PB95-916303

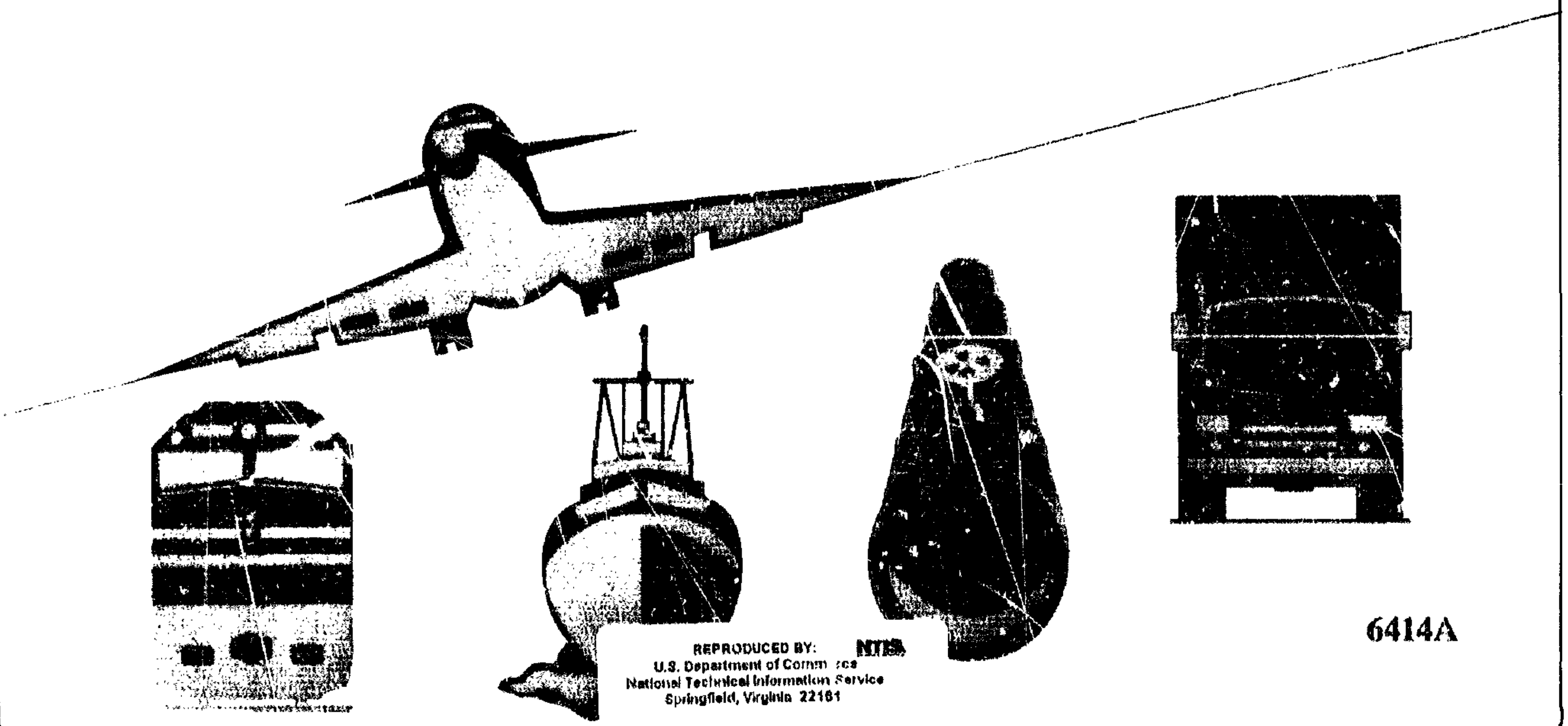
NTSB/RAR-95/03

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C. 20594

RAILROAD ACCIDENT REPORT

COLLISION AND DERAILMENT INVOLVING THREE BURLINGTON NORTHERN FREIGHT TRAINS NEAR THEDFORD, NEBRASKA JUNE 8, 1994



6414A

Abstract: This report explains the collisions of three Burlington Northern freight trains near Thedford, Nebraska, on June 8, 1994. Two people were killed and 2 people sustained minor injuries from this accident. The total estimated damage exceeded $2.5 million.

From its investigation of this accident, the Safety Board identified safety issues in the following areas: Train crew inattentiveness as a result of fatigue; train operations using the *restricted proceed* signal indication; and positive train separation.

As a result of its investigation of this accident, the Safety Board made recommendations to the American Short Line Railroad Association, the Association of American Railroads, Illinois Central Railroad Company, Kansas City Southern Railway Company, Norfolk Southern Railway Company and Soo Line Corporation (CP Rail System Heavy Haul). The Safety Board reiterated two recommendations to the Federal Railroad Administration.

Information about available publications may be obtained by contacting:

National Transportation Safety Board
Public Inquiries section, RE-51
490 L'Enfant Plaza East, S.W.
Washington, D.C. 20594
(202) 382-6735

Safety Board publications may be purchased, by individual copy or by subscription, from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
(703) 487-4600

NTSB/RAR-95/03 PB95-916303

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C. 20594

RAILROAD ACCIDENT REPORT

Collision and Derailment Involving Three Burlington Northern Freight Trains near Thedford, Nebraska June 8, 1994

Adopted: September 7, 1995

Notation 6414A

EXECUTIVE SUMMARY

About 3:25 a.m., mountain daylight time, on June 8, 1994, three Burlington Northern (BN) freight trains were involved in an accident. An eastbound train that had stopped for a train ahead was struck in the rear by a following eastbound train. The lead unit of the striking train derailed and came to rest on an adjacent track where it was struck by a westbound train. The engineer and conductor of the striking eastbound train were killed and the engineer and conductor of the westbound train were injured. Damages to track, equipment, and lading were estimated at $2.5 million.

The National Transportation Safety Board determines that the probable causes of this accident were the failure of the engineer of train OWY 9062 to obey the restrictive signal indication because he inappropriately was relying on peripheral cues and anticipated the signal would change; and the inattentiveness of the conductor of train OWY 9062 to train operations because of fatigue. Contributing to the accident were the fatigue of the engineer, which adversely affected his judgment and the manner in which he operated his train; the use of the *restricted proceed* signal indication; and the lack of a positive train separation control system.

The major safety issues discussed in this report are:

- Train crew inattentiveness as a result of fatigue,
- Train operations using the *restricted proceed* signal indication, and
- Positive train separation.

The report also discusses locomotive crashworthiness, locomotive fuel tank integrity, emergency response, and changes made by the Burlington Northern Railroad since the accident.

As a result of its investigation of this accident, the Safety Board made recommendations to the American Short Line Railroad Association, the Association of American Railroads, Illinois Central Railroad Company, Kansas City Southern Railway Company, Norfolk Southern Railway Company, and Soo Line Corporation (CP Rail System Heavy Haul). The Safety Board reiterated two recommendations to the Federal Railroad Administration.

INVESTIGATION

The Accident

About 3:25 a.m., on June 8, 1994, three Burlington Northern (BN) freight trains operating on BN tracks were involved in an accident on a double main track about 10 miles west of Thedford, Nebraska. OWY 9062[1] East, a loaded coal train, was operating on main track no. 1 when it struck the rear of stopped BN 6782 East, another loaded coal train, at milepost (MP) 252.1. The lead unit of OWY 9062 East derailed and came to rest angled across and obstructing the adjacent main track no. 2. A westbound train, BN 5532 West, which had empty hopper cars and was operating on main track no. 2, struck the derailed lead unit of OWY 9062 East. In the accident, the lead and trailing units from the OWY 9062 East and BN 5532 West locomotives and a total of 40 cars from all three trains derailed. The 40 cars comprised 21 loaded coal cars from OWY 9062 East, 8 loaded coal cars from BN 6782 East, and 11 empty cars from train BN 5532 West (figure 1).

The engineer and conductor of OWY 9062 East sustained fatal injuries in the accident. Before their train collided with the wreckage fouling their track, the engineer and conductor of BN 5532 West jumped from their lead unit and sustained minor injuries.

Precollision Events -- At 3:00:27 a.m., the BN dispatcher radioed the first eastbound train, KCS 735 East, that it would meet two westbound trains at Norway (MP 249.1), where the single main track from the east becomes a double main track (figure 2). According to the crew of BN 6782 East, shortly before the accident, they were following KCS 735 East on track no. 1 and were on an *approach* signal indication[2] when they received a *restricted proceed*[3] signal indication at the intermediate[4] signal at MP 250.8. Their signal indication was a result of KCS 735 East stopping in the block ahead. When he observed the end-of-train (EOT) device of KCS 735 East, the engineer of BN 6782 East stopped his train short of the signal at MP 250.8. The BN 6782 East conductor estimated that the rear end of KCS 735 East was about 550 feet east of the intermediate signal at MP 250.8 (figure 3).

---

[1] For ease of reference in this report, trains are identified by the following three-part designation: owner abbreviation, lead locomotive number, and direction of travel. In the case of OWY 9062 East, OWY is the symbol for an Oakway locomotive leased by BN from General Motors Corporation, 9062 is the number of the lead locomotive unit, and east is the direction of travel.

[2] As defined by Rule 9.1.8 of BN's "Special Instructions" for all subdivisions, an *approach* signal indication requires a train to "Proceed prepared to stop at next signal. Trains exceeding 35 mph immediately reduce to that speed."

[3] As defined by Rule 9.1.13 of BN's "Special Instructions" for all subdivisions, a *restricted proceed* signal indication requires a train to "Proceed at restricted speed." The definition of restricted speed is contained in the *General Code of Operating Rules* (GCOR), which states, "When a train...is required to make a move at restricted speed, movement must be made at a speed that allows stopping, within half the range of vision short of: train, engine, railroad car, men or equipment....Employees must keep a lookout for broken rail and not exceed 20 mph...."

[4] A fixed signal that shows the status of and that governs a train's approach to the next signal.

Figure 1 -- In the above aerial photograph provided by *The North Platte Telegraph*, the direction of travel for trains OWY 9062 East and BN 6782 East is from top to bottom. The direction of travel for BN 5532 West is from bottom to top.

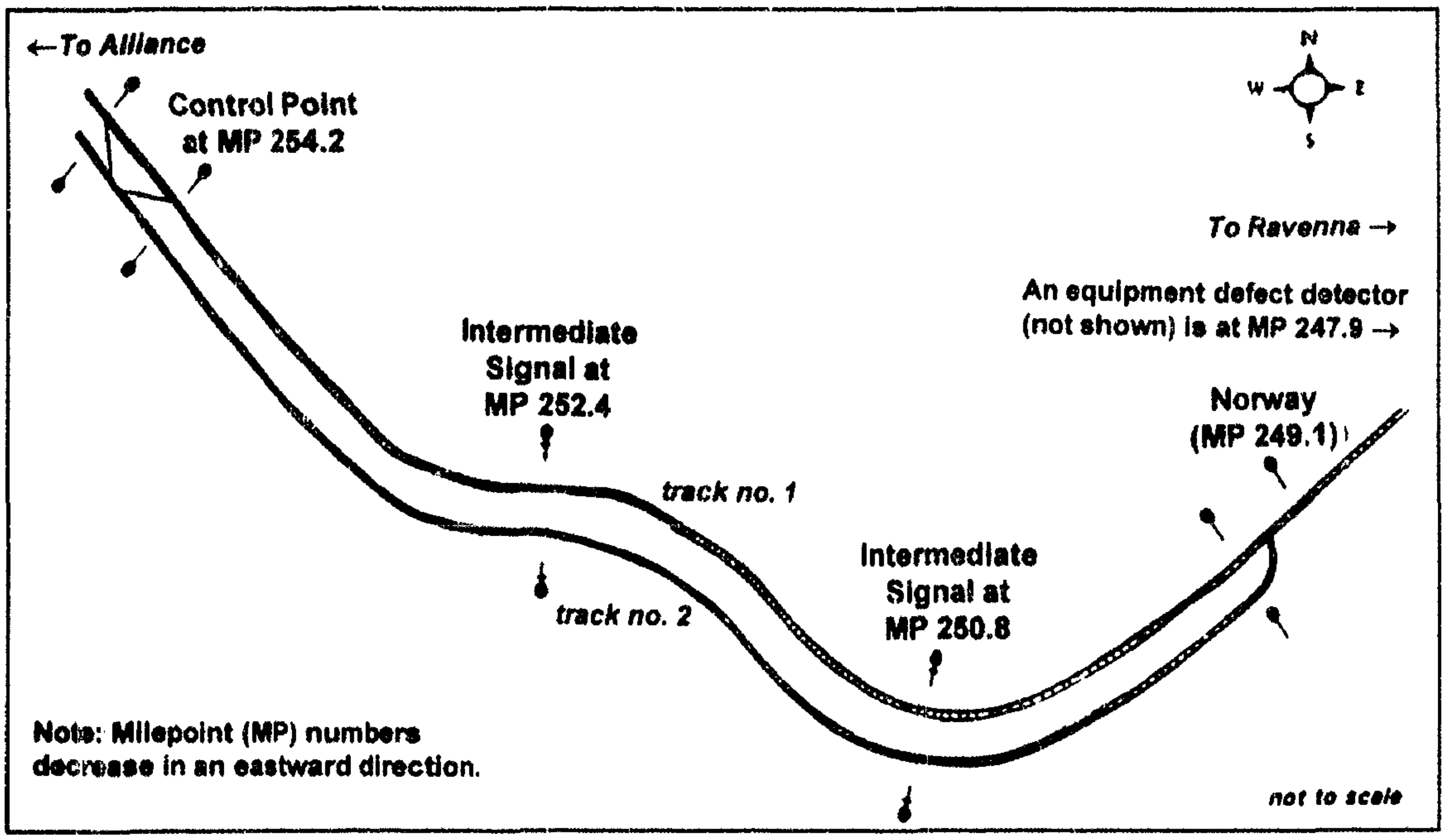


Figure 2 – Layout of accident area showing signal locations.

At MP 247.9, before the two westbound trains entered onto track no. 2, they activated an equipment defect detector,[5] which broadcast a status message for each train.

The engineer of OWY 9050 West stated that as he was proceeding along track no. 2, the rain was heavy when he passed two stopped eastbound trains (KCS 735 East and BN 6782 East) and met a third eastbound freight (OWY 9062 East) on the adjacent track (track no. 1) near MP 254. He stated that when OWY 9062 East passed him, its operator did not dim the train's headlight, which is required by BN operating rules.

