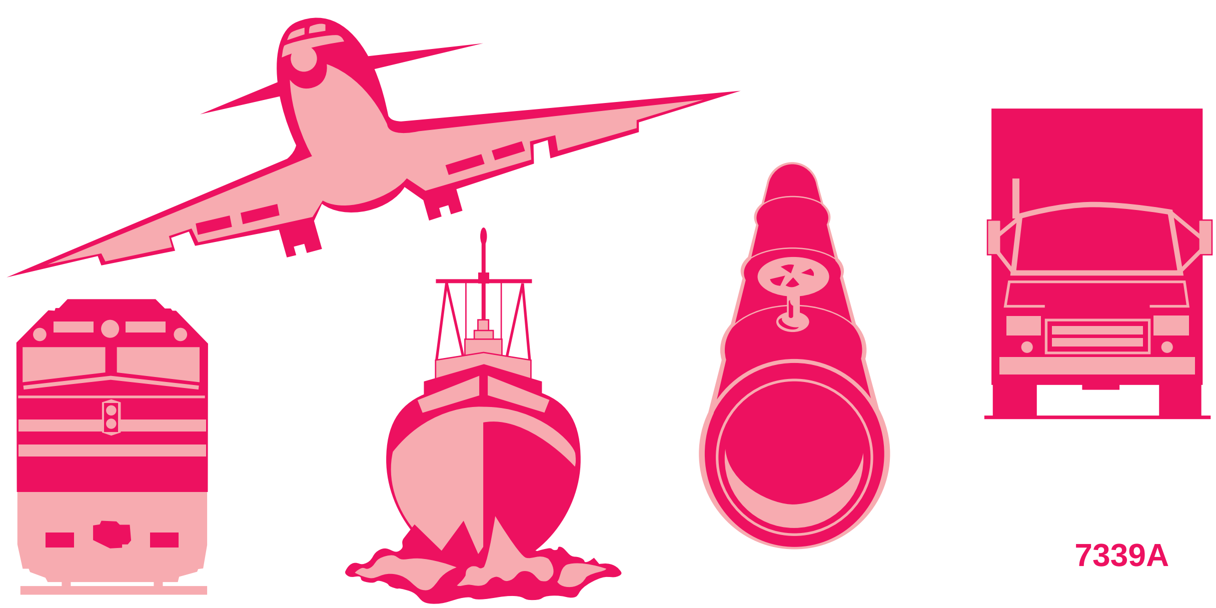
PB2001-916301
NTSB/RAR-01/01

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

COLLISION INVOLVING THREE CONSOLIDATED RAIL CORPORATION FREIGHT TRAINS OPERATING IN FOG ON A DOUBLE MAIN TRACK NEAR BRYAN, OHIO JANUARY 17, 1999



7339A

THIS CORRECTION IS *INCLUDED*
IN THIS VERSION OF THE PUBLISHED REPORT:

RAILROAD ACCIDENT REPORT
NTSB/RAR-01/01 (PB2001-916301)

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CONSOLIDATED RAIL CORPORATION FREIGHT TRAINS
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NEAR BRYAN, OHIO
JANUARY 17, 1999

- Page 13 has been revised to remove a reference to the conductor’s living arrangements. (01 Oct 2001)

Railroad Accident Report

Collision Involving Three Consolidated Rail Corporation Freight Trains Operating in Fog on a Double Main Track Near Bryan, Ohio January 17, 1999

NTSB/RAR-01/01
PB2001-916301
Notation 7339A
Adopted May 9, 2001

National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2001. *Collision Involving Three Consolidated Rail Corporation Freight Trains Operating in Fog on a Double Main Track near Bryan, Ohio, January 17, 1999.* Railroad Accident Report NTSB/RAR-01/01. Washington, DC.

Abstract: About 1:58 a.m. eastern standard time on January 17, 1999, three Consolidated Rail Corporation (Conrail) freight trains operating in fog on a double main track were involved in an accident near Bryan, Ohio. Westbound Mail-9, traveling near maximum authorized speed on track No. 1, struck the rear of a slower moving westbound train, TV-7, at milepost 337.22. The collision caused the derailment of the 3 locomotive units and the first 13 cars of Mail-9 and the last 3 cars of TV-7. The derailed equipment fouled the No. 2 track area and struck the 12th car of train MGL-16, which was operating eastbound on the adjacent track. The impact caused 18 cars in the MGL-16 consist to derail. The engineer and conductor of Mail-9 were killed in the accident. The crewmembers of TV-7 and MGL-16 were not injured. Total estimated damages were $5.3 million.

The safety issues discussed in this report are as follows: train movement under reduced visibility conditions, positive train control for collision avoidance, and adequacy of recorded information for postaccident analysis.

As a result of its investigation of this accident, the Safety Board makes safety recommendations to the Federal Railroad Administration, all Class I railroads, the Brotherhood of Locomotive Engineers, the United Transportation Union, the Association of American Railroads, and the American Short Line and Regional Railroad Association. Additionally, the Safety Board reiterates one and reclassifies three safety recommendations to the FRA.

Contents

Acronyms and Abbreviations

AAR	Association of American Railroads
BLE	Brotherhood of Locomotive Engineers
BNSF	Burlington Northern and Santa Fe Railway Company
CATDF	computer-aided train dispatcher’s facility
CFR	*Code of Federal Regulations*
Conrail	Consolidated Rail Corporation
CP	control point
C.R.	county road
CSXT	CSX Transportation
CVR	cockpit voice recorder
EMS	Emergency Medical Services
FRA	Federal Railroad Administration
LCVR	locomotive cab voice recorder
LPG	liquid petroleum gas
MARC	Maryland Rail Commuter
mgt	million gross tons
MP	milepost
NORAC	Northeast Operating Rules Advisory Committee
NS	Norfolk Southern
PTS	positive train separation
TCS	traffic control system
UP	Union Pacific Railroad
UTU	United Transportation Union

Executive Summary

About 1:58 a.m. eastern standard time on January 17, 1999, three Consolidated Rail Corporation freight trains operating in fog on a double main track were involved in an accident near Bryan, Ohio. Westbound Mail-9, traveling near maximum authorized speed on track No. 1, struck the rear of a slower moving westbound train, TV-7, at milepost 337.22. The collision caused the derailment of the 3 locomotive units and the first 13 cars of Mail-9 and the last 3 cars of TV-7. The derailed equipment fouled the No. 2 track area and struck the 12th car of train MGL-16, which was operating eastbound on the adjacent track. The impact caused 18 cars in the MGL-16 consist to derail. The engineer and conductor of Mail-9 were killed in the accident. The crewmembers of TV-7 and MGL-16 were not injured. Total estimated damages were $5.3 million.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the crew of train Mail-9 to comply with restrictive signal indications while operating at or near maximum authorized speed in dense fog. Contributing to the accident was the lack of uniformity and consistency in the operating practices of Consolidated Rail Corporation train crews when they encountered conditions of reduced visibility. Also contributing to the accident was the lack of a backup safety system that would have helped alert the crewmembers of train Mail-9 to the restrictive signal indications.

The major safety issues discussed in this report are as follows:

- Train movement under reduced visibility conditions,
- Positive train control for collision avoidance, and
- Adequacy of recorded information for postaccident analysis.

As a result of its investigation of this accident, the Safety Board makes recommendations to the Federal Railroad Administration, all Class I railroads, the Brotherhood of Locomotive Engineers, the United Transportation Union, the Association of American Railroads, and the American Short Line and Regional Railroad Association. Additionally, the Safety Board reiterates one and reclassifies three safety recommendations to the Federal Railroad Administration.

Factual Information

Accident Synopsis

About 1:58 a.m. on January 17, 1999, three Consolidated Rail Corporation (Conrail)[1] freight trains operating in fog on a multiple main track were involved in an accident near Bryan, Ohio.[2] (See figure 1.) Mail-9, an intermodal[3] train traveling westbound on track No. 1, struck the rear of a slower moving westbound van train, TV-7, at milepost (MP) 337.22. The collision caused the derailment of the 3 locomotive units and the first 13 cars of Mail-9 and the last 3 cars of TV-7. The derailed equipment fouled the adjacent No. 2 track area and struck the 12th car of train MGL-16, which was operating eastbound on that track. (See figure 2.) The impact caused 18 cars in the MGL-16 consist to derail. The derailed equipment from the 3 trains totaled 3 locomotives and 34 cars. The engineer and conductor of Mail-9 were killed in the accident. The crewmembers of TV-7 and MGL-16 were not injured.

Accident Narrative

Precollision Events

At 12:15 a.m., January 17, 1999, a high-tonnage, mixed-load Conrail freight train, PIEL-6A, departed Toledo traveling westbound on track No. 1 of Conrail's double-track Chicago main line. Less than a half hour later, beginning at 12:41 a.m., three westbound van trains, TV-99, TV-7, and Mail-9, departed Toledo about 10 to 17 minutes apart. After the van trains left Toledo, the dispatcher routed them behind PIEL-6A on track No. 1. Table 1 lists the respective trains by departure time, original assigned track, type, and authorized speed.

[1] In June 1997, Norfolk Southern Corporation (NS) and CSX Transportation, Inc., (CSXT) purchased 100 percent of Conrail's stock. In August 1998, the Surface Transportation Board approved the acquisition, and on June 1, 1999, NS and CSXT split and assumed operational control of the Conrail assets. Commercial operation on the section of track that includes the accident area is now part of the NS network.

[2] The events in this synopsis and the following accident narrative are reconstructed using information from dispatching records, data from event recorders, and statements from surviving crewmembers. All times are eastern standard time.

[3] *Intermodal* trains have rail cars that are designed to handle piggyback trailers or containers, or both. Conrail crews referred to the intermodal trains as "van trains," which is the term used in this report.

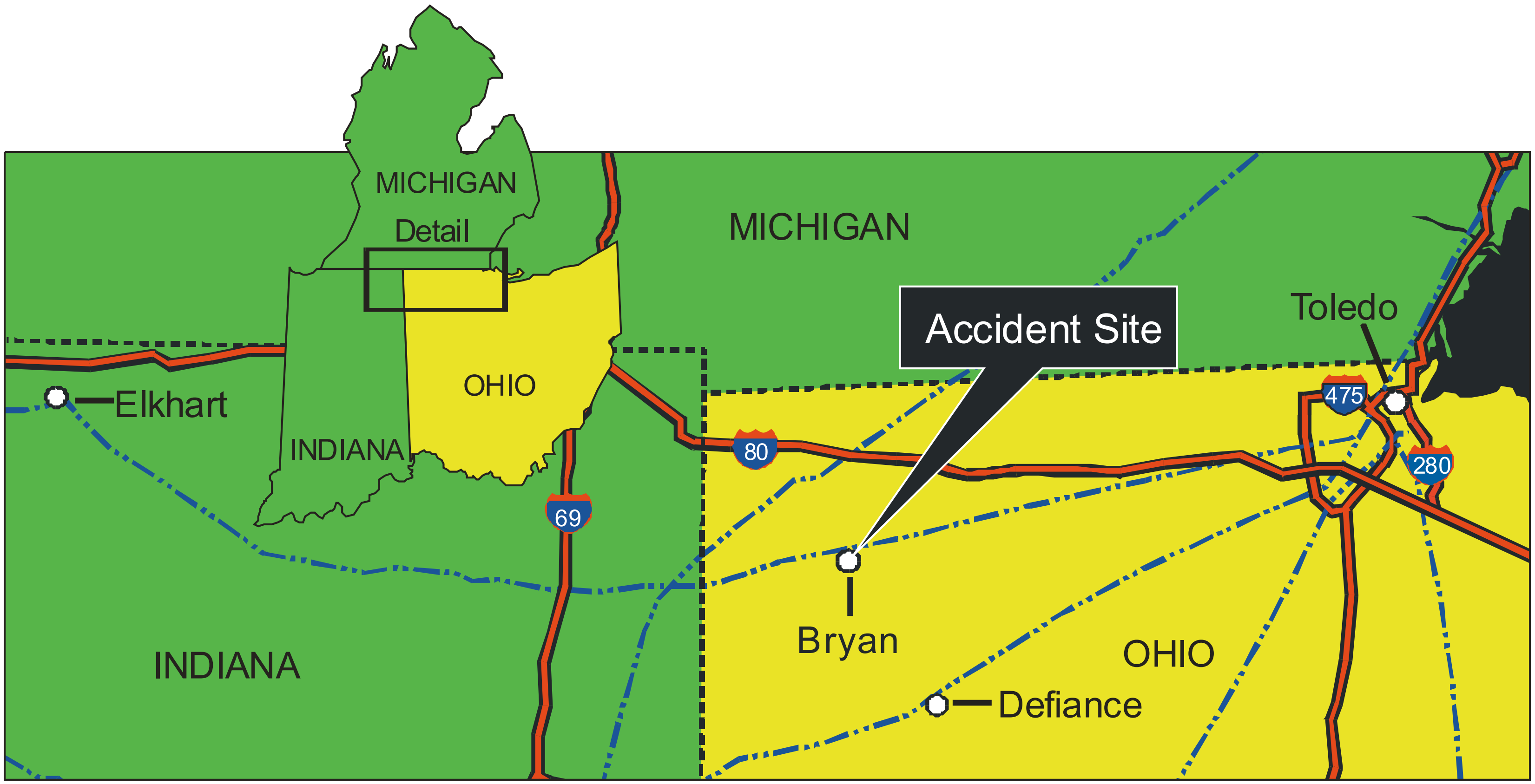


Figure 1. The collisions occurred about 65 miles west of Toledo, near Bryan, Ohio. On the night of the accident, a weather warning advised of “patchy dense fog” for southern Michigan, northern Indiana, and northwest Ohio. Visibility estimates ranged from zero to less than 1/4 mile.

