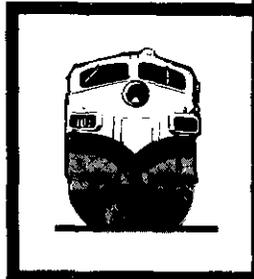


PB83-916309

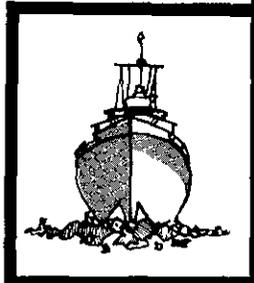
HE
1780
.A33
no.
83-9



NATIONAL TRANSPORTATION SAFETY BOARD

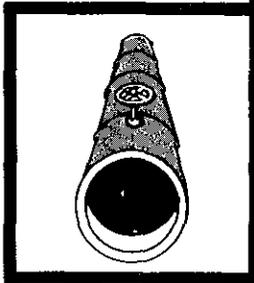


WASHINGTON, D.C. 20594



RAILROAD ACCIDENT REPORT

REAR END COLLISION OF TWO
BURLINGTON NORTHERN RAILROAD COMPANY
FREIGHT TRAINS
PACIFIC JUNCTION, IOWA
APRIL 13, 1983



NTSB/RAR-83/09



UNITED STATES GOVERNMENT

1. Report No. NTSB/RAR 83/09.		2. Government Accession No. PB83-916309		3. Recipient's Catalog No.	
4. Title and Subtitle Railroad Accident Report—Rear End Collision Of Two Burlington Northern Railroad Company Freight Trains, Pacific Junction, Iowa, April 13, 1983				5. Report Date December 1, 1983	
7. Author(s)				6. Performing Organization Code	
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594				8. Performing Organization Report No.	
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C 20594				10. Work Unit No. 3834	
				11. Contract or Grant No.	
				13. Type of Report and Period Covered Railroad Accident Report April 13, 1983	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
<p>16. Abstract About 3:55 a.m., c.s.t., on April 13, 1983, Burlington Northern Railroad Company (BN) freight train 64TF085 (64T85) (Extra 5086 West), while moving about 47 mph, struck the rear of standing BN freight train 43JJ005 (43J05) (Extra 5089 West) at Pacific Junction, Iowa. Four locomotive units and eight cars of train 64T85 and the caboose and seven cars of train 43J05 were derailed. The accident occurred about 2 miles within the yard limits at Pacific Junction. The engineer of train 64T85 was killed, and the head brakeman, conductor, and rear brakeman were injured. The engineer, head brakeman, conductor, and rear brakeman of train 43J05 were injured. Damage was estimated to be \$972,000.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer for undetermined reasons to operate train 64T85 in compliance with the operating rules so as to be able to stop the train before striking standing train 43J05. Contributing to the cause of the accident was the failure of the head brakeman of train 64T85 to monitor properly the engineer's operating performance and to stop the train when the engineer failed to do so, and the failure of the conductor and rear brakeman of train 64T85 to take action to contact the engineer or to slow or to stop the train when the train's speed was not reduced after it entered the Pacific Junction yard limits. Also contributing to the cause of the accident was the absence of a safety device on the locomotive of train 64T85 to keep the engineer alert or to stop the train if the engineer became incapacitated or was asleep, and the lack of procedures requiring traincrews to use the radio to communicate the positions of their trains.</p>					
17. Key Words alerting devices, deadman control, CTC absolute signal approach signal, radio, unauthorized personnel operating train, alcohol, influence of blood alcohol level, metabolic rate, rear marker light				18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161	
19. Security Classification (of this report) UNCLASSIFIED		20. Security Classification (of this page) UNCLASSIFIED		21. No. of Pages 43	
				22. Price	

CONTENTS

SYNOPSIS	1
INVESTIGATION	1
The Accident	1
Injuries to Persons	7
Damage	7
Personnel Information	7
Train Information	11
Method of Operation	12
Meteorological Information	15
Medical and Pathological Information	15
Survival Aspects	16
Tests and Research	16
ANALYSIS	18
The Accident	18
Physiological Aspects	19
Operations	21
Mechanical Aspects	22
Crashworthiness	23
CONCLUSIONS	24
Findings	24
Probable Cause	25
RECOMMENDATIONS	26
APPENDIXES	27
Appendix A--Investigation	27
Appendix B--Train 64T85 Crewmember Information	28
Appendix C--Train Orders Delivered to Train 64T85	29
Appendix D--Excerpts From 49 CFR Part 228	36
Appendix E--Excerpts From the Consolidated Code of Operating Rules	40
Appendix F--Stopping Distance Calculations	41

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: December 1, , 1983

REAR END COLLISION OF TWO
BURLINGTON NORTHERN RAILROAD COMPANY
FREIGHT TRAINS
PACIFIC JUNCTION, IOWA
APRIL 13, 1983

SYNOPSIS

About 3:55 a.m., c.s.t., on April 13, 1983, Burlington Northern Railroad Company (BN) freight train 64TT085 (64T85) (Extra 5086 West), while moving about 47 mph, struck the rear of standing BN freight train 43JJ005 (43J05) (Extra 5089 West) at Pacific Junction, Iowa. Four locomotive units and eight cars of train 64T85 and the caboose and seven cars of train 43J05 were derailed. The accident occurred about 2 miles within the yard limits at Pacific Junction. There was no flag protection provided by the standing train, and none was required by BN operating rules. There was no fire, and no hazardous materials were involved. The engineer of train 64T85 was killed, and the head brakeman, conductor, and rear brakeman were injured. The engineer, head brakeman, conductor, and rear brakeman of train 43J05 were injured. Damage was estimated to be \$972,000.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer for undetermined reasons to operate train 64T85 in compliance with the operating rules so as to be able to stop the train before striking standing train 43J05. Contributing to the cause of the accident was the failure of the head brakeman of train 64T85 to monitor properly the engineer's operating performance and to stop the train when the engineer failed to do so, and the failure of the conductor and rear brakeman of train 64T85 to take action to contact the engineer or to slow or to stop the train when the train's speed was not reduced after it entered the Pacific Junction yard limits. Also contributing to the cause of the accident was the absence of a safety device on the locomotive of train 64T85 to keep the engineer alert or to stop the train if the engineer became incapacitated or was asleep, and the lack of procedures requiring traincrews to use the radio to communicate the positions of their trains.

INVESTIGATION

The Accident

Train 43J05.--Burlington Northern Railroad Company (BN) train 43JJ005 (Extra 5089 West), 1/ hereinafter referred to as train 43J05, departed St. Joseph, Missouri, at 12:05 a.m., c.s.t., on April 13, 1983. The train consisted of a 3-unit locomotive, 100 empty high-side gondola coal cars, and a caboose (waycar), for a total load of 3,126 tons. The engineer and head brakeman were on the lead locomotive unit, and the conductor

1/ Timetable direction for train operation was east and west. Geographically the direction of movement was north and south. Geographical directions will be used in this report.

and rear brakeman were on the caboose. The train passed a train order office at Forest City, Missouri, 6.1 miles north of St. Joseph, at 1:01 a.m. where the engineer and conductor received a train order authorizing them to operate train 43J05 from the end of centralized traffic control (CTC) system territory at Napier, Missouri, over 77 miles of nonautomatic block signal (non-ABS) system territory to Pacific Junction, Iowa.

Train 43J05 arrived at Pacific Junction at 3:15 a.m. after an uneventful trip between St. Joseph and Pacific Junction. The crewmembers remained aboard the train awaiting the arrival of a relief crew. The rear of the train, with the caboose's red rear marker light illuminated, was located at milepost 173.1, about 2.1 miles north and inside of the posted Pacific Junction yard limit. (See figure 1.) There was no flag protection provided by the standing train, and none was required by BN operating rules for standing trains within yard limits.

About 3:45 a.m., while the conductor was seated facing rearward at his desk in the caboose, he saw the headlight of an approaching train about 2 miles behind train 43J05. When the headlight was not switched from bright to dim intensity, as is required when a train is moving closely behind another train, the conductor became concerned. He said that as he observed the approaching headlight of the train, he believed that the speed of the train was greater than it should have been and that the train did not appear to be slowing. He attempted several times to contact the approaching train by radio, but he did not receive a response. The engineer of train 43J05 reported later that he heard the conductor's radio calls to the approaching train. The rear brakeman descended from the cupola and also tried to contact the approaching train by radio, but he got no response. The conductor and rear brakeman then decided to leave the caboose because they did not believe that the approaching train would be stopped before it struck train 43J05. No attempt was made by the conductor of Train 43J05 to contact his engineer about the pending collision. The conductor and rear brakeman left the caboose from the west side and ran up an embankment.

The approaching train struck the caboose of train 43J05, moving the caboose about 60 feet forward and about 50 feet to the west. (See figure 2.) The rear crewmen of train 43J05 said that the approaching train was being operated under power until it derailed. No warning whistle was sounded to alert the men in the caboose of train 43J05 of the impending crash, and the headlight on the locomotive of the approaching train was never dimmed. They did not see anyone at the controls or any activity on the locomotive immediately before the collision.

Train 64T85.-- BN train 64TT085 (Extra 5086 West), hereinafter referred to as train 64T85, was called for at 11:50 p.m., c.s.t, on April 12, 1983, and departed St. Joseph at 12:35 a.m. on April 13, 1983. The train consisted of a 4-unit locomotive, 110 empty high-side gondola coal cars, and a caboose, for a trailing load of 3,327 tons. The engineer and head brakeman occupied the lead locomotive unit, which had its short hood forward, and the conductor and rear brakeman were on the caboose.