The engineer of the second westbound freight, BN 5532 West, said that he operated his train from the single main track onto main track 2 through the turnout at 25 mph. The event recorder shows that when the end of his train cleared the turnout, the BN 5532 West engineer increased his speed to about 33 mph. He testified that the heavy rain did not affect either his operation of the train or his visibility. He stated, "... I could see my signals clearly ... I could see them well in advance to react or act upon the signal indications ... until the collision."

When BN 5532 West passed Norway, the signal indication for KCS 735 East cleared to show a *proceed* indication. KCS 735 East then began moving eastward on the single track.

---

[5] A wayside device that scans a passing train for any "hot" axle bearings or dragging equipment and relays this information to the train crew over the train's radio. The message includes the location of the detector, number of axles, air temperature, and train speed. Because the information is transmitted on a radio frequency, crewmembers on any train in the broadcast vicinity can hear the announcement.

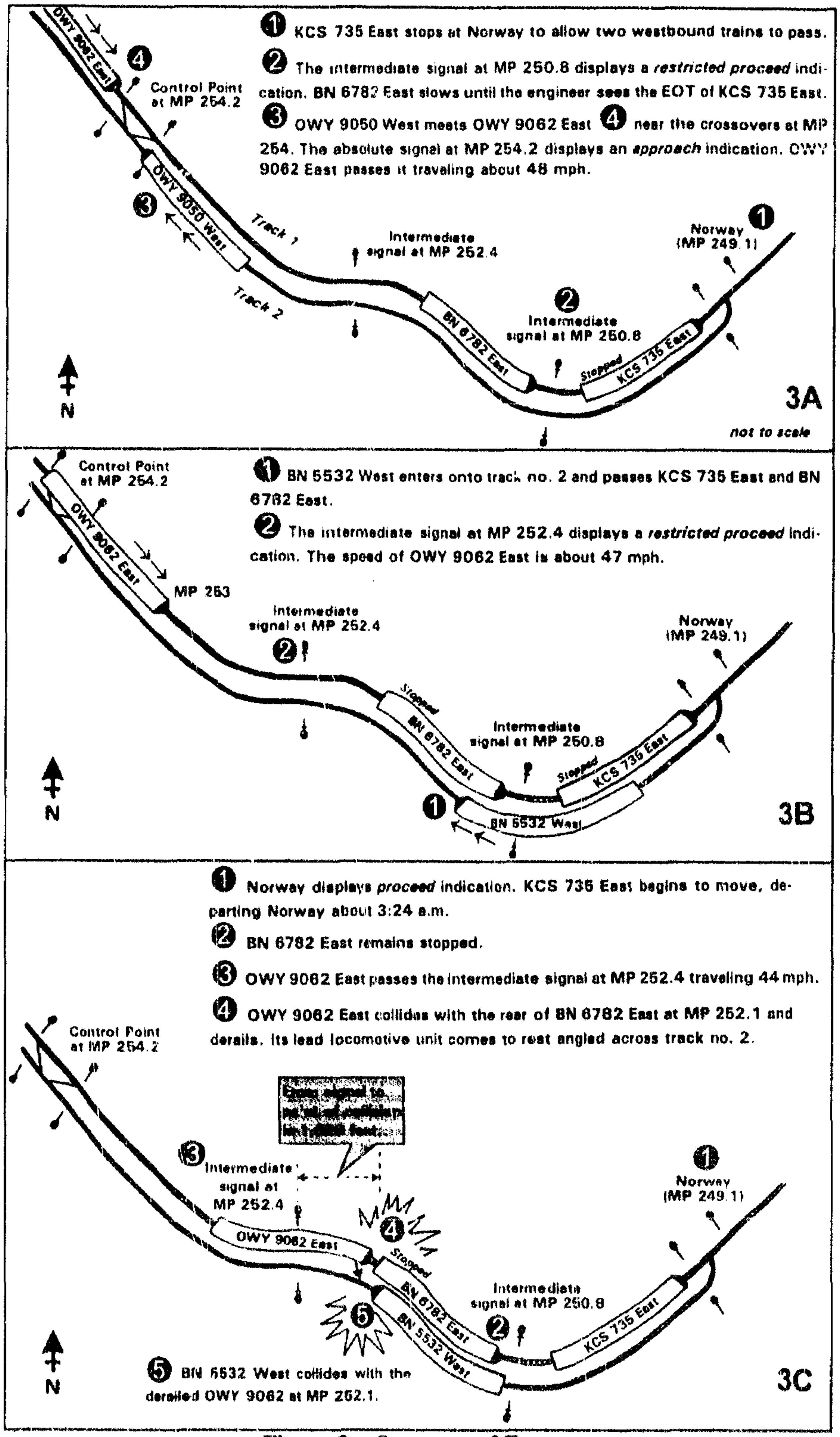


Figure 3 -- Sequence of Events

The Collision -- The engineer of the second eastbound train, BN 6782 East, stated that because he knew there was a train ahead and because of the track curvature, he remained stopped at the intermediate signal at MP 250.8. He stated that his train was then struck in the rear and shoved ahead about 140 feet; his train then went into emergency braking. He stated that he heard BN 5532 West go into emergency braking shortly thereafter.

OWY 9062 East had struck the rear of stopped BN 6782 East at MP 252.1. The lead unit of OWY 9062 East derailed and came to rest angled across and obstructing the adjacent main track no. 2. The engineer of BN 5532 West stated that he was about 15 to 20 car lengths (about 900 to 1,200 feet) away when he saw OWY 9062 East collide with the rear of the stopped BN 6782 East. He then placed his train into emergency and both he and the conductor jumped from the fireman's (left) side of the train. BN 5532 West was moving about 25 mph when it struck the engineer's side of the OWY 9062 cab (figure 4).

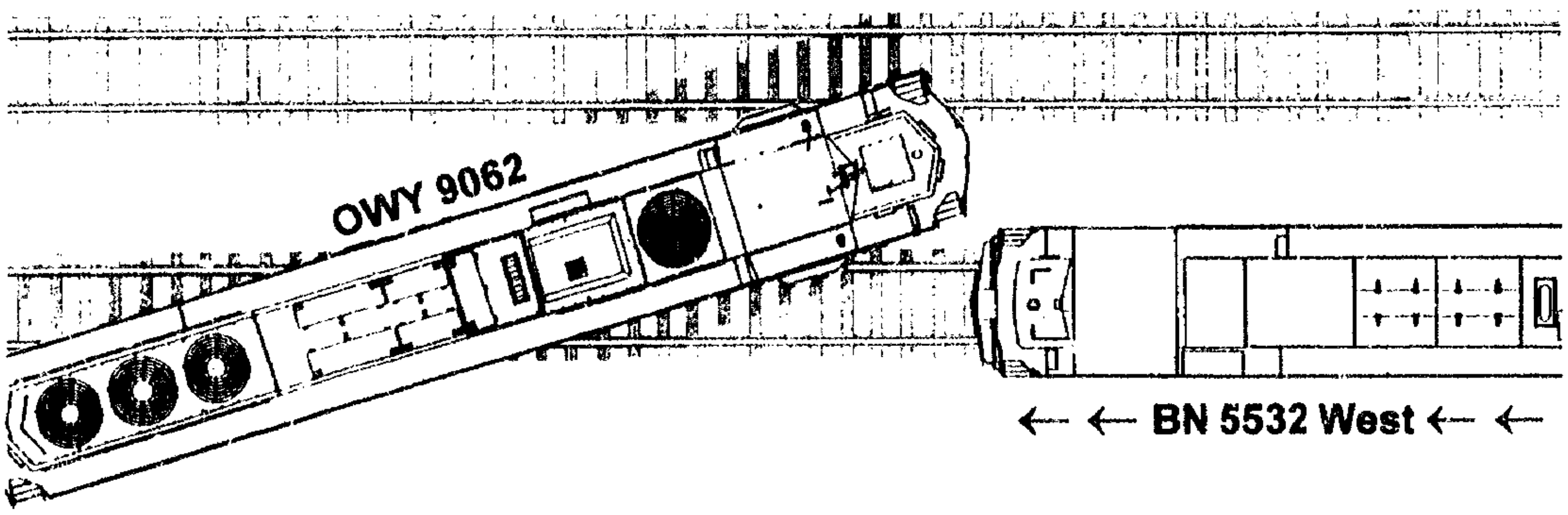


Figure 4 -- The illustration shows the approximate angle of impact into the cab of OWY 9062.

Postaccident Events -- About 3:30 a.m., an on-call Thedford emergency medical technician was monitoring BN radio traffic and heard a BN train crewmember notify the BN dispatcher of the accident. About 3:38 a.m., the BN Alliance, Nebraska, dispatcher notified the Thomas County Sheriff's dispatcher. Emergency response personnel, all volunteers from the Thedford and Mullen, Nebraska, fire departments, responded from 8 miles and 22 miles respectively, and arrived on scene about 4 a.m. The volunteer firefighters from Thedford extinguished a small fire that was near the wreckage, but which did not damage the locomotives or cars. Responders transported the two injured crewmembers from BN 5532 West to Great Plains Regional Medical Center in North Platte, Nebraska, where they were treated for multiple abrasions and contusions and released.

Injuries -- Table 1 is based on the injury criteria of the International Civil Aviation Organization.[6]

Table 1 -- Injuries sustained in Thedford railroad accident.

Injury Type	Operating Crew OWY 9062	Operating Crew BN 5532	Operating Crew BN 6782	Total
FATAL	2	0	0	2
SERIOUS	0	0	0	0
MINOR	0	2	0	2
NONE	0	0	2	2
TOTAL	**2**	**2**	**2**	**6**

Damages -- Burlington Northern provided the following damage estimate:

Equipment-cars	$ 549,000
Equipment-locomotives	$1,797,000
Track	$ 85,000
Lading	$ 36,000
	$2,467,000

Track -- About 1,000 feet of track was destroyed.

OWY 9062 East -- The lead unit, OWY 9062, was destroyed and its trailing unit, BN 9085, had sustained moderate damage. The OWY 9062 fuel tank had been separated from the underframe; it was crushed and had holes in its left, right, and under sides. The fuel tank of BN 9085 remained intact.

BN 5532 West -- The lead unit, BN 5532, was destroyed and its trailing unit, BN 7804, received minimal damage. During the collision, the fuel tank on BN 5532 remained attached; however, it was punctured during wreckage-clearing operations.

As a result of the accident and wreckage removal operations, about 5,000 gallons of diesel fuel were released from the two fuel tanks.

---

[6] 49 *Code of Federal Regulations* (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 that "(l) 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, muscle, 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.

Personnel Information

Professional Background and Experience -- The engineer of OWY 9062 East, age 34, was hired by BN as a section laborer on August 16, 1978. On January 8, 1980, he was tested and promoted to the position of locomotive engineer.

The engineer's personnel record indicates that he was disciplined twice for failing to stop his train before passing an absolute signal.[7] His first infraction at a stop indication was on August 26, 1983, and resulted in his censure and suspension. The second failure to stop at a stop indication occurred during an operations test on July 2, 1991, and resulted in his dismissal. The BN reconsidered his dismissal and reinstated him "on a leniency basis" on January 15, 1992. The engineer also was censured on July 1, 1988, for failing to stop his train short of a derail, which resulted in the derailment of, and damage to, a locomotive in a yard.

The conductor of OWY 9062 East, age 37, was hired by BN on July 14, 1977, as a laborer. He subsequently worked as a brakeman until being promoted to conductor on December 7, 1983. Although he was eligible for an assigned position because of his seniority, he chose to work from a reserve board position. BN management reported that the conductor did so to increase his income to pay for medical expenses incurred by family members.

The conductor's personnel record contains several disciplinary actions, including dismissal and reinstatement, for infractions such as failing to be available when called for duty and failing to ensure proper switch alignment.

Life Style and Routine -- The engineer of OWY 9062 East lived alone in Alliance. He did not smoke and drank about 12 cups of coffee daily. He drank beer occasionally, reportedly consuming a 6-pack of beer by himself about once a month. He reportedly never drank before he was scheduled to report for duty.

The conductor of OWY 9062 East lived with his wife and three children in Bridgeport, Nebraska, a 45-50 minute commute to and from work. According to his spouse, he smoked 1-2 packages of cigarettes and drank 20-25 cups of coffee daily. He seldom drank alcoholic beverages, but preferred to drink beer when he did so. His spouse said that he had never used any controlled dangerous substances and had not used any medications in recent years.

Medical Factors -- The most recent company physical for the engineer of OWY 9062 East was on January 20, 1992. It indicated that he was in good general health and that his vision and hearing were within normal limits. His family was not aware of any current medical problems. His physical condition reportedly was excellent. He had not filed any recent health insurance claims or participated in the BN Employee Assistance Program (EAP) during the 5 years before the accident. In 1987, he underwent radial keratotomy surgery so that he did not have to wear corrective lenses.

---

[7] A fixed signal at the entrance of a route or block governing train movements. Only one train at a time can enter a block governed by an absolute signal. The most restrictive signal indication is STOP.

The most recent company physical for the conductor of OWY 9062 East was on April 10, 1992. It indicated that he was in good general health, although he had a mild viral cold at the time of the examination. His vision was within normal limits. The physician detected some hearing loss. The conductor subsequently took an audiogram on April 15, 1992, which indicated that his hearing met BN standards According to his family, the conductor's current health was good. He had not filed any recent health insurance claims or participated in BN's EAP during the 5 years before the accident.

Work/Rest Activities Before the Accident -- The Safety Board reconstructed the activities of the OWY 9062 East engineer and conductor for the 72-hour period before the accident insofar as possible from BN records and interviews with next-of kin. (See table 2.)

OWY 9062 East Engineer -- On June 5, the engineer had rested in a hotel at an away-from-home terminal about 7 hours before reporting to work at 1:45 p.m. He then was off duty between 10:25 p.m. on June 5 to 8:55 p.m. on June 7. He received about 7 hours of sleep on the morning of June 6 and about 7 hours of sleep on the morning of June 7. He had been awake about 19 hours when the accident occurred.

