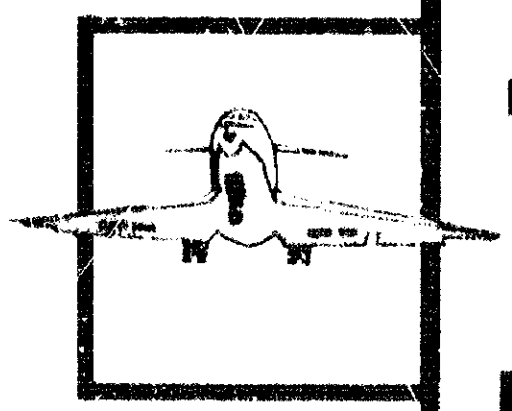

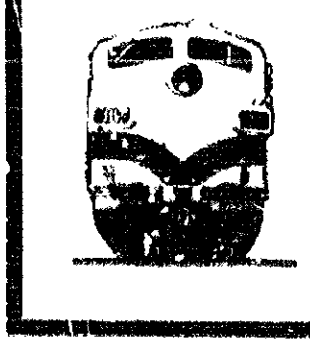

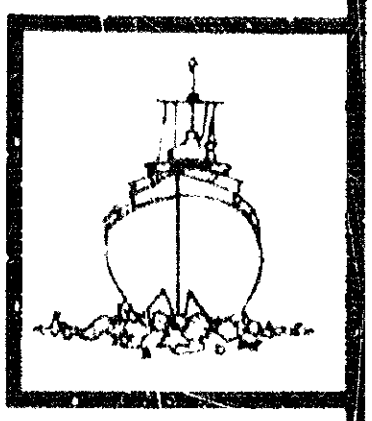

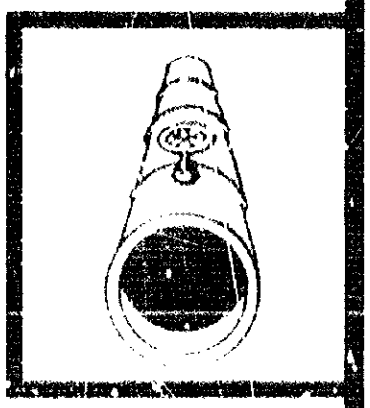

PB86-916302

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT/INCIDENT SUMMARY REPORTS

CONNELLSVILLE, PENNSYLVANIA - - MAY 29, 1984

GRANDBY, COLORADO - - APRIL 16, 1985

NTSB/RAR-86/01/SUM

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

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15. Supplementary Notes

16. Abstract

This publication is a compilation of the reports of two separate railroad accidents investigated by the National Transportation Safety Board. The accident locations and their dates are as follows: Connellsville, Pennsylvania, May 29, 1984; and Grandby, Colorado, April 16, 1985. A Brief of Accident containing the probable cause is included for each case.

17. Key Words **Derailment; radio; surface observation system; unsecured baggage/equipment; drainage culverts; embankment slide; emergency lighting system**		18. Distribution Statement **This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161**	
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National
Transportation
Safety Board

Washington, D.C. 20594

RAILROAD ACCIDENT/INCIDENT SUMMARY

Accident:	DCA-84-RM-010
Location:	Connellsville, Pennsylvania
Date and Time:	May 29, 1984, 6:40 a.m., eastern daylight time
Train Owner:	National Railroad Passenger Corporation (Amtrak)
Railroad and Operator:	Chessie System
Type of train, locomotive units, and cars:	Passenger, 2 units, 6 cars
Persons onboard:	144 passengers and 9 crewmembers
Injuries:	16 passengers, 7 crewmembers
Damage:	$1,500,000
Other Damage or Injuries:	None
Type of Occurrence:	Derailment (track washout)
Phase of Operation:	En route on main track

At 5:10 a.m., e.d.t. on May 29, 1984, Amtrak passenger train No. 440, the Capital Limited, departed Pittsburgh, Pennsylvania, en route to Washington, D.C. At the time, a light rain was falling. About 6:40 p.m., the train was operating on the eastbound track of the two-track Chessie System railroad that is on the north bank of the Youghiogheny River. The engineer and fireman stated that as the train proceeded past milepost 279.60 (48.2 miles from Pittsburgh), the signal was displaying a clear signal indication. The train then entered a 4-degree 30-minute curve to the right. As it proceeded around the curve at 38 mph (maximum authorized speed at that location is 40 mph), the engineer and fireman saw that the track ahead was washed out. The engineer shouted a warning, but before he could apply the train brakes the locomotive plunged into the washed-out section of track and lunged forward, coming to rest off its trucks and leaning at a 45-degree angle to the left side. The second locomotive unit also turned onto its left side after passing through the washed-out area. The mail car and the baggage car, the following cars behind the locomotives, went into the washed-out area and came to rest with one end of each car in the river. The next five passenger-carrying cars derailed, but stayed upright.

The Connellsville fire department received notification from the dispatcher at 7:20 a.m. and arrived at the scene at 8 a.m. Fire department personnel at the accident site radioed the police department at Connellsville that more help was needed. Several volunteer fire departments responded, as well as the Pennsylvania State Police. Because of the remote area and the lack of adequate roads to the area, helicopters were used to transport the injured to area hospitals.