The conductor of train 64T85 was given two sets of seven train orders at St. Joseph; he gave one set to the engineer. (See appendix C.) The train orders required the crew, particularly the engineer, to observe certain speed restrictions between St. Joseph and Pacific Junction. Train 64T85 was delayed at the Water Works, 6.1 miles north of the St. Joseph yard office about 5 minutes because of a red signal for which special authorization to pass was required from the operator at St. Joseph. When train 64T85 passed Forest City at 1:48 a.m., the operator delivered to the engineer and conductor train order No. 205, which authorized them to operate train 64T85 between Napier and Pacific Junction. The order was in the same format and for the same purpose as the order the Forest City operator earlier had delivered to train 43J05. (See appendix C.) According to

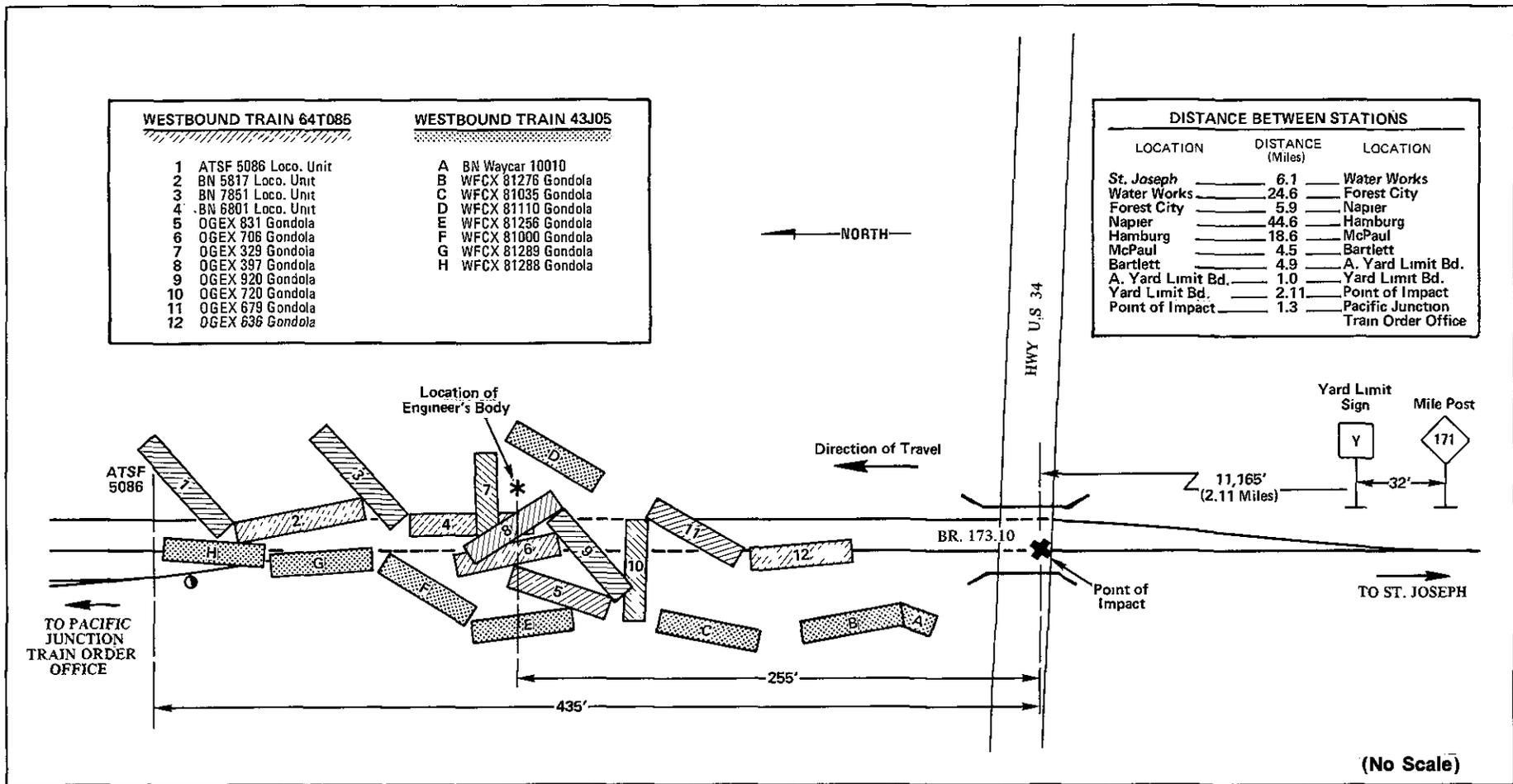


Figure 1.—Plan view of accident site.



Figure 2.—Caboose of train 43J05.

the crewmembers, the engineer of train 64T85 properly observed the en route speed restrictions imposed by the train orders. None of the crewmembers took exception to the manner in which the train was operated. Although he was not required by the rules to do so, the engineer did radio the "clear" train order signal aspect at Hamburg, Iowa, to his conductor on the caboose when the train passed that location, and the conductor radioed an acknowledgment of that transmission.

As the caboose passed McPaul, Iowa, the conductor radioed a following train that train 64T85 had passed McPaul. ^{2/} The engineer of the following train called the conductor of train 64T85 later, and the conductor subsequently radioed that train 64T85 was at Bartlett, Iowa. The conductor said that he did not hear any other radio communication. After train 64T85 passed Bartlett, which is 103.1 miles from St. Joseph and 4.9 miles from the yard limit at Pacific Junction, the conductor remarked to the rear brakeman that they ought to be nearing Pacific Junction. However, according to the conductor, it was so dark that he could not see any distinguishing landmarks, and therefore, he did not know the exact location of the train. The rear brakeman also said that it was too dark to see identifiable landmarks. Immediately after the conductor made the remark to the brakeman, train 64T85 struck the rear of train 43J05, and the two men were thrown forward in the caboose.

The head brakeman of train 64T85 said that, when the train passed Bartlett, he left the operating compartment of the locomotive to go down into the nose of the lead locomotive unit. He said that, at that time, he had not observed a caboose marker on any train ahead, he had not observed either the advance or yard limit boards for the yard at Pacific Junction, and he had not heard any radio communication from train 43J05 crewmembers or anyone else, nor did he so thereafter upon his return to the operating compartment. He said that he had not been aware of any fumes in the operating compartment and that the locomotive was not excessively noisy. He said that when he started back up the steps from the nose to reenter the operating compartment, he heard the engineer use an expletive in a manner that denoted surprise. Immediately thereafter, about 3:55 a.m., train 64T85 struck the rear of train 43J05.

The impact forces moved train 43J05 forward about 100 feet and caused its head-end crew to be jostled in the operating compartment. The caboose and seven cars of train 43J05 and the four locomotive units and eight cars of train 64T85 were derailed. The lead locomotive unit of train 64T85 stopped on the east side of the track at approximately a 45-degree angle to the track and about 435 feet north of the point of impact. The following three locomotive units stopped at various angles to the track behind the lead unit. The derailed cars of train 64T85 piled up either on top of the locomotive units or behind train 43J05. (See figure 3.) The enginecrew of train 43J05 and the rear-end crew of train 64T85 notified the operator at Pacific Junction of the accident by train radio, and the operator called the police and emergency services.

The engineer of train 64T85 was killed when he either jumped or was ejected from the operating compartment. The head brakeman of train 64T85 survived the crash, apparently as a result of lying on the floor of the operating compartment.

^{2/} The radio transmissions at Hamburg and McPaul were heard by the conductor and rear brakeman of train 43J05.

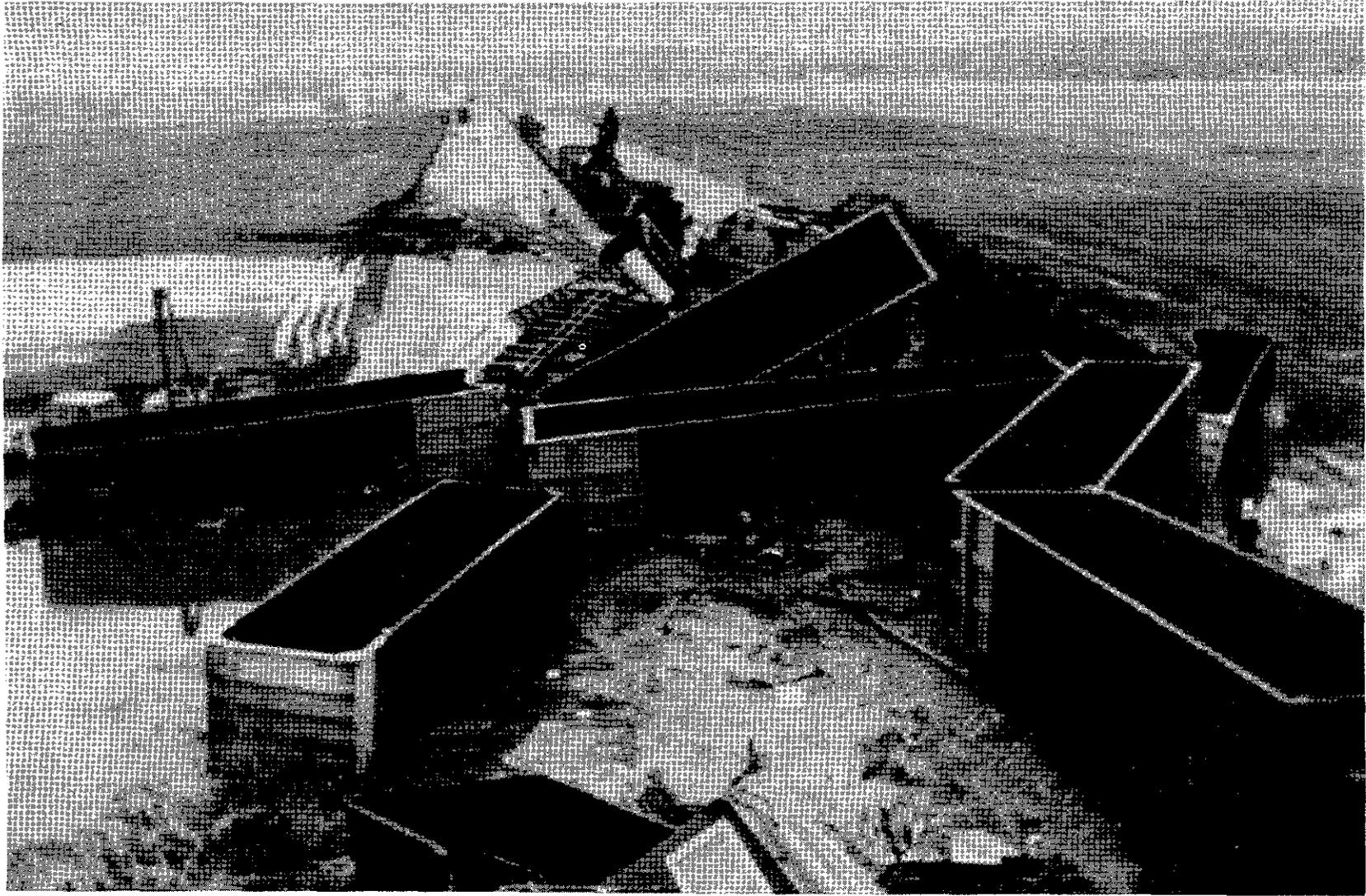


Figure 3.—Wrecked cars and locomotive units following collision.