BN records show that on June 7, he was called for work at 7:42 p.m. and went on duty at Alliance, his home terminal, at 8:55 p.m. He was called for BN 6782 East; however, when he reported to work, he was asked to provide a urine sample as part of a random drug test, but was physiologically unable to do so immediately. He subsequently was able to provide a sample, at which time he was reassigned to the OWY 9062 East. At the time he reported to duty for the accident trip, the engineer had been off duty for 46 hours and 30 minutes and thus was "rested" in accordance with applicable regulations.

Table 2 -- OWY 9062 East crew's duty schedule.

ENGINEER'S SCHEDULE	
Jun 5, Sunday	
0405-1345	Off duty (Guernsey)
1345-2225	On duty (Guernsey - Alliance - Guernsey (taxi) - Alliance)
2225-2400	Off duty (Alliance)
Jun 6, Monday	
0000-2400	Off duty (Alliance)
Jun 7, Tuesday	
0000-2055	Off duty (Alliance)
2055	On duty (Alliance)
Jun 8, Wednesday	
0325	**Accident**
CONDUCTOR'S SCHEDULE	
Jun 5, Sunday	
0215-0940	On duty (Alliance - Guernsey)
0940-1821	Off duty (Guernsey)
1821-2330	On duty (Guernsey - Alliance)
2330-2400	Off duty (Alliance)
Jun 6, Monday	
0000-0920	Off duty (Alliance)
0920-1400	On duty (Alliance - Ravenna)
1400-2400	Off duty (Ravenna)
Jun 7, Tuesday	
0000-0010	Off duty (Alliance)
0010-1055	On duty (Ravenna - Alliance)
1055-2230	Off duty (Alliance)
2230	On duty (Alliance)
Jun 8, Wednesday	
0325	**Accident**

OWY 9062 East Conductor -- On June 5, the conductor had rested about 7 hours during the morning in a hotel at an away-from-home terminal. On June 6, he had rested at home about 7 hours in the early morning before going on duty at 9:20 a.m. He went off duty at an away-from-home terminal at 2 p.m. and rested about 7 hours in a hotel before reporting back on duty shortly after midnight. After getting off duty at 10:55 a.m. on June 7, the conductor took a 3-hour nap in the afternoon and was awake for about 12 hours before the accident occurred. At the time he reported to duty for the accident trip, he had been off duty for 12 hours and 35 minutes and thus was "rested" in accordance with applicable regulations.

The BN's Crew Notification Process -- Crew-calling functions are basically universal throughout the BN system. The standard notification is 1 hour and 30 minutes. Extenuating circumstances may result in BN providing shorter notification, but the employee still can take 1 hour and 30 minutes to report to work. Crewmembers have local telephone access to a system that provides information pertaining to their respective call positions. They may obtain information regarding their call positions by telephoning the notification system. Position information is updated on a real time basis. The Alliance Division also has access to position information through a local cable television station.

Train Information

The three eastbound trains had departed Alliance between 10:45 p.m. and 11:20 p.m. on June 6, 1994. Train KCS 735 East had departed about 10:45 p.m., BN 6782 East had departed about 11 p.m., and OWY 9062 East had departed about 11:20 p.m. Train BN 5532 West had departed Ravenna at 10:15 p.m. (See figure 5.)

Train BN 6782 East -- The train had three diesel-electric units (BN 6782, BN 7269, and BN 7239) and 111 loads of coal (trailing tonnage 14,659) and was 6,090 feet long. It was equipped with an end-of-train[8] (EOT) device. BN 6782 East originated at Rochelle Mine, Wyoming, and was en route to Joppa, Illinois. BN personnel gave the train a roll-by inspection as it left Alliance at 11 p.m. and noted no problems.

Train OWY 9062 East -- The train had two diesel-electric units (OWY 9062 and OWY 9085) and 115 loads of coal (trailing tonnage 15,597) and was 6,095 feet long. It was equipped with an EOT device. OWY 9062 East originated at Jacob's Ranch mine in Wyoming and was en route to Cook, Illinois. BN maintenance personnel gave the train a roll-by inspection as it left Alliance at 11:20 p.m. and noted no problems.

Train BN 5532 West -- The train had two diesel-electric units (BN 5532 and BN 7804) and 118 empty hopper cars (trailing tonnage 2,623) and was 6,254 feet long. It had an EOT device. BN 5532 West originated at Cook, Illinois, and was en route to Jacob's Ranch mine. The crew did not report any problems with the train before the accident.

Safety Board investigators reviewed daily inspection sheets, locomotive inspection cards (blue cards), 1,000-mile brake test certificates, and maintenance records, and determined that

[8] An end-of-train device comprises a rear-of-train unit on the last car of the train and a front-of-train unit in the cab of the controlling locomotive unit. The rear unit is capable of determining the rear car brake pipe pressure and transmitting that information to the front unit for display to the engineer.

the required Federal inspections and tests had been conducted and were up to date for all locomotive units.

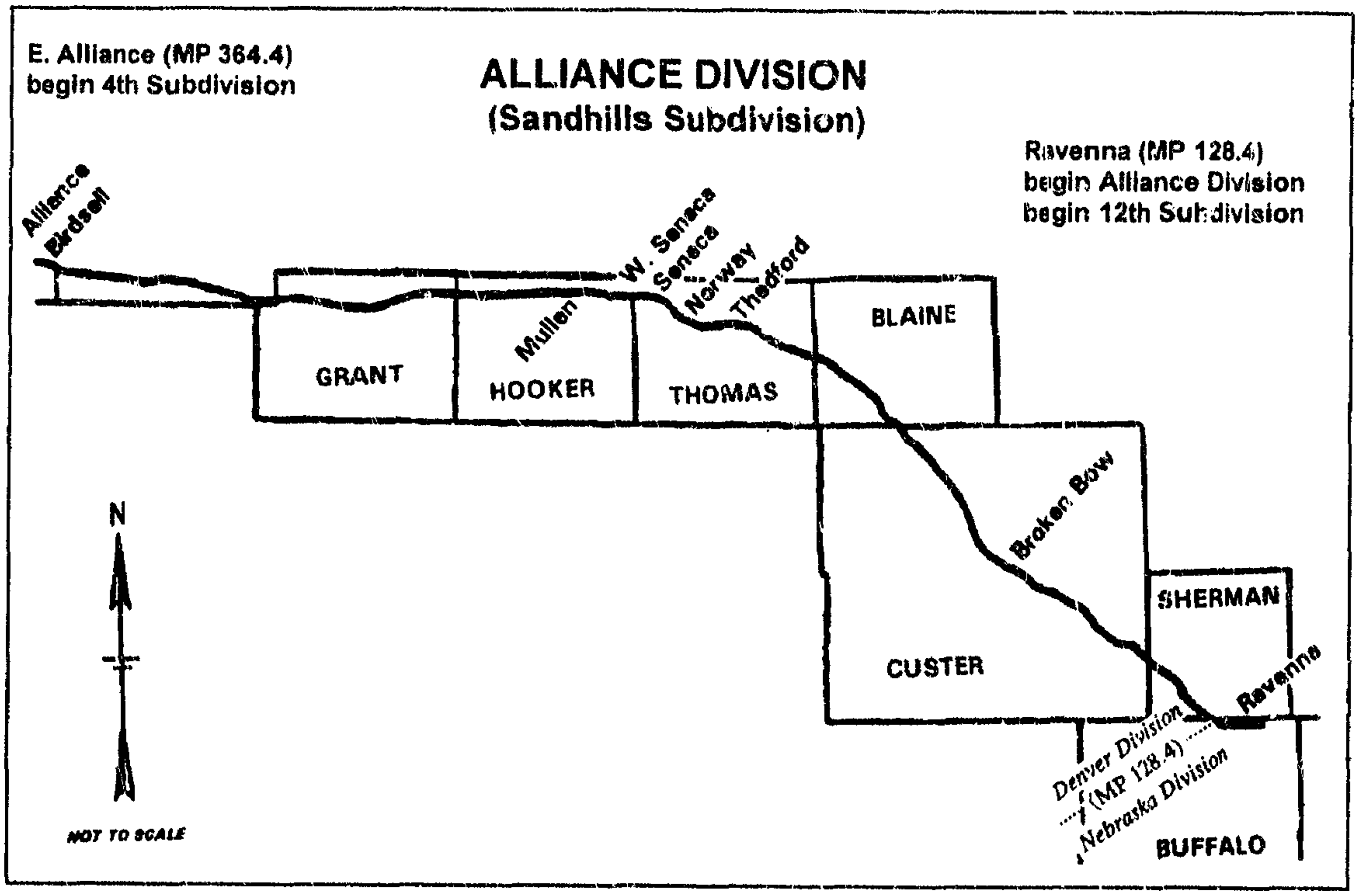


Figure 5 – Route between Alliance and Ravenna.

Track and Signal Information

The accident occurred on the double main track of the Sand Hills Subdivision of BN's Alliance Division. The north track is designated as main track no. 1 and the south track is main track no. 2. The eastbound trains were operating on main track no. 1 and the westbound trains were operating on main track no. 2. At Norway, MP 249.1, the tracks converge into a single main track.

Track -- At the accident site, the track is level and situated through open grazing land. It is slightly elevated above the terrain to the north. A slight, rising hillside parallels the track on the south side of main track no. 2. From the absolute signal at MP 254.2 to the point of collision at MP 252.1, the track alignment is straight for about 7,498 feet, then follows a 1-degree 45-second left-hand curve for about 1,478 feet, then is straight for about 1,637 feet, and then follows a 2-degree 36-second right-hand curve for 845 feet.

The BN maintains the track to meet or exceed the minimum requirements of the Federal Railroad Administration (FRA) Track Safety Standards for Class 4 track contained in Title 49 *Code of Federal Regulations* (CFR) Part 213. On May 4, 1994, an FRA inspector, accompanied by a BN roadmaster, examined the track and noted no exceptions. On May 25, 1994, a contractor performed an ultrasonic inspection on main track no. 1 and noted no defective rails. BN records also show that a BN track inspector had inspected the track twice weekly in accordance with FRA standards. The last inspection, which was on June 7, 1994, shows no exceptions noted.

Signals -- A dispatcher in Alliance controls train movements by a Centralized Traffic Control (CTC) system. Each track is signaled in both directions. The signal indications of the absolute signals at MP 249.1 (Norway), MP 254.2, and MP 259.2 correspond to the dispatcher's requests for train movements through the interlocking, to train movements already in the track circuit, or to rail continuity. The signal indications at the intermediate signals at MP 250.8, MP 252.4, and MP 256.5 provide corresponding signal indications consistent with the next signal, with train movements, and with rail continuity.

In addition, the signal system is equipped with a signal event recording log, which provides a record of the dispatcher's requests and indications for interlocking switch positions and the corresponding signals for train movement. For the morning of the accident, the signal event recorder log shows that BN 5532 West cleared the interlocking at Norway, MP 249.1 at 03:21:57, that OWY 9062 East passed the absolute signal at MP 254.2 at 03:22:33, and that KCS 735 East received a clear signal at Norway, MP 249.1, at 03:22:37 and was moving into the next track circuit at 03:24:21. System records show that no power outages associated with lightning or a storm affected the operation of the signal system in the accident area.

Safety Board investigators conducted an operational test of the signal system between MP 256.5 and MP 249.1 in both directions on both main tracks and determined that all signals functioned as designed.

Operations Information

General -- Burlington Northern reported that it operates about 51 trains daily between Alliance and Ravenna, Nebraska. The annual gross tonnage operated on the Sand Hills Subdivision during 1993 was about 120 million tons.

The movement of trains between Alliance and Ravenna is governed by the *General Code of Operating Rules* (GCOR), the *Alliance Division Timetable No.1,* and the BN System "Special Instructions," which were effective on April 10, 1994. Trains OWY 9062 East, BN 5532 West, and BN 6782 East each had a two-man crew, an engineer and conductor. The eastbound train crews operated from Alliance to Ravenna and the westbound train crews operated from Ravenna to Alliance.

Rule 6.21 of BN's GCOR requires train crews to protect trains and engines against any condition that may interfere with safety by advising the train dispatcher using the first available means of communication. None of the five train crews notified the dispatcher of any adverse weather conditions. Rule 5.9.1 states, in part, that the engineer is to dim the locomotive headlight when approaching or passing the head end or rear end of a train on an adjacent track. The engineer of OWY 9050 West reported that the headlight of OWY 9062 East was not dimmed when the two trains passed each other west of the crossovers at MP 254.

The conductor of BN 6782 East stated that after departing Alliance, their train was first stopped at MP 352 because of traffic ahead. They then proceeded to Ashby, MP 314.5, where they had to wait for four westbound trains to pass. The train was again stopped at MP 279.3. The conductor stated that they encountered quite a few approach signals because of the spacing of the trains. When they were at MP 267.3, the BN 6782 crew overheard the radio message to KCS 735 East from the dispatcher, advising, "KCS 735, meet two at Norway."

A tape of the Alliance dispatcher's transmissions between 2:27 a.m. and 4:37 a.m. on June 8, indicates that he contacted KCS 735 East at 03:00:27 to advise the train crew about meeting the two trains at Norway. At 03:04:45, train OWY 9050 West passed the Norway equipment defect detector at MP 247.9 and BN 5532 West passed it at 03:15:20.

Operational Testing -- BN requires that each active employee governed by the GCOR be given a "qualifying operations test by a designated BN officer." The objectives of the tests are to eliminate accidents caused by human error, to improve and maintain employee alertness, to improve employee knowledge of and compliance with the rules, and to increase the carrier's awareness of those areas in which employees demonstrate a need for improvement.

BN test records for the engineer of OWY 9062 East indicate that during the 5 years before the accident, he was tested on 42 occasions on a total of 220 rules. He had 18 recorded failures for such items as not inspecting a passing train, using an improper whistle for crossing, not reporting a train delay, and failing to stop at a stop signal. As mentioned in an earlier report section, his failure to stop for a stop signal resulted in his dismissal from train service for about 6 months.

BN test records for the conductor of OWY 9062 East indicate that during the 5 years before the accident, he was tested on 35 occasions on a total of 181 rules. He had 18 recorded failures, including items such as improper operation of a switch, train delays, and general non-operating rules.

Meteorological Information

The closest weather radar station was in Alliance. Weather radar overlay data show that at 3:19 a.m. on June 8, 1994, the accident area was in a strong weather echo (radar reflection) with a thunderstorm and heavy showers that were moving east toward Thedford. At 3:25 a.m., the weather echo became moderate with a moderate rainfall intensity. According to the National

Weather Service, no severe weather warnings were in effect for the accident area between 2 a.m. and 4 a.m.