Fourteen persons who sustained injuries were taken to the Connellsville hospital, arriving between 9:25 a.m. and 11:10 a.m.; five were transported to Uniontown Hospital, arriving about 10 a.m.; one person was transported by helicopter to Allegheny Hospital in Pittsburgh, arriving at 10:41 a.m.; and two were taken to the H.C. Frick Community Hospital in Mount Pleasant, Pennsylvania, arriving at 10:20 a.m. The engineer of the train was taken by State Police helicopter to the Westmoreland hospital in Greensburg, Pennsylvania, and arrived at 9:04 a.m.

On the previous day, the engineer had operated Amtrak passenger train No. 441 from Cumberland, Maryland, to Pittsburgh. The train had passed through the derailment area at 10:40 p.m. on the adjacent westbound track. The engineer stated that it was dark as the train passed through the area and that he did not see anything unusual or feel any roughness in the track. He stated that on the westbound trip from Cumberland the train had passed through heavy rain, "cloud bursts," for much of the trip. The Chessie System had not issued orders to indicate heavy rain fall or that flooding should be expected, a normal procedure during severe weather. The following forecasts for the Connellsville area were issued by the National Weather Service (NWS) Forecast Office at Pittsburgh:

0001 (May 29)--Overnight - small stream flooding. Rain until dawn.
0330 (May 29)--Today -- occasional rain. Wind southwest 10 to 15 MPH.

The Record of River and Climatological Observations, U.S. Department of Commerce for Connellsville, reported the 24-hour precipitation amounts for the period ending 8 a.m. on May 29 to be 2.10 inches. The Youghiogheny River Stage Reading at 7 a.m. on May 28 was 9 feet 7 inches, and on May 29, it was 12 feet 5 inches.

The amount of precipitation recorded from about 8 a.m. on April 30 to 8 a.m. on May 29 according to the Connellsville Record of River and Climatological Observations was 5.35 inches. Normal precipitation for Connellsville for the month of May is 4.46 inches. The greatest daily rainfall amount recorded in this area during May was 2.09 inches at Uniontown, Pennsylvania (about 10 miles from Connellsville). Climatological data from Uniontown indicates that an extreme amount of rainfall probably occurred at Connellsville during the 24-hour period before the accident.

In the area of the derailment, the Youghiogheny River is at the base of the slope of the railroad embankment and tall bluffs are on the north side of the tracks. Two drainage areas on the north side of the tracks join at the location of the washout. Drainage area No. 1 consists of approximately 83 acres, and drainage area No. 2 is approximately 18 acres. Run off is very rapid due to the steep bluff terrain. For example, drainage area No. 1 has a drop in elevation from 1,320 feet above sea level to 831 feet above sea level, a drop of 489 feet in about 200 feet. Drainage area No. 2 has a drop in elevation from 1,260 feet above sea level to 831 feet above sea level, a drop of 429 feet in about 200 feet. A drainage survey made following the derailment found that one 18-inch box culvert and two 12-inch culverts were partially blocked by discarded pieces of crossties, called tie butts. All three culverts were designed to carry drainage under the tracks from the bluff side to the river side. The survey revealed that the drainage ditch along the north track, on the bluff side, was flooded and that water was running through the subgrade below the track level.

On May 11, 1984, 18 days before the derailment, the Chessie System had conducted a special culvert inspection which revealed that a culvert about 900 feet from the washout area was buried under pieces of discarded wood crossties and that two other culvert inlets, about 370 and 211 feet, respectively, from the washout area, were inaccessible because of similar blockage which allowed only minimal seepage from their outlets. Another culvert located about 106 feet from the washout area also was found to be buried under discarded pieces of crossties and was dry on the outlet side. In addition, an 18-inch-diameter culvert, 181 feet west of the washout area, was overflowing because of diverted water from the drainage culverts that were severely blocked. This resulted in water passing through the ballast and grade from the bluff side of the tracks to the river side of the tracks, eroding the downhill slope of the railroad embankment.

The Chessie System should have cleaned the culverts immediately after the May 11 inspection because of the history of heavy water runoff at this location. Track maintenance personnel should not have discarded pieces of removed crossties in the drainage ditches along the track. The tie butts in the drainage ditch and blocking the culverts were debris that had been allowed to remain following track renewal. A tie renewal crew had used a tie shear to cut the old ties into three pieces. The tie shear then pushed the two end pieces of the tie out from under the track, and subsequently removed the center piece. The tie butts at the accident location had been thrown from the track surface to the ditch alongside the track structure. Because these pieces of crossties were hindering drainage, the Chessie System was not complying with 49 CFR 213.33 which states that "Each drainage or other water carrying facility under or immediately adjacent to the roadbed must be maintained and kept free of obstruction, to accommodate expected water flow for the area concerned."

The track was last inspected by two men in a high-rail truck on Friday, May 25, 1984. No discrepancies were noted on their report. This double track main line is regularly patrolled 5 days a week, Monday through Friday, except on holidays. Since Monday, May 28, 1984, was a holiday, the first time the tracks would have been patrolled after the weekend was between 7 a.m. and 4 p.m. on Tuesday, May 29, 1984, after the accident. However, since the last train before Amtrak No. 440 had gone through the washout area at 10:40 p.m. on May 28, 1984, and no unusual conditions were noted at that time, it is not likely that even if the tracks had been patrolled during the day on Monday, May 28, 1984, the potential washout would have been detected, and the accident most likely still would have occurred. Therefore, the Chessie System needs to develop a better weather observation system to determine the effects of weather on train operations. Since the derailment, the Chessie System has installed a 48-inch-diameter pipe at the washout location to help alleviate the drainage problem in this area.