Injuries to Persons

<u>Injuries</u>	<u>Train 64T85</u> <u>Crew</u>	<u>Train 43J05</u> <u>Crew</u>	<u>Total</u>
Fatal	1	0	1
Nonfatal	3	4	7
None	0	0	0
Total	<u>4</u>	<u>4</u>	<u>8</u>

Damage

The impact of train 64T85 destroyed the caboose of train 43J05, compressing it about 10 feet in length. The red rear marker light and the permanently mounted radio on the caboose were destroyed. Seven gondola cars were damaged moderately when body panels were dented and torn and trucks separated from car bodies.

The lead locomotive unit of train 64T85 was damaged extensively. (See figures 4 and 5.) The caboose of train 43J05 apparently overrode the locomotive unit's short hood and operating compartment and sheared off the engineer's side of the compartment at a height of about 3 feet above the locomotive deck. The compartment was destroyed beyond the high-voltage electrical cabinet. The body components at the trailing end of the locomotive unit were damaged extensively. The gear cases, brake levers, brake cylinders, and truck frames of the front truck were damaged. The diesel engine, main generator, and air compressor were displaced. The other three locomotive units incurred extensive to heavy damage. Eight gondola cars were damaged moderately when body panels were dented and torn and trucks separated from car bodies.

The damage was estimated to be:

Track	\$ 35,000
Equipment	352,000
Locomotive units	<u>585,000</u>
Total	\$972,000

Personnel Information

The crewmembers of each train were qualified for their assignments according to BN operating rules 3/ and requirements. All crewmembers had been off duty a minimum of 8 hours, the required rest period prescribed by Federal regulations (49 CFR Part 228, Hours of Service of Railroad Employees). (See appendix D.)

Head Brakeman, Train 64T85.--The head brakeman of train 64T85 did not have a regular assignment and was assigned to an extra man pool (extra-board), from which persons were called as needed to fill vacancies occurring in regularly assigned crew pools. He had completed an assignment on April 11, 1983, and had gone off duty in St. Joseph between 10 p.m. and 11 p.m. He said that before he left the terminal, he checked with the chief clerk 4/ to determine when he could expect to be called for another assignment.

3/ The Burlington Northern uses the Consolidated Code of Operating Rules also used by 15 other major and short-line railroads. The current version is "Edition of 1980."

4/ The chief clerk, also called a crew clerk, calls all train crew personnel when they are needed to operate a train.

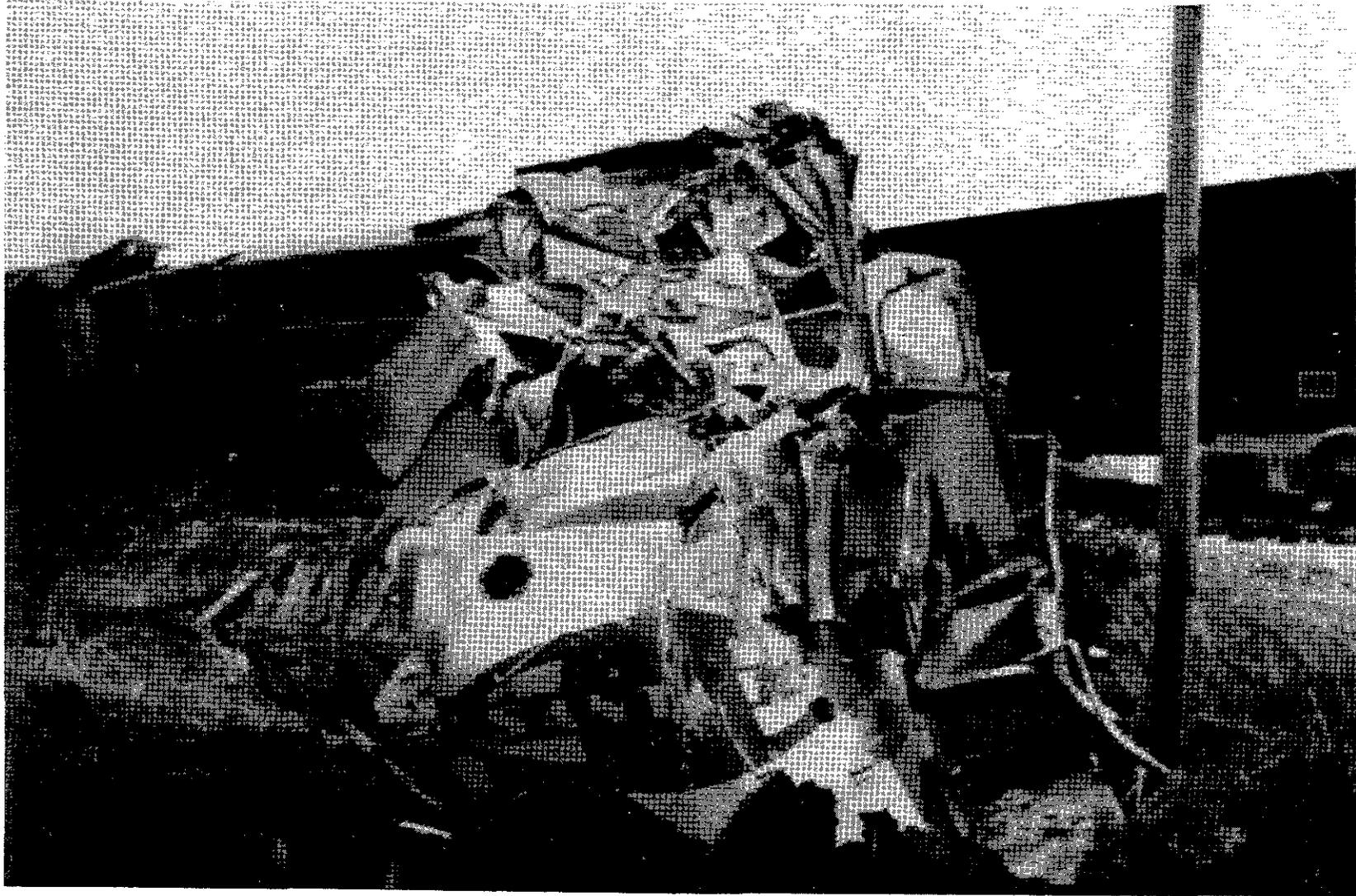


Figure 4.--Operating compartment damage to ATSF locomotive unit 5086 of train 64T85.

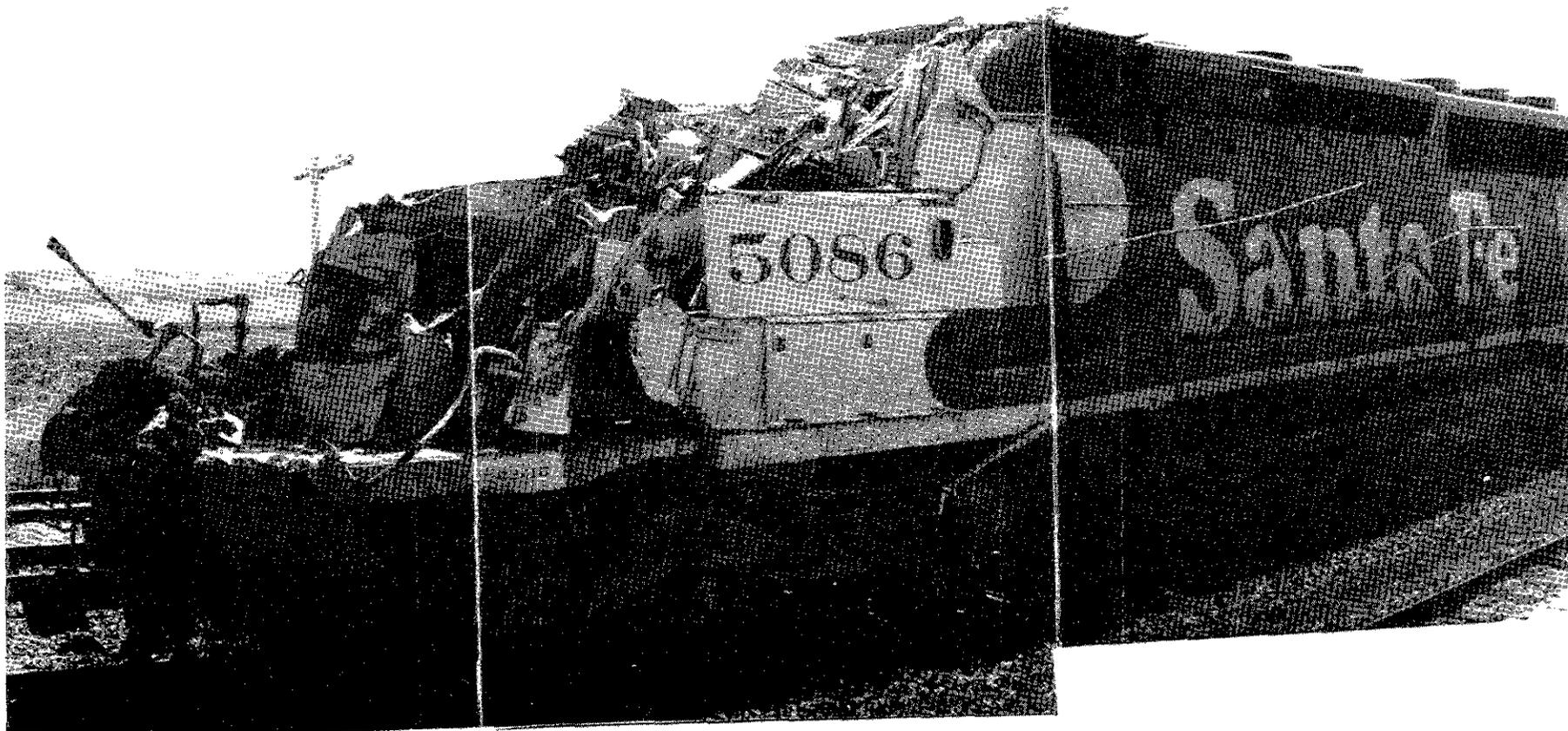


Figure 5.--Side view of ATSF locomotive unit 5086 of train 64T85.

He was told that he probably would not get another assignment before noon on April 13. He drove to his home, which was 35 miles from St. Joseph, and went to bed. He arose about 9 a.m. on April 12 and ate a light breakfast. About noon he called the chief clerk again to check his standing and was told that his status was unchanged. He then drove into St. Joseph on personal business, and about 4 p.m., again checked his standing with the chief clerk. He was told that he could be called for an assignment between 6 a.m. and noon on April 13. The head brakeman said that he ate a snack about 4 p.m., played pool, and had three or four beers, the last of which was consumed about 6:30 p.m. He arrived home between 7:30 p.m. and 7:45 p.m. Between 10:10 p.m. and 10:30 p.m., before he had gone to bed, he received a telephone call from the chief clerk to report for an assignment at 11:30 p.m. in St. Joseph. He only had time to shower, dress, and make himself a lunch before leaving for St. Joseph.