Medical and Pathological Information

OWY 9062 East Train Crew -- The 34-year-old engineer and the 37-year-old conductor of train OWY 9062 East sustained fatal injuries in the collision. They were taken to the Western Pathology Consultants Laboratory, in Scottsbluff, Nebraska, where autopsies were performed.

The autopsy reports show the conductor's cause of death was blunt trauma with multiple lacerations and contusions to the head, neck, chest, abdomen, pelvis, and left leg. The engineer's cause of death was massive blunt trauma to the abdomen, pelvis, and both legs, a fracture of the right humerus, and a compound fracture of the right femur.

BN 5532 West Train Crew -- The engineer and conductor had jumped from the left (fireman) side of their train seconds before it collided with the derailed lead unit of OWY 9062 East. They were taken to the emergency room at the Great Plains Regional Medical Center in North Platte, Nebraska, where the engineer was treated for a small scalp laceration and multiple abrasions and the conductor was treated for multiple abrasions on the head, chest and extremities. Neither was admitted.

Toxicological Testing

When he arrived to go on duty at Alliance, the engineer of OWY 9062 East was chosen for drug testing by the BN in accordance with Federal random testing requirements. His urine specimen was sent for testing to Compu-Chem Laboratories in North Carolina. The examination established that marijuana, cocaine, phencyclidine (PCP), opiates (morphine and codeine), and amphetamines were not present in the sample.

In accordance with the FRA postaccident toxicological testing requirements, blood from the engineer and blood and vitreous fluid from the conductor were sent to Compu-Chem Laboratories for analysis. The engineer's blood sample and the conductor's two specimens were negative for drugs and alcohol according to FRA testing protocol.

At the request of the Safety Board, specimens from the fatally injured OWY 9062 East engineer and conductor were sent for testing to the Center for Human Toxicology (CHT) in Salt Lake City, Utah. The engineer's blood specimen was negative for drugs and alcohol. Because blood was not available, tissues from the conductor's brain and liver were tested at CHT. The brain tissue was negative for drugs and alcohol. His liver tissue contained alcohol at a concentration of .27 gm/100gm of liver.

The BN 5532 West and BN 6782 East crewmembers and the Alliance dispatcher were toxicologically tested in accordance with the FRA requirements. All test results were negative for drugs, including alcohol.

Survival Aspects

Response Activities -- Responders found both OWY 9062 East crewmembers lying at the base of the electrical panel in the control compartment of the lead unit, OWY 9062. The locomotives had to be moved before their bodies could be recovered.

Disaster Preparedness -- The Thomas County disaster plan was not activated because the accident did not meet the criteria of a major disaster. During the 3 years before the accident, BN railroad held training classes in Mullen for local fire departments. A 1-day course covered identification of hazardous materials and interaction with train hazardous materials crews.

Postaccident Examination -- Safety Board investigators examined the damaged locomotives at the site. The operating compartments of the lead units, OWY 9062 and BN 5532, which had been positioned forward for operation, had sustained extensive damage as noted below.

OWY 9062 -- The superstructure of this EMD SD-60[9] model unit had suffered extensive crush damage from the front windshield of the operating compartment rearward. The unit had been separated from its trucks. The collision posts were undamaged; however, the sheet metal covering the front hood was creased and dented. The operating compartment had been crushed back and in toward the centerline on the right side. The roof had been crushed down and peeled back. (See figures 6-8.)

BN 5532 -- The superstructure of this GE C-30-7 model unit had sustained extensive damage. The front hood and the operating compartment were completely destroyed. The right side collision post was bent inward toward the centerline and the rear. The left side collision post had been bent rearward and to the left of center. The hood, operating compartment, and roof had collapsed down and rearward. (See photo 9.)

Tests and Research

Train Movement Data -- The Safety Board had the event recorders from OWY 9062 East and BN 5532 West removed and sent to its laboratory in Washington, D.C., for readout. Investigators also obtained signal event recorder data and crew statements and conducted field measurements and signal tests. The Board used this information to determine the throttle

---

[9] The Electro-Motive-Division (EMD) of General Motors classifies its locomotives with six traction motors as Special Duty (SD) followed by a two digit number for the series designating the horsepower. The General Electric Company (GE) classifies its locomotives with six traction motors with a "C" followed by two numbers designating the horsepower and series.

positions, braking, clock times, signal aspects, and time and distances between events so that it could reconstruct the respective train movements and conduct simulation tests.

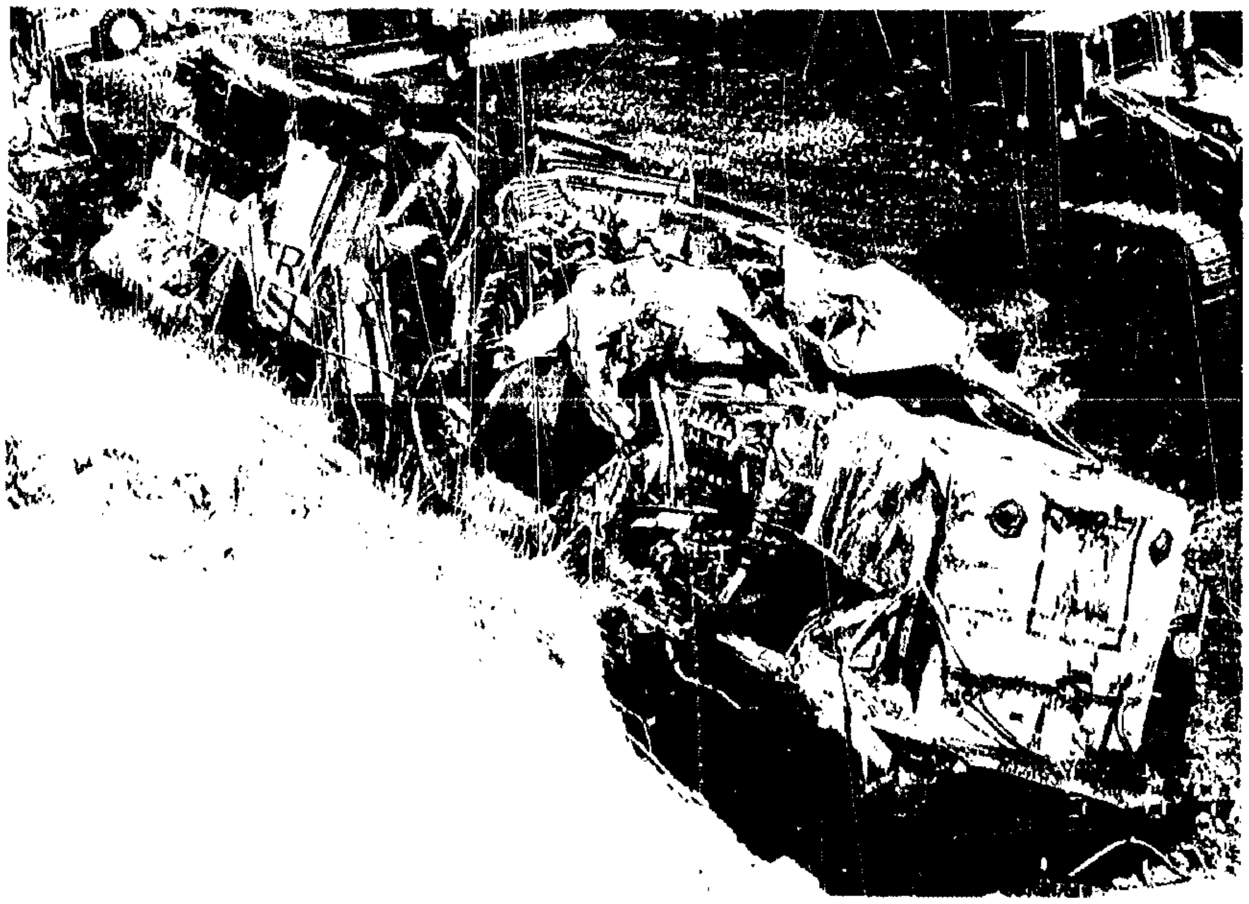


Figure 6 -- Overall view of locomotive OWY 9062.

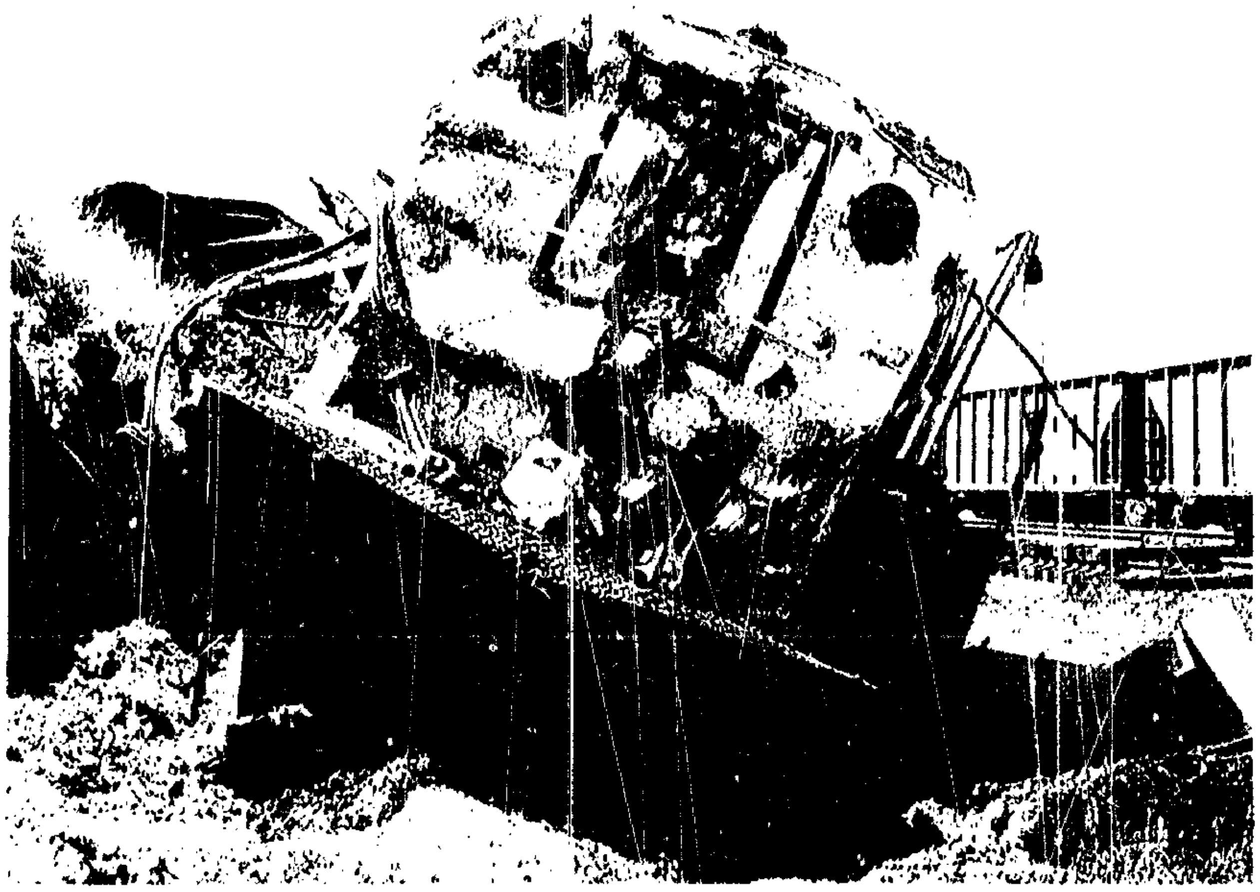


Figure 7 -- View of low hood (front end) of OWY 9062.

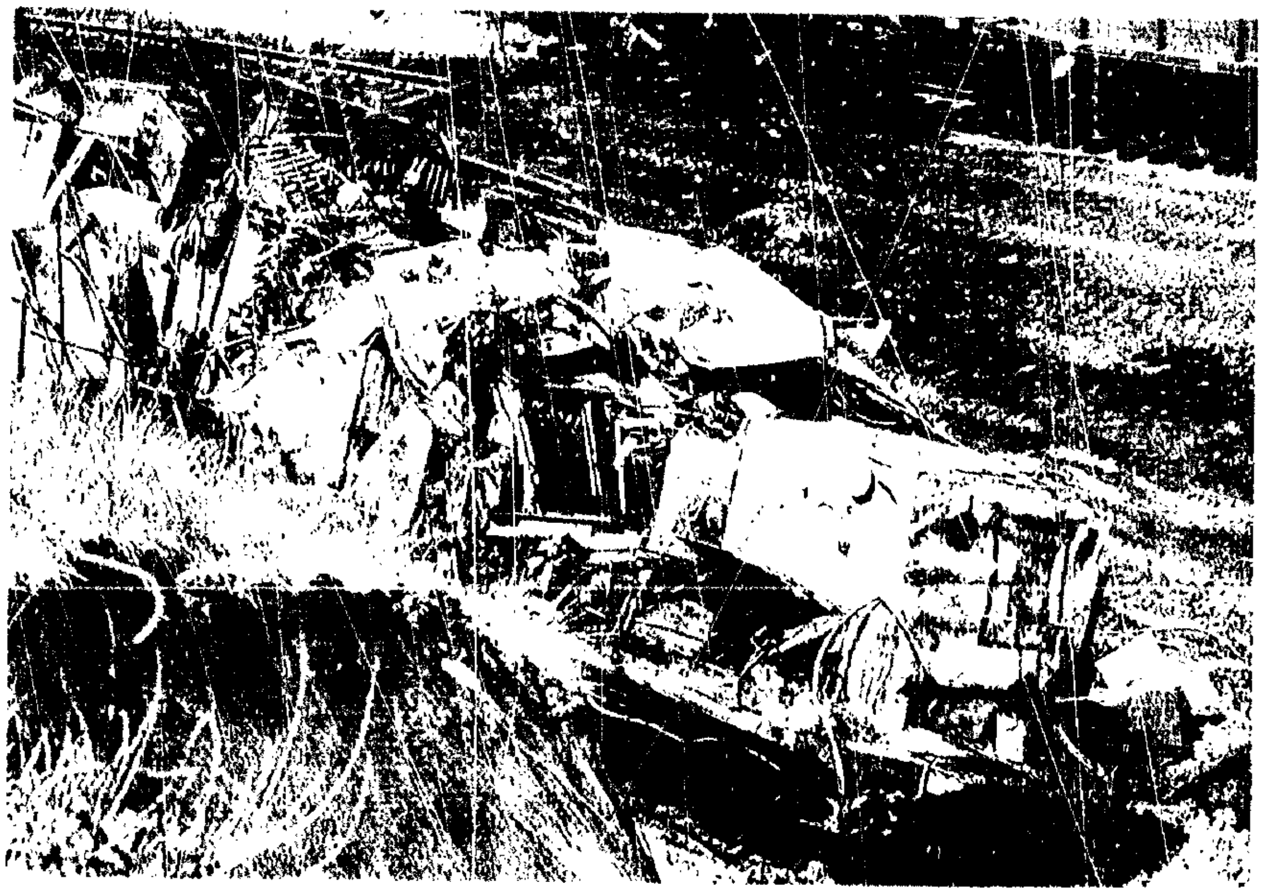


Figure 8 -- View of OWY 9062 cab compartment on engineer's side.