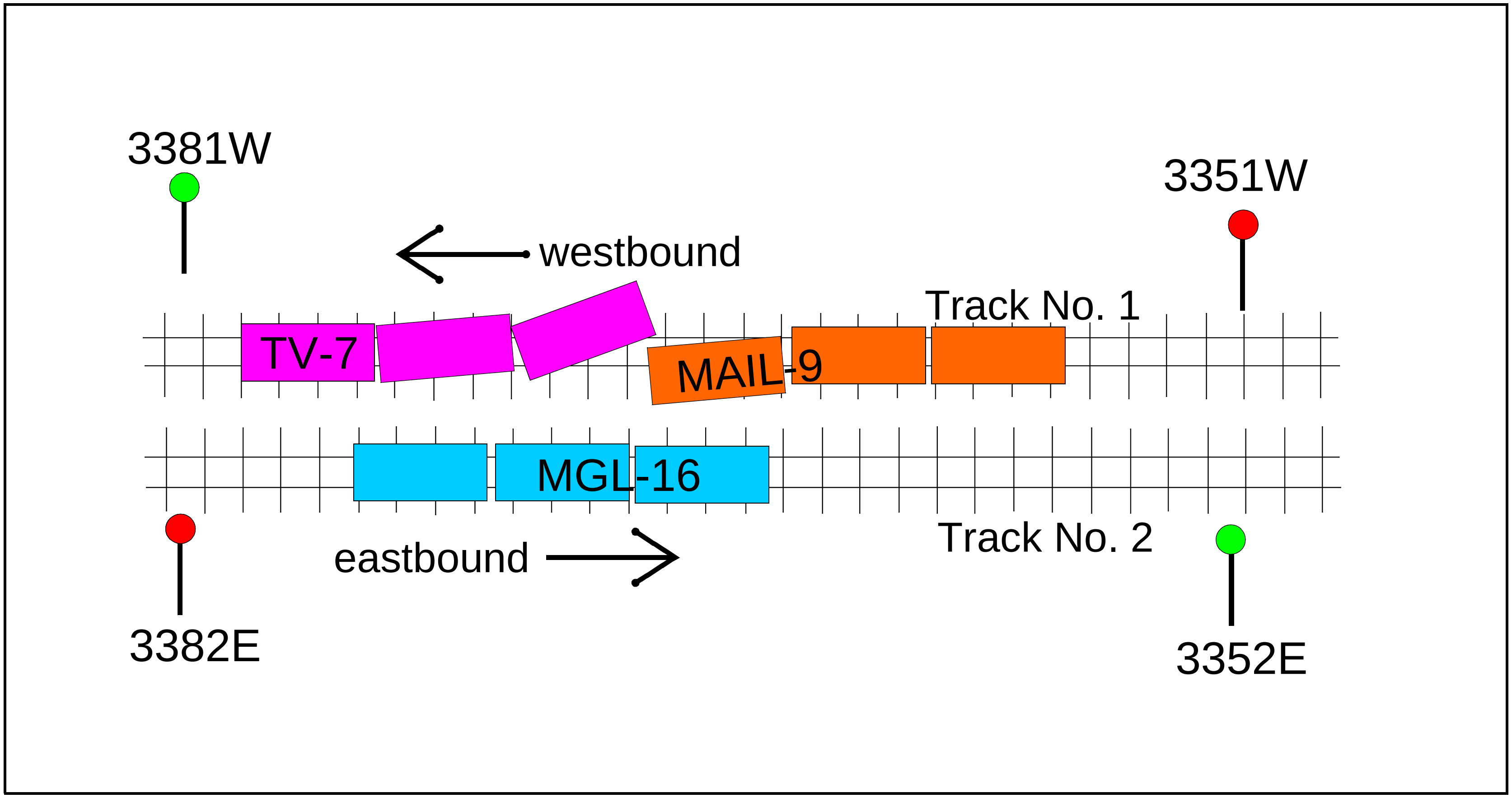


Figure 2. When train Mail-9 struck the rear of train TV-7, equipment from both trains derailed and struck train MGL-16, causing 18 cars from the MGL-16 consist to derail.

Table 1. Description of freight trains dispatched westbound from Toledo.

Train	Departure Time (a.m.)	Track Assignment	Type of Freight	Authorized Speed (mph)
PIEL-6A	12:15	No. 1	mixed	50
TV-99	12:41	No. 2[a]	van	60
TV-7	12:51	No. 1	van	60
Mail-9	1:08	No. 1	van	60

[a] About 1:10 a.m., TV-99 crossed over to track No. 1, putting it directly behind PIEL-6A.

About 1:28 a.m., PIEL-6A passed signal 3341W,[4] which was about 3.12 miles before the accident site. The PIEL-6A engineer radioed the dispatcher, "Just to let you know, it's about 100-foot visibility down here. A lot of fog." The dispatcher did not, nor was he required to, notify the trailing van trains about the visibility or advise them to adjust their speeds for the fog.

The operators of the first two van trains, TV-99 and TV-7, each said that when they approached signal 3341W, it was displaying a *clear* indication (green aspect). Northeast Operating Rules Advisory Committee (NORAC) operating rule No. 281 states that upon encountering a *clear* indication, the train operator should "proceed not exceeding Normal [authorized] Speed." (See figure 3.)

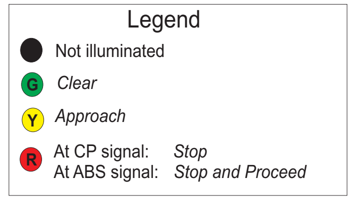
Event recorder data indicate that when the lead locomotive of TV-99 passed signal 3341W at 1:38:14 a.m., the train's speed was about 55 mph. When the lead locomotive of TV-7 passed the signal at 1:45:12 a.m., its speed was 60 mph. Based on radio communications with PIEL-6A, the TV-99 engineer then slowed his train, passing 3351W at 42 mph.

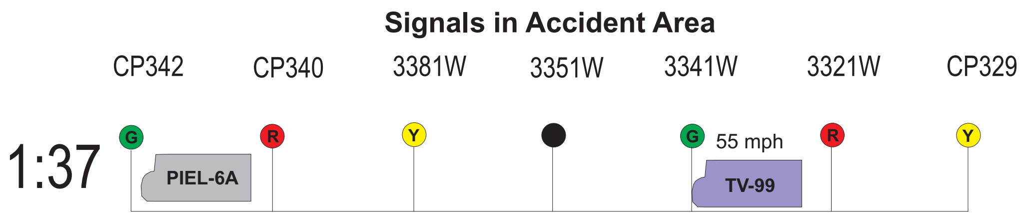
Because of the dense fog, the TV-7 engineer slowed his train from 60 mph at 3341W to 39 mph at 3351W. When the TV-7 engineer saw that 3351W displayed an *approach* indication, he continued to slow his train because he said he could not see the signals until he "was just about on top of them," or a distance of "about two car lengths" (about 100 feet), and he thought the next signal (3381W) would be displaying a *stop and proceed* indication. NORAC operating rule No. 285 states that upon encountering an *approach* signal indication, the train operator should "proceed prepared to stop at the next signal" and, if the train is exceeding medium speed, "begin reduction to Medium Speed [not exceeding 30 mph] as soon as the engine passes the Approach Signal." NORAC rule No. 291 states, in part, that upon receiving a *stop and proceed* indication, the train operator must stop and then proceed at "restricted speed"[5] until the entire train passes a

[4] The signal designation combines the MP number, the track number, and the traffic direction. In this case, 3341W stands for MP 334, track 1, westbound traffic.

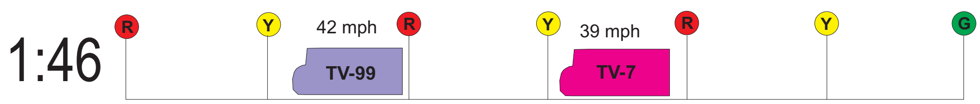
[5] Title 49 *Code of Federal Regulations* (CFR) 236.812 defines *restricted speed* as "a speed that will permit stopping within one-half of the range of vision, but not exceeding 20 mph."

The Chicago main line traffic control system has two types of signals: control points and automatic block signals. Control points (CPs) are controlled and monitored by the dispatcher and are illuminated at all times, although their aspects change depending on the presence of trains. Between CPs, the traffic system has automatic block signals with approach lighting operation, meaning the signals illuminate when the track circuitry indicates the approach of a train. The presence of a train in the block causes the signal behind the occupied block to turn red and the signal two blocks back to turn yellow.

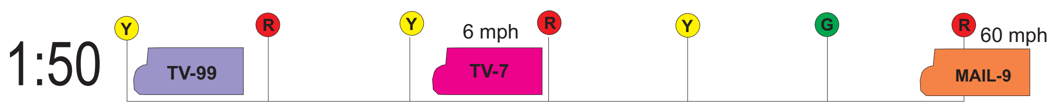




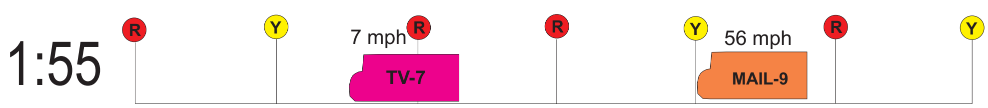
PIEL-6A passes CP 340. Meanwhile, the first van train, TV-99, reaches 3341W. The dispatcher had planned to move PIEL-6A to track No. 2 so that the trailing van trains could pass. Because of concerns that the almost 2-mile-long PIEL-6A might not fit between CP 340 and CP 342, the dispatcher tells the train engineer "not to chance it."



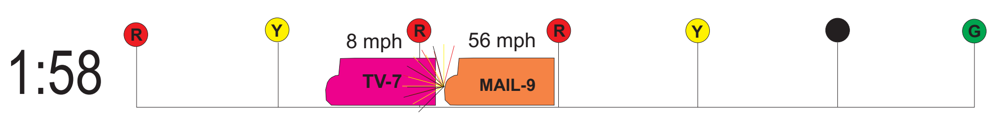
TV-99 slows in anticipation of stopping at CP 342. Meanwhile, TV-7, traveling 39 mph, passes 3341W.



After being stopped at CP 342 because PIEL-6A occupied the block ahead, TV-99 begins to move. The TV-7 engineer, having been notified that TV-99 was stopped, slows his train in anticipation of receiving a *stop and proceed* indication at 3381W.



Upon encountering a yellow aspect, or *approach* indication at 3381W, the TV-7 engineer switches from braking to power, and his train slowly begins to accelerate. Mail-9 passes signal 3341W traveling 56 mph.



After passing signal 3351W, which displays a *stop and proceed* indication, Mail-9 continues to operate near maximum authorized speed. Mail-9, traveling 56 mph, strikes TV-7, which is moving at 8 mph.

Figure 3. Progress of the trains during the 21 minutes before the accident. Clock times are at the left of the track layout.

more favorable fixed signal. About 1 mile west of 3351W, TV-7 was operating at 6 mph. About 1:47 a.m., the TV-99 engineer radioed TV-7 that his train had caught up with the freight train (PIEL-6A) and had stopped in accordance with a *stop* signal indication at Control Point (CP) 342.

The TV-7 engineer stated that when he saw that the next signal, 3381W, displayed an *approach* indication, he switched from applying dynamic braking to applying power, and the train slowly began to accelerate.

Meanwhile, the third van train, Mail-9, was continuing to operate at or near maximum authorized speed. Event recorder data show that when Mail-9 passed signal 3341W, which displayed an *approach* indication, at 1:55:39 a.m., the train was operating in the No. 8 throttle position and traveling 56 mph. The next signal, 3351W, is about 1.8 miles from signal 3341W. About 1/4 mile before reaching signal 3341W, the track declines from 0.01 to 0.14 percent descending grade. As Mail-9 descended that grade, its speed gradually rose from 55 mph until it reached a high of 58 mph about 1/2 mile past the signal. The train operator then reduced the throttle position from position 8 to idle in four discrete steps (8-5-6-3-idle). After 11 seconds in idle, the speed had dropped to 57 mph. The train was now approaching the point where the track transitions from a descending grade to a 0.03 percent ascending grade at MP 335.3 and further rises to a 0.20 percent ascending grade at MP 335.9. The engineer increased the throttle from idle to position 8 in six discrete steps (idle-1-2-3-4-5-8). As Mail-9 ascended the grade, the speed initially dropped to 54 mph but came back to 56 mph.

Operating rules require that the engineer sound the horn for grade crossings. Along the approximate 3-mile segment of track between signal 3341W and the point of collision, there are six grade crossings (three passive and three active). Inspection of the event recorder data identified 23 instances in which the horn was turned on or off along that segment of track. A comparison of the locations where the horn was sounded with the grade crossing locations determined that, for the first five crossings, the horn was sounded one or more times in advance of every grade crossing and continued up to, or slightly past, the crossings. The horn was not sounded for the grade crossing at C.R. (county road) 19, which was about 1/4 mile before the point of collision, until the lead locomotive was about 200 feet past the crossing. After Mail-9 passed C.R. 19, the horn was next sounded for 2 seconds immediately before the point of collision. The collision occurred about 1.32 miles past signal 3351W.

Data from three roadside crossing detectors between the two signals indicate that Mail-9 continued to operate near maximum speed through the block. Mail-9 passed signal 3351W, which was displaying a *stop and proceed* indication, at 55 mph. Shortly thereafter, Mail-9, traveling 56 mph, struck the rear car of TV-7, which was traveling about 8 mph. The train event recorder indicated that the Mail-9 engineer applied neither dynamic nor automatic air brakes between *approach* signal 3341W and the point of collision.

The engineer of TV-7 said that the lead locomotive of his train was past signal 3381W when he felt a “run-in,”[6] and the train’s brakes went into emergency. The TV-7 conductor then walked to the rear of the train and saw that a collision and a derailment had occurred.

About the same time that westbound TV-7 was approaching signal 3381W, eastbound train MGL-16, with a consist of empty gondola cars, was passing on track No. 2. The MGL-16 crewmembers stated they had just passed the rear end of TV-7 when they saw the head end of Mail-9 appear out of the fog. Both MGL-16 crewmembers said they thought the speed of Mail-9 was too fast “for the situation,” given the speed and proximity of the van train that they had just passed (TV-7). The MGL-16 conductor said that he then heard a crash, and his train went into emergency braking.

The Collisions

The collision of Mail-9 with TV-7 caused the derailment of the 3 locomotive units and the first 13 cars of Mail-9 and the last 3 cars of TV-7. Eastbound train MGL-16 was traveling about 49 mph on the adjacent track at the time of the collision. The derailed equipment of the Mail-9 and TV-7 trains struck the MGL-16’s 12th car and caused cars 12 through 29 in the MGL-16 consist to derail. (See figure 4.)

Figure 4. Firefighters survey the wreckage of the accident. Of the 3 locomotives and 34 cars that derailed, 2 locomotives and 30 cars were destroyed. (Photograph courtesy of the Bryan Fire Department.)

Postaccident Events

At 1:59:10 a.m., the MGL-16 engineer reported an emergency to the Conrail dispatcher and suggested that an ambulance be dispatched to the site. The dispatcher asked for their location, but the crewmembers could not tell him where they were. The MGL-16

[6] *Run-in* refers to the bunching action of the cars and the resulting bump to the locomotives caused when the trailing cars move faster than the first unit (locomotive).

conductor said that he got off the locomotive to determine their location but, because of the fog, he "couldn't see more than 10, 15 feet" in any direction. He said he tried to find the crossing that they had just gone over (C.R. 19) but could not locate it at first.[7]

In the meantime, at 2:04:56 a.m., the Conrail train dispatcher called the Williams County 911 dispatcher, advising of a "probable train wreck…somewhere between County Road 16.25 and C.R. 18." When the 911 dispatcher asked whether the trains carried hazardous materials, the Conrail dispatcher told him they did not.[8]

At 2:05 a.m., the 911 dispatcher radioed a message asking all area officers on patrol to investigate. Several Williams County Sheriff's Department officers, as well as officers from the Bryan and Stryker police departments, proceeded toward the general area. Officers later told the Safety Board that dense fog delayed their response. A Williams County deputy sheriff stated that when he was about 1 to 1 1/2 miles from the crash site, "the visibility was probably 15 to 20 feet off the end of my patrol car." He said that his average speed was about 20 mph, which he characterized as "a little too fast at times." He estimated that visibility at the accident site was about 10 to 15 feet.

Meanwhile, the county dispatcher radioed Williams County Emergency Medical Services at 2:11 a.m. and the Bryan Fire Department at 2:12 a.m. to stand by for a possible train derailment and wreck. The fire chief, who responded from his home at 2:14 a.m., characterized conditions as "very, very heavy thick fog." He further stated, "You really couldn't see anything." He estimated that, at the most, the maximum visibility while he was en route to the accident site was less than 25 feet. He said that he lived about 4 1/2 miles from the incident; he added, "It took me 10 minutes to arrive at that scene. And I probably drove faster than I should have…."

At 2:14 a.m., a resident near the collision site called Williams County 911 to report that she had heard "a loud crash" and could see "a red glow in the sky by the railroad tracks." Using her information, the Williams County dispatcher directed resources to the area and requested standby support from the Springfield Township-Stryker Village Fire Department (Stryker Fire Department). In the meantime, at 2:18 a.m., the Bryan Fire Department chief, while en route to the scene, ordered a full response of the Bryan Fire Department resources.

At 2:24 a.m., a responding deputy en route on C.R. 19 radioed that he heard "popping explosions." He then reported that an unidentified, ash-like substance was "showering down on him" and that he was "backing away" from the site because the train was on fire and "serious explosions" were occurring. Shortly thereafter, the Bryan fire chief arrived at the grade crossing at C.R. 19, where he met the conductor of MGL-16.