Following the accident, the train crew was unable to use the locomotive radio or the hand-held crew radios to advise the dispatcher that the train had derailed and that medical assistance was required. The locomotive radio would not operate because the trucks had been dislodged from under the locomotive and the battery boxes, which supply power to the radio, had been destroyed. Because the hand-held radios would not reach a sufficient distance to enable crewmembers to notify anyone on duty on the Chessie System of the derailment, the conductor walked about 2 1/2 miles to locate a telephone at a private residence.

The lead locomotive unit involved in this accident was equipped with the latest type of radio equipment which can operate on any one of the 97 Association of American Railroad (AAR) standard communication channels. This single, two-way radio is designed to operate in any area that Amtrak serves. Amtrak positions the removable radio pack in front of the fireman's seat in the front bulkhead. Examination and postaccident testing of the radio equipment indicated that the transmitter/receiver functioned properly. A wet cell battery section, which is located under the floor frame on the left side of the locomotive, supplies power to the radio. A postaccident examination of the batteries indicated that power was grounded out to the radio because water had entered the battery locker.

The location of the batteries in the locker under the frame of the locomotive units, which is peculiar to Amtrak's F40PH type units, makes them highly vulnerable when a locomotive derails and the carbody separates from the trucks. The locomotive and

carbody separated in this accident as well as the Amtrak derailment investigated by the Safety Board at Granby, Colorado, on April 16, 1985, 1/ and the Amtrak derailment near Essex Junction on July 7, 1984. 2/ In the Granby accident, two locomotive units and the forward four cars of the 12-car train derailed and were heavily damaged as they fell into the slide area. In the Essex Junction accident, two locomotive units and the forward seven cars of the train derailed and were destroyed or heavily damaged as the train went into the washed out area.

At Granby, as at Essex Junction and Connellsville, it was necessary for a crewmember to walk a considerable distance to reach a telephone at a private residence and to report the accident. In all three accidents, the locations were relatively remote. There were 5 fatalities and 26 persons seriously injured in the Essex Junction derailment; 16 persons were injured in the Granby accident. With almost total reliance on radios for communications on the railroads, it is intolerable that help for the injured occupants of passenger trains is delayed because it is necessary for train crewmembers to walk to the nearest telephone. In the Connellsville accident, the delay in arriving at the hospitals was due, in part, to the remote location of the accident which made access difficult. Also, some of this delay was caused by the inability of train crewmembers to communicate with anyone. The Safety Board believes that reliable emergency power for radio usage or an ability for the radio to broadcast an emergency message in the event of a serious accident is essential on Amtak locomotives.

As a result of its investigation of the Amtrak derailment at Essex Junction, the Safety Board recommended that the National Railroad Passenger Corporation (Amtrak):

> Eliminate the vulnerability of the battery boxes supplying power for radio usage and lighting on its locomotives in derailment by relocating them in the carbody, above the underframe of the locomotive units (Class II, Priority Action) (R-85-125)

The National Weather Service forecasts did not give any warning to indicate that the weather could be causing heavy water runoff with flooding. The Chessie System relies on tower operators along the line to report on weather conditions; however, many of the agents and operator positions have been eliminated over the years, and because May 28, 1984, was a holiday, many stations were closed and would not reopen until 8 a.m. on May 29. Only one tower, 30.8 miles from the derailment site, was in operation at the time of derailment.

The failure of the Chessie System to have a surface observation system in place to identify weather related occurrences that affect train operations has been noted in other train accidents. At Essex Junction, 3/ the Central Vermont Railway (CV) lacked an effective method for monitoring weather from varied sources along its routes and was not utilizing the NWS weather radio service. Consequently, the CV dispatcher was unaware of the serious weather conditions, and he did not hear any weather alerts.

1/ Railroad Accident/Incident Summary--"Derailment of Amtrak Train No. 6 (The California Zephyr) on the Denver and Rio Grande Western Railroad, Granby, Colorado, April 16, 1985" (NTSB/RAR-85/01/SUM).
2/ Railroad Accident Report--"Derailment of Amtrak Train No. 60 (The Montrealer) on the Central Vermont Railway, Essex Junction, Vermont, July 7, 1984" (NTSB/RAR-85-14)
3/ Ibid.

The Safety Board is pleased that the CV and Amtrak began utilizing the NWS weather service after the accident; however, in its investigation of the Amtrak derailment on the Burlington Northern (BN) at Emerson, Iowa, on June 15, 1982, 4/ the Safety Board found that the BN, like the CV and the Chessie System, had eliminated many of its station agent and operator positions along its routes and was unable to effectively monitor weather conditions between stations many miles apart. As a result of its investigation, the Board recommended on February 26, 1983, that the Association of American Railroads (AAR), which includes the Chessie System:

> Inform its membership of the facts and circumstances of the derailment at Emerson, Iowa, on June 15, 1982, and recommend to its member railroads that they adopt a system of professionally gathered and evaluated meteorological information to better assure timely knowledge of climatic conditions that may affect the safe operation of train movements. (Class II, Priority Action) (R-83-27)

The Safety Board also recommended that Amtrak:

> Adopt a system of professionally gathered and evaluated meteorological information to better assure timely knowledge of climatic conditions that may affect the safe operation of passenger train movements for all Amtrak routes. (Class II, Priority Action) (R-83-21)
>
> Require that those railroads under contractual agreement to operate passenger trains adopt a system of professionally gathered and evaluated meteorological information to better assure timely knoweledge of climatic conditions that may affect the safe operation of those passenger train movements. (Class II, Priority Action) (R-83-22)

On June 27, 1983, in response to Safety Recommendation R-83-21, Amtrak replied that it would subscribe to the NWS weather monitoring for its Operations Control Center in Washington, D.C. However, Amtrak did not indicate that it would require those railroads under contractual agreement to operate its trains to also adopt a professionally gathered meteorological information system as recommended by Safety Recommendation R-83-22.