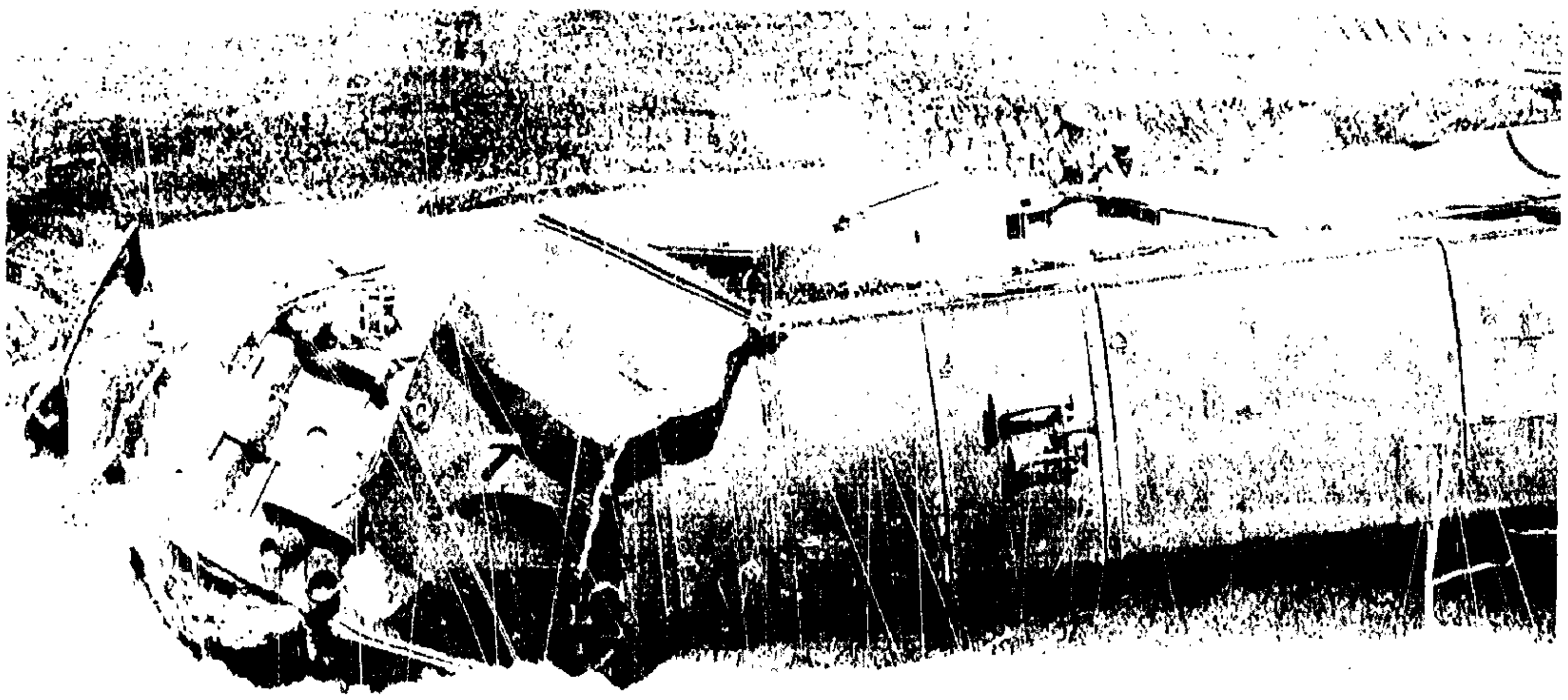


Figure 9 -- View of locomotive BN 5532.

The event recorder data shows that BN 6782 East came to a stop short of the signal at MP 250.8 about 03:19:40 and experienced an emergency brake application between 6.5 and 7.0 minutes later.

The signal event recorder data shows that OWY 9062 East had been following BN 6782 East for about 40 miles with about 10-12 minutes separating the two trains. Recorded information also shows that OWY 9062 East passed the intermediate signal at MP 256.5 (which would have displayed an *approach medium*[10] indication) at 03:20:20 traveling 48 mph with the throttle position at IDLE/1/2 and the brakes released. The train next passed the absolute signal at MP 254.2 (which would have displayed an *approach* indication) at 03:22:33 traveling 48 mph with the throttle at position 5 and the brakes released. About 3,800 to 3,500 feet before the point of impact, a 6 psi (pounds per square inch) application of the train brakes was made. A series of incremental brake applications followed, but no reduction in speed. The brake applications and speed of the train between 3,500 feet to the point of impact were as follows: 3,500 to 3,050 feet -- 10 psi and 47 mph; 3,050 to 2,640 feet -- 14 psi and 47 mph; 2,640 to 2,229 feet -- 18 psi and 47 mph. OWY 9062 East then passed the intermediate signal at MP 252.4 (which would have displayed a *restricted proceed* indication) at 03:24:56 traveling 44 mph with the throttle position at IDLE/1/2 and the brakes in a 22 psi reduction. An emergency application of the train brakes occurred a maximum of 6.3 seconds later. At approximately 03:25:11, the train, traveling 42 mph and with its throttle in the IDLE/1/2 position, struck the rear of BN 6782 East.

Recorded information showed that the second westbound train, BN 5532 West, passed the absolute signal at MP 249.1(Norway) (which would have displayed an *approach diverging* indication) about 03:18:30 at 25 mph with the throttle in position 6 and the brakes released. About 03:25:24, the train struck the derailed lead unit of OWY 9062 East at 25 mph. This collision was about 13 seconds after OWY 9062 East struck the rear of BN 6782 East. Data also showed that about 8 seconds before BN 5532 West collided with the lead unit of OWY 9062 East, the BN 5532 West engineer placed his train into emergency braking.

Sight Distance Tests -- Tests were performed during the early morning on June 11, 1994, in dark, clear weather conditions. At the point of impact, investigators positioned a hopper car with a rear-mounted EOT device. Using a similar locomotive and operating eastward, they determined that the illuminated EOT device was visible from the engineer's position from about 1,189 feet. The signal at MP 252.4 was visible from at least 2 miles.

Signal Tests -- Tests performed on the signal system after the accident showed that the system operated as designed. Simulation of the three eastbound and two westbound train movements correctly replicated the signal indications that the intermediate signals at MP 252.4 and MP 250.8 should have displayed on the morning of the accident. That is, when an eastbound train, such as BN 6782 East, occupied the next signal block east of the eastbound intermediate signal at MP 252.4, that signal displayed a *restricted proceed* (red) indication. The next signal, the eastbound absolute signal at the crossover at MP 254.2, displayed an *approach* (yellow-over-red) indication. A review of signal defect reports shows that the signal system in the accident area was not affected by any electrical outages caused by lightning.

Train Simulation Stopping Tests -- The Safety Board performed two tests at Freight-Master in Fort Worth, Texas, to simulate the operation of OWY 9062 East. The first test

---

[10] Rule 9.1.6 of BN's "Special Instructions" for all subdivisions states that the *approach medium* signal indication requires a train to "proceed prepared to pass next signal not exceeding 35 mph."

replicated the train handling methods registered on the train's event recorder that resulted in the collision. In the second simulation, OWY 9062 East was operated in observance of the operating rules, the timetable instructions, and the signal indications displayed on the morning of the accident.

The second test demonstrated that OWY 9062 East could be stopped short of the point of collision with BN 6782 East. The test showed that applying the train's dynamic brake at the intermediate signal at MP 256.5, which displayed an *approach medium* indication, slowed the train from about 49 mph to 34 mph by the time it reached the absolute signal at MP 254.2, which displayed an *approach* indication. With the dynamic brake still applied, the train continued to slow and was traveling about 6 mph by the time it reached the intermediate signal at 252.4, which displayed a *restricted proceed* indication. A service application of the train brakes made about 1,180 feet[11] from the end of the train ahead stopped OWY 9062 East short of the rear end of BN 6782 East.

Locomotive Air Brake Component Tests -- The Safety Board had the air brake components removed from each of the derailed locomotive units and sent to Lincoln, Nebraska, for testing. Some components had minor problems when tested; however, the problems were not the type that would affect an engineer's ability to apply the brakes.

Alerters -- All lead locomotive units involved in this accident were equipped with an alerter, which monitors an engineer's actions to detect whether he is incapacitated by sleep, unconsciousness, or death. If the engineer does not reset the system by manipulating various controls, such as the throttle, the three brake systems, the horn, the bell, the reverser, the manual sander, or the alerter reset switch, the warning lights and the alarm on the alerter will activate for a given amount of time, after which the system will trigger a penalty brake application.

A BN machinist and a mechanical/electrical foreman who had inspected and tested the alerter of OWY 9062 on June 7, 1994, provided the Safety Board with a statement that the alerter was in working order when they examined it. After the accident, the Safety Board recovered the alerter, a Pulse Sentry II, for postaccident testing, but found it would not operate because of damage sustained in the collision.

End-of Train (EOT) Devices -- Safety Board investigators recovered the BN 6782 East's EOT, a Pulse Train Link II (BNRQ7605). The car inspector's and conductor's reports show that this device was installed on DDJX8559, the rear car of BN 6782 East. The engineer of BN 6782 East stated that he was receiving a brake pipe pressure and a marker light indication on the locomotive cab telemetry device. He also reported the head-end telemetry unit lost contact with the EOT rear unit when his train went into emergency.

---

[11] Based on the findings from the sight distance tests.

Other information

BN's Postaccident Actions -- On January 1, 1995, as a result of this accident and discussions with Safety Board investigators, BN discontinued the use of the *restricted proceed* indication and began using *stop and proceed* signal indications for train operations. BN informed the Safety Board that its personnel have been trained on the change. (See appendix C.)

The BN has installed grade markers (a sign with a "G") on selected signal masts to alert train operators that they are approaching areas where ascending or descending grades are such that stopping a train may be detrimental. In these situations, trains are allowed to proceed without stopping past a signal displaying a *stop and proceed* aspect at restricted speed, such as they did with the *restricted proceed* signal indication. According to BN officials, the use of a grade marker is normally limited to areas of substantial ascending track grade where restarting a stopped train would be difficult, if not impossible. The grade marker may also be used on steep descending grades where stopping would place excessive demands on a train's air brake system.

In addition, BN instituted a "banner" test as part of its oversight and operational testing for engineers. The test involves placing a white plastic coated banner imprinted in red with the word STOP across the track beyond the location where the train's engineer is to slow his train and operate at *restricted speed*. The engineer must stop short of the banner to be considered operating within the definition of *restricted speed*. Prior testing was based on the engineer operating at or less than the speed allowed by the definition of *restricted speed*. The new method removes subjective interpretation and application of *restricted speed*. The Safety Board staff observed a demonstration of the banner test on the BN near Denver, Colorado, on September 8, 1994.

ANALYSIS

General

The Safety Board's investigation showed that the train equipment, the track, and the signal system functioned as designed and that the train dispatcher's activities were proper. Personnel statements, inspection reports, and readouts from the event recorder show no evidence of equipment failure. Pre- and postaccident track inspection and measurements showed no defects or deviations from FRA track safety standards. Pre- and postaccident observations, tests, and inspections of the signal system indicated that it functioned as designed.

Results of postaccident toxicological tests indicate that neither the dispatcher nor the crewmembers of BN 6782 East, OWY 9062 East, and BN 5532 West were impaired by alcohol or drugs. The absence of alcohol in the blood and the vitreous fluid of the OWY 9062 East conductor indicates that the alcohol in his liver specimen did not result from ingestion. Therefore, the Safety Board concludes that alcohol detected in the liver specimen resulted from post mortem generation and had no relevance to the accident. The general health and physical condition of the OWY 9062 East engineer and conductor were good. They also had adequate training and experience to be qualified in their duties.

The Safety Board concludes that the weather was not a factor and that visibility at the time of the accident was adequate for the engineer of OWY 9062 East to see and respond to the signal indications. Neither the engineer of OWY 9062 East nor any other train crews operating in the immediate area had reported any weather-related visibility problems to the dispatcher. The engineer of BN 5532 West stated that he could see his signals clearly and "well in advance to react or act upon the signal indications."

Accident Sequence

The first of three eastbound trains, KCS 735 East, was stopped by signal indication at Norway (MP 249.1) to allow two westbound freights to pass. The second eastbound train, BN 6782 East, which was following KCS 735 East on the same track, encountered a *restricted proceed* signal indication at the intermediate signal at MP 250.8. This signal indication resulted from KCS 735 East being stopped in the next signal block ahead. The engineer of train BN 6782 East proceeded at restricted speed and stopped short of the intermediate signal at MP 250.8 when he saw the EOT device of the train ahead (KCS 735 East).

When the third eastbound train, OWY 9062 East, approached the accident site, signal 254.2 displayed an *approach* indication. The engineer of OWY 9062 East should have slowed immediately to 35 mph and been prepared to stop at the next signal. Instead, he passed this signal traveling about 48 mph. The event recorder showed a slight incremental increase in brake application; however, the train speed remained about 47 mph. When OWY 9062 East passed signal 252.4, which was displaying a *restricted proceed* indication, it was traveling about 42 mph with the train brakes in a 22 psi reduction position. The engineer should have slowed to restricted speed. That is, he should have slowed his train and prepared to stop within half his range of vision (in this case the train ahead) and not exceeded 20 mph. Even though he made an emergency application of the train brakes, it was too late, and the train collided with the rear of the stopped eastbound BN 6782 East and derailed. The lead unit of OWY 9062 East came to rest with the engineer's side of the locomotive unit across and obstructing the adjacent main track no. 2. About 13 seconds later, westbound BN 5532 West, operating on main track no. 2, collided with the derailed lead unit of OWY 9062 East.