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[7] The conductor continued to walk westward and located the C.R. 19 crossing, where he subsequently met the Bryan Fire Department chief.

[8] The Mail-9 cargo manifest showed nine hazardous materials references, eight of which were paints and related flammable substances. One reference indicated a 152-pound liquid petroleum gas (LPG) shipment. The TV-7 train manifest also showed hazardous materials references; however, the cars that were struck and derailed were empty.

The conductor advised the fire chief that hazardous materials were possibly in the containers, whereupon the fire chief, at 2:33 a.m., advised all units that the incident involved hazardous materials and requested that a hazardous materials unit be dispatched to the scene. Shortly thereafter, at 2:38 a.m., police officers radioed that while walking alongside the train cars, they had observed "corrosives" placards affixed to the cargo loads.

By 2:53 a.m., after an initial search of the wreckage failed to locate the two missing crewmembers, the Bryan fire chief, in his capacity as incident commander for this response, determined that the flying debris from explosions, the unidentified hazardous materials cargo, the potentially toxic smoke, and the size of the fire posed, at the time, too great a danger to the firefighters. Further, the depth of the snow severely restricted the transport of firefighting equipment to the site. The fire chief directed response personnel to relocate about 1/2 mile from the wreckage site, at the C.R. F and C.R. 19 intersection, which he established as the primary staging area and incident command site. The incident commander then activated the Williams County hazardous materials emergency response and disaster preparedness plans and began devising and organizing a fire suppression strategy that would begin at daybreak.

At 2:59 a.m., Toledo Edison, the electrical company that had overhead utility lines near the site, was notified to cut power to the lines. At 3:12 a.m., the incident commander notified Ohio Gas of the accident, and gas company personnel arrived on scene at 3:45 a.m. to monitor the gas line pressure. An access to the wreckage was plowed through the snow and a (water) tanker truck staging area was established.

Meanwhile, about 4:00 a.m., the Williams County Sheriff's Department started a voluntary evacuation of residences within about 1 mile of the site. The evacuation affected 38 people in 16 homes.

About 4:08 a.m., the incident commander received from Conrail faxed copies of the freight manifests, which showed that some containerized cargo on TV-7 and Mail-9 had been declared as hazardous materials. The three TV-7 cars that had been struck and had derailed were empty. The 13 Mail-9 cars that had derailed were primarily loaded with ordinary mail and small domestic delivery parcels. The Mail-9 manifest showed hazardous materials references for paints, related flammable substances, and a 152-pound LPG shipment.[9]

About 7:50 a.m., the fire suppression effort began. For the most part, firefighters were able to suppress the fire with water; they used two 5-gallon containers of foam on the wreckage. By 9:38 a.m., most of the fire had been extinguished. Firefighting teams or their relief crews remained on scene to deal with small hot-spots that continued to rekindle. About 1:04 p.m., the incident commander began to release unneeded equipment from the scene. By 4:00 p.m., the incident was concluded.

[9] The 152-pound LPG shipment was identified in the freight manifest as containing 24 individual LPG containers.

In all, response agencies from 12 municipalities and counties participated in this incident. The fire chief estimated that several hundred firefighters, emergency medical service (EMS) personnel, and municipal police, as well as 18 sheriff's deputies, responded to the scene. About 42 fire and ambulance vehicles were used in the incident response, and about 84,700 gallons of water were transported to the scene by fire department tanker trucks.

Injuries

Table 2 summarizes the injuries sustained by the operating crews of the three trains involved in the accident. The table is based on the injury criteria of the International Civil Aviation Organization, which the Safety Board uses in accident reports for all transportation modes.

Table 2. Injuries sustained by the operating crews in the Bryan accident

Type	Mail-9	TV-7	MGL-16	Total
Fatal	2	0	0	2
Serious	0	0	0	0
Minor	0	0	0	0
None	0	2	2	4
Total	2	2	2	6

49 CFR 830.2 defines *fatal injury* as "any injury which results in death within 30 days of the accident" and *serious injury* as "an injury which: (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burn affecting more than 5 percent of the body surface."

Damages

Conrail provided the following estimates for damages resulting from the accident:

Equipment (cars and locomotives)	$3,215,000
Track and signal	90,000
Wreckage clearing	50,000
Ohio Gas Company	4,000
Lading	1,935,000
Total	**$5,294,000**

Personnel Information

Requirements for Qualification

Title 49 CFR 217.11 stipulates that each railroad must periodically test and train its employees on the company's operating rules. Conrail conductors and engineers were required to take and successfully pass an annual written examination containing multiple-choice questions on "critical" rules governing safe operations. The railroad determined which rules were critical by their application to everyday working situations.

Title 49 CFR 240 requires that locomotive engineers be certified every 3 years. In compliance with Federal requirements, Conrail's locomotive engineer qualification program stipulated that engineers fulfill the following requirements within prescribed time limits:

- Receive and pass a physical examination that includes vision and hearing tests.
- Provide the system road foreman with a copy of a State driver's license record for present and previous years, as available, up to 5 years.
- Attend an operating rules class and pass a 50-question written examination on operating rules, hazardous materials, personal safety, train handling, and air brake procedures, and a 10-question oral examination on the physical characteristics of their principal routes.
- Receive and pass a performance skills check by a supervisor while operating a locomotive or a locomotive simulator.

A grade of 85 percent, or no more than nine incorrect answers, was required to pass the oral and written examinations. Engineers who failed the certification examinations were not allowed to serve as a locomotive engineer until they attended another rules class and passed the tests.

General

This employee background information is based on Conrail personnel records and testimony of the TV-7 and MGL-16 crewmembers. Some crewmembers listed below were hired by various predecessor railroads that merged with Conrail in 1976.

TV-7 Crew. The TV-7 conductor, age 55, was hired as a trainman in April 1965. He was promoted to conductor in October 1966. He last received a book of rules examination, which he passed, in November 1998. His last company medical examination was conducted in July 1998; the medical documents do not note any medical restrictions.

The TV-7 engineer, age 55, was hired on the railroad as a fireman in April 1962. He was promoted to engineer in September 1970. He last received a book of rules examination, which he passed, in February 1998. His last company medical examination was conducted in April 1997; the medical documents do not note any medical restrictions.

MGL-16 Crew. The MGL-16 conductor, age 43, was hired as a trackman in May 1976. In May 1977, he transferred to a job as a trainman. He was promoted to conductor in January 1993. He last received a book of rules examination, which he passed, in March 1998. His last company medical examination was conducted in November 1998; the medical documents do not note any medical restrictions.

The MGL-16 engineer, age 58, was hired in October 1969 and promoted to engineer in February 1974. He last received a book of rules examination, which he passed, in October 1998. His last company medical examination was conducted in September 1996; the medical documents note that he was restricted to wearing corrective lenses.

Mail-9 Crew. The Mail-9 conductor, age 53, was hired in September 1964 as a brakeman. He was promoted to conductor in May 1966. He had worked on the Chicago main line since 1993. He last received a book of rules examination, which he passed, in March 1998. His last company medical examination was conducted in June 1998; the medical documents note that he was restricted to wearing corrective lenses.

The Mail-9 engineer, age 58, was hired in July 1965 as a fireman. He was promoted to engineer in September 1971. He had worked on the Chicago main line since 1986. He last received a book of rules examination, which he passed, in February 1998.

In his June 1998 certification, the Mail-9 engineer received passing ratings for his operating knowledge and ability based on the results of his rules tests and on observations by supervisors during rides. At the required physical examination for certification, medical personnel noted that the distant vision in the engineer’s left eye did not meet the Federal Railroad Administration (FRA) certification requirement in 49 CFR 121 that stipulates distant vision must be at least 20/40 in both eyes with or without corrective lenses. In July 1998, the engineer had a cataract removed from his left eye. Two weeks after the surgery, his doctor found that the engineer’s left eye vision with glasses was 20/25. Conrail medical records indicate that, on July 30, 1998, the engineer was medically “qualified with accommodations,” with the specific accommodation of “must wear corrective lenses.”

Before Mail-9 departed Toledo, a Conrail road foreman of engines had talked with the engineer. The foreman also prepared a postaccident statement, provided by Conrail to the Safety Board, indicating that the engineer had “looked fine and fit for duty.”[10] At a deposition conducted by the Safety Board, the road foreman reiterated that he did not take any exception to the engineer’s fitness when he observed him on January 17.

[10] Conrail required its first- and second-level supervisors to attend “Management Awareness Program” (MAP) classes that provided information on recognizing the physical and behavioral characteristics of employees under the influence of drugs or alcohol and advice on how to deal with a drug-impaired employee. The road foreman of engines interviewed had attended MAP training in 1986, 1990, and 1991 and had received refresher training on determining fitness for duty in 1994.

Work-Rest Schedules

Conrail provided database payroll records for the 60 days preceding the accident for all crewmembers involved in the collision. The schedules of the crewmembers for the few days before the accident are summarized below. All times are based on a 24-hour clock. On- and off-duty time intervals are rounded to the nearest 1/2 hour.

TV-7 Crew. The conductor had gone off duty from his previous assignment at 0030 on January 15, 1999. He next entered on duty at 0005 on January 17, 1999. Thus, he had been off duty for 47 1/2 hours before reporting for the accident trip and had been on duty less than 2 hours at the time of the accident.

The engineer had gone off duty from his previous assignment at 1245 on January 15, 1999. He next went on duty at 0005 on January 17, 1999. Thus, he had been off duty for 35 hours before reporting for the accident trip and had been on duty less than 2 hours at the time of the accident.

MGL-16 Crew. The conductor had gone off duty from his previous assignment at 0805 on January 16, 1999. He next went on duty at 1855 that same day. Thus, he had been off duty for 11 hours before reporting for the accident trip and had been on duty for about 7 hours at the time of the accident.

The engineer had gone off duty from his previous assignment at 0805 on January 16, 1999. He next went on duty at 1855 that same day. Thus, he had been off duty for 11 hours before reporting for the accident trip and had been on duty for about 7 hours at the time of the accident.

Mail-9 Crew. The conductor had gone off duty from his previous assignment at 1215 on January 8, 1999. He asked for and was granted permission to be off duty from 1937 on January 10 until 0930 on January 11 and from 2135 on January 13 until 0930 on January 14. He next went on duty at 0015 on January 17. Thus, he had been off duty about 8 1/2 days before reporting for the accident trip and had been on duty less than 2 hours at the time of the accident.

The engineer's three assignments before the accident trip were at night. He worked from 2115 on January 11 until 1225 on January 12; from 0040 until 1035 on January 14; and from 2030 on January 14 until 0800 on January 15. He reported for duty at 0015 on January 17. Thus, he had been off duty for more than 40 hours before reporting for the accident trip and had been on duty less than 2 hours at the time of the accident. According to the engineer's wife, he had made a point of trying to get about 5 hours of sleep during the late afternoon and early evening of January 16. The precrash 72-hour history for the Mail-9 crew is summarized in table 3.

Table 3. 72-hour work histories of the Mail-9 crewmembers before the accident

Date	Engineer	Conductor
January 14	0040 - 1035 2030 - 2400	Off
January 15	0000 - 0800	Off
January 16	Off	Off
January 17	0015 - 0158	0015 - 0158

Train Information

A mechanical group comprising Safety Board investigators, FRA inspectors, and other parties to the investigation reviewed the daily inspection sheets, locomotive inspection cards, 1,000-mile brake test certificates, and maintenance records for the three trains involved in the collision. The three accident trains, their routes, and the tests they received prior to the accident are described below.

TV-7

At the time of the accident, TV-7 consisted of two General Motors SD80MAC locomotive units (CR 4129 and CR 4115) pulling 48 loaded cars. TV-7 had a trailing weight of 3,906 tons and was 7,158 feet long. The train had originated on January 15, 1999, in Boston, Massachusetts (Beacon Park). Conrail inspection records show that the train received an equipment inspection before departing Beacon Park. All the cars added to the consist at Worcester and at Springfield, Massachusetts, had been previously tested and inspected by Conrail carmen. At Cleveland, Ohio, carmen had performed an intermediate “1,000-mile” air-brake test.

Mail-9

At the time of the accident, Mail-9 consisted of three General Electric C40-8 locomotive units (CR 6096, CR 6049, and CR 6031) pulling 52 loaded cars. Mail-9 had a trailing weight of 4,966 tons and was 7,002 feet long. The train had originated in Morrisville, Pennsylvania. The event data recorder readout showed that the train received an initial-terminal air brake test, and Conrail inspection records showed that the train received an equipment inspection before departing Morrisville. Cars added to the consist at Harrisburg, Pennsylvania, had been previously tested and inspected by Conrail carmen. At Conway Yard in Pittsburgh, Pennsylvania, the motive power units were changed and a trainline continuity test was performed.

The lead locomotive unit had been equipped with a Quantum Engineering, Inc., model 2500 alerter, which was destroyed in the collision. An alerter is a vigilance monitoring system that is tied into the primary locomotive controls. It has audible and visible warning in-cab components that activate electronically when a "significant movement"[11] does not occur within a time interval. If the engineer fails to acknowledge the alerter alarm in a timely manner, an automatic brake application will occur.

The Quantum 2500 time interval is 5 minutes for speeds of 3 mph or less and 2 minutes for speeds greater than 3 mph, up to and including 20 mph. For speeds greater than 20 mph, the alerter interval is in seconds, which the device calculates by dividing 2,400 by the speed. For example, at 60 mph, the alerter interval is 40 seconds; and at 30 mph, the interval is 80 seconds.

MGL-16

The consist of the MGL-16 train included two General Motors Electro-Motive Division GP-15-1 locomotive units (1697 and 1698) and 63 empty class F-50 gondola cars. The train had a trailing weight of 1,889 tons and was 2,971 feet long.

MGL-16 had originated at the Midwest Steel plant in Portage, Indiana. The crew had conducted an initial terminal air brake test and equipment inspection before the train departed Portage. At Elkhart, Indiana, the original locomotive units were replaced by other units.

Site Information

The accident occurred on the two main tracks of the Chicago main line in Conrail's Dearborn Division. The north track is designated as main track No. l and the south track is main track No. 2. The estimated point of collision on main track No. 1 was at MP 337.22, which is 1,228 feet west of the C.R. 19 centerline.

At the time of this accident, Conrail owned the Chicago main line and inspected and maintained the two tracks to meet or exceed the FRA class 4 safety standards contained in 49 CFR 213. According to the Conrail Dearborn Division timetable, the maximum allowable operating speed for both tracks was 79 mph for passenger trains, 60 mph for van trains, and 50 mph for freight trains.

The main tracks are oriented geographically in an easterly to westerly direction and by timetable for east and west traffic movement. The milepost numbering increases in the westward timetable direction.

Following the collision, Mannik and Smith, Inc., a consulting firm from Maumee, Ohio, conducted a site survey to document the Conrail right-of-way, the track profile, the

[11] The movement required varies among the different types of vigilance monitoring systems. Some systems require the train operator to touch a certain metal object; other systems require the operator to make a control manipulation, such as a throttle movement or brake adjustment. Some systems require that the operator both touch a metal object and make a control movement.

positions of utilities, and other pertinent information. The consulting firm's findings are summarized, in part, below.

The vertical alignment of main track No. 1 for westward train movement between MP 290.0 and MP 337.22 undulates gently, with no grades ascending more than 0.33 percent or descending more than 0.21 percent. About 1/4 mile before signal 3341W, the track descends from 0.01 to 0.14 percent descending grade. Beginning at MP 335.3, the track transitions from a descending grade to a .03 percent ascending grade. At MP 335.9, the grade ascent increases to 0.20 percent. The horizontal track alignment is straight between MP 290.3 and MP 358.8.

