apply the resulting percentage to Northeast Corridor operations. We used the Auto-Train service because Amtrak participated in the negotiations relating to the amount of wages to be paid to the Auto-Train engineers and assistant engineers. We applied the Auto-Train information to the total costs incurred by Amtrak for its Northeast Corridor engineers, which include wages, overhead, and crew accommodations.

The engineers for Amtrak Auto Trains are currently paid an hourly wage (effective May 18, 1984) of $17.51 per hour and the assistant engineers are paid $16.26 per hour, or about 92.9 percent of the engineers' wage. We used this percentage differential to calculate the additional wages Amtrak would have to pay for adding a second person in its Northeast Corridor locomotives.

In 1983 Amtrak paid about $13.2 million in wages to engineers operating trains in the Northeast Corridor. Thus, we estimate that Amtrak would pay an additional $12.3 million (92.8 percent of $13.2 million) in wages annually if it were to station a second person in its Northeast Corridor locomotives.[2]

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[1]Amtrak's Auto Train service runs from Northern Virginia to Florida.

[2]We included the total wages Amtrak paid to its Northeast Corridor engineers in our estimate of the additional wage costs of stationing a second person in Amtrak's Northeast Corridor locomotives. However, we do not know whether a labor agreement covering the second person in the locomotive would include such a provision, and if so, what the amount would be. This issue would be subject to negotiations; we have no way of knowing the outcome of such a negotiation.

A second category of costs is labor overhead, which includes such costs as fringe benefits. Amtrak officials estimate that their overhead for nonmanagement skilled positions, which is how the second person in the locomotive would be classified, is about 32.4 percent of the hourly wage rate. Thus, the total overhead costs of stationing a second person in the Northeast Corridor locomotives would amount to about $4 million (32.4 percent of $12.3 million.)

A third category of costs is the costs of crew accommodations. This category includes the costs of lodging, travel, and meals. Amtrak officials estimated that approximately $200,000 was spent for crew accommodations for its Northeast Corridor engineers in 1983. We estimate that it would cost Amtrak an additional $200,000 annually for crew accommodation costs if it added a second person in its Northeast Corridor locomotives.

The following table summarizes our estimate of the total additional annual costs to Amtrak if it added a second person in its Northeast Corridor locomotives.

Cost category	Amount
	(millions)
Wages	$12.3
Overhead	4.0
Crew accommodations	.2
Total	$16.5

APPENDIX I

National Railroad Passenger Corporation 400 North Capitol Street, N.W. Washington, D.C. 20001 Telephone (202) 383-3000

Amtrak

January 10, 1985

Mr. J. Dexter Peach
Director - Resources, Community
and Economic Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

Amtrak has reviewed the General Accounting Office draft report, "Amtrak's Northeast Corridor Train Operations With One Person in the Locomotive Cab," and agrees that it fairly describes the various safety systems in effect to ensure trains are operated within authorized speeds in the Northeast Corridor.

The report did not address the fact that self-propelled, electric Multiple Unit (MU) trains have been operated in the Northeast Corridor with only one man in the cab, and implies that no trains operated in the Northeast Corridor with one man in the cab until January 1983.

The Penn Central first put the MU Metroliner cars in service between New York and Washington in 1969 which were designed for a maximum speed of 150 mph. This equipment was operated by Penn Central and later Conrail, with only one man in the cab, at speeds equal to or above those now operated by our present Metroliner trains.

In 1981, Amtrak replaced the original Metroliner equipment with Amfleet cars pulled by AEM-7 locomotives. This earlier equipment was transferred to the Harrisburg-Philadelphia line (600 series trains) and a Harrisburg-New York schedule. This equipment still operates on these routes with only one man in the cab.

It should also be noted that from the early 1920's, the Pennsylvania Railroad, then Penn Central and Conrail, all operated electrified commuter trains with one man in the cab, and all present-day commuter agencies do the same. Most commuter MU cars are geared to operate at 100 mph.

[GAO note: **On the basis of these comments, information relating to the use of one person in the cab before 1983 was added to p. 1 of this report.**]

We appreciate the opportunity to review this report in draft, and believe some reference to the points made above would be appropriate. Additional comments were discussed and provided to the General Accounting Office staff for correcting, revising and clarifying several areas in the report.

Sincerely,

W. Graham Claytor, Jr.

W. Graham Claytor, Jr.
President

(343774)

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