From its investigation, the Safety Board identified two primary safety issues in this accident: the performance of the OWY 9062 East train crew, and the BN's use of the *restricted proceed* signal indication. In addition, the Safety Board looked at positive train separation, survivability and crashworthiness of the lead locomotive of OWY 9062 East, locomotive fuel tank integrity, and the emergency response to the accident.

Performance of the OWY 9062 East Train Crew

The Safety Board attempted to determine why OWY 9062 East proceeded past three restrictive signal indications at high speed without appreciably slowing, and whether the traincrew, specifically the engineer, did so purposefully. Two plausible explanations for the crewmembers' behavior emerged during the investigation: they were susceptible to the effects of fatigue at the time of the accident and the engineer likely was using peripheral cues to anticipate a signal change.

Fatigue Factor -- The accident occurred at 3:25 a.m., a point in the crewmembers' circadian cycles at which their alertness and ability to perform would have been reduced.[12] Such circadian disharmony, in combination with varying degrees of sleeplessness, could have adversely affected the crewmembers' performance.

The conductor's opportunity for rest may have been regularly reduced because of his 45- to 50-minute commute to and from the Alliance terminal. Further his consumption of 20 to 25 cups of coffee suggests that he relied on caffeine to mitigate the effects of fatigue. In the 27 hours before the accident, he had rested only 3 hours. His entire sleep schedule during the 72 hours before the accident was as follows: On June 5, he had rested about 7 hours during the morning in a hotel at an away-from-home terminal. On June 6, he had rested at home about 7 hours in the early morning before going on duty at 9:20 a.m. He went off duty at an away-from-home terminal at 2 p.m. and had rested about 7 hours in a hotel before reporting back on duty shortly after midnight. After getting off duty at 10:55 a.m. on June 7, the conductor took a 3-hour nap later that afternoon and was awake for about 12 hours before the accident occurred. Because the conductor's duties typically required little physical activity, he likely found it difficult to remain alert. Therefore, the Safety Board concludes that the conductor likely was suffering the adverse effects of fatigue from inadequate rest and from circadian disharmony, and

---

[12] T.H. Monk and J.A. Wagner, "Social Factors Can Outweigh Biological Ones in Determining Night Shift Safety," *Human Factors*, Vol. 31, No. 6, December, 1989.

his alertness may have been severely impaired, or he may have been asleep at the time of the accident. As a result, he failed to monitor the actions of the engineer and the progress of the train, which removed the human redundancy that a conductor should provide to ensure the safe operation of the train.

Although the engineer had obtained about 7 hours of sleep the night (actually early morning) before the accident, he too would have been susceptible to the adverse effects of fatigue. His entire sleep schedule during the 72 hours before the accident was as follows: On June 5, the engineer had rested in a hotel at an away-from-home terminal about 7 hours before reporting to work at 1:45 p.m. He then was off duty at his home between 10:25 p.m. on June 5 to 8:55 p.m. on June 7. He had been awake about 19 hours before the accident. His fatigue would have resulted primarily from circadian disharmony, but the long period without rest could have exacerbated his fatigue. The Safety Board concludes that although the engineer was sufficiently alert to manipulate the locomotive's controls, fatigue likely adversely affected his judgment and contributed to the accident.

Industry Actions Combating Crew Fatigue -- As a result of recommendations stemming from the Safety Board's investigation of a head-on collision between two Consolidated Rail Corporation (Conrail) freight trains near Thompsontown, Pennsylvania, on January 14, 1988,[13] the railroad industry has taken several positive actions in the area of work/rest cycles and train crewmember fatigue. Conrail has addressed the problems in meetings with major union leaders and labor relations officers; the company has also embarked on a multimillion dollar program to complete a network analysis and a strategic demand program. The Brotherhood of Locomotive Engineers (BLE) is working with other railroad organizations to resolve work-related and environmental problems. The AAR has encouraged its members to improve work/rest cycles, to provide education and counseling to employees on health regimens and sleep deprivation avoidance, and to evaluate the design of cab alerters. The BLE and the AAR have also formed a joint task group to identify and statistically evaluate the work/rest problems of train crews. Several other companies, including UP, BN, CSX, and the Atchison, Topeka, & Santa Fe Railway Company, are providing their crewmembers with pamphlets and safety videos addressing the problems.

Use of Peripheral Cues -- Another possible explanation for the engineer's behavior was that he was using peripheral cues to anticipate train movements and signal changes. Control movements recorded by the event recorder established that the engineer was awake and controlling the train, albeit inappropriately, before the accident. While he operated the locomotive's controls, he passed a series of three restrictive signals instructing him to reduce the speed of his train. The event recorder readout further establishes that he took no action to appreciably reduce the speed of his train in response to the signals. The failure of the engineer to respond to and comply with the signals indicates that he probably was using other information to anticipate the locations and movements of the two trains he followed, a common practice among experienced engineers. Although the engineer had various cues by which he

---

[13] For further information, read *Head-end collision of Consolidated Rail Corporation Freight Trains UBT-506 and TV-61 near Thompsontown, Pennsylvania, January 14, 1988* (NTSB/RAR-89-02)

could assess the operational circumstances at the time, his reliance on the signal system resulted in an assessment that, although logical, was incorrect.

The BN's Division Manager of Operating Practices testified that engineers use peripheral cues, such as auditory transmissions and sequential signal indications, to estimate the locations of other trains and to anticipate signal changes. The radio transmission of an equipment defect detector, the location of which is fixed, identifiable, and familiar, is one such peripheral cue that can be used to judge a train's location. The Safety Board believes that the engineer, in an effort to monitor the progress of trains ahead of his own, had developed the practice of using peripheral cues to anticipate signal changes and to estimate other trains' locations in order to avoid bringing his train to a complete stop.

Before the accident, the two westbound trains passed the equipment defect detector at Norway, the first (OWY 9050 West) at 03:04:45 and the second (BN 5532 West) at 03:15:20. The engineer of OWY 9062 East may have overheard the defect detector's transmissions and mistakenly believed that both eastbound trains ahead of him had begun to move and that the signal block ahead would be vacated soon. His supposition would have been reinforced when he passed the first oncoming westbound train near the crossover at MP 254. Because he may have perceived that the trains ahead of him were moving, he possibly anticipated that the *restricted proceed* indication at the intermediate signal at MP 252.4 was about to change and disregarded it. Although he began to reduce the speed of his train somewhat as he approached and passed the signal, he was unable to stop his train before colliding with the stopped BN 6782 East.

The engineer's employment records show that BN had sanctioned him on two previous occasions for failing to obey absolute stop signal indications. A 1983 violation resulted in his censure and suspension; a 1991 violation during an efficiency test resulted in his dismissal. BN reconsidered his case and reinstated him on a leniency basis.

The Safety Board concludes that the engineer may have disregarded signal indications in favor of information from peripheral cues at the time of the accident.. The BN had previously detected and recorded such examples of inappropriate operational behavior. Despite BN's disciplinary actions against the engineer, he had not corrected his method of operation.

Use of the *Restricted Proceed* Signal Indication

During interviews, BN engineers in the Alliance Division advised Safety Board investigators that because of track curvature and topography, some engineers arbitrarily treat *restricted proceed* signals like *stop and proceed* signals because they are aware of trains ahead. The *restricted proceed* signal indication does not require an engineer to stop the train. It only requires that the engineer slow the train to *restricted speed* and be prepared to stop. Some railroads have operated with *stop and proceed* signals, which require that a train first come to a stop and then proceed at *restricted speed*. For reasons of fuel economy and the problems posed by stopping heavy tonnage trains on grades, some railroads changed from the *stop and proceed* signal indication to the *restricted proceed* signal indication.

On December 1, 1983, the BN changed from a *stop and proceed* signal indication to a *restricted proceed* signal indication. Since 1987, the Burlington Northern has had 21 rear-end collisions, of which 9 reported collisions involved a *restricted proceed* signal indication.[14] As stated earlier, following this accident, the BN discontinued the use of the *restricted proceed* signal indication, except for special circumstances.

Some railroads either do not use a *restricted proceed* signal indication or have stopped using it after experiencing several rear-end collisions. They have replaced the *restricted proceed* with a *stop and proceed* signal indication that requires an engineer to bring his train to a stop before entering the track area controlled by the signal. This serves to enhance the engineers awareness of the train's location and the circumstances of the signal indication, and create an environment in which his response to the unexpected would be improved. CSX Transportation used *restricted proceed* from 1989 to 1992 and on January 4, 1993 changed to a *stop and proceed* signal indication after experiencing several rear-end collisions.[15]

The FRA advised the Safety Board that it is aware of only four major class 1 carriers using the *restricted proceed* signal indication such as BN did before this accident: Soo Line (CP Rail System Heavy Haul-US), Kansas City Southern, Illinois Central, and Norfolk Southern.

Based on the circumstances of this accident, the Safety Board concludes that the use of the *restricted proceed* signal indication may be a less safe operating practice than the use of a *stop and proceed* signal indication and should not be used in general applications to control train movement. However, the Safety Board is aware that under certain applications, such as requiring a heavy tonnage train to stop on a grade, the elimination of the *restricted proceed* signal indication could present unreasonable operating difficulties. Therefore, the Safety Board believes that the Association of American Railroads (AAR) and the American Short Line Railroad Association should inform their members of the circumstances of this accident and recommend that use of a *restricted proceed* signal indication be limited to those special circumstances where prohibition would present unreasonable operating difficulties. In addition, the Safety Board believes that the Soo Line (CP Rail System Heavy Haul-US), Kansas City Southern, Illinois Central, and Norfolk Southern should limit the use of the *restricted proceed* signal indication to those special circumstances where elimination would present unreasonable operating difficulties.

---

[14] The NTSB investigated three accidents: Falls City, Nebraska, on July 17, 1990; Glendive, Montana, on January 7, 1988; and Mandan, North Dakota on October 19, 1990. The FRA investigated the others: Willbridge, Oregon on May 31, 1987; Blacktail, Montana, on January 31, 1989; Seattle, Washington, on January 18, 1990; Lakes, Minnesota, on June 2, 1990; Austin, Montana, on April 21, 1991; and Stoddard, Wisconsin, on March 23, 1994.

[15] According to FRA statistics for rear-end collisions in signal territory, the CSXT had 8 rear-end collisions from 1989 to 1993. On January 4, 1993, CSXT changed to a *stop and proceed* signal indication. As of January 1995, the latest date for available FRA records, CSXT has not reported any rear-end collisions.

Positive Train Separation

The Safety Board has long been an advocate of advanced train control systems (ATCS) that have the capability to provide positive train separation (PTS). An ATCS with PTS can automatically intercede in the operation of a train to prevent trains from colliding.

Railroads rely on train crews complying with operating rules to prevent collisions. The operating rules explain the meaning of each signal, the proper response to a particular signal aspect, the procedure for conveying track warrants, the individual duties of the train crew members, and other vital information needed to safely operate trains. The operating rules provide all necessary guidelines to prevent collisions providing crews understand and obey them.

Of all train accidents that the Safety Board has investigated, between 70 and 80 percent have been the result of human error. The best efforts by railroads to train and test their train crews for compliance with operating rules have not guaranteed that individuals will take the correct action or that accidents will not happen. Highly trained individuals still have accidents. An ATCS with PTS provides the back-up to the engineer that ensures a train is properly operated.

After its investigation of a May 1986 rear-end collision at Brighton, Massachusetts,[16] the Safety Board issued the following Safety 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.

Currently, the recommendation is classified "Open--Acceptable Response." In 1990, the Safety Board included PTS on its list of most wanted transportation safety improvements.

After its investigation of an August 9, 1990, collision and derailment of two Norfolk Southern freight trains at Sugar Valley, Georgia,[17] the Safety Board issued the following Safety Recommendation to the FRA:

> R-91-25
>
> In conjunction with the Association of American Railroads and the Railway Progress Institute, expand the efforts now being made to develop and install advanced train control systems for the purpose of positive train separation.

---

[16] Railroad Accident Report--*Rear End Collision Between Boston and Maine Corporation Commuter Train No. 5324 and Consolidated Rail Corporation Train TV-14, Brighton, Massachusetts, May 7, 1986* (NTSB/RAR-87/02).

[17] Railroad Accident Report--*Collision and Derailment of Norfolk Southern Train 188 with Norfolk Southern Train G-38 at Sugar Valley, Georgia, August 9, 1990* (NTSB/RAR-91/02).

Based on the FRA's train control report to Congress and the level of effort by BN and Union Pacific (UP) in their Pacific Northwest pilot project, the Safety Board classified Safety Recommendation R-91-25 "Closed---Acceptable Response" on November 15, 1994.

As a result of its investigation of a head-on collision on the BN on July 29, 1993, near Ledger, Montana,[18] the Safety Board issued the following Safety Recommendation to the FRA:

R-93-12

In conjunction with the Association of American Railroads and the Railway 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 also issued this recommendation to the Association of American Railroads (AAR) and the Railway Progress Institute (RPI) (Safety Recommendations R-93-13 and -15, respectively).

The Safety Board classified Safety Recommendation R-93-12 as "Open--Acceptable Response" after the FRA took the proactive measure of seeking the "final system definition, migration path, and timetable" for PTS by the end of 1994. The Safety Board also classified Safety Recommendations R-93-13 to the AAR and R-93-15 to the RPI as "Open-Acceptable Response" based on their responses.

The Safety Board subsequently investigated a head-on collision between two trains in Kelso, Washington,[19] on November 11, 1993. As a result of that investigation, the Safety Board reiterated Safety Recommendations R-87-16 and R-93-12 to the FRA. The Safety Board also issued the following new safety recommendations to the FRA:

R-94-13

As part of your monitoring and oversight activities on the Burlington Northern and the Union Pacific Railroad's train control demonstration project, identify and evaluate all potential safety and business benefits of the train control system currently proposed for the northwest region of the United States. Consider the value of these benefits in your overall assessment of the system.