In a letter dated April 19, 1984, the Safety Board stated that while it "is pleased that Amtrak's Corporate Operations Control Center will monitor the National Weather Service, the Board believes that those railroads under contractual agreement with Amtrak should be required also to adopt a system of professionally gathered and evaluated meteorological data. Such a requirement should be included in Amtrak's contractual agreement with each railroad. The Safety Board will hold Safety Recommendation R-83-22 in an "Open--Acceptable Action" status pending further response from Amtrak.

On October 12, 1984, Amtrak stated that it "has undertaken further steps to strengthen its response to weather emergencies. Tone Alert radio receivers for weather information are installed in towers, dispatching offices and transportation offices on Amtrak owned or maintained property. A contract weather report service has been installed in the Operations Control Center at Corporate Headquarters in Washington, D.C.

4/ Railroad Accident Report—"Derailment of Amtrak Passenger Train No. 5 (The San Francisco Zephyr) on the Burlington Northern, Emerson, Iowa, June 15, 1982 (NTSB/RAR-83/02).

to cover all Amtrak owned right of way. All railroads under contractual agreement to Amtrak have been contacted with regard to their weather response activity and written responses are being received as to their activities. To date, the following railroads have responded that they do have a system of meteorological information to check climatic conditions available to them or being installed:

> Seaboard System
> Missouri Kansas-Texas
> Burlington Northern
> Central Vermont
> Richmond, Fredericksburg & Potomac
> Southern Pacific
> Santa Fe Denver & Rio Grande
> Grand Trunk
> Missouri Pacific Railroad Company
> Chessie System Railroads
> Conrail."

Many passengers sustained injuries when they were thrown from their seats and struck objects in the cars. Others were injured when struck by luggage falling from the overhead racks. Passenger evacuation was difficult because the derailed cars were leaning and it was necessary for them to walk over the fallen luggage.

The unrestricted luggage which had fallen during the derailment and injured passengers also was a problem in several other accidents. As a result of its investigation of the 1983 Amtrak derailment at Wilmington, Illinois, on July 28, 1983, 5/ the Safety Board recommended that Amtrak:

> 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. (Class II, Priority Action) (R-84-40)

Safety Recommendation R-84-40 was reiterated on February 4, 1985, in the Safety Board's report of the investigation of an Amtrak derailment at Woodlawn, Texas, on November 12, 1983. 6/

Amtrak responded to Safety Recommendation R-84-40 on March 13, 1985, reporting that as its coaches were overhauled the locking devices intended to prevent seat rotation would be modified to include a positive locking feature that would prevent undesired rotation. Additionally, Amtrak reported that it was replacing complete car sets of seat frames with a design equipped with a step latch with positive locking device that prevents the seat from falling away from the coach wall, as well as undesired seat rotation. In addition, Amtrak will equip all newly constructed coaches with the improved seat frames.

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

6/ 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).

Regarding the problem of unsecured baggage in overhead racks, Amtrak responded that it has designed a web-type retention device to be applied to the racks of a new prototype sleeping car it has ordered. This and other baggage retention devices are to be evaluated for potential application on a new prototype coach. However, Amtrak reported that it does not plan to retrofit existing cars with baggage retention devices. As for unsecured equipment in food service cars, Amtrak advised that it still will enhance securement of microwave and convection ovens by adding an extra steel bar across the top of the ovens to prevent displacement under extreme shock. The modification was being implemented as food service cars undergo overhaul and 120-day maintenance programs.

On July 29, 1985, the Safety Board informed Amtrak that it was pleased that Amtrak was working to eliminate design inadequacies in its coach seats and oven securement in food service cars, but was keeping Safety Recommendation R-84-40 in an "Open--Unacceptable Action" status inasmuch as Amtrak did not plan to retrofit the overhead luggage racks in its existing cars with retention devices. In this regard, the Board cited an Amtrak derailment at Queens, New York, on July 23, 1984, 7/ in which passengers were struck by loose baggage dislodged from overhead racks.

In the Amtrak derailment at Connellsville, Pennsylvania, coach passengers reported to Safety Board investigators that personal belongings and baggage "were flying everywhere." One woman was struck repeatedly and was literally buried under suitcases that fell from an overhead rack. Passengers reported that timely evacuation of the coaches was difficult because the aisles were full of fallen luggage. Considering the range of options that could be employed to effectively modify the existing luggage racks, the Safety Board believes that Amtrak should reconsider its position and move energetically to eliminate this common cause of injuries to coach passengers in derailments. Similarly, the use of shatterproof glass in mirrors would prevent serious injuries to passengers in sleeping car compartments and coach lounges. Amtrak also should investigate measures to prevent the exposure of headrest frames as a result of cushion displacement on its Heritage class coaches.