Between 3341W, the point where the train crews first reported the presence of fog, and the point of collision, there are 6 grade crossings (3 active and 3 passive).

Signals

General

Under the traffic control system (TCS) on the Chicago main line, train movements are authorized by colored light signals that are installed on the wayside of each "block," or segment, of track. The appearance, or "aspect," of the signal conveys an "indication," or information specifying the allowed movement within the block.

The signals within the Chicago main line TCS were either CPs or automatic block signals with approach lighting operation. The wayside CPs were illuminated at all times, although their indications changed depending upon the absence or presence of trains in the block. The CPs were controlled and monitored by Conrail's divisional dispatching office in Dearborn, Michigan. CPs also were locations in the TCS where the dispatcher could direct trains to cross from one track to another.

Between CPs, the TCS had automatic block signals with approach lighting operation, meaning that the signals illuminate when the track circuitry senses the approach of a train. The presence of a train in a track block not only affects the signal for the occupied block, but also the signals for the two blocks behind the occupied block. The signal for the block immediately after an occupied block displays a red aspect, and the signal for the second block after an occupied block displays a yellow aspect.[12]

Other features of the TCS included wayside defect detectors, many models of which broadcast information about the train to the operating crew.[13] The accident area between MP 320.0 and MP 339 had several wayside defect detectors. Two sites, MP 320.0

[12] The signal aspect for the second block behind the occupied block displays a yellow aspect only if a train is approaching the block; otherwise, the signal is dark.

[13] Because a detector transmits the information on radio frequencies, crews on trains other than the train triggering the broadcast can hear the transmission if they are within the radio band and listening to the same channel.

and MP 339, had defect detectors that were actually three detector devices in one: a “hot box” detector, which determines whether any journal bearings are overheating; a “dragging equipment” detector, which determines whether any equipment, such as brake rigging or mechanical connections, is dragging or whether any debris that can damage the track connections, ties, or switches has become lodged under the train; and a “hot wheel” detector, which determines whether any wheels are overheated, a condition caused by sticking brakes. MP 334 had a dragging equipment detector. Some of the defect detectors were equipped with an event recorder, which records the information radioed to the crew.

Between CP 329 and CP 340, which included the accident area, three highway-rail grade crossings, located respectively at MPs 334.8, 335.3, and 335.8, were equipped with event recorders.

Signals Near Bryan

Some of the signals in the accident area were mounted on ground masts, placing them about 17 feet above the ground. Others were on bracket masts and were about 28 feet above the ground. Signals 3321W and 3321E were ground mast signals. (See figure 5.) Signal 3341W was a 28-foot-high bracket mast signal that was mounted 24 feet 1 inch from the track. Signal 3351W was a 17-foot-high ground mast signal mounted 20 feet 3 inches from the track.

Operations

General

Dearborn Division records show that in 1998, Conrail transported 57 million gross tons on main track No. 1 and 60.2 million gross tons on main track No. 2. During the week of January 10 through 16, 1999, an average of 66 trains, including 6 Amtrak passenger trains, operated daily on the two tracks.

At the time of the accident, the general written instructions governing train movement through the accident territory were *NORAC Operating Rules*, dated January 1, 1997, and *Conrail System Timetable*[14] *No. 7,* dated January 15, 1999. Train movement was authorized by TCS signal indication.

A system of operation based solely on TCS does not have redundancy features, such as automatic train control systems, for controlling the movement of a train. (See “Other Information” for more detail about train control systems.) With a TCS, safe operations are contingent upon the locomotive engineer seeing and complying with the speeds and movements indicated by the signal aspects and timetables.

[14] A *timetable* is a printed booklet containing schedules and the following special instructions: information about directives from the dispatcher, such as Conrail’s Form D; illustrations of various signal indications; and procedures for complying with the signal indications.

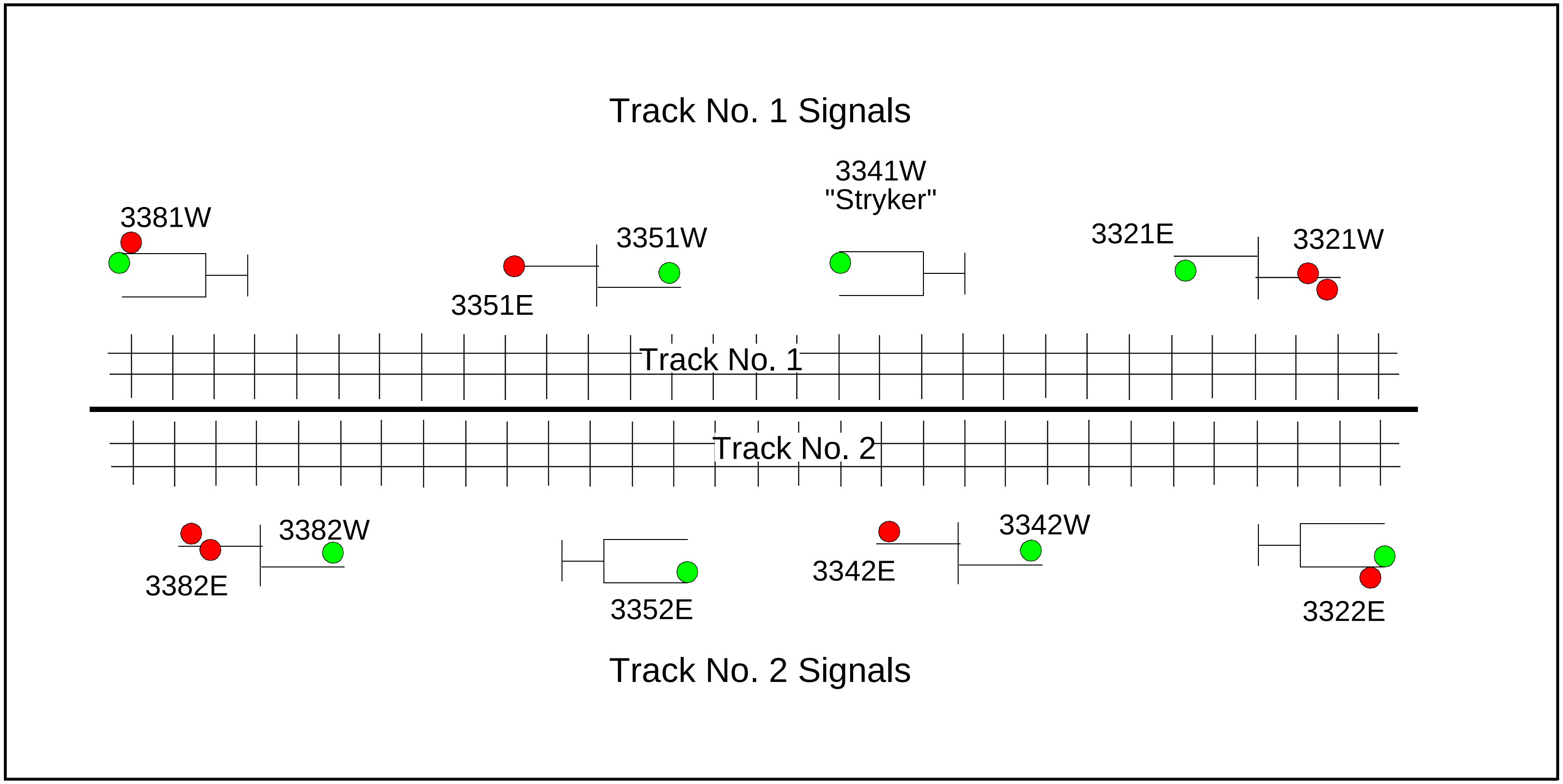

Figure 5. The signals in the accident area were on bracket masts alternating with ground masts. In the layout of the accident area shown above, the westbound signals at MP 334 (Stryker) and MP 338 are bracketed masts with single-direction light units. The westbound signal at MP 335 is a ground mast with back-to-back light units.

Operating Rules and Practices

Conrail operating rules contained procedures for radio use, including channels to use in various locations and required message traffic. Crews were to use channel 2 when operating within the yard and channel 1 when operating on road track. Train crews were required to acknowledge receipt of defect detector information by announcing on the radio the MP number and the name of the train immediately after the detector broadcast. If the train crew's radio transmission was not "stepped on," or overridden, by a broadcast from another train, the acknowledgement was captured on the recorder in the dispatch center. The dispatch center recorder, a MagnaSync/Moviola multi-track "Specialist," captured radio, telephone, and various other communications for 40 separate tracks in the Dearborn Division of the Conrail system.

When Safety Board investigators reviewed the taped record of channel 1 broadcasts, some radio transmissions were not readily identifiable or were unintelligible. Investigators made a digital audiotape of the transmissions captured by the Specialist recorder and took the digital tape to the Safety Board's audio laboratory for analysis. (For further information, see "Tests and Research.")

Signal Calling. NORAC operating rule No. 94, "Responsibilities of Employees: Signals and Restrictions," contains these instructions under "General Requirements":

> Employees qualified on the operating rules and located on the leading engine or car must be on the lookout for signals affecting the movements of their train. They must communicate to each other in a clear manner the name of each signal as soon as it becomes clearly visible. After the name of a signal has been communicated, employees must observe it until passed. Any change in the signal must be communicated in the required manner.
>
> When a train reaches a point 2 miles from a temporary restriction, employees qualified on physical characteristics and located on the leading engine or car must immediately communicate with the Engineer and confirm the requirements of the restriction.
>
> If a train is not operated in accordance with the requirements of a signal indication or restriction, qualified employees located on the leading engine or car must communicate with the Engineer immediately. If necessary, they must stop the train.

Crew Testimony. A conductor who was on duty but who was not involved in the Bryan accident said that it was a common practice among Conrail operating crews to call only yellow and red signals and not to call green signals. He added, "But, in a fog, or anytime when visibility was limited, we called every signal" to keep "alert and awake."

The TV-7 conductor, when asked whether he called all signals, stated, "I think that the company would like us to do that, but I only call the ones that aren't clear." The MGL-16 conductor, when asked whether crews are required to call all signals, stated, "No, but we were…my engineer was calling them out." The TV-7 engineer and the MGL-16 engineer both testified that they called all the signals in the cab.

In interviews, a general road foreman for Conrail stated that he was aware that train crewmembers usually did not call the clear signals.

Operating in Reduced Visibility Conditions. NORAC operating rule No. 958, "Visibility Compromised: Regulating Speed," contains the following instructions relating to ensuring safety in poor weather conditions:

> If anything distracts attention from a constant lookout ahead or if weather conditions make observation of signals in any way doubtful, Engine Service Employees must at once regulate the speed of their train to ensure safety.

Crew Testimony. The MGL-16 engineer testified that fog conditions varied on the night of the accident, with some areas having less fog and other areas having heavy fog. At Waterloo, Indiana, about 25 miles west of the accident site, he had stopped for a signal to allow two passenger trains to pass. He said, "After a while I couldn't see the signal" because fog enveloped it. He pulled closer to it and, upon seeing that it was an *approach* indication, waited for it to change to a *clear* indication because he "didn't want to search for the next signal" in the fog. He said that he had operated with the train's headlight on dim because "if you put it on bright, you couldn't see…I had my ditch lights on…you could see better that way." He estimated that visibility in the Bryan area was "100 to 200 feet."

The MGL-16 engineer said that he had been operating "right around 50 [mph]…I try to keep it [the train], of course, at the speed limit." When asked whether Conrail encouraged train operators to slow down for fog conditions, he responded "No." When questioned whether the company expected train operators to run at track speed in foggy conditions, he responded, "Yes, as long as you can see the signals."

The MGL-16 conductor testified that the visibility on the night of the accident was "really bad, heavy fog. Ice crystals in the air reflected most of the light in your face." When asked whether train crews change their operating procedures in fog, the conductor said:

> It depends on the situation and the conditions…. If…you can't see the whistle posts, then you might want to slow down a bit…. But if you've got clear signals…you know there's not going to be anything there but crossings, so you just blow the whistle more often.

He said that, on the night of the accident, when the engineer was not sure where the whistle boards were, he sounded the horn "periodically."

The TV-7 engineer said that when visibility is poor and he encounters an *approach* indication, he changes his speed "from 60 mph to between 10 and 15 mph." He described the fog on the night of the accident as being "very thick." He said, "With the visibility, I had to keep it down." He said that because he encountered a yellow signal at 3351W, he proceeded slowly because he did not know whether signal 3381W would be yellow or red. He estimated that in full dynamic braking mode at 7 or 10 mph, it takes "four or five car lengths" to stop the train. When asked if he could see the signals from that distance on the night of the accident, he said he could not.

When asked whether the chief dispatcher, the train dispatcher, or others in the Dearborn computer-aided train dispatcher's facility (CATDF) encouraged engineers to run track speed in inclement weather, the TV-7 engineer said, "They would like you to." He indicated that they "sometimes" gave him a "hard time" if he did not. He added, "They ask you, what's your problem, are you having engine trouble?"

A conductor who was not involved in the accident but who was on duty at the time testified:

> I've worked with probably every engineer out there…some would reduce their speeds, maybe 5, sometimes 10 mph. Most of the guys would run track speed...If you were in the lead of the fleet and you weren't going track speed…a lot of times the guys would get on the radio and say, 'Hey, what's going on up there? How come you're going so slow?'…It's a pride thing out there…we probably put pressure on ourselves to get the trains over the road.

He added, "If someone wanted to slow it down and the dispatcher knew the reason, I don't think he would say anything…. If it's a hot train, the dispatcher would get on the radio and want to know what was going on."

The conductor described working in fog as a "tough trip" that keeps crews on the edges of their seats, which is fatiguing. He said, "Sometimes you can't even see road crossings or pick up a marker [landscape feature]." He explained that his strategy for trying to spot a signal in the fog was to "glue your face to the windshield" and "anticipate that if you're going 60 mph, you know in the next minute or 2 minutes you're going to be coming to a signal." He added that when it was "really bad," he would try to time the distance to the signal using his watch. If "it's been a while…[you] slow the train down until you do see [the signal] or come to whatever's next."

An engineer who was not involved in the accident testified that crewmembers usually operated at track speed despite fog. He stated, however, that he did not feel that the carrier exerted overt pressure on crews to maintain speed. He said, "I think that we more or less do that [maintain track speed in fog] on our own. It's…a matter of pride…."

Dispatcher's Procedures. When asked whether crews made a practice of reporting fog conditions to the dispatcher, a conductor stated that crews try to report the conditions to the dispatcher so that the dispatcher can govern the traffic accordingly. He said that the practice of relaying weather reports to trains was "up to the dispatcher, but it's not really a procedure that we do." He further stated, "If there's fog, I notify other trains coming onto my territory that there may be patchy fog in areas and I give the locations, but not always." Conrail's director of rules and operating practices said that Conrail did not require its dispatchers to report weather information such as dense fog to the operating crews. He said that the CFR requires that the dispatcher record on the train sheets any condition, including weather, that might affect train movement.[15] He stated, "It's a good idea to have the dispatcher know what the weather conditions in his territory are…. But…because fog can be intermittent, we leave that [the decision to slow down or stop] up to the judgment of the engineer."

Operational Testing

Conrail's employee efficiency testing manual, *Conrail Operating Rules Promote Safety* (CORPS), discussed the company's policy for monitoring and evaluating "an employee's application, understanding, and compliance with the Rules, based upon the circumstances applying at the time."

Supervisory monitoring of an employee's operating procedures and skills took two forms: an unannounced operational efficiency test and an onboard trip or field observation test by a supervisor. The CORPS manual stipulated, "If the employee fails, immediate action must be taken to determine the reason for the failure and what must be done to remedy the situation." The manual also advised supervisors, "Employees who consistently comply with all operating rules should also be periodically advised that they were found to be in compliance in recent operational checks."