---

[18] Railroad Accident Report--*Head-on Collision between Burlington Northern Freight Trains 602 and 603 near Ledger, Montana, on August 30, 1991* (NTSB/RAR-93-01).

[19] Railroad Accident Report--*Head-on Collision and Derailment of Burlington Northern Freight Train with Union Pacific Freight Train, Kelso, Washington, November 11, 1993* (NTSB/RAR-94-02).

R-94-14

In conjunction with the AAR, identify and evaluate all of the potential benefits of positive train separation and include them in any cost benefit analysis conducted on positive train separation control systems.

R-94-15

Identify possible use for positive train separation control systems data and information and conduct a study to identify ways in which this information can be used to enhance grade crossing safety.

Concurrently, the Safety Board issued the following Safety Recommendation to the AAR:

R-94-16

In conjunction with the FRA, identify and evaluate all of the potential benefits of positive train separation and include them in any cost benefit analysis conducted on positive train separation control systems.

Safety Recommendations R-94-13 through -16 are classified "Open -- Response Received" as of August 1995.

On June 22, 1995, Safety Board staff met with the AAR for an up-date on the status of the BN/UP PTS pilot project in the Pacific Northwest. The project coordinators stated that they expected to award a contract for PTS software in July 1995, complete the system specification requirements by August 1995, and start the physical pilot test program in the fall of 1995. They indicated that an initial field demonstration of Global Positioning System mapping is scheduled in the fourth quarter of 1996, and that the project completion date is targeted for early 1997. They advised the Safety Board that several other activities have been included in the PTS pilot project, such as development of technology for improving grade crossing safety, and coordination with the State of Washington Department of Transportation and Amtrak for performance requirements to integrate high-speed passenger service through an FRA grant.

On August 21, 1995, the U. S. Department of Transportation (DOT) issued a news release (see appendix D) stating that as part of the FRA-funded project and the BN/UP project, General Electric-Harris-Railway Electronics will develop a computer model of the dense northwest rail corridor in the United States. The Safety Board notes that the DOT release indicates that the model will enable users to assess the potential costs and benefits of using PTS and the effect of adding high-speed passenger traffic on existing freight corridors. The Board believes that the FRA and AAR could use the modeling data from this project in performing their own evaluations of PTS benefits. The Safety Board intends to continue monitoring the issue of business benefits associated with PTS with both the FRA and the AAR.

The Thedford, Nebraska, accident is the latest in a series of collisions that could have been prevented had a PTS system been in place. A PTS system could have detected that the OWY 9062 East engineer was not responding appropriately to signal indications and then could have slowed and stopped the train, thus preventing the collision. The Safety Board concludes that a fully implemented PTS control system would have prevented this accident. The Safety Board believes that the FRA, AAR, and the railroad industry should expedite their efforts to develop and implement a PTS control systems on the nation's railroads. In addition, the Safety Board reiterates Safety Recommendations R-87-16 and R-93-12 to the FRA. The Safety Board intends to closely monitor the progress made on this important issue and to continue discussing the benefits of PTS in all reports of accidents that could have been prevented by such a system.

Locomotive Crashworthiness

For more than 20 years, the Safety Board has been concerned about the crashworthiness of locomotive operating compartments and has issued several safety recommendations to the FRA and the industry on this issue.

On August 3, 1992, Congress enacted the Rail Safety Enforcement and Review Act of 1992 (Public Law 102-365). Section 10 of the act required that the Secretary of Transportation, within 30 months of the enactment date, complete a rulemaking proceeding to consider prescribing regulations for improving the safety and working conditions of locomotive operating compartments. In support of the proceeding, the Secretary was required to have research and analysis conducted, including computer modeling and full-scale crash testing, to consider the costs and benefits associated with equipping locomotives with ten crashworthiness features that were listed in the act.

In June 1995, the FRA published three volumes of a four-volume report entitled *Locomotive Crashworthiness Research.*[20] Volume 1 describes the modeling development and validation; volume 2 covers proposed crashworthiness features, and evaluates their effectiveness in limiting cab intrusion and their influence on occupant survivability; volume 3 provides a cost/benefit analysis for each of the proposed crashworthiness features. To date, volume 4 has not been published.

The FRA is currently incorporating its crashworthiness study findings with health, environmental, and safety assessments on locomotive control compartments into the Secretary's required report to Congress. The FRA has not initiated a rule-making effort to provide crash protection to locomotive control compartment occupants based on its locomotive crashworthiness research study.

The Safety Board thoroughly discussed the issue of crashworthiness in its report on the

---

[20] *Locomotive Crashworthiness Research*, U.S. Department of Transportation, Federal Railroad Administration, Office of Research and Development, Washington, D.C. June 1995.

Selma, North Carolina, accident of May 16, 1994.[21] In that report, the Safety Board noted that Safety Recommendation R-87-23 had asked that the FRA "Promptly require locomotive operating compartments to be designed to provide crash protection for occupants of locomotive cabs." The Safety Board reclassified Safety Recommendation R-87-23 "Open--Acceptable Response," until it had the opportunity to determine whether the FRA completed the appropriate actions. (See appendix E.)

In the Thedford accident, the engineer and conductor were killed in the locomotive control compartment of OWY 9062 East after the unit was subjected to two collisions. The first impact, in which the lead locomotive of OWY 9062 East collided with the rear of BN 6782 East at 42 mph, resulted in the lead unit of OWY 9062 East derailing and coming to rest at a slight angle across track No. 2 with the engineer's side of the cab facing the oncoming westbound train. In the second collision, BN5532 West struck OWY 9062 at 25 mph. The impact was at an angle that further crushed and destroyed the control compartment.

Locomotive BN 5532 sustained intrusion from its front hood to the control compartment's electrical panel. Had the crew of locomotive BN 5532 remained in the control compartment, they probably would not have survived.

The Safety Board concludes that the energy from the impacts to the lead locomotives involved in this accident resulted in a lack of survivable space in each of their control compartments.

Both lead locomotive units were built prior to the AAR's S-580[22] current crashworthiness requirements, which apply to locomotives built after August 1990. Unit OWY 9062 was built in 1986 and BN 5532 was built in 1977. The locomotive safety standards in effect at that time were the FRA's 49 CFR 229.141.

As part of the FRA's *Locomotive Crashworthiness Research*[23] study, computer simulations were performed for a head-on collision between two locomotives built to AAR S-580 standards colliding at a closing speed of 30 mph. The study's evaluation of the simulation results states the following for braced collision posts:

> Collision posts stronger than those required by S-580 appear to offer substantial practical benefit to improving freight locomotive crashworthiness. Our results suggest that with no weight penalty and little additional cost, substantial improvements in protection against cab crush can be obtained. In

---

[21] Railroad Accident Report--*Amtrak Train 87 Derailment After Colliding with Intermodal Trailer from CSXT Train 176, Selma, North Carolina on May 16, 1994* (NTSB/RAR-95/02).

[22] AAR rule S-580 is a voluntary industry rule adopted by letter ballot in 1989. This rule contains such construction requirements as anti-climbers, increased thickness of the steel sheeting around the cab control compartment, and greater collision post shear resistence than required by 49 CFR 229.141.

[23] *Locomotive Crashworthiness Research*, U.S. Department of Transportation, Federal Railroad Administration, Office of Research and Development, Washington, D.C., June 1995 (Vol. 2 ppg 4-1 and Vol. 3 ppg 2-4).

addition, locomotives being built today generally have collision post strengths substantially greater than that required by S-580. For example, it is general knowledge that Canadian National requires each collision post to have a 500,000- lb strength at 30 inches above the deck. Thus, not only do our results suggest the feasibility of equipping locomotives with collision posts stronger than that required by S-580, but it is now common practice.

Locomotive Fuel Tank Crashworthiness

The fuel tank on OWY 9062 separated from the unit and was crushed and ruptured in the collisions. The fuel tank on BN 5532 was punctured during the wreck-clearing operations. The BN hazardous materials personnel cleaned up the spillage from both units, which totalled about 5,000 gallons of diesel fuel. Although a fire occurred at the accident site, it was minor in nature, and responding fire fighters were able to extinguish it before it spread to the spillage.

This accident again reinforces the Safety Board's concern about the potential for diesel fuel fires in railroad accidents to cause fatalities and injuries to trapped crewmembers, to contribute to hazardous materials fires in the train, and to endanger life and property near the accident site.

As a result of its 1992 safety study on the integrity of locomotive fuel tanks,[24] the Safety Board asked that the FRA, the AAR, and the two major manufacturers of locomotives, General Electric and General Motors Electro-Motive Division, "conduct research to determine if the locomotive fuel tank can be improved to withstand forces encountered in the more severe locomotive derailment accidents or if fuel containment can be improved to reduce the rate of fuel leakage and fuel ignition." The Board further asked that "consideration be given to crash or simulated testing and evaluation of recent and proposed design modifications to the locomotive fuel tank, including increasing the structural strength of end and side wall plates, raising the tank higher above the rail, and using internal tank bladders and foam inserts." (Safety Recommendations R-92-10 to the FRA, R-92-14 to the AAR, and R-92-16 and -17 to General Electric (GE) and General Motors, respectively.)[25]

The 1995 FRA locomotive crashworthiness study did not address (nor was it required to address) locomotive fuel tank integrity. However, the Mechanical Division of the AAR has recently adopted a recommended practice addressing performance requirements for diesel-electric locomotive fuel tanks that is effective for all freight locomotives built after July 1, 1995. (See appendix F.) The effectiveness of this recommended practice, of course, cannot be determined until accidents involving locomotives built after July 1, 1995, are investigated and

---

[24] Safety Study -- *Locomotive Fuel Tank Integrity*, October 27, 1992 (NTSB/SS-92/04)

[25] Safety Recommendations R-92-10, -14, and -17 are currently classified "Open--Acceptable Response." R-92-16 is classified "Open--Await Response." Although the Safety Board has not received a formal response from GE, it is aware through discussions with industry and its accident investigation activities that GE has been working with Amtrak on new locomotives that have a new fuel tank design.

analyzed. Also, the recommended practice applies only to freight locomotives, and the Safety Board has investigated several accidents in which the fuel tanks of passenger locomotives have been breached or ruptured. The Safety Board will follow up with the recipients of these recommendations to determine what, if any, additional efforts are being contemplated to improve the integrity of locomotive fuel tanks, particularly on passenger locomotives.

Emergency Response

Emergency responders arrived on scene within 30 minutes of being notified by a Thedford emergency medical technician and the BN Alliance dispatcher. They immediately extinguished a small postcrash fire, thus preventing any danger of a more serious fire involving the 5,000 gallons of spilled diesel fuel. The two surviving crewmembers of BN 5532 West were promptly transported to the hospital in North Platte. The emergency responders were volunteers from the Thedford and Mullen fire departments responding from 8 miles and 22 miles, respectively, to the accident scene. The Safety Board concludes that the response by the volunteer fire department personnel was timely and effective.

CONCLUSIONS

Findings

The train equipment, track, and signal system functioned as designed and the train dispatcher's activities were proper. Neither the dispatcher nor the crewmembers of BN 6782 East, OWY 9062 East, and BN 5532 West were impaired by alcohol or other drugs. Both the engineer and conductor of OWY 9062 had adequate training and experience to be qualified in their duties.

The weather was not a factor. Visibility at the time of the accident was adequate for the engineer of OWY 9062 East to see and respond to the signal indications.

The conductor likely was suffering the adverse effects of fatigue from inadequate rest and from circadian disharmony, and his alertness may have been severely impaired, or he may have been asleep at the time of the accident.

Although the engineer was sufficiently alert to manipulate the locomotive's controls, fatigue likely adversely affected his judgment and contributed to the accident.

The engineer may have disregarded signal indications in favor of information from peripheral cues at the time of the accident.

The use of the *restricted proceed* signal indication may be a less safe operating practice than the use of a *stop and proceed* signal indication and should not be used in general applications to control the train movement.

A fully implemented positive train separation control system would have prevented this accident.

The energy from the impacts to the lead locomotives involved in this accident resulted in a lack of survivable space in each of their control compartments.

The response by the volunteer fire department personnel was timely and effective.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer of OWY 9062 East to obey the restrictive signal indication because based on his inappropriate reliance on peripheral cues, he anticipated the signal would change; and the inattentiveness of the conductor of OWY 9062 East to train operations because of fatigue.

Contributing to the accident were the fatigue of the engineer of OWY 9062 East, which adversely affected his judgment and the manner in which he operated his train; the use of the restricted proceed signal indication; and the lack of a positive train separation control system.

RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board recommends:

--to the American Short Line Railroad Association:

> Inform your members of the circumstances of this accident and recommend that they limit the use of the *restricted proceed* signal indication to special circumstances in which its prohibition would present unreasonable operating difficulties. (Class II, Priority Action)(R-95-35)

--to the Association of American Railroads:

> Inform your members of the circumstances of this accident and recommend that they limit the use of the *restricted proceed* signal indication to special circumstances in which its prohibition would present unreasonable operating difficulties. (Class II, Priority Action)(R-95-36)

--to the Illinois Central Railroad Company:

> Limit the use of the *restricted proceed* signal indication to special circumstances in which its elimination would present unreasonable operating difficulties. (Class II, Priority Action)(R-95-37)

--to The Kansas City Southern Railway Company:

> Limit the use of the *restricted proceed* signal indication to special circumstances in which its elimination would present unreasonable operating difficulties. (Class II, Priority Action)(R-95-38)

--to the Norfolk Southern Railway Company:

> Limit the use of the *restricted proceed* signal indication to special circumstances in which its elimination would present unreasonable operating difficulties. (Class II, Priority Action)(R-95-39)

--to the Soo Line Railroad Company:

> Limit the use of the *restricted proceed* signal indication to special circumstances in which its elimination would present unreasonable operating difficulties. (Class II, Priority Action)(R-95-40)

Also as a result of its investigation, the National Transportation Safety Board reiterates 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 Railway Progress Institute, establish a firm timetable that includes at a minimum, dates for final development of required advanced train control system hardware, dates for 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.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES E. HALL
Chairman

ROBERT T. FRANCIS II
Vice Chairman

JOHN A. HAMMERSCHMIDT
Member

JOHN J. GOGLIA
Member

September 7, 1995

APPENDIX A

Investigation

The Safety Board was notified of the accident by the United States Coast Guard National Response Center at 6:40 a.m. eastern daylight time, on June 8, 1995. The Board launched a major railroad accident investigation team, which was accompanied by then Board Chairman Carl Vogt and a representative of public affairs. The on-scene team formed groups to investigate the track and signals, operations, mechanical, human performance, and survival factors.