Based on the findings in these latest accidents, the Safety Board is placing Safety Recommendation R-84-40 in a "Closed--Unacceptable Action/Superseded" status and is issuing a new recommendation that Amtrak take action to correct the luggage retention problem as well as the non-shatterproof mirrors and seat cushion displacement problems.

See attached brief of accident for probable cause.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

March 31, 1986

7/ 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).

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20594

Reported by: AMTRAK

Brief of Railroad No.: DCA-84-R-MØ1Ø

Location:	Time:	Date:	Weather:	Visibility:
Connellsville, Pennsylvania	6:40 a.m.	5/29/84	Cloudy	6 miles

Train:	Railroad:	Class:	Direction:	Operating Phase:	Track No.:
1	Amtrak/Chessie System	Passenger	East	En Route	2 Main
2					

Accident Description:

National Railroad Passenger Corporation (Amtrak) eastbound passenger train No. 440, The Capital Limited, while traveling 38 mph, entered a 4 degree 30 minute curve. As the train proceeded around the curve, the engineer and fireman saw that there was a washout ahead, but before the engineer could apply the train brakes, the locomotive plunged into the washed out section of track. Two locomotives and seven cars derailed.

Probable Cause:
1. Failure of Chessie System to keep drainage culverts free of obstructions.
2. Failure of Chessie System to have a surface observation system to monitor the affects of weather on operating conditions

Other Factors:
1. Heavy water run off from unusual heavy rainfall
2.

Fatalities:	Number:	Description:	Injuries:	Number:	Description:
	0			4	Hospitalized (2 passengers, 2 crew)
	0			20	Treated and Released (14 passengers, 5 crew, 1 rescuer)

Probable Cause of Casualty:
1.
2.

Property Losses:
Railroad: $1,500,000
Non-Railroad:

National
Transportation
Safety Board

Washington, D.C. 20591

RAILROAD ACCIDENT/INCIDENT SUMMARY

Accident:	DCA-85-RM-005
Location:	Granby, Colorado
Date and Time:	April 16, 1985, 7:25 p.m., mountain standard time
Train Owner:	National Railroad Passenger Corporation (Amtrak)
Railroad and Operator:	Denver and Rio Grande Western Railroad (D&RGW)
Type of train, locomotive units, and cars:	Passenger, 2 units, 12 cars
Persons on Board:	5 D&RGW crewmembers, 12 Amtrak service employees, and 129 passengers
Injuries:	2 Amtrak service employees and 14 passengers hospitalized
Damage:	$2,920,000
Other Damage or Injuries:	None
Type of Occurrence:	Derailment (earth slide)
Phase of Operation:	En route on main track

About 7:15 p.m., m.s.t., April 16, 1985, eastbound Amtrak Train No. 6, The California Zephyr, departed Granby, Colorado, milepost 75.8, en route to Denver, Colorado. The train was 1 hour behind schedule as it entered a series of curves in the Fraser River Canyon, approximately 3 miles east of Granby.

The fireman, a qualified engineer, who was at the controls of the lead locomotive unit, stated that as the train neared milepost 70.3, about 7:25 p.m., both he and the engineer noticed a long void under the track structure where the roadbed fill had slumped into the river bed. The fireman immediately made an emergency application of the train's air brake valve. However, the emergency brake application did not materially slow the 30-mph speed of the train before the two locomotive units and first four cars derailed. The two locomotive units fell into the void below the track structure and the two following baggage cars jackknifed and came to rest across the top of the locomotive units. The next two cars, a sleeper and a coach, jackknifed on the track structure at the west end of the void. The remaining eight cars did not derail. The locomotive units and first four cars were heavily damaged, and 420 feet of track were destroyed.

Immediately after the accident, the engineer and the fireman attempted to contact the dispatcher via radio. However, they were unsuccessful because the batteries for the locomotive were damaged during the derailment. They then crawled out of the lead locomotive unit and walked about 1/2 mile east of the accident site to a dispatcher block telephone and requested assistance.

At 7:58 p.m., the police dispatcher at the Colorado State Patrol and the Grand County Sheriff's Department, located in Hot Sulphur Springs, was notified of the Amtrak train derailment by the Denver and Rio Grande Railroad dispatcher.

The Grand County Sheriff's Department responded to the accident and requested that emergency rescue units assemble at the Granby D&RGW railroad depot which was to be used as a staging area for access to the accident site located 5 1/2 miles to the east. The Granby Volunteer Fire Department and the Grand Lake Fire Department also responded to the emergency. Local emergency medical and first-aid personnel were taken to the accident site by hi-rail vehicles since the site of the accident was inaccessible by road.

An emergency medical technician from the Grand County Emergency Rescue Services, who arrived at the derailed train at 8:35 p.m. with the first rescue units on motorized rail cars, stated that the passengers were triaged by the two lead emergency medical technicians at the crash site. Three passengers were to be brought out from the scene by the motorized rail car, but it was learned that another locomotive was on its way in to pull the train back to Granby. Consequently, the motorized rail car would have blocked the track for the locomotive so these passengers were placed back on the train. The emergency medical technician also stated that he walked through the entire train of standing cars and did not observe any emergency lights in the dining and lounge cars. In some cars, the emergency lights were burning but were of such a low intensity that they were of no value for rescue purposes.