Upon his arrival at the terminal about 11:30 p.m., he spoke briefly with several crewmembers who had been called to operate other trains and with the rear brakeman and engineer of train 64T85 to which he was assigned. The rear brakeman did not take exception to the head brakeman's condition or capability to work. The head brakeman and the conductor for train 64T85 saw each other only from a distance.

The head brakeman said that he did not feel sleepy or tired during the trip to Pacific Junction, and that he considered himself to be alert for the entire trip. He said he had made 5 to 8 trips to Pacific Junction during 1982. He said he was not on any medication and was not worried about any problems.

Engineer, Train 64T85.--The engineer of train 64T85 was 35 years old, was 5 feet 10 inches tall, and weighed about 200 pounds. According to his family, he exercised semiregularly at a local health spa and he did not take drugs or drink alcoholic beverages. However, he did drink a considerable amount of coffee and smoked about 1 1/2 packs of cigarettes a day. The engineer's mother had recently suffered a stroke. The engineer was considered by his coworkers to be considerate and reliable, and a good engineer.

The engineer had been off one trip before he reported for the assignment on April 12. His wife reported that he had rested well the previous night, but that during the day of April 12, he complained of chest pains and said he was not feeling well. Also, he was sweating profusely. He was not a sickly person and he seldom complained of feeling ill. He did not have a history of heart problems or chest discomfort. The engineer had complained of considerable indigestion during the week before the accident and had been taking nonprescription medication for relief. However, he appeared to be in good spirits during the day and occupied himself running several errands. The evening of April 12, he took his daughter to a movie because it was her birthday. His wife reported that when he returned home he did not look well and had a poor appetite. She said that he was clammy and sweaty, and that he had a grayish color.

About 10 p.m. the BN chief clerk called the engineer for a tour of duty to begin at 11:50 p.m. According to the engineer's wife, her husband asked to be excused from that assignment because he said he was feeling ill and it was his daughter's birthday. However, the chief clerk told him that he was short of engineers and that he needed him for this trip. The engineer agreed to report for duty at 11:50 p.m.

The head brakeman said that after they reported for duty, the engineer was alert and properly observed all the slow orders without being reminded. He said that the engineer did not complain of being ill or fatigued, but that he was a little unhappy about having to work the trip. He said that the engineer was not talkative.

Conductor, Train 64T85.--The conductor of train 64T85 had worked an assignment on a work train between St. Joseph and Kansas City, Missouri, for about 10 hours on April 12. After he went off-duty at 3:15 p.m., he drove 10 miles home and ate dinner. He was called again to report for a tour of duty to begin at 11:50 p.m. on April 12. The trip was his first trip to Pacific Junction since January 1983 during which time he made two trips over the route. However, he had worked on a local freight train over the district for a number of years during the past 24 years. He was not on any medication, and he was not concerned about any problems.

Rear Brakeman, Train 64T85.--The rear brakeman had gotten off duty at 6:50 p.m. on April 11 and had rested well that night. After about 29 hours off duty he was called for an assignment beginning at 11:50 p.m. on April 12. He did not hold a regular crew assignment, but like the head brakeman, he worked from the extra-man pool (extra board). During his work as a brakeman, he had made about 50 trips between St. Joseph and Pacific Junction, but only 4 or 5 of those trips had been on the caboose. He said he felt he knew the physical characteristics of the road. He chose to ride the caboose so that he could learn more of a conductor's responsibilities and duties. He said he had no problems that concerned him that morning. He said he was not concerned about the movement of the train and felt comfortable with the experienced conductor. He knew the engineer of train 64T85 only slightly, but said that he had confidence in his ability as an engineer. He said that the engineer appeared to be tired when he saw him at St. Joseph.

For additional crewmember information see appendix B.

Train Information

Train 43J05.--Train 43J05 consisted of three 3,000-horsepower diesel-electric locomotive units of mixed design, BN units 5089, 5801, and 5565. The train was composed of 101 empty cars with a train length of 5,543 feet. The train was a unit or commodity coal train consisting of 100 identical cars identified by the Association of American Railroads (AAR) as class GT. The class GT cars are open-top cars with high fixed sides and ends and a solid bottom. (See figure 3.) They are used for hauling coal, and dumping is accomplished by means of a dumping machine. The cars are further identified by the AAR's Uniform Alphabetical Code as WFCX, identifying the owner of the cars as the Western Farmers Electric Cooperative.

The caboose was of all steel construction with two 4-wheel trucks and was designated by the AAR as class NE. The caboose was equipped with a top-mounted, wide-vision cupola, a permanently mounted two-way FM radio, and a single red rear marker light that met the regulatory requirements of the Federal Railroad Administration (FRA).

The BN caboose was equipped with a spotlight at each end of the car which the crewmembers could switch on and off as needed. BN supervisory personnel said that the lights had been installed for use by the crewmembers to inspect passing/standing trains for defects.

Train 64T85.--Train 64T85 consisted of four 3,000-horsepower diesel-electric locomotive units. The lead unit was Atchison, Topeka and Santa Fe (ATSF) No. 5086, a model SD40-2 manufactured by General Motors Corporation. The second unit was BN 5817, a General Electric Company model U30-CM. Units three and four, both General Motors Corporation models SD40-2, were BN 7851 and BN 6801, respectively. Train 64T85 was also an empty unit coal train consisting of 110 class GT empty gondola coal

cars and a caboose, for a total train length of 6,138 feet. The cars of train 64T85 were identified by the AAR's Uniform Alphabetical Code as OGEX, owned by the Oklahoma Gas and Electric Company. The caboose of train 64T85 was equipped with a rear red marker light, a permanently mounted radio, and two spotlights. The conductor of train 64T85 said that he customarily used the spotlights to identify landmarks and mileposts but that he did not use either spotlight on April 13 because they were inoperable.

Train 64T85 was given a 1,000-mile terminal mechanical inspection at the ATSF yard in Kansas City on April 12. The engineer who operated the train from Kansas City to St. Joseph said he made an initial terminal brake test from a fully charged train line (80 psi). He then made a 20-psi brakepipe reduction, the brakes applied, and the train was inspected. Upon the proper signal he released the brakes and again the train was inspected. The engineer was given clearance to leave, and train 64T85 departed the ATSF yard at 8:40 p.m. No problems or difficulties were reported to him concerning the train's brakes or mechanical condition.

All of the locomotive units of train 64T85 were equipped with speed tape recording devices, but only the lead unit had an operating recorder. All the units were equipped with two-way FM radios. Because the ATSF radio set on the lead locomotive unit did not have a compatible BN radio frequency capability, a BN crewmember exchanged the radio set in the second locomotive unit of train 64T85 for the radio unit on the first locomotive unit so that the crew would have radio communications on BN frequencies. The BN radio set was on the lead locomotive unit of train 64T85 when it arrived at St. Joseph. None of the locomotive units was equipped with a deadman foot pedal or an alerting device, and neither device is required by the FRA.

Method of Operation

Train 43J05 and train 64T85 were operated over the BN's Denver Region, Nebraska Division, first subdivision. Trains are operated between St. Joseph and Napier by the signal aspects of a centralized traffic control (CTC) system, timetable, and train orders. Trains are operated between Napier and Pacific Junction by train orders and timetable. The last train order office between St. Joseph and Pacific Junction which is open 24 hours a day is Forest City. There is a daytime office located at Hamburg.

Traincrews are called at St. Joseph for the operation of trains either south (timetable direction east) to Kansas City, Missouri, over the Springfield Region, Springfield Division, eleventh subdivision, or north (timetable direction west) to Pacific Junction. The chief clerk calls a person for an assignment about 1 1/2 hours before the person has to report for duty. The BN maintains two freight crew pools at St. Joseph. Members of one pool are qualified to operate trains either from St. Joseph to Kansas City, Missouri, or from St. Joseph to Pacific Junction. The members of the other pool are qualified to operate trains from St. Joseph west to Table Rock, Kansas, and then to Lincoln, Nebraska. However, most of the rail traffic to the west at the time of the accident was routed via Pacific Junction.

Because the traincrews operating between St. Joseph and Pacific Junction are not qualified so as to be allowed to operate between Pacific Junction and Lincoln, their runs terminate at Pacific Junction. Relief crews are sent from Lincoln to Pacific Junction to operate the trains between Pacific Junction and Lincoln. If a relief crew is not present or available at Pacific Junction when a train arrives from St. Joseph, the inbound crew must stay with the train until a relief crew arrives, providing the inbound crew does not violate the 12-hour on-duty limit imposed by Federal regulations. After 12 hours on duty the BN has to relieve the crewmembers of duty. The crewmembers may wait on the train or in the yard office but they are no longer required to protect the train.

The BN uses a taxi/van service to transport employees from terminal to terminal, such as from Lincoln to Pacific Junction, or from Pacific Junction to St. Joseph. This procedure is followed especially when an imbalance of crews exists at a given terminal because there are no trains for them to operate back to their home terminal. Scheduling crew arrivals at Pacific Junction occasionally results in a delay such as that experienced by train 43J05 on April 13.

At the time of the accident, the BN was moving a heavy volume of coal traffic from coal mines in Wyoming to Oklahoma. Between 6 a.m. on April 12 and 6 p.m. on April 13, 12 trains moved north (west) from Napier to Pacific Junction. There were no trains operated south between Pacific Junction and Napier during the same time. Train 43J05 was a train of empty gondolas en route from Tulsa, Oklahoma, to Buckskin, Wyoming, where it would be loaded with coal and returned to Tulsa. Train 64T85, also a train of empty gondolas, was being returned from Red Rock, Oklahoma, to Thunder Junction, Wyoming, where it would be loaded with coal and returned to Red Rock. The equipment of each train was used exclusively in this unit coal train service. The empty gondola trains were being routed back to the mines via Pacific Junction. This route was used in part because of track/signal work on other available routes, and in part to utilize the first subdivision personnel and prevent additional train delays.

The south approach to the yard limit at Pacific Junction was marked with a square reflectorized white board located at milepost 171. The letter "Y" is painted in black on the reflectorized background. The yard limit sign was preceded by an advance yard limit sign of similar design located at milepost 170. (See figure 6.) Neither board was lighted, but both were in plain, unobstructed view on the east side of the track. They are defined in the operating rules as fixed signals and as such should be acknowledged by the locomotive crew in accordance with operating rule No. 34. (See appendix E.) BN operating rule No. 93 requires that trains in yard limits move at a speed prepared to stop within one half the range of vision but not to exceed 20 mph. (See appendix E.)