The Mail-9 conductor had been tested a total of 101 times on rules and had received no failures between January 16 and December 3, 1998. His procedural reviews had included 10 tests for compliance with restrictive signal indications.

The Mail-9 engineer had been tested a total of 177 times on rules between January 8, 1998, and January 14, 1999. He had received four failures related to proper use of the radio, which resulted in his receiving either counseling or a verbal reprimand. His procedural reviews had included compliance with 4 red signals and 14 yellow signals. The engineer had passed all tests dealing with proper operating procedures at restrictive signal indications.

Meteorological Information

An Automated Surface Observing System (ASOS) at the Defiance (Ohio) Memorial Airport, about 12 miles from the collision site, made four weather data recordings between 12:53 and 2:31 a.m. on January 17, 1999. The recordings indicate that the weather was freezing fog, the area visibility was 1/4 mile or less, and the temperature was 25° F. The wind was between 0 and 3 mph, and the dew point ranged between 23° and 25° F.

At 1:07 a.m., the Northern Indiana National Weather Service issued a short-term forecast warning of "patchy dense fog" for areas of southern Michigan, northern Indiana, and northwest Ohio, which included the Bryan site. The forecast advised motorists to use extra caution, "as visibility will be close to zero in some spots."

[15] Title 49 CFR 228.17.

According to information obtained from the National Climatic Data Center, the area that includes Bryan has “dense” fog, that is, fog that limits visibility to less than 1/4 mile,[16] an average of 17.8 days a year.

Medical and Pathological Information

The bodies of the Mail-9 engineer and conductor were transported to the Williams County morgue at the Bryan Hospital, where pathological examinations were performed and blood samples were taken for toxicological tests. At the request of the Williams County Coroner, both bodies were transported to the Lucas County Coroner’s Office in Toledo for more detailed pathological examination. The Lucas County Coroner’s Office autopsy summaries indicate that both the engineer and conductor died of “craniocerebral injures.”

Toxicological Testing

Federal regulations require that railroads ensure that all employees directly involved in an accident provide blood and urine samples for toxicological testing. Title 49 CFR 219.203 (b), “Timely sample collection,” specifies: “(1) The railroad shall make every reasonable effort to assure that samples are provided as soon as possible after the accident or incident.”

On the morning of January 17, 1999, between 10:00 and 11:00 a.m., the TV-7 and MGL-16 crewmembers provided blood and urine specimens at Bryan Hospital. The specimens were shipped to the FRA’s contract laboratory, Northwest Toxicology Labs, where the specimens were found to be negative for alcohol and illegal drugs.

The Lucas County Coroner’s Office autopsy reports for the deceased Mail-9 crewmembers do not show any evidence of alcohol. At the request of Safety Board investigators, the coroner’s office sent blood and tissue samples from the crewmembers to the Civil Aeromedical Institute (CAMI) for independent toxicological testing. CAMI reported that the tests were negative for alcohol and for a panel of legal and illegal drugs that included marijuana, cocaine, phencyclidine (PCP), opiates (morphine and codeine), and amphetamines (amphetamine and methamphetamine).

[16] National Weather Service definition.

Wreckage

Locomotive No. 6096, the lead unit of Mail-9, was destroyed. The locomotive's collision post assemblies[17] were in place; however, the short hood structure, operating cab assembly, electrical cabinet, prime mover (diesel engine), main generator, and air compressor equipment had been sheared off at the surface of the underframe assembly. (See figure 6.) The diesel engine and main generator were found adjacent to the underframe assembly. The diesel locomotive fuel tank and both truck assemblies had separated from the unit. Investigators noted a large quantity of diesel fuel residue around the wreckage.

Figure 6. Locomotive underframe assembly.

The locomotive cab had been breached, crushed, and displaced from the underframe assembly and had come to rest almost inverted against a gondola car, which was about 10 feet in front of the underframe debris of locomotive No. 6096. The cab interior did not show evidence of fire damage. (See figure 7.) The event data recorder, which was found beneath the wreckage, sustained such significant damage that the Safety

[17] *Collision posts* are vertical steel members, installed within the "short hood" structure (forward of the operating cab), that are designed to absorb kinetic energy in the event of a frontal collision.

Board and the parties to the investigation agreed not to attempt to download the information on scene. The event data recorder was taken to the manufacturer, Quantum Engineering, where a Safety Board investigator, an FRA inspector, and a Conrail representative oversaw the downloading of data from the device.

Figure 7. Postaccident cab interior.

Locomotive No. 6049, the second locomotive unit in the consist, had separated from both the lead and trailing locomotives and sustained heavy damage. The front and rear pilot plates were significantly deformed, but the cab of the unit was substantially intact. The frame at the aft end of the unit had buckled, and the engine compartment had received fire damage. The unit had come to rest on its trucks, leaning toward its right side, and skewed about 30 degrees to the right of the track.

Locomotive No. 6031, the third unit in Mail-9's consist, had separated from the second locomotive and its trailing freight car, and had been consumed by fire. The cab was partially separated from the unit, and the carbody was extensively battered. The unit came to rest on its right side, skewed almost parallel to the No. 1 track. The leading end of the unit was about 30 feet west of the estimated point of impact.

Disaster Preparedness

The Williams County Emergency Management Agency (EMA) Emergency Operations Plan (EOP), issued in August 1993 and revised in December 1997, addresses, among other disaster preparedness topics, hazard identification, operations and administration, communications and notifications, logistics, and resource management. The Williams County EMA also maintains a plan for responding to hazardous materials emergencies that was last updated in August 1998.

The constituent emergency response agencies of Williams County, including the Bryan and Stryker fire departments, last conducted a live drill with a scenario involving a freight train (a grade crossing collision) about 5 years before the Bryan accident. Officials for both fire departments indicated, however, that in the past several years, their personnel had responded to numerous automobile collisions at grade crossings and locomotive fires. As a result, their personnel were somewhat familiar with freight railroad equipment and procedures. The Williams County emergency response agencies had last received formal, on-site, instructional training in emergency response procedures involving railroad passenger equipment from Amtrak in August 1997.

Tests and Research

Train Movement Data

Safety Board investigators took the locomotive event data recorder from Mail-9's lead locomotive to the manufacturer, Quantum Engineering, for readout. The printout showed, among other information, the speed, throttle position and manipulation, and horn operation. Recorder and signal specialists compared the locomotive event recorder data to the CATDF log and wayside defect detector recordings. Excerpts from the recordings were used to chart the chronology in appendix B.

Radio Tape Study

As reported earlier, some of the recorded radio transmissions between the four trains and the CATDF were garbled and unintelligible. The Safety Board's audio laboratory conducted a sound waveform analysis of the taped radio communications for any evidence indicating who had made each transmission.

Following a cursory review of the spectrum and its energy content, the Safety Board audio laboratory closely examined 11 transmissions. The results of the study indicate the following: four transmissions were unintelligible; one transmission was partially audible but contained no call sign or train identification; two transmissions could be positively identified as coming from Mail-9; and four other transmissions appear to have come from four separate train crews. Each of the four unintelligible transmissions occurs after the recordings of defect detector transmissions in the area between MP 300.0 and MP 334.1, which includes the accident area. Two of the four unintelligible transmissions occur immediately after detectors (at MP 300.0 and 320.0) broadcast axle counts of 322, which matched the number of axles in the Mail-9 train consist.

Sight Distance Observations

Safety Board investigators arrived at the accident scene during daylight hours, when firefighters were still fighting the blaze. When the Safety Board arrived, conditions were foggy; however, by the time the incident commander had concluded the incident, the fog had dissipated. Investigators subsequently conducted sight distance tests at signals 3341W and 3351W at 10:40 p.m. on January 17, 1999. During nighttime tests in clear weather on the straight track, investigators could make out the color of the next block signal immediately after passing the signal for the preceding block, a distance of 10,000 feet or more.

Signal Inspection and Tests

Upon notification of the accident, Conrail examined the signal housings for tampering and sealed them in accordance with company protocol. When Safety Board investigators arrived on scene, they visually examined signals 3341W and 3351W for tampering and observed that the seals on the housings were intact.

On January 17, 1999, the signal group, including Safety Board investigators and FRA inspectors, visually inspected signals 3321W, 3341W, 3351W, and 3381W and documented the positions of vital relays, took ground readings, and tested the signals for grounds, battery voltage, and lamp voltage. No exceptions were noted in any of these tests, and all signal lamps were operable.

Examination of Signal Operation. Between 12:00 noon on January 19 and 3:30 p.m. on January 20, members of the signal group maintained a watch of signal 3351W to observe its operation as trains moved through the block. On January 20, 1999, the signal group installed recorders at signals 3341W and 3351W to capture the position of the signal relays over a period of 6 months to ensure that the signals were operating properly. According to a report prepared by the FRA inspector, the tape shows that no faulty relays occurred during the monitoring period.

Train Movement Simulations. Using the information captured on the Dearborn CATDF log, investigators twice conducted train movement simulations in the accident area using comparable locomotive equipment, or shunts, or both. The first simulations, which were performed on the day after the accident, duplicated the westward movement of TV-99, TV-7, and Mail-9 from CP 329 to CP 340.

For TV-99's movement, testers first applied and then progressively removed shunts at the end of each signal block beginning east of 3321W and continuing through 3381W. Investigators left a shunt in place west of 3381W to simulate TV-99 occupying the block. For TV-7's movements, a test locomotive began at CP 329 and proceeded west until it encountered a red-over-red aspect at 3351W, indicating the block ahead was occupied. Testers then lifted the shunt west of 3381W, and the signal displayed a yellow aspect. At the same time, 3351W displayed a red aspect because the "TV-7" test train occupied the block, and 3341W displayed a yellow aspect. For Mail-9's movement, testers applied and removed shunts from 3321W to 3381W.

During simulation tests on January 18 that used shunts to replicate the movement of TV-7 and a locomotive to replicate the movement of Mail-9, the engineer, Safety Board investigators, and FRA inspectors observed the focus, alignment, brightness, preview, and operation of 3321W, 3341W, 3351W, and 3381W as the test train moved through the blocks. When the test Mail-9 train was west of 3351W, that signal displayed a red aspect, and 3341W displayed a yellow aspect.

On January 21, 1999, investigators performed another series of simulations that included the three westbound trains and the eastbound MGL-16 to determine if train movements on track No. 2 might affect the signals on track No. 1. Again, signal 3341W displayed a yellow aspect and 3351W displayed a red aspect during Mail-9's "movement" through the blocks. In all tests, the signal system performed as designed.

Angle of View Measurements

Based on the height differences of the wayside signals in the accident area and the deposition testimony of crewmembers regarding their ability to observe the signals in the fog, the Safety Board arranged for a special postaccident examination of a GE C40-8 locomotive unit to determine the forward angle of view from the cab. Because Mail-9's lead locomotive had been destroyed, NS provided an exemplar locomotive for the examination. Safety Board investigators measured the distances from the eye position of a seated engineer to the top, bottom, and sides of the windshield. The investigators also measured the vertical distance from the engineer's eye position to the ball of the rail. From these measurements, the Safety Board calculated the viewing area and distances in clear weather from the cab to wayside signals that are 17 feet (such as signal 3351W) and 28 feet (such as signal 3341W) higher than the rail. Figure 8 shows the angle of view from the engineer's position while approaching a 28-foot-high signal.

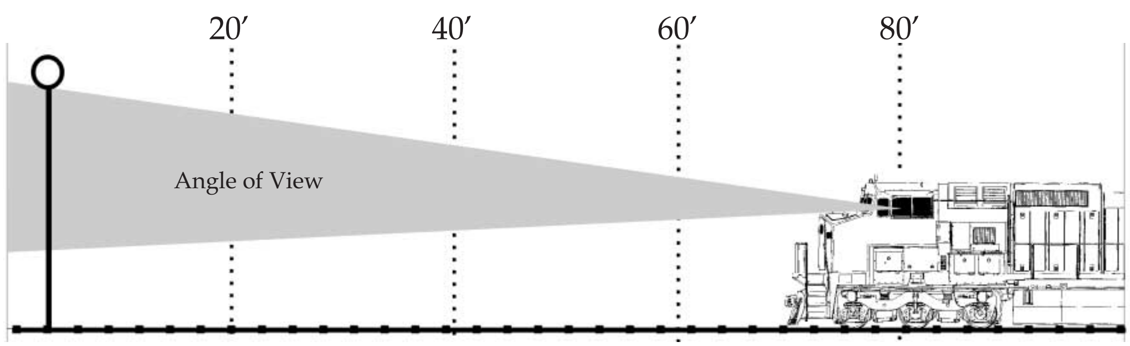

Figure 8. At about 80 feet away, the engineer's view of the 28-foot-high signal is completely obstructed by the top of the cab window.

Visibility tests determined that, in clear weather, both 17- and 28-foot-high signals were first visible from the locomotive cab at a distance of more than 10,000 feet. Based on the calculated angle of view, a 28-foot-high signal would begin to move out of the engineer’s angle of view once the locomotive moved to within about 83 feet of the signal. At about 80 feet, the calculations indicated that the engineer’s view of the signal would be completely obstructed by the top of the locomotive window.

Air Brake Tests

On January 17, 1999, Safety Board investigators participated, with the area FRA motive power and equipment inspector and Conrail mechanical personnel, in postaccident air brake inspections and tests on the locomotive equipment that did not derail in the accident. During an initial terminal air brake test and equipment inspection of TV-7’s cars that were undamaged in the collision, the mechanical group applied and released the brakes and measured the piston travel. The group found two deficiencies: One car had a broken end-of-car cushioning unit and another car had a broken knuckle. During tests of Mail-9’s cars, investigators noted that a truck brake on one car did not apply and release. Federal standards at 49 CFR 232.1 stipulate that, for any train operated with power brakes, not less than 85 percent of the cars must have brakes in working order.

Other Information

Train Control Systems

Current Systems. Some carriers, on parts of their systems, use some type of electrical or electro-mechanical device to help ensure safe train operations. The train control systems currently used within the railroad industry include automatic cab signals, automatic train stop, and automatic train control. The attributes of the systems are summarized below.

With *automatic cab signals*, the signal indication is transmitted to and displayed in the engineman’s compartment or locomotive cab. The system does not require the train operator to acknowledge receipt of a more restrictive signal or to properly respond to the signal indication. Nor does the system enforce speed restrictions set by the timetable or established by the dispatcher. Automatic cab signal equipment was installed on many Conrail locomotives, including the locomotives of TV-7 and Mail-9; however, the track in the Dearborn Division was not wired to transmit automatic cab signals.

Automatic train stop is a trackside system that works in conjunction with equipment installed on a locomotive to automatically apply the air brakes and stop the train should the engineer not acknowledge a restrictive wayside signal within 8 seconds of passing the signal. Automatic train stop systems do not enforce speed restrictions or ensure compliance with signal indications because as long as the train operator acknowledges the signal indication, the system does not activate, even if the train operator does not take appropriate action in response to the signal.

The main line tracks in the accident area and the locomotives that operated over them were once equipped with an automatic train stop system. Between 1922 and 1934, in response to Interstate Commerce Commission Order 13413,[18] the New York Central Railroad and family lines installed a form of automatic train stop on 5,600 track miles from Croton, New York, to Englewood, Illinois, which included what is now the Chicago main line. The Penn Central Transportation Company (Penn Central), which was formed from a merger of the Pennsylvania Railroad and the New York Central, sought authority from the FRA on September 17, 1970, to discontinue the automatic train stop system on the lines formerly owned by the New York Central. On January 22, 1971, the FRA granted the request, and the carrier subsequently removed the automatic train stop system from its lines.