The locomotive from the following freight train was dispatched to the crash site and the eight non-derailed passenger cars were pulled back to the Granby depot, arriving at 10:20 p.m. At the depot, some injured passengers were removed from the top level of the cars by a front end loader because of the narrow stairway between the two levels of the cars which would have aggravated passenger injuries.

Injured passengers then were transported to the Community Clinic and Emergency Center (C.C.E.C.) in Granby. Three passengers were transported to the hospital in Kremmling, Colorado. Seven of the 32 injured passengers who were taken to the C.C.E.C. were airlifted to a hospital in Denver, Colorado. Uninjured passengers were taken by school buses to the high school in Granby and were later transported to Denver by buses provided by Amtrak.

The D&RGW crewmembers had reported for duty at Grand Junction, Colorado, about 1 p.m. on the day of the accident. Each crewmember stated that he was fully rested and in compliance with the hours of service law when he reported for duty and that he was thoroughly familiar with the train operation and the physical characteristics of the railroad for the scheduled run of 275 miles to Denver.

Granby is at an elevation of 7,935 feet. The high temperature for the day of the accident was 82° F, some 20° above the normal high temperature. Snow was melting from the mountainside adjoining the track because warmer temperatures had prevailed several days before the accident. At the time of the accident, it was dark, and the weather was party cloudy with a temperature of 51° F.

The train derailed 5 1/2 miles east of Granby on the D&RGW Railroad, Colorado Division, main track. The accident site consists of a single main track constructed on a 25-foot-high side hill fill built from rock and dirt materials cut from the mountainside during construction of the roadbed in 1907.

The single main track extends north and south in a geographical direction (timetable direction is westward and eastward, respectively). The track alignment at the point of derailment is tangent and the grade is ascending at 0.68 percent for eastbound trains. The

track is constructed with a series of curves between milepost 73.0 and milepost 67.0 which restrict train speed to a maximum of 30 mph. At the time of the derailment, the train had just begun to exit a 2-degree, 59-minute left-hand curve with the locomotives moving on tangent track before entering a 6-degree right hand curve.

The track structure is constructed of 136-pound continuous welded rails. The rails rest on 8- by 14-inch double shoulder tie plates with two inside and two outside spikes per tie plate. The treated timber crossties measure 7 inches by 9 inches by 8 feet 6 inches. Every other crosstie is box anchored. The crossties rest on about 12 inches of slag ballast. The track is well-maintained and exceeds the minimum requirements of the Federal Railroad Administration's Track Safety Standards for a class 3 track.

A D&RGW track supervisor patrols the track on a high-rail vehicle between Tabernash and Bond, milepost 66.0 and milepost 130. The track is patrolled at least in one direction every other day and, in some instances, once each day. Since some of the territory is class 5 track, the Federal Railroad Track Safety Standards require a twice weekly track inspection with at least one calendar day interval between inspections.

On the day of the accident, the track supervisor was patrolling his territory in a westerly direction. He stated that he arrived at milepost 70.3, the accident site, at approximately 1 p.m. and that he noticed some ice and debris accumulating at the inlet of the 36-inch-diameter corrugated metal pipe culvert approximately 40 feet west of the point of the accident. He said that he notified the section foreman to proceed to milepost 70.3 to clean out the inlet of the culvert and another 36-inch-diameter culvert located approximately 1,000 feet east of the point of derailment.

A westbound coal train passed over the track about 2:20 p.m. The crew of that train stated they did not notice any sign of track roughness or instability.

The section foreman stated that when he and two crewmen arrived by motor car at milepost 70.3, there was some water flowing in the drainage ditch between the two culverts. Most of the water flowed from a stream located about 1,000 feet east of the slide. The stream normally flowed directly through the culvert at that location; however, the culvert had become blocked, mostly with ice. They cleaned out the ice and debris from the inlet ends of the culverts and viewed water flowing through the pipes. The section foreman stated that they did not notice anything wrong with the track structure or subgrade when they left at approximately 3:30 p.m.

About 3,500 cubic yards of subgrade and ballast that slumped into the river bed were washed away. The landslide, which was first noticed after the accident, probably began as a slump of the berm supporting the railroad, and then rapidly became a debris flow. The slump/debris flow occurred sometime between 3:30 p.m. and just prior to the derailment at 7:25 p.m. The debris flow extended some 100 feet out into the Fraser River and nearly dammed the river. The slide, which was about 100 feet wide along the track centerline and about 220 feet long from top to base, probably was very mobile and occurred within a few minutes.

The debris flow portion of the slide included many large blocks of railroad subgrade over 2 feet thick. Inspection showed that the blocks were frozen solid and that many of the blocks had dry grasses growing, indicating that they came from the sloping face of the berm. Other blocks had top surfaces composed of ballast which came from the track structure.

The material involved in the slide consisted primarily of dark gray, silty sand with rock fragments up to boulder size. This material was used to construct the berm. Seepage was observed through the fractures in the bedrock. Excavation within the slide area exposed small springs in the head of the slide area which flowed continuously during reconstruction of the berm. The springs apparently are charged with water flowing through the vertical fractures in the mountainside bedrock.

The failure of the embankment by landsliding apparently occurred as a result of saturation of the embankment material by snowmelt water. Water probably entered the embankment through (1) surface runoff from melting snow on the mountain slope above the embankment, (2) seepage into the embankment from joints in the bedrock, and (3) water from the ditch between the track and the uphill bedrock slope.