Although BN locomotives and cabooses are radio equipped, traincrews are not required to communicate signal aspects to the conductor on the caboose or to use the radios for specific operations. Nor has the BN issued any guidelines or rules to traincrews on how to use the radio in specific train operations. However, the BN does admonish its radio users to abide by the Federal Communications Commission's radio procedures, some of which are summarized as rules in the BN operating rule book. At times trains are dispatched from St. Joseph with only a portable radio, which has limited coverage, on the locomotive. Generally, a portable radio is supplied if the lead unit in a locomotive consist has a radio that does not have a compatible BN radio frequency. The enginecrews and traincrews use the radio almost constantly as a courtesy to inform other trains of their locations. The conductor of a lead train generally will call a following train from McPaul and tell the crew that his train is past that point, but this is a voluntary action and it is not required by a company rule.

The dispatcher at Lincoln receives radio transmissions from many trains. Because radio wave propagation is attenuated by many variables, the strength of these transmissions can vary considerably. At times, a radio transmission desired by the dispatcher will be overridden by a stronger signal and the desired transmission becomes unintelligible. The dispatcher has the option of selecting a repeater station which will receive, "boost," and retransmit a weak radio signal from a train. By selecting the repeater station, the dispatcher then receives a stronger and more usable radio transmission. The BN radio system has a tape monitor at Lincoln that routinely records radio transmissions.

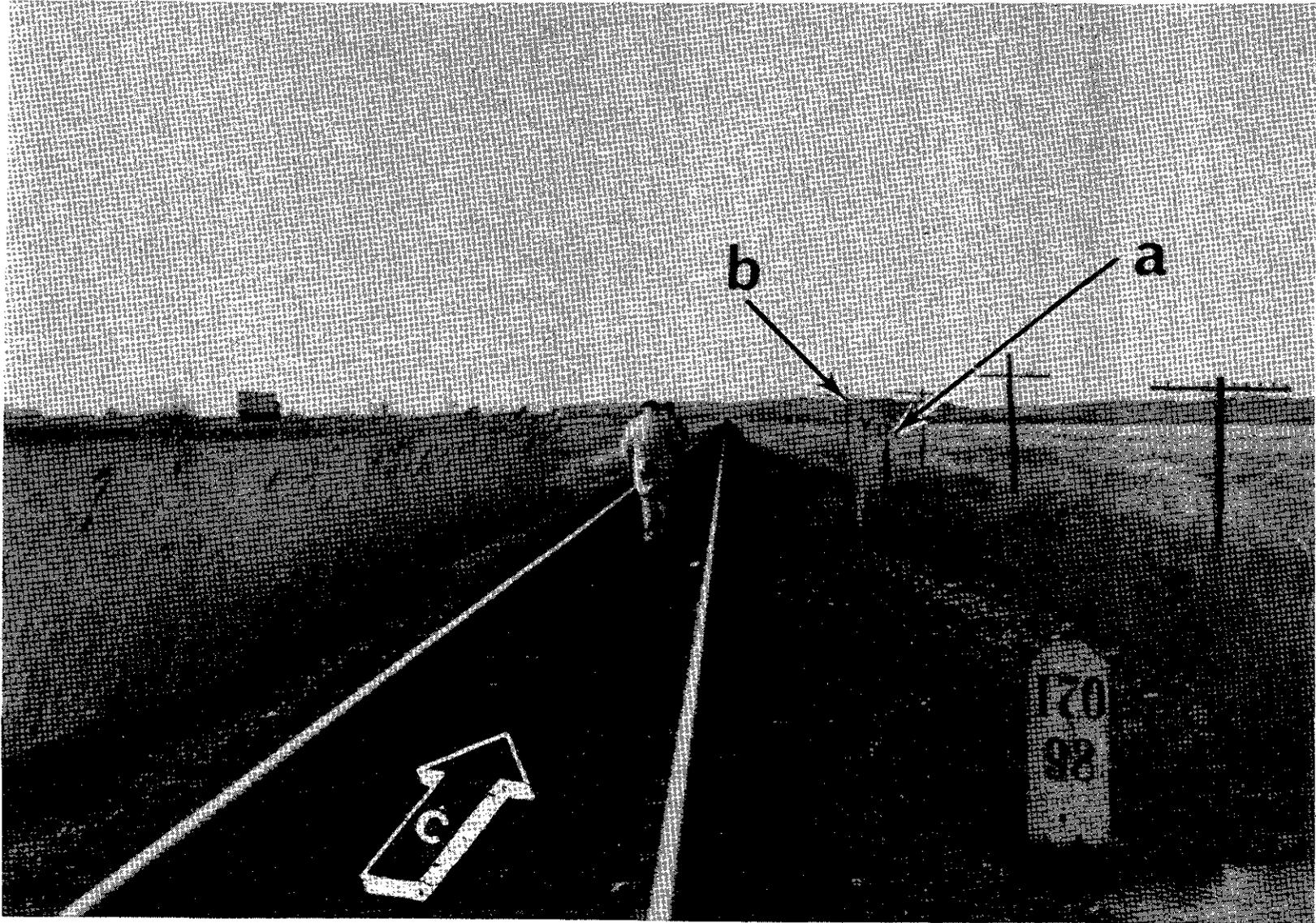


Figure 6.--Pacific Junction yard limit sign at milepost 171.

Radio wave propagation between Pacific Junction and Lincoln was poor on April 13 and the tape monitor recorded only several weak transmissions from the area that BN personnel were unable to transcribe meaningfully because of interference by overriding stronger transmission signals. Therefore, the monitor tape did not contain recordings to verify radio transmissions made in the Pacific Junction area before the accident. Following the accident, the dispatcher selected and used the Ashland, Nebraska, repeater station, and the radio transmissions of on-the-scene conversations at Pacific Junction were recorded.

Meteorological Information

At 6 a.m. on April 13, the temperature at Pacific Junction was 39° F, there was no wind, and the sky was overcast. The night was dark, but there was no fog or rain.

The conductor of train 43J05 said that although it was a dark night, he was able to see a complex of grain storage silos which was located on the east side of the track about 100 yards south of the yard limit sign. He used these silos as a landmark to alert him to the location of the yard limit sign, and on the morning of April 13 he did not have to use a light to locate or see the silos.

Medical and Pathological Information

The engineer and head brakeman of train 43J05 received back and neck strains when their locomotive was moved violently forward. The conductor strained a shoulder muscle when he climbed the embankment to escape the collision area. Similarly, the rear brakeman also pulled ligaments in his right arm and received a small cut on his right hand during his climb up the embankment.

The body of the engineer of train 64T85 was found under the wreckage. An autopsy indicated negative results for alcohol and drugs. The report indicated that focally severe coronary atherosclerosis was present in the proximal portion of the left anterior descending coronary artery. Thrombotic occlusion of this vessel was not identifiable grossly. Because of the condition of this artery, and the circumstances under which the accident occurred, the BN arranged to have heart tissue from the engineer examined by a pathologist at the Mayo Clinic, Rochester, Minnesota. Based on the tissue samples and the information available to the pathologist, the pathologist concluded that death was not caused by heart disease.

The head brakeman of train 64T85 complained of neck and back injuries, but no injuries were found other than slight strains and some abrasions. He also suffered from retrograde amnesia as a result of shock and the traumatic experience of the accident. A toxicological test was administered at 6:55 p.m. on April 13, and a blood alcohol level (BAL) of 0.004 percent was indicated. At 7 p.m. the same date, a urine sample was taken and tested. The urine sample did not indicate the presence of alcohol but was found to contain a trace of THC. ^{5/} The head brakeman said that he occasionally smoked a marijuana cigarette to help him go to sleep. However, he said that he had not smoked any marijuana since about April 9, 1983.

^{5/} THC is the abbreviated signature for a metabolite delta-9-THC acid found in human urine after ingesting delta-9-tetrahydrocannabinol, the active ingredient in marijuana.

The conductor of train 64T85 injured his leg and back and received bruises and abrasions when he was thrown about the caboose. The rear brakeman of train 64T85 split his tongue when he was thrown about in the caboose.

Survival Aspects

The caboose of train 43J05 was crushed by the impact forces when it was struck by train 64T85. (See figure 2.) It is doubtful that the caboose occupants, who had jumped from the caboose and run up an embankment to safety, would have survived the deformation of the caboose and the violent movement caused by the impact forces. The rear brakeman stated that he was almost struck by the derailing caboose as he ran up the embankment.

The operating compartment of the lead locomotive unit of train 64T85 was overridden by the caboose of train 43J05 when the trains collided. The operating compartment was crushed and distorted, especially on the engineer's side. The engineer's seat was ejected from the operating compartment. The engineer's body was found 255 feet north of the point of impact. No bodily evidence such as blood was found in the operating compartment to indicate any presence of the engineer or head brakeman in the compartment during its deformation. The engineer apparently was killed when he either jumped or was ejected from the operating compartment. A person in the operating compartment could have survived the collision only by lying on the floor as the head brakeman apparently did. Had the head brakeman been in the fireman's seat, he would not have survived. A checkbook register and an unopened pack of cigarettes belonging to the head brakeman were found in the left front corner of the operating compartment where a small pocket was formed by the deformed enclosure. An Iowa State Trooper found the front brakeman about 2 hours after the accident wandering in an incoherent state about 1 mile from the crash scene.

The engine crewmembers on train 43J05 and the caboose crewmembers on train 64T85 were jostled by the collision, but the equipment in which they were riding was not damaged.

Tests and Research

The speed recorder from the lead locomotive unit of train 64T85 was inspected, tested, and calibrated following the accident. It was found to be in an operating condition. The recorder had about a 4-percent deviation, registering a higher speed than the train was traveling. The discrepancy was attributed to wheel wear on the locomotive. The wheel from which the recorder was operated measured 37.65 inches compared to a new wheel measurement of 40 inches. The 4-percent difference is an acceptable deviation. Correction for the deviation resulted in the speed of train 64T85 actually being about 47 mph instead of 49 mph as registered on the speed tape.

A standing brake test was performed on the undamaged cars of train 64T85, i.e., cars 9 through 111, before the rear of the train was moved. The test was performed by representatives of the FRA and BN mechanical personnel before Safety Board investigators arrived at Pacific Junction. The air was found to be cut out on car OGEX 409, car 90 from the locomotive, because the combination cutout cock/dirt collector was broken at the pipe bracket. The break appeared to have been recent, and the investigators concluded that the break probably occurred after the Kansas City terminal inspection. The brakes on car OGEX 202 failed to apply on the initial test, but they applied during later tests when an emergency brake application was made. The persons conducting the tests concluded that the initial failure resulted from the reservoir on that car being insufficiently charged.