Automatic train control is a system that enforces signal and some civil speed restrictions (such as restrictions made necessary by track geometry) by either applying the brakes of a speeding train to slow it to the speed required by a restrictive signal indication or by applying a full-service brake until either the train stops or the engineer operates the controls to reduce the train speed.

Future Systems. Since 1987, the Safety Board has advocated train control systems that have collision avoidance capability. The UP and the BNSF railroads used the term "PTS" (positive train separation) for their test program of a collision avoidance system on some of their main lines in Oregon and Washington.

The FRA defines PTS as "the application of technology to control the movement of trains in a manner that precludes the occurrence of collisions." The FRA lists PTS as a component of positive train control, which the agency describes as:

> a concept, rather than a single technology or system. PTC [positive train control] involves the application of digital data communications, automatic positioning systems, wayside interface units (to communicate with switches and wayside detectors), on-board and control center computers, and other advanced display, sensor, and control technologies to manage and control railroad operations.

The FRA maintains on its Web site a source of information on the status of positive train control implementation efforts and of the benefits offered by the technology.

Procedures for Informing Emergency Responders of Hazardous Materials

Upon learning that the Conrail dispatcher did not check the Mail-9 manifest before calling the 911 dispatcher, the Safety Board asked Conrail officials whether the company had written procedures for dispatchers to use when notifying emergency response agencies. The Conrail director of operating rules and practices indicated that the company considered checking the manifest for hazardous materials shipments a "common sense" procedure and that it was not specified in Conrail's manual. The Safety Board surveyed NS and other Class I railroads to determine what, if any, written procedures they had in

[18] The Interstate Commerce Commission order required 49 railroads to install either automatic train stop or automatic train control systems.

this regard. All of the railroads surveyed indicated that they have formal written procedures for checking the consists and advising emergency agencies of hazardous materials shipments. For example, NS's *Division Emergency Action Plan for Hazardous Material Incidents* requires that the train dispatcher, upon learning of a train accident or incident, notify the chief train dispatcher, who, in turn, checks the train consist for cars carrying hazardous materials. The chief train dispatcher then provides the information to the NS police department, which is responsible for calling the emergency response agencies. In addition to having the written action plan for reference, the NS dispatchers receive annual training on the proper responses to emergencies.

Analysis

Exclusions

Nothing in the predeparture mechanical and air brake tests, the postaccident equipment inspection, or the data downloaded from the event recorder indicated that an equipment malfunction occurred on Mail-9. None of the four crews that operated Mail-9 after it left Morrisville reported any problems with the train. Postaccident inspections and tests of the two main line tracks found no defects or deviations from FRA track safety standards for Class 4 track. Each train crewmember had received the necessary operational training and experience to competently perform his duties. Further, each member had passed Conrail's physical and visual examinations and rules tests and had been observed and tested on stop signal and operational movements. The crewmembers' postaccident toxicological tests were negative for alcohol and for a panel of legal and illegal drugs.

The Safety Board concludes that Mail-9's train equipment and the two main line tracks functioned as designed and the train crews were qualified, trained, and rule-tested to properly perform their duties. Further, no individual tested as a result of this accident was found to have been impaired by alcohol or drugs.

The signal system in the accident area was inspected and tested, and no irregularities were found. During operational testing of the signal system using simulated train movements, no false *proceed* signal indication was observed. During all tests, the signal system performed as designed and as expected, and no evidence was found that the TCS was not working properly and displaying the correct signal indications at the time of the accident. Therefore, the Safety Board concludes that the signal system in the accident area functioned as designed and did not cause or contribute to this accident.

Accident Analysis

Between 12:15 and 1:08 a.m. on January 17, 1999, four westbound Conrail freight trains departed Toledo and were routed, one behind the other, onto Chicago main line track No. 1. When the lead train, PIEL-6A, was a little more than an hour out of Toledo, the train engineer radioed the dispatcher that he had run into very heavy fog at signal 3341W. The dispatcher did not, nor was he required to, notify the trailing van trains about the visibility conditions or advise them to adjust their speeds for the fog.

The first two van trains, TV-99 and TV-7, operating near maximum authorized speed, passed signal 3341W on *clear* indications less than 5 minutes apart. Based on radio communications with PIEL-6A, the TV-99 engineer then slowed his train, passing 3351W at 42 mph. Because of the dense fog, the TV-7 engineer slowed his train from 60 mph at

3341W to 39 mph at 3351W. When he saw that 3351W displayed an *approach* indication, he continued to slow his train because he could not see the signals until he “was just about on top of them,” and he thought the next one (3381W) would be displaying a *stop and proceed* indication.

Following another radio communication with the PIEL-6A engineer, the TV-99 engineer radioed TV-7 that he was moving slowly toward CP 342. About 2 minutes later, the TV-99 engineer had to stop his train at CP 342 because PIEL-6A occupied the block ahead. The TV-99 engineer radioed the TV-7 engineer that he was stopped. Because of the denseness of the fog, the TV-7 engineer slowed his train more than usual after passing 3351W. About 1 mile west of 3351W, TV-7 was operating at 6 mph.

Meanwhile, the third van train, Mail-9, was approaching the slowed trains at or near maximum authorized speed. Mail-9 crewmembers did not lower their train speed despite the reduced visibility, and they appear not to have been aware that the trains ahead of them were stopping or slowing considerably. They continued to operate their train as if all conditions were normal, as if appropriate spacing were being maintained between all the trains on that section of track, and as if they would be able to see and comply with all signal indications. At no time did Mail-9 deviate by more than a few miles per hour from the maximum authorized speed, and locomotive event recorder data indicated that neither dynamic brakes nor automatic air brakes were applied from the time the train passed the *approach* indication at signal 3341W until the collision with the rear of train TV-7.

From its investigation, the Safety Board identified the following primary safety issues in this accident:

- Train movement under reduced visibility conditions,
- Positive train control for collision avoidance, and
- Adequacy of recorded information for postaccident analysis.

In addition, the Safety Board considered the emergency response to the accident.

Actions by the Mail-9 Operating Crew

Both Mail-9 crewmembers had worked for Conrail or its predecessor railroads for more than 30 years. They each had extensive experience over the accident territory. Both men had passed their most recent book of rules examinations less than a year before the accident. They both had been subject to, and had successfully completed, several operational efficiency tests. The Mail-9 engineer had passed all tests dealing with proper operating procedures at restrictive signal indications.

Both Mail-9 operating crewmembers had been medically qualified for duty with a restriction for corrective lenses. Little in their work-rest schedules during the 72 hours before the accident indicates that fatigue may have been a factor in this accident. The engineer, in particular, had worked comparable shifts the week before the accident; he also had made a special effort to sleep several hours before beginning his shift. On the night of the accident, a road foreman of engines who talked with the Mail-9 engineer before the train left Toledo took no exception to the engineer's fitness for duty.

Locomotive event recorder data show that the Mail-9 operator made 33 throttle or horn control changes during the 3 1/4 minutes it took to travel from signal 3341W to the point of collision, or an average of 1 control action every 6 seconds. All of the control changes could be logically correlated with features of the environment**.** The Safety Board concludes that the Mail-9 operator was actively controlling his train as he neared the collision site, and, with the notable exception of the crew's failure to comply with signal indications at 3341W and 3351W, his control actions were responsive to the physical characteristics of the territory.

The Safety Board attempted to determine why the Mail-9 crew proceeded past two restrictive signal indications without appreciably slowing the train.

Signal Visibility

Event recorder data show the speeds at which Mail-9 proceeded through the blocks controlled by signals 3341W and 3351W. Based on measurements taken from the engineer's position inside the locomotive cab, Safety Board investigators determined the engineer's likely field of view as the locomotive approached and passed the signals. Investigators then used time and distance calculations to help determine how much time Mail-9 crewmembers would have had, under low-visibility conditions, to see and respond to the two signals immediately before the point of collision.

Even at a visibility of 200 feet, which is substantially better than the visibility estimated by those on the scene at the time, the 28-foot-high signal 3341W that the Mail-9 operator failed to comply with (which showed an *approach*, or yellow, aspect) would have been within his field of view for about 1.5 seconds or less as he passed it at about 56 mph. Had the engineer been even momentarily distracted, or had he taken a few seconds to check his speed or even scan the instrument panel, he could easily have missed the signal.

At a visibility of 100 feet, the yellow signal would have been within the engineer's field of view for less than 0.21 second. The 17-foot-high signal 3351W (which displayed a *stop and proceed*, or red, aspect) would have been within the engineer's view for less than 1.2 seconds before it passed to the right of his cab window.

Based on witness statements, the visibility at the time of the accident was only 10 to 25 feet. Under these conditions, the Mail-9 engineer could not have seen the yellow signal at all before it passed out of his field of view. The red signal would have been visible for less than 0.23 second as it passed across the right edge of the windshield, behind the pillar, and across the side window. The Safety Board acknowledges that the actual visibility at the signal locations at the time Mail-9 passed cannot be known.

Furthermore, one or both of the crewmembers could have been positioned where their angle of view would have been greater than the one calculated. Nevertheless, based on all available information, the Safety Board concludes that because of the diminished signal visibility in the dense fog and the speed of the train, the Mail-9 crew probably did not see either the *approach* or the *stop and proceed* signal that indicated the presence of another train on the same track ahead.

Train Movement Practices in Reduced Visibility Conditions

For operations on a TCS-based railroad to be safe, locomotive engineers must comply with signal indications and operate at a proper speed. When engineers traveling in dense fog try to anticipate the signal indications or operate the train at speeds that are too great to facilitate recognition of or compliance with the signals, they compromise the system.

NORAC operating rule No. 958 stipulates that an engineer must regulate the train's speed to ensure safety whenever weather conditions "make observation of signals in any way doubtful." Yet, despite fog so dense that seeing and perhaps identifying signal indications in the Bryan area was difficult, most of the van train engineers operating in that area at the time of the accident were operating their trains at imprudent speeds. Several crewmembers described unsafe practices on the night of the accident. The MGL-16 engineer said that while he was waiting for another train to pass, fog enveloped the wayside signal where he was stopped. He pulled closer to the signal and waited for it to clear so that he would not have to "search" for the next signal in the fog. He then ran the train about 50 mph despite his visibility being less than 200 feet.

Even the TV-7 engineer, the only train handler who significantly adjusted the speed of his train for the dense fog, probably was not operating slowly enough for optimum safety. By his own calculations, he estimated that braking at 7 or 10 mph would take "four or five car lengths" to stop the train. He admitted that, on the night of the accident, he had not been able to see the signals from that distance.

Obviously, the Mail-9 crewmembers would have reduced the likelihood of their missing signals if they had slowed their train commensurate with the reduced visibility. The Safety Board considered various explanations as to why the Mail-9 engineer did not slow his train.

Interviews with Conrail crewmembers and supervisors indicated that, for a variety of reasons, crews operating on Conrail's Dearborn Division generally made every attempt to maintain their speed and their schedule, even during inclement weather. This reluctance to upset schedules may partially explain why even those train operators who did slow their trains still ran at speeds that could have been considered unsafe given the conditions. In some cases, the crews used the radio to alert other crews to their speeds and locations, but as shown by this accident, such communication can be inconsistent, and the quality of the transmissions cannot be ensured. Furthermore, radio communication between trains, because it is *ad hoc,* can itself lead to misunderstandings that could compromise safety.

As a risk management measure, all railroad operating crews should be reminded about the dangers and potential consequences of operating at speeds that are not appropriate for weather conditions, particularly dense fog. The Safety Board therefore believes that the Brotherhood of Locomotive Engineers and the United Transportation Union should advise their members of the Safety Board's findings in its investigation of the Bryan, Ohio, accident and alert them to the hazards of operating at or near maximum authorized speed during periods of reduced visibility. Also, the Safety Board believes that the Association of American Railroads and the American Short Line and Regional Railroad Association should advise their member railroads of the Safety Board's findings in its investigation of the Bryan accident and should alert them to the hazards of operating at or near maximum authorized speed during periods of reduced visibility.

The Safety Board is concerned that Conrail's procedures for dealing with fog were inadequate, even though fog is not an infrequent occurrence in the Bryan area and its effect, by obscuring signal indications, can undermine the safety of the TCS. The Safety Board notes that officials of NS (which now owns and operates the portion of the Conrail system where this accident occurred) have recognized the dangers posed by fog and have attempted to improve safety on the railroad by issuing special instructions for safe movement in severe conditions that include, among others, dense fog. The Safety Board is concerned, however, that the special instructions may not be sufficient to ensure safety in operations. The instructions still permit different locomotive engineers to respond differently, and not necessarily predictably, when they encounter reduced visibility.

Variations in operating procedures from one engineer to another can pose a potential risk to safety. The effects of fog are variable. A train may move in and out of dense fog, the result being that the engineer who properly slows for poor visibility may not operate at a uniform track speed. If the fog clears for trailing trains or if the engineers of trailing trains operate at faster speeds, they will catch up with the lead train and line up in succeeding blocks behind it. If visibility remain clear, a close line-up is not necessarily dangerous; however, if dense fog envelopes an area occupied by several trains in proximity to one another, the risk to the train crews increases significantly, particularly if the train engineers do not uniformly alter their operating procedures and train speeds. In the case of the Bryan accident, the lack of uniformity in operating procedures proved fatal. The Safety Board concludes that the variable nature of fog and of the operating styles of train engineers can potentially result in a lack of uniformity in operation that puts train crews at risk when dense fog occurs.

The operating areas of most major railroads are so expansive that almost all of the companies have areas of track where fog or other conditions can pose visibility problems. In the view of the Safety Board, an effective management oversight and monitoring program is necessary if railroad management is to ensure that its train crews are following proven, consistent, uniform, and safe operating practices during periods of reduced visibility. But any oversight program must be supplemented by efficiency testing designed to ensure that those crews are prepared to respond consistently to reduced visibility conditions. The Safety Board therefore believes that all Class I railroads should include, in their operational (efficiency) testing program, specific signal tests designed to ensure that their train crews consistently follow uniform operating procedures when they encounter reduced visibility conditions en route.

Positive Train Control for Collision Avoidance

Although the signals in the area of the accident were operating properly, the TCS did not include any mechanism to help make train crews aware of signal indications and did not incorporate safeguards to prevent engineers from accidentally or purposely failing to comply with restrictive signals. Most Conrail locomotives, including the lead locomotive on Mail-9, had automatic cab signal equipment that was designed to display signal indications inside the locomotive cab. The system was not functional, however, because the track was not wired for it. Had the system been functional, the restrictive signals in this accident would have been displayed inside the cab of Mail-9, where they might have been seen and responded to by the engineer.

At one time, the Chicago main line was equipped with an intermittent automatic train stop system that was designed to automatically apply the air brakes and stop the train should the engineer not acknowledge an audible alarm within a few seconds of passing a restrictive wayside signal. This feature, however, was eliminated, with the approval of the FRA, in the early 1970s after the Penn Central Railroad was created from the merger of the Pennsylvania and New York Central Railroads.

Even though a working automatic cab signal or automatic train stop system might have helped prevent this accident, the Safety Board notes that these systems, too, rely for their effectiveness on the alertness, judgment, and responsiveness of the train crew. For example, the automatic cab signal system displays signal indications but does nothing to ensure that the crew responds appropriately. Similarly, the automatic train stop system, while offering a level of safety beyond that of cab signals, does not enforce compliance with restrictive signal indications. So long as the engineer pushes a button or turns a lever to acknowledge and silence the system alarm, the automatic stop system does not activate.