In addition, three extraordinary circumstances which existed at the time of the accident may have contributed to the saturation of the embankment: (1) both surface and ground-water flow probably were greater than normal for the time of year because of abnormally high temperatures during the previous week, and residual ground-water levels in the embankment foundation probably were high before spring runoff began as a result of the extraordinary levels of precipitation in the area in 1983 and 1984; (2) the frozen surface of the embankment may have served as an impermeable membrane preventing drainage from the embankment; and (3) extra water probably was introduced into the embankment with plugging by ice of the culvert about 1,000 feet upstream from the landslide. The plugging resulted in a significant flow of water in the ditch between the track and the upward bedrock slope; the water exited the ditch through a free-flowing culvert under the embankment downstream from the landslide. The section crew noted no ponding of water in the ditch at 3:30 p.m. However, persons who arrived first at the scene of the accident noted a flow about 3 to 4 feet wide and 1 foot deep in the ditch. Although there apparently was no significant ponding in the ditch, flow of this magnitude undoubtedly resulted in some seepage into the embankment and probably contributed to the failure.

Granby County has a 5-year-old disaster plan which is the responsibility of the Director of the Grand County Emergency Medical Services located in Granby. According to the Director, the disaster plan needs updating. The disaster plan was not put into effect on the night of the accident, and no formal command post was established. The Sheriff requested that responding rescue units assemble at the Granby depot because he knew that they would be relayed into the crash site by motorized rail cars and because that seemed like the logical place to stage rescue units. Communications between the initial rescue units that proceeded to the crash site and rescue personnel at the depot were poor because the Amtrak locomotive radio batteries providing power were damaged and portable radios were inadequate to communicate between the accident site and Granby. No one at the depot knew the number of persons injured or the severity of their injuries until the undamaged passenger cars were pulled back to the depot. However radio communications improved when a locomotive, which had been dispatched to pull the train, arrived at the scene. Portable lights also were provided at the crash site because it was dark and the coach emergency lights were too dim to provide adequate illumination.

The operation of the emergency lights in the cars after an accident is important for several reasons. First, sufficient illumination is necessary for the crew to assist injured passengers. Both crew and passengers must simply be able to see one another. Second, rescue personnel must have sufficient light to be able to locate passengers, conduct them to the triage area, and render medical assistance to those who need it. If the emergency lights are of such a low intensity that rescue personnel must depend on flashlights and

lanterns for illumination, their value is negated. Third, sufficient light is needed so that passengers can evacuate the cars at night. This accident occurred in a completely dark canyon in rural Colorado. Also, with the lights on, passengers are less likely to become panicky. After the train comes to a stop, confidence is restored once passengers can see each other, the crew, rescue personnel, and exits.

The Safety Board initially recommended improvements to emergency lighting systems in passenger cars in its investigation of the Amtrak derailment at Emerson, Iowa, on June 15, 1982. 1/ As a result of that investigation, the Board recommended that the National Railroad Passenger Corporation (Amtrak):

> Evaluate and modify, as necessary, emergency lighting systems in passenger-carrying cars to better protect the functioning of emergency lights in emergency situations. (Class II, Priority Action) (R-83-25)

In a June 23, 1982, fire in a sleeping car of an Amtrak passenger train at Gibson, California, 2/ 2 passengers died, 2 passengers were seriously injured, and 57 passengers and 2 train crewmembers were treated for smoke inhalation. As a result of its investigation, the Safety Board recommended that Amtrak:

> Install in each sleeping compartment and all passenger car hallways effective, low mounted emergency lights which provide a lighted escape path in the event of heavy smoke when an emergency evacuation is required. (Class II, Priority Action) (R-83-66)

In response to the Safety Board's recommendations, Amtrak stated:

> In a continuing effort to improve emergency lighting features, Amtrak will use invertor ballast direct current fluorescent lights in the new low level prototype cars. Construction of two sleeping cars and one dining car with this type of lighting is expected to begin in July 1985. If this type of emergency lighting proves to be more beneficial, we will include this lighting system in the new prototype coaches when they are built.
>
> Emergency lights remain dependent upon energy from the storage batteries. We believe that the existing type and placement configuration of storage batteries are adequate.

The Safety Board ultimately placed Safety Recommendation R-83-66 in a "Closed--Unacceptable Action" status since Amtrak does not intend to retrofit the existing fleet of passenger cars. The Board, however, continues to hold Safety Recommendation R-83-25 in an "Open--Unacceptable Action" status since we believe that modifications to the existing fleet are needed.

While improvements in emergency lighting may and should be built into the new prototype coaches, the low speed derailment near Granby, in which there was virtually no damage to the coaches (all but one passenger car remained on the tracks and yet a number

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1/ Railroad Accident Report--"Derailment of Amtrak Train No. 5 (The San Francisco Zephyr) on the Burlington Northern Railroad, Emerson, Iowa, June 15, 1982" (NTSB/RAR-83/02).

2/ Railroad Accident Report--"Fire Onboard Amtrak Passenger Train No. 11, Coast Starlight, Gibson, California, June 23, 1982" (NTSB/RAR-83/03)

of the emergency lights in the cars did not function), again demonstrates the need for improved emergency lighting in the existing fleet of passenger cars. Consequently, the Safety Board reiterates Safety Recommendation R-83-25 as it pertains to the existing fleet of Amtrak passenger cars.