A computer simulation of train 64T85 was performed by the BN following the accident. When the parameters of train 64T85 were duplicated in the computer simulation, the results indicated that the train could have been stopped in a distance of 1,200 feet in 26 seconds from a speed of 49 mph by an emergency brake application (68 psi brake cylinder pressure). (See appendix F.)

The BN Westinghouse Airbrake Company (WABCO) radio set from the lead locomotive unit of train 64T85 was tested in the BN radio shop at Lincoln. The test indicated a good receiver sensitivity (0.65 microvolts), a good transmitter output (38 watts), a modulation deviation of 5 kilohertz, and that it was in good working order.

Tracings on the speed tape from the speed recorder enabled accident investigators to identify points along the traveled route. The stop at the Water Works was identifiable, and locations where the engineer slowed the train to comply with slow orders were verified by the reduced speed tracing indicated on the speed tape. The smaller wheel diameter on the lead unit of train 64T85 also caused a small distance variation in recorded distance versus timetable distance, but the error was insignificant in the approximately 3.8 miles between St. Joseph and Pacific Junction.

The postaccident positions of the locomotive controls which were documented cannot be relied upon because several railroad employees and rescue persons entered the operating compartment during the search and rescue phase, and may have moved or inadvertently struck the controls before a BN Road Foreman of Engines documented the positions. However, the postaccident positions of the locomotive controls as documented were:

<u>Control</u>	<u>Position</u>
Throttle	Idle
Dynamic brake	Off
Train brake	Release
Independent brake	Partially applied
Reverser	On center or neutral
Emergency brake valve on fireman's side	Not operated

The braking system of the lead locomotive unit of train 64T85 could not be tested as a system because of damage, but the vital control components of the locomotive unit brake system and the valves controlling the train brakes were removed from the locomotive and tested. The 26F control valve, the 26L brake valve, the A-1 charging cutoff pilot valve, the F-1 selector valve, and the J-1 relay valve were removed from the damaged unit and installed on a similar locomotive unit under the guidance of a Safety Board engineer. All of the valves operated normally throughout the test. The fireman's emergency valve was recovered from the locomotive unit and found to be in a closed or unoperated position. It was not necessary to test the valve because, if it had been operated, it would have remained in the operated (open) position. It takes a positive action to change the position of the valve to either open or close.

On April 15, 1983, Safety Board investigators and a BN Road Foreman of Engines boarded the lead locomotive unit of a northbound empty gondola train at Bartlett to observe the rear marker light of a caboose ahead while it was stopped at the approximate location of the caboose of train 43J05. The test was conducted about 9 p.m. under similar

weather and darkness conditions. When the investigators boarded the locomotive, they immediately were able to clearly see the caboose rear red marker light on the train ahead from a distance of about 5 miles. The caboose marker light never disappeared from sight during the entire test as the locomotive approached over the 5-mile distance. The investigators also observed the advance and yard limit boards, which were readily visible in the locomotive's headlight.

ANALYSIS

The Accident

According to the rear crewmen of train 43J05, train 64T85 struck the rear of standing train 43J05 under power, without sounding a warning whistle, and without dimming its headlight. The positions of the locomotive controls at the time of the accident could not be accurately determined. However, the speed of train 64T85 at the time of collision was determined to be 47 mph. After train 64T85 passed the yard limit sign, more than 2 miles from the caboose of train 43J05, the engineer should have operated train 64T85, according to BN operating rule 93, at a speed that would have enabled train 64T85 to stop short of the caboose of train 43J05. An alert engineer and head brakeman could have perceived the yard limit sign and the lighted red marker on the caboose of the standing train. Reasonable use of the train brakes by the engineer had he sighted either in a timely manner would have stopped train 64T85 short of the caboose. Notwithstanding the fact that the head brakeman was in the nose of the locomotive unit at the time, he knew that the train had passed Bartlett and he should have sensed that the train was not being slowed for entrance into the yard. If the head brakeman had reentered the operating compartment earlier and carried out his responsibility under BN operating rules of alerting the engineer, or had he applied the brakes in emergency when the engineer did not control the train as he should have, the train would have been stopped short of the rear of train 43J05.

When the engineer still had not reduced the speed of train 64T85 after the caboose passed the yard limit sign, the conductor should have questioned whether something was wrong, and he should have contacted the engineer and used the conductor's brake valve on the caboose to apply the brakes if he got no response. The contention by the conductor of train 64T85 that he did not know the exact location of the train at the time of the accident is totally inconsistent with the responsibility of operating personnel on board trains to identify landmarks and keep themselves informed as to their location at all times. As a matter of fact, management on most railroads requires train dispatchers, personnel operating trains, and supervisors of operating personnel to go over the railroad on a local freight train as a means of learning the characteristics of the railroad. This was the practice on the BN. The lack of a spotlight should not have handicapped an experienced railroad crewman in locating his position on the railroad. The conductor knew that the train had passed Bartlett. The conductor should have known the train's location because of his past experience in working on local freight trains in the area. The conductor should have realized that a train moving about 50 mph would reach the Pacific Junction yard limit in just 2 or 3 minutes after it passed Bartlett. The locomotive, more than a mile ahead of the caboose, would have reached the yard limit even sooner than the caboose. He also knew that a heavy volume of trains was being operated on the subdivision, which should have caused him to anticipate the possible presence of a train ahead, especially since it was not unusual for trains to be held at Pacific Junction for relief crews from Lincoln.

The rear brakeman was not experienced in traveling on the railroad in a caboose. Since it was a dark night, he may not have been able to pinpoint the train's location. Nevertheless, the rear brakeman also knew that the train had passed Bartlett. Being less experienced than the conductor, he may have been reluctant to say anything about the train's speed and was relying on the conductor for guidance. Even if he did not want to assert himself and take action to slow the train, he should have questioned the conductor about the speed in view of the train's proximity to the yard.

The postaccident test of the radio on the locomotive of train 64T85 indicated that it was operable, but neither crewmember answered the calls from the crewmembers on the caboose of train 43J05. Since the engineer of train 43J05 heard the conductor of train 43J05 calling train 64T85, it is evident that the caboose radio on train 43J05 was operable, even though it was destroyed in the accident and could not be tested.

There was no evidence to establish conclusively whether the head end and rear end crews were alert after train 64T85 passed Bartlett. None of the slow orders held by train 64T85 would have required the engineer to reduce the train's speed north of Hamburg, so there is no check available from that source to determine his state of alertness. However, the engineer was not heard on the radio, either initiating or acknowledging a radio call, after the train passed Hamburg. Moreover, immediately before the collision, the rear end crew of train 43J05 could see no activity in the cab. There were no radio calls initiated or acknowledged by the rear end crew of train 64T85. Even if the engineer of train 64T85 became aware of the standing train seconds before the collision, as suggested by the head brakeman, it was not in time for him to react effectively.

The Safety Board concludes that all crewmembers of train 64T85 were inattentive to their duties.

Physiological Aspects

The engineer of train 64T85 appeared to coworkers to be tired when he reported for duty. According to his wife, he had complained of indigestion all week and on April 12, he was clammy, sweating, and had a grayish color. These complaints and signs can be symptoms of angina. The autopsy results indicated that the engineer had severe arteriosclerosis of a major branch of the coronary artery. Furthermore, he had several risk factors listed by the American Medical Association that are associated with the potential for heart attack--he was a heavy smoker and drinker of coffee and had a family member who had had a stroke. Although the autopsy did not find evidence of a heart attack, there is not necessarily any such evidence in a sudden cardiac death. Since the head brakeman of train 64T85 said that the engineer was alert immediately before the collision, it does not appear that the engineer had a heart attack. However, it is possible that the engineer was experiencing the same pain and general malaise that he had experienced all week and as result was incapacitated, preoccupied, or inattentive.

The engineer of 64T85 was reportedly displeased because he had to work that trip. Probably in anticipation of having the night off, he had not rested in preparation for a night's duty. Therefore, he was physically tired. It is difficult to stay awake in an environment that is conducive to sleep, such as a warm locomotive operating compartment with the steady droning noise of the locomotive, and these effects appear to be intensified in early morning hours. Also, the effects of fatigue on the performance of duty could have been increased by the pain he had experienced all week. The head brakeman said that he was not aware of any fumes in the operating compartment and that the locomotive was not excessively noisy. While it seems clear that the engineer's failure to act was due to his being inattentive to his surroundings and location, the Safety Board was unable to determine the reason.

The head brakeman had consumed several beers on the afternoon and evening of April 12. If the head brakeman drank his last beer about 6:30 p.m. on April 12, as he stated, 5 hours before reporting to work, the alcohol would have been metabolized and none would have shown in the blood or urine tests made 24 hours later. The urine test was negative for alcohol. However, a blood test revealed that the head brakeman had a 0.004 percent blood alcohol level (BAL). This BAL is not significant and is interpreted by toxicologists as negative for alcohol.

Even though THC was found in the urine of the head brakeman and he admitted that he had smoked marijuana occasionally, the Safety Board could not determine that he had smoked marijuana on April 12 or 13. THC enters the bloodstream quickly after marijuana is smoked and is stored in the fatty tissues of the body for as long as 30 days. It is released sporadically into the urine for a period of time after its ingestion. Therefore, marijuana may be present in the fatty tissues of the body long after it is no longer detectable in the blood. Research has indicated that marijuana, even in small doses, impairs perceptual and psychomotor processes such as attention, tracking, coordination, and memory. Also, marijuana may have an additive effect in combination with alcohol in the system. Since the head brakeman said that he smoked the marijuana as an aid to induce sleep, there is little basis to conclude that he used it on the evening of April 12 when he knew that he would be going to work before bedtime. For the foregoing reasons, the Safety Board could not conclude if the head brakeman had used marijuana shortly before the accident or whether he was or was not affected by marijuana at the time of the accident.

The Safety Board believes that the head brakeman was inattentive to his duty because of possible fatigue, which may have been aggravated by his lack of sleep during the previous 20 hours, his use of alcohol before coming on duty, and because of his reliance on an engineer in whom he had confidence to operate the train safely. The head brakeman made a reasonable effort to find out when he could expect to be called for his next assignment. The call he received to report for work earlier than he or the chief clerk had anticipated is an example of the difficulty that operating employees face in ensuring that they are sufficiently rested between assignments. Many variables can cause an employee to be called for duty after 8 hours off-duty, but sooner than expected. When the head brakeman was not expecting to be called for work for 36 hours, he undoubtedly considered it reasonable and safe not to go to sleep immediately after his last assignment and to have a few drinks. There is no simple solution, but railroad management and labor need to make a concerted effort to make it easier for operating personnel to accurately determine when they will be called to report for duty.