The Safety Board has long been a proponent of automated systems that prevent train collisions by automatically interceding in the operation of a train when the engineer does not comply with the requirements of the signal indication. Had Mail-9 been equipped with such a system, the system would have intervened by slowing the train when the train operator failed to slow in response to passing the *approach* signal indication, whether or not the operator had actually seen the signal. Likewise, had the operator failed to see or respond to the *stop and proceed* indication of the next signal, a positive train control system would have intervened to automatically stop the train. The Safety Board concludes that a fully implemented positive train control system would have prevented Mail-9 from passing the *stop and proceed* indication at signal 3351W and striking the rear car of TV-7.

The Bryan collision is only the latest in a very long list of collision accidents investigated by the Safety Board in which a positive train control system that incorporated collision avoidance could have prevented the tragic outcome. (See table 4.)

Table 4. Collision Accidents

Date	Location	Railroads	Fatalities	Injuries
Aug 20, 1969	Darien, CT	Penn Central	2	45
Oct 30, 1972	Chicago, Il	Illinois Central Gulf	45	332
Jan 2, 1975	Botanical Garden Station, NY	Penn Central	0	265
May 30, 1975	Meeker, LA	Texas and Pacific	30	0
Oct 17, 1975	Wilmington, DE	Penn Central	0	25
Feb 4, 1976	Pettisville, OH	Penn Central	4	2
Jul 13, 1976	New Canaan, CT	Conrail	20	30
Jun 9, 1978	Seabrook, MD	Conrail and Amtrak	0	176
Jan 31, 1979	Muncy, PA	Conrail	2	3
Oct 1, 1979	Royersford, PA	Conrail	2	0
Feb 12, 1980	Orleans Road, WV	Baltimore & Ohio	1	5
Sep 6, 1980	Welch, WV	Norfolk & Western	3	0
Oct 16, 1980	Hermosa, WY	Union Pacific	2	2
Apr 13, 1984	Wiggins, CO	Burlington Northern	5	2
Apr 22, 1984	Newcastle, WY	Burlington Northern	2	2
Jul 10, 1985	Cleveland, OH	GCRTA	0	50
May 7, 1986	Brighton, MA	Boston & Maine and Conrail	0	153
Jul 10, 1986	North Platte, NE	Union Pacific	1	3
Jan 4, 1987	Chase, MD	Amtrak and Conrail	16	174
Aug 9, 1991	Sugar Valley, GA	Norfolk Southern	3	4
Aug 30, 1991	Ledger, MT	Burlington Northern	3	5

Table 4. Collision Accidents

Date	Location	Railroads	Fatalities	Injuries
Nov 11, 1993	Kelso, WA	Burlington Northern and Union Pacific	5	0
Feb 16, 1996	Silver Spring, MD	MARC and Amtrak	11	26
Jun 22, 1997	Devine, TX	Union Pacific	4	2
Jul 2, 1997	Delia, KS	Union Pacific	1	1
Mar 25, 1998	Butler, IN	Norfolk Southern and Conrail	1	2
Jan 17,1999	Bryan, OH	Conrail	2	0
		Total	165	1,309

As early as 1970, following its investigation of the August 20, 1969, head-on collision of two Penn Central Commuter trains near Darien, Connecticut, in which 4 people were killed and 45 people were injured,[19] the Safety Board asked the FRA to study the feasibility of requiring a form of automatic train control to protect against operator error and prevent train collisions. Following the Darien accident, the Safety Board continued to investigate one railroad accident after another caused by human error and, during the next two decades, issued a number of safety recommendations to the FRA or individual railroads asking for train control measures to prevent train collisions.[20] Following its investigation of the May 7, 1986, rear-end collision involving a Boston and Maine Corporation commuter train and a Conrail freight train in which 153 people were injured, the Safety Board made the following recommendation to the FRA:

> R-87-16
>
> Promulgate Federal standards to require the installation and operation of a train control system on main line tracks that will provide for positive separation of all trains.

In a June 1990 response to the Safety Board, the FRA stated that it fully supported the use of automatic train control equipment by the railroads; however, the agency stated that practical reasons precluded issuing such regulations "for the entire country."

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[19] National Transportation Safety Board, *Head-on Collision between Penn Central Trains N-48 and N-49 at Darien, Connecticut, August 20, 1969*, Railroad Accident Report NTSB/RAR-70/03 (Washington, D.C.: NTSB, 1970).

[20] This section is not intended as a comprehensive discussion of all the Safety Board's previous investigations and recommendations regarding positive train control; rather, it discusses only three of the more important safety recommendations that have been issued to the FRA on this issue.

In subsequent investigations, the Safety Board found that despite the efforts by railroads to train and test their train crews for compliance with operating rules, accidents resulting from human error continued to occur. Consequently, in September 1990, the Safety Board placed PTS (meaning a positive train control system that provides collision avoidance) on its "Most Wanted" list.[21]

In May 1991, the FRA, writing in response to Safety Recommendation R-87-16, provided the Safety Board with a copy of its report prepared in response to the Railroad Safety Improvement Act of 1988. That act required the FRA to assess the feasibility of requiring automatic train control on all rail corridors that handle passengers or hazardous cargo. The FRA concluded that requiring automatic train control on all rail corridors that handled trains carrying passengers or hazardous materials was not feasible because of the anticipated costs to the industry. The FRA stressed that it was concerned about the issue of automatic train control and stated that it was actively monitoring industry developments that required less costly systems.

In 1992, the Rail Safety Enforcement and Review Act required the FRA to conduct a safety inquiry on the matter of automatic train control systems, which included a PTS component. In a June 1993 letter to the Safety Board, the FRA cited several test projects with automatic train control system communications platforms that major railroads were beginning to install. The agency also cited a number of research initiatives that would enable it to evaluate rail lines for priority application of automatic train control systems. Based on the FRA's response, the Safety Board classified Safety Recommendation R-87-16 "Open—Acceptable Response."

In 1993, following its investigation of a head-on collision on the Burlington Northern Railroad near Ledger, Montana,[22] the Safety Board issued the following safety recommendation to the FRA:

> <u>R-93-12</u>
>
> In conjunction with the Association of American Railroads and the Railroad Progress Institute, establish a firm timetable that includes at a minimum, dates for final development of required advanced train control system hardware, dates for an implementation of a fully developed advanced train control system, and a commitment to a date for having the advanced train control system ready for installation on the general railroad system.

The Safety Board classified Safety Recommendation R-93-12 "Open—Acceptable Response" after the FRA took action to seek the "final system definition, migration path, and timetable" for a positive train control system by December 1994.

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[21] In October 1990, the Safety Board developed the "Most Wanted" list, drawn up from previously issued safety recommendations, to bring special emphasis to the safety issues the Board deems most critical. The Most Wanted list is reviewed, revised, and reissued annually.

[22] National Transportation Safety Board, *Head-on Collision Between Burlington Northern Freight Trains 602 and 603 near Ledger, Montana, on August 29, 1991*, Railroad Accident Report NTSB/RAR-93/01 (Washington, D.C.: NTSB, 1993).

In 1996, the Safety Board investigated the February 16, 1996, accident in Silver Spring, Maryland, in which the crew of a Maryland Rail Commuter (MARC) train did not comply with signal indications and collided with an Amtrak passenger train.[23] The collision, derailment, and subsequent fire killed 11 people, including the entire MARC train crew, and injured 26 other people. In its report on that accident, the Safety Board, noting the FRA's lack of progress toward fully complying with Safety Recommendation R-87-16, reiterated the recommendation to the FRA.

Also as a result of its investigation of the Silver Spring accident, the Board issued the following safety recommendation to the FRA:

> <u>R-97-13</u>
>
> Require the implementation of positive train separation control systems for all trains where commuter and intercity passenger railroads operate.

In a February 25, 1998, letter responding to Safety Recommendation R-97-13, the FRA acknowledged the safety value of signal-based positive train control systems and noted that:

> [I]nnovative train control approaches are emerging that can meet the safety needs identified by the board in its recommendations…. The FRA concurs that implementation of more capable train control systems can contribute significantly to the safety of passenger rail service…. To bring about PTC, the FRA has set out to: assess risk on rail corridors that could be reduced by PTC systems; update and refine cost-benefit analyses; demonstrate and evaluate PTC technologies; invest in enhanced train control on the northeast corridor; promote interoperability of PTC systems; facilitate introduction of new technology through regulatory action; and support federal policies necessary for successful PTC systems.

In its response to the FRA letter, the Safety Board expressed its disappointment with the pace of development of train control systems. The Safety Board also noted that one important issue that remained to be addressed was a timetable for the installation of such systems as a mandatory part of passenger operations. Pending a requirement that positive train control systems be implemented where commuter and intercity passenger railroads operate, the Board classified Safety Recommendation R-97-13 "Open—Acceptable Response."

The Safety Board notes the efforts that have been and are being made to refine train control technology and to address the barriers to implementation. A number of projects, variously described as "pilot," "demonstration," "technology development," and "commercial installation," have been undertaken to focus on positive train control issues. In one of the most recent such projects, the FRA is cooperating with the AAR and the Illinois Department of Transportation to design, test, build, and install a positive train control system on a section of the high-speed Chicago–St. Louis Corridor. In 1995, the

[23] National Transportation Safety Board, *Collision and Derailment of Maryland Rail Commuter* MARC *Train 286 and National Railroad Passenger Corporation* Amtrak *Train 29 Near Silver Spring, Maryland, February 16, 1996,* Railroad Accident Report RAR-97-02 (Washington, D.C.: NTSB, 1997).

FRA funded a demonstration project of a train control system between Porter, Indiana, and Kalamazoo, Michigan. That system has been in use for about 1 year on the 71-mile Amtrak-owned portion of the Chicago-Detroit high-speed corridor under FRA sponsorship in partnership with the State of Michigan, Amtrak, and Harmon Industries.

The Board also notes the efforts by some railroads on some corridors to implement automatic train control systems that have a collision avoidance component. For example, the Safety Board is encouraged by the employment of such a system along the high-density Northeast Corridor between New Haven, Connecticut, and Boston, Massachusetts. Another project, an advanced speed enforcement system with collision avoidance capabilities, is being planned for installation on 540 track miles owned by New Jersey Transit. Also, the Alaska Railroad Corporation is midway through a four-phase project to install a positive train control system on the corporation's approximately 600 miles of right-of-way.

The Safety Board also acknowledges the ongoing work of the FRA's Railroad Safety Advisory Committee, which in 1997 established a working group to address positive train control. Among other objectives, the group is attempting to address the current Federal regulations and their applicability to new train control systems under development and to draft new regulations as necessary. The working group has also done preliminary work to identify specific rail corridors where a positive train control system would have the greatest impact.

Despite these partial initiatives and other efforts in the area of PTS, the Safety Board continues to be disappointed with the pace of development and implementation of collision avoidance technologies. As noted above, the FRA and the railroad industry have created numerous study groups and carried out several demonstration projects and, in some locations, have successfully implemented systems with collision avoidance capabilities. Nevertheless, no plan for industry-wide integration has been developed. And while progress has been particularly slow along rail lines that primarily serve freight carriers, even those lines with significant passenger traffic remain largely unprotected today, some 11 years after this item was first placed on the Safety Board's "Most Wanted" list. Meanwhile, the Safety Board continues to investigate accidents that could have been prevented by a working positive train control system. The Safety Board concludes that, without the installation of positive train control systems, preventable collision accidents will continue to occur and will continue to place railroad employees and the traveling public at risk.

The Safety Board acknowledges progress in this area but is disappointed that automatic train control standards have not been established after 14 years. The Board will continue to urge the FRA to require the implementation of proven collision avoidance technologies. In the meantime, and in recognition of the promise of positive train control, the Safety Board believes that the FRA should continue to focus on this issue and facilitate the actions necessary for development and implementation of positive train control systems that include collision avoidance, and require implementation of positive train control systems on main line tracks, establishing priority requirements for high-risk corridors such as those where commuter and intercity passenger railroads operate.

Because this recommendation incorporates the intent of open Safety Recommendations R-87-16, R-93-12, and R-97-13, the Safety Board reclassifies those recommendations “Closed—Acceptable Action/Superseded.”

Recorded Information for Postaccident Analysis

Because neither crewmember of Mail-9 survived the accident, the Safety Board can only speculate about why they did not slow their train in response to the reduced visibility. As indicated above, they may have been anticipating train movements and signal changes by using peripheral cues, such as voice communications on the radio or status transmissions from defect detectors. Or their focus may have been on maintaining their schedule rather than on safety. Although event recorder data indicated that no Mail-9 mechanical malfunction was reflected within the parameters monitored on the night of the accident, the crew may have been distracted by some real or perceived mechanical problem. Unfortunately, the actual reasons may never be known, and the industry will thus be denied possible lessons learned that could prevent future accidents of this kind.

Investigators were aided in this accident by information obtained from the trains’ locomotive event recorders, the CATDF logs, the radio communications tape, the grade crossing event recorders, the wayside defect detector recorders, and the statements from the accident survivors. One key source of information—the radio communications tape—does not contain verifiable conversations between Mail-9 and other trains or between Mail-9 and the train dispatcher. For the most part, the tape contains the verifiable conversations and acknowledgments of crews on the trains ahead of Mail-9 on track No. 1 and of crews on the trains on track No. 2. The transmissions that investigators attribute to the Mail-9 crew are, for unknown reasons, garbled and unintelligible.

Even if the radio transmissions from Mail-9 had been intelligible, investigators would still have been missing one piece of information that could have been decisive in determining the cause of this accident: the conversation of the crewmembers in the cab of Mail-9 in the moments preceding the collision. The Safety Board is convinced that at least one additional recording device is needed to identify conditions or events within the cab that may adversely affect railroad safety.

For several years, the Safety Board has been a proponent of installing and using locomotive cab audio recorders (LCARs) to help determine the cause of accidents. In the Bryan accident, audio recordings would have captured the voices of the crewmembers if and when they called out the signal indications to one another, as required by NORAC rule No. 94. According to the testimony of several Conrail employees and of a road foreman of engines, many operating crewmembers had lapsed into the practice of not calling *clear* indications; however, all the Conrail employees interviewed stated that they called restrictive indications. If the MAIL-9 operating crew, like their peers, had been calling restrictive indications by name or color, an audio recorder in the locomotive cab would have recorded them calling out “*approach*” or “yellow” at 3341W. The absence of a callout at 3341W could mean either that they perceived the indication to be *clear* or that they failed to see the signal because of the denseness of the fog or because they were distracted.

An LCAR would have captured the conversations between the engineer and the conductor, which would have shown how the crewmembers were interacting and whether they were using crew resource management techniques to operate their train. An LCAR could possibly have captured the crew discussing equipment problems and, depending on the nature of the equipment malfunction, the noises generated by some equipment problems. The LCAR might have captured other sounds within the locomotive cab that could have been important in reconstructing the accident.

The Safety Board concludes that, had the Mail-9 train been equipped with an LCAR, the recorded crew communications may have provided valuable clues in reconstructing the accident, which, in turn, could have possibly enabled the carrier, the railroad unions, and the FRA to make systemic changes to prevent similar accidents from occurring.

In its investigation of the February 16, 1996, accident in Silver Spring, Maryland, involving the collision of a MARC train with an Amtrak passenger train, the Safety Board identified the need for train operating cabs to have voice recording devices, similar to the type installed in the cockpit of aircraft. In its report of the Silver Spring accident, the Safety Board observed that in aviation, for more than 35 years, the cockpit voice recorder (CVR) has been a key tool in documenting the circumstances leading up to an accident and has proven to be invaluable in determining the cause of aviation accidents and in enhancing aviation safety. The Board noted that, although current locomotive event recorders had great utility in providing mechanical response data, they could not answer some human performance questions about the crewmembers' actions. In the case of the Silver Spring accident, the Safety Board concluded that if the MARC locomotive had been equipped with an LCAR, investigators could have determined from the communications before the collision the factors that may have affected the MARC train operator's actions. The Safety Board therefore made the following recommendation to the FRA:

<u>R-97-9</u>

> Amend 49 *Code of Federal Regulations* Part 229, to require the recording of train crewmembers' voice communications for exclusive use in accident investigations and with appropriate limitations on the public release of such recordings.