The investigation of this accident revealed that the nearest microwave base station for receiving and transmitting radio communications was about 29 miles from the accident site. Under such circumstances, reliable communications from a locomotive radio source require at least 72 volts of power. Hand-carried radios and CB radio packs do not have a sufficient power source to transmit effectively in restricted topographic areas, such as the Fraser River Canyon. The conductor's hand-carried set was able to receive radio transmission from the dispatcher but could not transmit to him. Had the locomotive been equipped with an emergency battery source capable of providing at least 5 minutes of 72-volt production, communication to the dispatcher could have been maintained.

The lead locomotive unit involved in the accident was equipped with the latest type of radio equipment which can operate on any one of the 97 Association of American Railroad (AAR) standard communication channels. This single, two-way radio is designed to operate in any area that Amtrak serves. Amtrak positions the removable radio pack in front of the fireman's seat in the front bulkhead. Examination and postaccident testing of the radio equipment indicated that the transmitter/receiver functioned properly. A wet cell battery section located under the floor frame on the left side of the locomotive supplies power to the radio. A postaccident examination of the batteries indicated power was grounded out to the radio because water had entered the battery locker.

The location of the batteries in the locker under the frame of the locomotive units, which is peculiar to Amtrak's F40PH type units, makes them highly vulnerable when a locomotive derails and the carbody separates from the trucks. The locomotive and carbody separated in this accident as well as the Amtrak derailment near Connellsville, Pennsylvania, on May 29, 1984, 3/ and the Amtrak derailment near Essex Junction, Vermont, on July 7, 1984. 4/ In the Connellsville derailment, 2.1 inches of rain had fallen in the area resulting in rapid runoff that backed up behind a blocked box culvert. About 60 feet of the Chessie System's former Baltimore and Ohio Railroad's embankment was washed into the Youghiogheny River before Amtrak's Capital Limited reached the location at 6:40 a.m. where the two locomotive units and the following two baggage cars derailed in the washed-out area. In the Essex Junction accident, two locomotive units and the forward seven cars of the train derailed and were destroyed or heavily damaged as the train went into the washed-out area.

At Essex Junction, as at Granby, it was necessary for an engineman to walk a considerable distance to reach a telephone and report the accident. In the Connellsville accident, the conductor had to walk 2 1/2 miles to use the telephone in a private residence. In all three accidents, the locations were relatively remote. There were 5 fatalities and 26 persons seriously injured in the Essex Junction derailment, and 23 persons were injured, 4 seriously, in the Connellsville accident. With almost total

3/ Railroad Accident/Incident Report--"Derailment of Amtrak Train No. 440 (The Capitol Limited) on the Baltimore and Ohio Railroad, Connellsville, Pennsylvania, May 29, 1984" (NTSB/RAR-85/01/SUM).

4/ Railroad Accident Report--"Derailment of Amtrak Train No. 60 (The Montrealer) on the Central Vermont Railway, Essex Junction, Vermont, July 7, 1984" (NTSB/RAR-85/14).

reliance on radios for communications on the railroads, it is intolerable that help for the injured occupants of passenger trains is delayed because it is necessary for train crewmembers to walk to the nearest telephone.

As a result of its investigation of the Amtrak derailment at Essex Junction, the Safety Board recommended that the National Railroad Passenger Corporation:

> Eliminate the vulnerability of the battery boxes supplying power for radio usage and lighting on its locomotives in a derailment by relocating them in the carbody, above the underframe of the locomotive units. (Class II, Priority Action) (R-86-125)

The Safety Board believes that reliable emergency power for radio usage or an ability for the radio to broadcast an emergency message in the event of a serious accident is essential on Amtrak locomotives.

See attached brief of accident for probable cause.

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

March 31, 1986

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20594

Reported by: Denver and Rio Grande Western Railroad **Brief of Railroad No.:** DCA-85-R-M005

Location:	Time:	Date:	Weather:	Visibility:
Granby, Colorado	1925 MST	April 16, 1985	Clear	Dark/1,000 feet

Train:	Railroad:	Class:	Direction:	Operating Phase:	Track No.:
1	Amtrak	Passenger	East	Enroute	Main
2					

Accident Description:

Amtrak Passenger Train No. 6, the California Zephyr, traveling on the Denver & Rio Grande Western Railroad Company, Colorado Division main track, derailed at Mile Post 70.3, 5 1/2 miles east of Granby, Colorado. The derailment resulted when two locomotives and the first 4 coaches of a 12-coach train derailed at a 20 foot deep and 100 foot long roadway embankment slide. The two locomotive units and four coaches were heavily damaged when the first two coaches (baggage cars) landed on top of the locomotive units. In addition, 420 feet of the main track structure was destroyed and approximately 3,500 cubic yards of sub-grade and ballast were washed away by the Fraser River.

Probable Cause: 1. Track embankment slide because of excessive soil saturation from rapid snow melt, underground water and diverted water from a plugged under track culvert.
2.

Other Factors: 1.
2.

Fatalities:	Number:	Description:	Injuries:	Number:	Description:
	-0-			14	Passengers
				2	Crewmembers

Probable Cause of Casualty:
1.
2.

Property Losses:
Railroad: $2,920,000
Non-Railroad:

*U.S. GOVERNMENT PRINTING OFFICE: 1985-491-098/40010