The Safety Board believes that the conductor of train 64T85 also may have been unresponsive because of fatigue and a reliance on an engineer in whom he had confidence to operate the train safely. After he had worked 10 hours on a work train on April 12, he had only been off duty 8 hours 35 minutes when he returned to duty at 11:50 p.m. the same day. During this rest period he had to drive home and eat, acknowledge the telephone call from the chief clerk for the assignment, and hurriedly prepare for work and drive to his reporting station. At most, the conductor had only about 6 hours of quiet time at home. Since his engineer had a good operating reputation and record, the conductor probably was confident that he would conform to all operating requirements and handle the train safely.

Neither the carrier nor the conductor violated 49 CFR 228.19(a) which requires carriers to report "excess service" such as when "(4) a member of a train or engine crew or other employee engaged in or connected with the movement of any train, including a hostler, returns to duty without at least 8 consecutive hours off duty during the preceding

24 hours." These requirements were met in this instance because all crewmembers had at least 8 consecutive hours off duty. However, it is doubtful that a person can be rested enough to perform at maximum efficiency, including being fully alert, with the minimal rest afforded by only 8 hours off-duty where travel and time for meals interrupts the rest period. In this case, the engineer, the conductor, and the head brakeman assumed that they would have the night to rest and therefore did not take bed rest in anticipation of an early assignment. Time for travel to their home and personal activities also were factors. The FRA and the railroad industry should examine whether more extended off-duty time is needed for proper rest and should determine whether impaired performance of railroad operating personnel may be resulting from insufficient rest. The Safety Board investigated an accident that occurred at Lewisville, Arkansas, on March 28, 1978, 6/ in which the off-duty time of the crewmembers was within Federal requirements, but the events preceding the accident indicated that at least the engineer may have dozed off while on duty. His bed rest time was not determined, but Safety Board investigators were convinced that the crew had not had sufficient rest.

There is no evidence from which to conclude that the rear brakeman of train 64T85 was fatigued. He was probably the most rested member of the crew.

Operations

Normally, most of the empty coal train traffic was routed via Table Rock to Lincoln. However, because of signal work and other maintenance being done on that route, the empty coal trains were being routed to Lincoln via Pacific Junction and the first subdivision. There is no fault to be found in this operation. The BN operating rules adequately provide for the safe movement of trains in non-ABS territory. On entering the nonsignaled territory at Napier, trains must be separated by not less than 10 minutes (rules 91 and 91A, see appendix E). The two trains involved in the collision were operating about 50 minutes apart at Napier. Each had proper running orders and the same slow orders. Thereafter, safety of operations was dependent upon the crews.

Since the volume of traffic was unusually heavy between Napier and Pacific Junction, the BN management should have provided additional guidance to traincrews that would have improved the safety of train operations. One medium that was available to improve safety of operations over the first subdivision was the radio. The ATSF radio set on the lead locomotive unit of train 64T85 did not have provisions for a BN radio frequency, but a crewmember removed a BN radio set from the second locomotive unit and transferred it to the lead ATSF unit so radio communications would be available from that unit. The engineer of train 64T85 voluntarily radioed the train order signal aspect at Hamburg to the conductor on the caboose. This is a good practice, even when it is not required by operating rules. If there had been a company requirement for crewmembers of one train to communicate by radio their respective locations with crewmembers of other trains in circumstances such as those involving the trains closing up at Pacific Junction, safety would not have been dependent exclusively on the operating crews voluntarily advising each other of their locations. The conductor of train 43J05 gave no indication in his statement that he would have contacted the crew of train 64T85 to inform that train of his location except that he became alarmed because of train 64T85's closing speed. An attempt to contact train 64T85 when its headlight first became visible might have alerted its crew to the need to reduce speed and stop.

6/ Railroad Accident Report--"St. Louis Southwestern Railroad Company Freight Train Derailment and Rupture of Vinyl Chloride Tank Car, Lewisville, Arkansas, March 20, 1978" (NTSB-RAR-78-8).

BN management does not consider the use of radio communications essential to safe operations, but rather that it is a convenience. Specific BN radio procedures requiring use of radios by standing and advancing trains to enhance the safety of operations might have prevented this accident.

Mechanical Aspects

The vital components of the brake system of the lead locomotive unit of train 64T85 worked properly during tests. Therefore, the Safety Board concludes that the brakes were in proper operating condition and that the train could have been stopped in about 1,200 feet by an emergency application of the train's brakes as a last resort. This was verified by computer simulation and mathematical computations. The lead locomotive unit was not equipped with either a deadman foot pedal or an alerting device. Either of these safety devices, especially the alerting device, might have prevented the accident. A deadman foot pedal must be depressed at all times when the locomotive is in operation. If the foot pedal is released at any time after the brakepipe has been charged, the brakes will apply and stop the train. However, in practice the function of the foot pedal can be defeated easily so that the engineer does not have to keep a foot on the pedal at all times. For this reason, the railroad industry, in general, is removing the deadman foot pedal device which is not required equipment in FRA regulations. Alerting devices operate on a different principle, their essential feature being that they require that the engineer make some physical movement within an average time of about 22 seconds. If the alerting device detects no movement within the prescribed time, a warning tone will sound for about 6 seconds. If there is no acknowledgment within this time, the train brakes will be applied automatically, and the train will be stopped.

As a result of its investigation of a train accident at Herndon, Pennsylvania, on March 12, 1972, 7/ the Safety Board recommended on March 14, 1973, that the FRA, in cooperation with the AAR:

Develop a fail-safe device to stop a train in the event that the engineer becomes incapacitated by sickness or death, or falls asleep. Regulations should be promulgated to require installation, use and maintenance of such a device. (R-73-8)

The recommendation was reiterated in a report the Safety Board issued following its investigation of a train collision at Indio, California, on June 25, 1973. 8/ All of the FRA's responses to Safety Recommendation R-73-8 have rejected the need for such development.

In a response letter from the FRA dated December 24, 1980, the FRA pointed out that on November 27, 1978, the FRA issued a request for proposal for a research locomotive and train handling evaluator to be utilized in examining the many problems encountered by operating personnel within the locomotive cab. The letter also acknowledged that currently there are devices available which will stop a train in the event the engineer becomes incapacitated for any reason. The research locomotive has been built and currently is being used by the Illinois Institute of Technology for experimental work. The FRA stated that it would not be able to accurately evaluate the

7/ Railroad Accident Report--"Head-On Collision of Two Penn Central Freight Trains, Herndon, Pennsylvania, April 12, 1972" (NTSB-RAR-73-3).

8/ Railroad Accident Report--"Rear-End Collision of Two Southern Pacific Transportation Company Freight Trains, Indio, California, June 25, 1973" (NTSB-RAR-74-1).

need for regulatory action (concerning an alerting device) until an evaluation process is completed. Safety Recommendation R-73-8 is currently classified by the Safety Board as "Open--Unacceptable Action."

The Safety Board is investigating a side collision between a BN freight train and a Denver and Rio Grande Western (DRGW) Railroad Company freight train on May 27, 1983, at Palmer Lake, Colorado. The BN train ran a signal displaying an approach aspect without reducing its speed, continued past an absolute signal displaying a red or stop aspect, and struck the DRGW train at the 67th car from the locomotive while the DRGW train was moving from the single main track to the northbound double main track. The investigation is not complete and the probable cause has not been determined. However, information obtained in the accident investigation to date indicates that an alerting device might have prevented the accident.

The Safety Board urges the FRA to expedite the action initiated in response to Safety Recommendation R-73-8 and to issue regulations that will require alerting devices on locomotives operating on main tracks. The FRA also should consider the imposition of monetary penalties on persons responsible for nullifying alerting devices.

Crashworthiness

In general, when a locomotive strikes a caboose or a light freight car, the caboose or car overrides the locomotive operating compartment, frequently with devastating results. Locomotive operating compartments are not designed structurally to withstand medium to high-speed impacts. The crewmembers on a locomotive frequently are faced with the dilemma "do I jump or ride it out" when there is an impending collision. Jumping is risky even at slow speeds because of the danger posed by striking unyielding objects and by derailing equipment. If the operating compartment provided a higher degree of protection, the best action might be to "ride it out."

In the Pacific Junction accident, the engineer apparently was ejected from the operating compartment and crushed by derailing equipment. He probably would have been killed even if he had remained in the locomotive. The head brakeman survived apparently by being in the only part of the operating compartment that was not crushed severely by the overriding caboose. Because his checkbook register and some cigarettes were found in the corner of the operating compartment, it is fairly conclusive that the head brakeman rode through the collision in the locomotive operating compartment. Since the head brakeman survived the collision and the collapse of the operating compartment, the Safety Board believes that the FRA should initiate and/or support a design study to provide a protected area in the locomotive operating compartment for the crew when a collision is unavoidable.

The Safety Board's investigation of an accident at Riverdale, Illinois, on September 8, 1970, 9/ identified the lack of crash protection for the occupants of locomotive operating compartments as a factor in the severity of the accident. On November 24, 1971, the Safety Board issued Safety Recommendation R-71-44 recommending that the FRA and the railroad industry "continue and expand their cooperative efforts toward the timely improvement of the crashworthiness of railroad

9/ Railroad Accident Report—"Illinois Central Railroad Company and Indiana Harbor Belt Railroad Company Collision Between Yard Trains at Riverdale, Illinois, on September 8, 1970" (NTSB-RAR-71-3).

equipment, particularly as it is related to the protection of the occupants of locomotive control compartments." On January 16, 1973, the AAR advised the Safety Board that a locomotive control compartment committee had been organized, that the AAR had requested a contractor to design a program of testing to determine locomotive cab crashworthiness, and that the test program would set requirements for anticlimbing devices and design requirements for locomotive crash posts and pilots. Based on these actions, the Safety Board classified the recommendation as "Closed--Acceptable Action." However, since 1971, the Safety Board has investigated several more accidents 10/ in which crashworthiness has been identified as inadequate to provide protection to the occupants of locomotive control compartments. This lack of crashworthiness has resulted in at least 14 deaths, and numerous injuries.