The FRA responded on February 25, 1998, stating, in part,

> Unlike event recorders, which have value in determining rules compliance prior to an accident, use of voice recorder information would, as suggested by the recommendation, be limited exclusively to use in an accident investigation. Other uses would be viewed as inappropriate electronic monitoring of employees' conversations in the workplace, whether or not work related. Capturing voice recordings in a locomotive cab may present practical issues not encountered in aviation. Headsets with intercom capability are the exception, rather than the rule, in locomotive cabs. Significant interrelationships exist between efforts to limit occupational noise exposure in cabs and the effective recording of conversations.

> Issues of comfort have also been raised by employees and their representatives when use of headsets has been proposed for reduction of occupational noise exposure. Employee representatives cite 8-12-hour shifts and varying environmental conditions in locomotive cabs.
>
> The potential release of voice recordings subsequent to an accident presents additional issues. A special statutory exception has been required in the aviation context to prevent inappropriate use of voice recordings following events drawing significant notoriety. Enacting full effective regulations in the absence of special-purpose legislation would appear to present a difficult conflict in public policy...Since the Board would be the primary user of voice data, does the Board intend to utilize the power conferred under its charter statute to recommend legislation affording appropriate controls on release of voice recordings in the rail mode?

On September 30, 1999, the Safety Board responded, in part,

> The issues you raise, while new to the railroad industry, have been resolved concerning the use of voice recordings in aviation. You may wish to discuss the issues with [the] Federal Aviation Administrator…to obtain an understanding of how these issues were satisfactorily resolved allowing the use of this important technology to improve aviation safety. This understanding would be useful in helping to overcome the obstacles to the use of cab voice recorders to improve railroad safety.
>
> We also suggest that the FRA contact the Coast Guard to review the pending requirements for the use of voice recordings on the bridges of vessels. The International Maritime Organization, a United Nations' specialized agency responsible for improving maritime safety and preventing pollution from ships, is developing requirements that certain ships have voice recorders by 2002. You may also be aware that legislation to address voice recording privacy in all the modes of transportation is included in the Board reauthorization bill pending before Congress. However, while we are ready to work with you to resolve this matter, we believe there is more than enough experience in the other modes of transportation for the FRA to begin the process leading to the use of cab voice recorders. Since your reply indicates a lack of positive action, the Board classifies R-97-9 "Open—Unacceptable Response."

In answer to the FRA's concern about the release of information, the Safety Board notes that Public Law 106-424, signed on November 1, 2000, includes provisions for withholding from public disclosure voice and video recorder information for all modes of transportation. Section 5 (d)(1), "Confidentiality of Recordings," stipulates, in part:

> The [Safety] Board may not disclose publicly any part of a surface vehicle voice or video recorder recording or transcript of oral communications by or among drivers, train employees, or other operating employees responsible for the movement and direction of the vehicle or vessel, or between such operating employees and company communication centers, related to an accident investigated by the Board. However, the Board shall make public any part of a transcript or any written depiction of visual information that the Board decides is relevant to the accident.

With the passage of this legislation, the Safety Board is now able to protect the data obtained from an LCAR in the same manner the Board has always protected data obtained from a CVR.

The Safety Board is convinced that, for the safety of train operating crews, the conversations and voice communications of those in the locomotive cab must be recorded to help identify the causes of accidents. With the additional evidence provided by the Bryan, Ohio, accident, the Safety Board reiterates Safety Recommendation R-97-9 to the FRA.

Emergency Response

Although visibility was dangerously poor and they had only a general idea of the location of the derailment, which was in a rural area, emergency responders from surrounding cities arrived on site within a half hour of being notified about the accident. The Williams County 911 dispatcher originally was erroneously advised by the Conrail dispatcher that hazardous materials were not involved in the derailment. However, when a county deputy sheriff reported explosions in the area and an unidentified ash-like substance in the air and when the MGL-16 crew advised the Bryan Fire Department of possible hazardous materials on the trains, the incident commander prudently radioed all units that the incident involved hazardous materials and activated the county plans for hazardous materials emergency response and disaster preparedness. Gas and electric utilities were notified, and, as a precaution, residences within about 1 mile of the site were evacuated.

When the initial search of the wreckage failed to locate the two missing crewmembers, the incident commander deferred the fire suppression effort until daybreak. The Safety Board does not find these actions to be inappropriate, given the circumstances, which included the fact that the accident site was remote; the deep snow hindered the transport of equipment to the site; and several conditions put firefighters at risk, including the size and character of the fire, the amount of spilled diesel fuel, the unidentified hazardous materials cargo, the potentially toxic smoke, and the threat of flying metal from exploding LPG tanks. The incident commander subsequently received cargo manifests from Conrail showing that cargo parcels on Mail-9 contained quantities of paints and related flammable substances. Because the fire suppression strategy was well organized and implemented and because equipment was staged effectively, firefighters were able to extinguish most of the fire within 2 hours of beginning the suppression effort.

The Safety Board concludes that the local emergency responders were prepared, adequate emergency response resources and personnel were dispatched to and effectively managed at the scene, and the overall emergency response effort was timely, appropriate, and effective, given the circumstances of this accident.

Conclusions

Findings

1. Mail-9's train equipment and the two main line tracks functioned as designed and the train crews were qualified and trained to properly perform their duties. Further, no individual tested as a result of this accident was found to have been impaired by alcohol or drugs.

2. The signal system in the accident area functioned as designed.

3. The Mail-9 operator was actively controlling his train as he neared the collision site, and, with the notable exception of the crew's failure to comply with the signal indications at 3341W and 3351W, his control actions were responsive to the physical characteristics of the territory.

4. Because of the diminished signal visibility in the dense fog and the speed of the train, the Mail-9 crew probably did not see either the *approach* or the *stop and proceed* signal that indicated the presence of another train on the same track ahead.

5. The variable nature of fog and of the operating styles of train engineers can potentially result in a lack of uniformity in operation that puts train crews at risk when dense fog occurs.

6. A fully implemented positive train control system would have prevented Mail-9 from passing the *stop and proceed* indication at signal 3351W and striking the rear car of TV-7.

7. Without the installation of positive train control systems, preventable collision accidents will continue to occur and will continue to place railroad employees and the traveling public at risk.

8. Had the Mail-9 train been equipped with a locomotive cab audio recorder, the recorded crew communications may have provided valuable clues in reconstructing the accident, which, in turn, could have possibly enabled the carrier, the railroad unions, and the Federal Railroad Administration to make systemic changes to prevent similar accidents from occurring.

9. The local emergency responders were prepared, adequate emergency response resources and personnel were dispatched to and effectively managed at the scene, and the overall emergency response effort was timely, appropriate, and effective, given the circumstances of this accident.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the crew of train Mail-9 to comply with restrictive signal indications while operating at or near maximum authorized speed in dense fog. Contributing to the accident was the lack of uniformity and consistency in the operating practices of Consolidated Rail Corporation train crews when they encountered conditions of reduced visibility. Also contributing to the accident was the lack of a backup safety system that would have helped alert the crewmembers of train Mail-9 to the restrictive signal indications.

Recommendations

As a result of its investigation of the January 17, 1999, accident in Bryan, Ohio, the National Transportation Safety Board makes the following safety recommendations:

New Recommendations

To the Federal Railroad Administration:

> Facilitate actions necessary for development and implementation of positive train control systems that include collision avoidance, and require implementation of positive train control systems on main line tracks, establishing priority requirements for high-risk corridors such as those where commuter and intercity passenger railroads operate. (R-01-6)

To all Class I railroads:

> Include, in your operational (efficiency) testing program, specific signal tests designed to ensure that your train crews consistently follow uniform operating procedures when they encounter reduced visibility conditions en route. (R-01-7)

To the Brotherhood of Locomotive Engineers: (R-01-8)
To the United Transportation Union: (R-01-9)

> Advise your members of the findings of the National Transportation Safety Board's investigation of the January 17, 1999, railroad accident in Bryan, Ohio, and of the criticality of complying with operating rules when operating under reduced visibility conditions.

To the Association of American Railroads: (R-01-10)
To the American Short Line and Regional Railroad Association: (R-01-11)

> Advise your member railroads of the findings of the National Transportation Safety Board's investigation of the January 17, 1999, railroad accident in Bryan, Ohio, and of the criticality of complying with operating rules when operating under reduced visibility conditions.

Recommendations Reiterated in This Report

To the Federal Railroad Administration:

R-97-9

Amend 49 *Code of Federal Regulations*, Part 229, to require the recording of train crewmembers' voice communications for exclusive use in accident investigations and with appropriate limitations on the public release of such recordings.

Recommendations Reclassified in This Report

To the Federal Railroad Administration:

R-87-16

Promulgate Federal standards to require the installation and operation of a train control system on main line tracks that will provide for positive separation of all trains.

R-93-12

In conjunction with the Association of American Railroads and the Railroad Progress Institute, establish a firm timetable that includes at a minimum, dates for final development of required advanced train control system hardware, dates for an implementation of a fully developed advanced train control system, and a commitment to a date for having the advanced train control system ready for installation on the general railroad system.

R-97-13

Require the implementation of positive train separation control systems for all trains where commuter and intercity passenger railroads operate.

Safety Recommendation R-87-16, previously classified "Open—Acceptable Action," and Safety Recommendations R-93-12 and R-97-13, both previously classified "Open—Acceptable Response," are reclassified "Closed—Acceptable Action/Superseded" in the "Positive Train Control for Collision Avoidance" section of this report.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

CAROL J. CARMODY
Acting Chairman

JOHN A. HAMMERSCHMIDT
Member

JOHN J. GOGLIA
Member

GEORGE W. BLACK, JR.
Member

Adopted: May 9, 2001

John A. Hammerschmidt, Member, filed the following concurring and dissenting opinion on May 9, 2001. John J. Goglia, Member, joined Member Hammerschmidt in this opinion.

Notation 7339A

Member HAMMERSCHMIDT, concurring in part and dissenting in part:

I concur in the analysis, conclusions, probable cause, and recommendations contained in this report, with the following exceptions:

I do not fully concur with the analysis in the section of the report entitled “Positive Train Control for Collision Avoidance” because it provides an incomplete picture of this important subject. For example, two sources of key information on this topic are conspicuously absent from this section. They are:

(1) the *Report of the Railroad Safety Advisory Committee to the Federal Railroad Administration* concerning “implementation of Positive Train Control Systems” (September 8, 1999), its conclusions and recommendations.

(2) the Federal Railroad Administration’s most recent response on this issue, contained in a letter to the Safety Board (March 30, 2001).

Therefore, after careful examination of the facts and circumstances of this accident, coupled with the prevailing information on positive train control, I think it is more appropriate to:

say “could” rather than “would” in Conclusion 6;

eliminate conclusion 7;

and revise Recommendation [R-01-6] to say “Facilitate actions necessary for development and implementation of positive train control systems that include collision avoidance and establish priority requirements on main line track for high-risk corridors such as those where commuter and intercity passenger railroads operate.”

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Appendix A

Investigation and Depositions

The National Transportation Safety Board was notified at 4:35 a.m. eastern daylight time on January 17, 1999, of a collision and derailment involving three Conrail freight trains near Bryan, Ohio. The investigator-in-charge and other members of the Safety Board investigative team were dispatched from the Washington, D.C., headquarters office, and from the Chicago, Illinois, and Los Angeles, California, field offices. Upon arriving on scene, the Board established investigative groups to study operations, track, signals, mechanical, survival factors, human performance, and hazardous materials issues.

The Safety Board was assisted in the investigation by the Federal Railroad Administration, Conrail, Norfolk Southern, the Ohio Gas Company, the Public Utility Commission of Ohio, the Brotherhood of Locomotive Engineers, the United Transportation Union, and the City of Bryan Fire Department.

As part of its investigation, the Safety Board held deposition proceedings on June 22 and 23, 1999, in Romulus, Michigan. Parties to the depositions were the Public Utilities Commission of Ohio, the Federal Railroad Administration, Conrail, the Brotherhood of Locomotive Engineers, and the United Transportation Union. Thirteen witnesses were deposed.

Appendix B

Selected Event Recorder Data from Train Mail-9

Landmark or Event	Time	MP	Miles to Collision	Speed	ABRK	Throttle	Horn
Mail-9							
C.R. 24	1:51:15	329.91	7.31	60	90	6	On
C.R. 25	1:52:03	330.70	6.52	61	90	6	Off
Signal 3321 *Clear* indication	1:53:28	332.13	5.09	59	90	3	On
C.R. 23.50	1:53:39	332.31	4.91	59	90	3	On
C.R. 22.75	1:54:27	333.08	4.14	56	90	3	Off
Throttle to 6	**1:54:39**	**333.27**	**3.56**	**56**	**90**	**8**	**Off**
Throttle to 8	**1:55:05**	**333.67**	**3.55**	**54**	**90**	**6**	**Off**
C.R. 22	1:55:17	333.85	3.37	55	90	8	Off
Signal 3341 *Approach* indication	1:55:34	334.10	3.12	56	90	8	Off
Stryker Detector	1:55:36	334.13	3.09	56	90	8	Off
Bryan Detector	1:55:55	334.43	2.79	58	90	8	Off
Throttle to 5	**1:56:03**	**334.56**	**2.66**	**58**	**90**	**5**	**Off**
Throttle to 6	**1:56:05**	**334.60**	**2.62**	**58**	**90**	**6**	**Off**
Main St.	1:56:07	334.62	2.60	58	90	6	On
N. West St.	1:56:22	334.87	2.35	58	90	6	On
Throttle to 3	**1:56:27**	**334.95**	**2.27**	**58**	**90**	**3**	**On**
Throttle to Idle	**1:56:28**	**334.97**	**2.25**	**58**	**90**	**IDLE**	**On**

Landmark or Event	Time	MP	Miles to Collision	Speed	ABRK	Throttle	Horn
Throttle to 1	**1:56:39**	**335.14**	**2.08**	**57**	**90**	**1**	**Off**
Horton St.	1:56:46	335.25	1.97	57	90	2	On
Throttle to 2*	**1:56:46**	**335.25**	**1.97**	**57**	**90**	**2**	**On**
Throttle to 3	**1:56:53**	**335.36**	**1.86**	**56**	**90**	**3**	**Off**
East End of Bridge Deck	1:56:58	335.44	1.78	56	90	4	On
Throttle to 4*	**1:56:58**	**335.44**	**1.78**	**56**	**90**	**4**	**Off**
West End of Bridge Deck	1:57:00	335.47	1.75	56	90	4	On
Throttle to 5	**1:57:02**	**335.50**	**1.72**	**56**	**90**	**5**	**On**
Throttle to 8	**1:57:04**	**335.54**	**1.68**	**56**	**90**	**8**	**Off**
Signal 3351 *Stop and proceed* indication	1:57:28	335.90	1.32	55	90	8	On
C.R. 297	1:57:28	335.90	1.32	55	90	8	On
C.R. 19.50	1:58:02	336.41	0.81	55	90	8	On
Culvert	1:58:11	336.56	0.66	55	90	8	Off
C.R. 19 + Mainline	1:58:39	336.99	0.23	56	90	8	Off
Collision Point	**1:58:54**	**337.22**	**0.00**	**56**	**90**	**1**	**On**

*Because the event recorder samples data once per second, the throttle position change may have occurred up to 1 second earlier than indicated.