The Safety Board was assisted in this investigation by the Burlington Northern Railroad Company, the Federal Railroad Administration, the Brotherhood of Locomotive Engineers, and an observer from the Nebraska Public Service Commission.

Depositions

As part of its investigation, the Safety Board held a 1-day deposition proceeding in Denver, Colorado, on September 7, 1994. Parties to the depositions included the Burlington Northern Railroad Company, the Federal Railroad Administration, and the Brotherhood of Locomotive Engineers. Nine witnesses provided testimony.

APPENDIX B

CHRONOLOGY[26]

Date	Time	Event
6/7	7:42 p.m.	Engineer and conductor are called for train BN 6782.
	8:55 p.m.	Engineer for train BN 6782 East is delayed by random drug test and reassigned to train OWY 9062 East.
6/7	10:45 p.m.	Train KCS 735 East departs Alliance.
	11:00 p.m.	Train BN 6782 East departs Alliance.
	11:20 p.m.	Train OWY 9062 East departs Alliance.
6/8	3:00:27 a.m.	Dispatcher radios KCS 735 East to meet two trains at Norway.
	3:04:45 a.m.	Train OWY 9050 West past defect detector at Norway.
	3:07:54 a.m.	Train OWY 9050 West passes both stopped eastbound trains at Norway (trains KCS 735 and BN 6782.)
	3:15:20 a.m.	Train BN 5532 West past defect detector at Norway.
	3:18:30 a.m.	Train BN 5532 West past Norway, diverging to track no. 2.
	3:19:40 a.m.	Train BN 6782 East stops short of intermediate signal at MP 250.8 behind train KCS 735 East.
	3:20:20 a.m.	Train OWY 9062 East at intermediate signal at MP 256.5, which is displaying a flashing yellow indication
	3:22:33 a.m.	Train OWY 9062 East at absolute signal at MP 254.2, which is displaying a yellow indication
	3:24:21 a.m.	Train KCS 735 East departs from Norway.
	3:24:56 a.m.	Train OWY 9062 East at intermediate signal at MP 252.4, which is displaying a red signal.
	3:25:11 a.m.	Train OWY 9062 East collides with rear of train BN 6782 East at MP 252.1.
	3:25:24 a.m.	Train BN 5532 West collides with derailed equipment of train OWY 9062 East at MP 252.1.
	3:27:57 a.m.	Train KCS 735 past Norway defect detector.
	3:30 a.m.	Engineer/conductor of train BN 6782 East call dispatcher reporting accident.
	4:00 a.m.	Emergency response personnel arrive.

[26] Reconstructed using witness statements, signal recorder logs, and event recorder logs. All times are Mountain Daylight Time.

APPENDIX C

BN Correspondence on *Restricted Proceed* Signal Indications

BURLINGTON NORTHERN RAILROAD

Transportation Department
Alan L. Lindsey
Director, Operating Rules and Practices

1500 Continental Plaza
777 Main Street
Fort Worth, Texas 76102
(817) 333-3073

Mr. Ed Dobranetski
Chief, Major Investigations
Office of Surface Transportation
Railroad Division
National Transportation Safety Board
490 L'Enfant Plaza East, S.W.
Washington, D.C. 20594

September 13, 1994

SUBJECT: NTSB Investigation of Burlington Northern Accident near Thedford, Nebraska on June 8, 1994

Dear Mr. Dobranetski:

This is to advise you that Burlington Northern Railroad has made the decision to discontinue the use of "Restricted Proceed" and begin using "Stop and Proceed", effective January 1, 1995. We have determined that this time is necessary to adequately train all employees on the change, to identify those location where the placement of grade markers will be necessary, and to attach the grade markers at those select locations. As I'm sure you are aware, grade markers are used at locations where the ascending or descending grades are such that it could be detrimental to have a train stop. Under those circumstances the train is allowed to pass that signal at restricted speed.

If you have any further questions please feel free to contact me.

Sincerely,

Alan L. Lindsey

cc: Mr. Don Henderson
Mr. Dick Wicka
Mr. Dan Watts
Mr. Tom Lee

APPENDIX C

BURLINGTON NORTHERN RAILROAD

Transportation Department
Alan L. Lindsey
Director, Operating Rules and Practices

1600 Continental Plaza
777 Main Street
Fort Worth, Texas 76102
(817) 333-3073

Mr. Ed Dobranetski
Chief, Major Investigations
Office of Surface Transportation
Railroad Division
National Transportation Safety Board
490 L'Enfant Plaza East, S.W.
Washington, D.C. 20594

May 3, 1995

SUBJECT: NTSB Investigation of Burlington Northern Accident near Thedford, Nebraska on June 8, 1994

Dear Mr. Dobranetski:

This is to advise that Burlington Northern did discontinue the use of "Restricted Proceed" signal indications and began using "Stop and Proceed" indications effective January 1, 1995 as stated in my letter to you of September 13, 1994. I take this opportunity to thank Mr. Jim Remines and Mr. George Cochran, of your staff, and yourself for assisting us in evaluating the issues surrounding this incident. I personally believe that it was the cooperative nature in which you three approached this matter that lead to the proper decision.

Sincerely,

Alan L. Lindsey

cc: Dick Wicka

APPENDIX D

DOT NEWS RELEASE ON FRA GRANT TO WASHINGTON

U.S. Department of Transportation

News:

Office of the Assistant Secretary for Public Affairs
Washington, D.C. 20590

FOR IMMEDIATE RELEASE
Monday, August 21, 1995

FRA 19-95
Contact: David A. Bolger
Tel.: (202) 366-0881

FRA AWARDS WASHINGTON $750,000 TO ADVANCE HIGH-SPEED TRAIN CONTROL

The U.S. Department of Transportation's Federal Railroad Administration (FRA) today announced a grant of $750,000 to the Washington State Department of Transportation to help develop high-speed train control technology.

The grant will be used to help develop positive train separation (PTS) systems that will be compatible with both freight and passenger train operations.

Secretary of Transportation Federico Peña said, "This grant represents the Clinton Administration's continued commitment to making high-speed passenger rail a reality in this country. Technologically-advanced train control systems are essential to ensure the safety and efficiency of existing and future high-speed ground transportation. These technologies have the potential to prevent train-on-train collisions as well as highway-rail grade crossing crashes."

FRA Administrator Jolene M. Molitoris stated, "I commend the states of Washington and Oregon for their leadership in developing a safe and reliable high-speed rail network for the Pacific Northwest. We are pleased to work in partnership with the two states, the Association of American Railroads, the Burlington Northern (BN) and Union Pacific (UP) railroads and Amtrak to develop the next generation of high-speed freight and passenger train service."

The BN and UP railroads are developing a positive train separation system on an 800-mile rail corridor through Washington and Oregon. The BN/UP project has been endorsed by the Association of American Railroads as an instrumental effort in the development of interoperable PTS systems by the freight railroad industry. The BN and the UP have stated that the methods, procedures, and designs produced as part of the project will be made available to all railroads and suppliers to obtain the widest possible benefits for the industry.

Working with the railroads, Washington and Oregon are developing a high-speed rail passenger corridor stretching 464 miles from Vancouver, B.C., to Eugene, Ore. Increasing train operating speeds above the present 79 mph limit would require installation of a train control system. The FRA, the states, and the railroads are working to assure that the freight industry PTS development and future high speed-train control system requirements are consistent.

-more-

APPENDIX D

-2-

When they become fully operational, PTS systems will control the movement of trains, preventing operations above allowable speed limits and stopping trains before they move into unauthorized areas. The system uses advanced technologies such as the Global Positioning System, on-board computers, digital radio, and an onboard data base of track characteristics which is used as a navigation reference by the onboard computer to assure safe operations.

As part of the project, General Electric-Harris-Railway Electronics, located in Melbourne, Fla., will develop a computer model to simulate the dense northwest United States rail corridor. The model will be used as an assessment tool to determine potential costs and benefits of using positive train separation and the effect of adding high-speed passenger traffic on existing corridor freight traffic flow.

The project will also include fitting four Amtrak passenger locomotives with the new PTS technology to ensure the prototype is compatible with future high-speed passenger train operations.

A key objective of FRA's North American train control initiative is interoperability, enabling trains equipped with the same or similar systems to operate nationwide on all railroads interchangeably and automatically without hindrance, delay or additional on-board equipment.

Molitoris added, "I commend our partners in this project for their commitment to develop and apply these new technologies to further increase rail safety. We hope our combined efforts will reduce the tragic consequences of train-on-train collisions and accidents at highway-rail crossings, the number one cause of death in the rail industry."

# # # # #

An electronic version of this document can be obtained via the World Wide Web at: http://www.dot.gov/affairs/index.htm

APPENDIX E

TEXT OF CORRESPONDENCE TO THE FEDERAL RAILROAD ADMINISTRATION

Honorable Jolene M. Molitoris
Administrator
Federal Railroad Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

Dear Ms. Molitoris:

The National Transportation Safety Board is reviewing its files to identify those safety recommendations about which there has been no correspondence for an extended period of time. This letter concerns Safety Recommendation R-87-23, which was issued to the Federal Railroad Administration (FRA) as a result of the Safety Board's investigation of the rear- end collision and derailment of two Union Pacific freight trains near North Platte, Nebraska, on July 10, 1986.

Safety Recommendation R-87-23 asked the FRA to promptly require that locomotive operating compartments be designed to provide crash protection for occupants of locomotive cabs. We have reviewed the status of recent locomotive crashworthiness activities and have noted two significant efforts that warrant recognition. One important accomplishment has been the crashworthiness standards for road locomotives built after August 1, 1990. The Safety Board is collecting data on recent accidents to use in evaluating these standards. In addition, research underway in response to the Rail Safety Enforcement and Review Act (Public Law 102-365), which requires full-scale locomotive crash testing, should yield significant data for analysis of current and proposed crashworthiness features. The Safety Board expects prompt regulatory action once the analysis is complete. One factor that needs resolution is the features that should be incorporated when locomotives are rebuilt. Until the Safety Board has had an opportunity to determine that appropriate actions are being taken, Safety Recommendation R-87-23 has been classified "Open--Acceptable Response."

Sincerely,

ORIGINAL SIGNED BY
JIM HALL

Jim Hall
Chairman

cc: Dr. Donald R. Trilling, Director
Office of Environment Energy and Safety

APPENDIX F
EXCERPTS FROM THE AAR MANUAL

Association of American Railroads
Mechanical Division
Manual of Standards and Recommended Practices

PERFORMANCE REQUIREMENTS FOR DIESEL ELECTRIC LOCOMOTIVE FUEL TANKS

Recommended Practice

RP-506

Adopted 1995

Effective: July 1, 1995

1.0 SCOPE

The objective of this recommended practice is to provide the basic performance requirements for four and six axle diesel electric locomotives. This Recommended Practice is effective for all freight locomotives built after its effective date.

2.0 BACKGROUND

By virtue of their location beneath the underframe and between the trucks, locomotive fuel tanks are vulnerable to damage from impact during a derailment or collision, or by debris and loose equipment on the roadbed. Typically, damage during derailment is caused by impact with the track structure, or from a puncture by a broken rail or debris from other equipment, such as the locomotive truck components. During a collision, the damage can either be caused by impact with the structure of another vehicle or by deformation of the structure of the locomotive itself. Severe damage to or puncture of the tank results in fuel spillage and all the associated problems that accompany it. Fuel loss can also occur in cases where the tank structure is not damaged, but the locomotive comes to rest at an attitude where the fuel can leak from the filler/vent assembly.

3.0 LIMITATIONS

The performance requirements contained in this recommended practice are intended to address the structural and puncture resistance properties of the locomotive fuel tank to reduce the risk of fuel spillage to acceptable levels under derailment and minor collision conditions. The complete elimination of fuel spills under the most severe accident conditions is considered to be impractical.

M-1

4.0 STRUCTURAL STRENGTH REQUIREMENTS

4.1 Design Considerations

4.1.1 Load Case 1 - Minor Derailment

Support on the end plate of the fuel tank a sudden loading of one half the weight of the car body at a vertical acceleration of 2 g's, without exceeding the ultimate strength of the material. The load is assumed to be supported on one rail, within a plus or minus an eight inch band at a point nominally above the head of the rail, on tangent track.

Consideration should be given in the design of the fuel tank to maximize the vertical clearance between the top of the rail and the bottom of the fuel tank.

4.1.2 Load Case 2 - Jackknifed Locomotive

Support on the fuel tank transversely at the center for a sudden loading equivalent to one half the weight of the locomotive at a vertical acceleration of 2 g's, without exceeding the ultimate strength of the material. The load is assumed to be supported on one rail, distributed between the longitudinal center line and the edge of the tank bottom, with a rail head surface width of two inches.

4.1.3 Load Case 3 - Side Impact

Consider the case of a side impact collision at the longitudinal center of the fuel tank by an 80,000 pound GVW tractor/trailer. The fuel tank shall withstand, without exceeding the ultimate strength, a 200,000 pound load (2.5 g's) distributed over an area of six inches by forty-eight inches (half the bumper area) at a height of thirty inches above the rail (standard DOT bumper height).

4.1.4 Load Case 4 - Penetration Resistance

The minimum thickness of the sides, bottom sheet and end plates of the fuel tank shall be equivalent to 5/16 inch steel plate at 25,000 psi yield strength (where the thickness varies inversely with the square root of yield strength). The lower one third of the end plates shall have the equivalent penetration resistance by the above method of 3/4 inch steel plate at 25,000 psi yield strength. This may be accomplished by any combination of materials or other mechanical protection.

4.2 Sideswipe

To minimize fuel tank damage during sideswipes (railroad vehicle and grade crossings), all drain plugs, clean-out ports, inspection covers, sight glasses, gauge openings, etc., must be flush with the tank surface or adequately protected to avoid catching foreign objects or from breakage. All seams must be protected or flush to avoid catching foreign objects.

4.3 Spill Controls

Vents and fills shall be designed to avert spillage of fuel even in the event of a roll over.

4.4 Fueling

Internal structures of tank must not impede flow of fuel through the tank while fueling at a rate of 300 gpm.