As a result of its investigation of an accident at Goldonna, Louisiana, on December 28, 1977, 11/ in which the lack of crashworthiness features on the locomotive resulted in the deaths of two crewmembers, the Safety Board issued recommendation R-78-27 on June 28, 1978, that the FRA expedite its study of improvements in the design of locomotive operator compartments regarding crashworthiness. On October 7, 1982, the FRA informed the Safety Board that a report, "Analysis of Locomotive Cabs," which addressed crashworthiness, was completed. The Safety Board classified Safety Recommendation R-78-27 as "Closed--Acceptable Action" and urged the FRA to foster the use of the design suggestions in the report. Although the FRA has studied the crashworthiness of locomotives and much data have been developed, including publication of the 1982 report, no significant changes in the crashworthiness design standards for locomotives have been recommended by the FRA or voluntarily adopted by the railroad industry. The Safety Board urges the FRA to expeditiously address those issues dealing with the crashworthiness of locomotive operating compartments and similar studies related to crashworthiness of passenger-carrying equipment, and move to see that the industry makes use of data and that guidelines are developed.

CONCLUSIONS

Findings

1. Train 43J05 was standing 2.1 miles within the limits of the yard at Pacific Junction.

10/ Railroad Accident Reports--"Freight Train Derailment/Passenger Train Collision with Hazardous Material Car, Sound View, Connecticut, October 8, 1970" (NTSB-RAR-72-1); "Derailment of Extra 5701 East at Sheridan, Wyoming, March 28, 1971" (NTSB-RAR-72-4); "Collision of the State-of-the-Art Transit Cars with a Standing Car, High Speed Ground Test Center, Pueblo, Colorado, August 11, 1973" (NTSB-RAR-74-2); "Head-End Collision of Louisville and Nashville Railroad Local Freight and Yard Train at Florence, Alabama, September 8, 1978" (NTSB-RAR-78-2); "Head-End Collision of Amtrak Passenger Train No. 74 and Conrail Train OPSE-7, Dobbs Ferry, New York, November 7 1980" (NTSB-RAR-81-4); "Head-On Collision of Boston & Maine Corp. Extra 1731 East and Massachusetts Bay Transportation Authority Train No. 570, Beverly, Massachusetts, August 11, 1981" (NTSB-RAR-82-1); "Side Collision of Two Missouri Pacific Railroad Company Freight Trains at Glaise Junction, Near Possum Grape, Arkansas, October 3, 1982," (NTSB-RAR-83-06).

11/ Railroad Accident Report--"Collision of a Louisiana & Arkansas Railway Freight Train and a L.V. Rhymes Tractor-Semitrailer at Goldonna, Louisiana, December 28, 1977" (NTSB-RHR-78-1).

2. The caboose of train 43J05 was equipped with an illuminated red marker light, which was visible from the rear for about 5 miles.
3. The radio transmissions made by the conductor and rear brakeman from train 43J05 at Pacific Junction when they sighted the oncoming train were not acknowledged by the crew of train 64T85.
4. The advance yard limit sign and the yard limit sign were clearly visible from the cab when illuminated by the headlight of a locomotive.
5. The locomotive crewmembers of train 64T85 neither dimmed the headlight, reduced the throttle, nor applied the train's brakes before it struck train 43J05.
6. The rear-end crew of train 64T85 made no attempt to contact the head-end crew or to slow or stop the train after it entered the yard limits and did not reduce speed.
7. None of the crewmembers of train 64T85 carried out their responsibilities regarding the proper speed in yard limits.
8. Train 64T85 was traveling about 47 mph when it collided with the caboose of train 43J05.
9. The radios in the locomotive and caboose of train 64T85 were operable before the collision.
10. The brake system control components on the lead locomotive unit of train 64T85 were operable before the collision.
11. The crewmembers of train 64T85 were not alert approaching the collision point.
12. An alerting device might have prevented this accident.
13. The Safety Board was unable to determine whether the trace of THC in the urine of the head brakeman of train 64T85 was related to recent use of marijuana or whether or not the brakeman's performance at the time of the accident was affected by marijuana.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer for undetermined reasons to operate train 64T85 in compliance with the operating rules so as to be able to stop the train before striking standing train 43J05. Contributing to the cause of the accident was the failure of the head brakeman of train 64T85 to monitor properly the engineer's operating performance and to stop the train when the engineer failed to do so, and the failure of the conductor and rear brakeman of train 64T85 to take action to contact the engineer or to slow or to stop the train when the train's speed was not reduced after it entered the Pacific Junction yard limits. Also contributing to the cause of the accident was the absence of a safety device on the locomotive of train 64T85 to keep the engineer alert or to stop the train if the engineer became incapacitated or was asleep, and the lack of procedures requiring traincrews to use the radio to communicate the positions of their trains.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended that:

--the Burlington Northern Railroad Company:

Establish train operating procedures requiring the use of the radio to exchange information between trains on, entering, or departing main track routes. (Class II, Priority Action) (R-83-101)

--the Federal Railroad Administration:

Initiate and/or support a design study to provide a protected area in the locomotive operating compartment for the crew when a collision is unavoidable. (Class II, Priority Action) (R-83-102)

As a result of its investigation of this accident, the National Transportation Safety Board reiterates the following recommendation issued to the Federal Railroad Administration on March 14, 1973, as the result of its investigation of the accident on March 12, 1972, at Herndon, Pennsylvania: 12/

In cooperation with the Association of American Railroads, develop a fail-safe device to stop a train in the event that the engineer becomes incapacitated by sickness or death, or falls asleep. Regulations should be promulgated to require installation, use and maintenance of such device. (R-73-8)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G. H. PATRICK BURSLEY
Member

DONALD D. ENGEN, Member, did not participate.

December 1, 1983

12/ Railroad Accident Report--"Head-On Collision of Two Penn Central Freight Trains, Herndon, Pennsylvania, April 12, 1972" (NTSB-RAR-73-3).

APPENDIXES

APPENDIX A

INVESTIGATION

The National Transportation Safety Board was notified of this accident about 8:30 a.m. on March 13, 1983, by the National Response Center of the U. S. Department of Transportation shortly after the Burlington Northern Railroad Company reported the accident to the center. An investigator dispatched from the Safety Board's Denver Field Office arrived at the accident site about 1 p.m. Two investigators dispatched from Safety Board headquarters in Washington, D.C., arrived at the site about 9:30 p.m.

There were no formal depositions taken, and the BN was the only party to the investigation. The FRA conducted its own investigation of the accident, but it cooperated in the Safety Board's investigation by sharing the information it had developed.

APPENDIX B
TRAIN 64T85
CREWMEMBER INFORMATION

Engineer

Michael Wayne Linder, 35, was employed by the former Chicago, Burlington and Quincy Railroad Company on June 3, 1966, as a switchman/brakeman. He transferred to engine service on January 21, 1974. He was promoted to engineer on August 14, 1974, after taking the engineer's training program. He passed his last physical and visual examination on November 18, 1980, and his last operating rules examination on February 17, 1983.

Conductor

Donald Wayne Sullivan, Jr., 44, was employed as a brakeman by the former Chicago Burlington and Quincy Railroad Company on August 5, 1959. He was promoted to conductor on November 4, 1966. He passed his last operating rules examination on February 17, 1983. His personnel record indicates he passed a physical and visual examination on May 5, 1975.

Rear Brakeman

Merle Lee Bryant, 28, was employed by the Burlington Northern, Inc., on April 11, 1974, as a section laborer. On April 30, 1979, he transferred to train service as a brakeman. He was promoted to conductor on December 8, 1981. He passed his last operating rules examination on February 15, 1983. His last physical examination as recorded in his personnel record was on April 28, 1979.

Head Brakeman

James Joseph Smith, 34, was employed by the Burlington Northern, Inc., on August 21, 1978, as an extra gang (track) laborer at Denver, Colorado. He advanced to assistant foreman on September 11, 1979. On December 25, 1979, he transferred to train service as a switchman/brakeman. He was promoted to conductor on February 6, 1982, at which time he passed an operating rules examination. His last physical examination is shown as June 20, 1979, in his personnel record.

APPENDIX C

TRAIN ORDERS DELIVERED TO TRAIN 64T85

TRAIN ORDER NO. 405



DATE	JAN 1 1983
R	OPER.
TIME	

LOCATION	ST JOSEPH
TO	
TO	C AND E WESTWARD TRAINS VIA MODOKAY
TO	
TO	
TO	

FRT TRAINS AND EMPTY UNIT COAL TRAINS DO NOT EXCEED 40 MPH
LOADED UNIT COAL TRAINS DO NOT EXCEED 30 MPH BETWEEN MP 97.5
AND MP 89 BETWEEN NAPIER AND STARKS AND BETWEEN MP 79 AND
MP 72.50 BETWEEN STARKS AND AMAZONIA

JSS

TIME COMPLETED	1221 AM	OPERATOR	PEARSON
----------------	---------	----------	---------

FORM 1010 1-79 READ TRAIN ORDERS PROMPTLY - DISCUSS, UNDERSTAND AND COMPLY WITH THEM

TRAIN ORDER NO. 419



DATE	<u>Jan 13 1983</u>
BY	OPER
TIME	.. M

LOCATION	<u>ST JOSEPH</u>
TO	<u>C+E WESTWARD TRAIN Via Rodaway</u>
TO	
TO	
TO	
TO	

AT Napier 300 FEET OF WEST END
 STOCK TRACK and WEST SWITCH of STOCK
 TRACK HAVE BEEN REMOVED
 TRW

TIME COMPLETED	OPERATOR
<u>159 PM</u>	<u>Hurd</u>

FORM 15100-1 76 READ TRAIN ORDERS PROMPTLY - DISCUSS, UNDERSTAND AND COMPLY WITH THEM

TRAIN ORDER NO. ⁴⁷⁷ _____



DATE	MAR 31 1983
K	OPER.
TIME	M

LOCATION	ST JOSEPH
TO	
TO	C&E WESTWARD TRAINS VIA BIBELOW
TO	
TO	
TO	

DO NOT EXCEED 30 MPH BETWEEN MP 139 AND MP 141, 25 BETWEEN
WATSON AND HAIBURG

TRW

TIME COMPLETED	1023 AM	OPERATOR	BIDDINGER
----------------	---------	----------	-----------

FORM 15104 J 76

READ TRAIN ORDERS PROMPTLY - DISCUSS, UNDERSTAND AND COMPLY WITH THEM

TRAIN ORDER NO. 402



DATE	APR 8 1983
TIME	OPER.

LOCATION	ST JOSEPH
TO	
TO	C&E WESTWARD TRAINS VIA BIGELOW
TO	
TO	
TO	

DO NOT EXCEED 30 MPH BETWEEN MP 113.75 AND MP 115 BETWEEN
DRAIG AND CORNING

.BJT

TIME COMPLETED	818AM	OPERATOR	BIDDINGER
----------------	-------	----------	-----------

FORM 10100 3-76

READ TRAIN ORDERS PROMPTLY - DISCUSS, UNDERSTAND AND COMPLY WITH THEM

TRAIN ORDER NO. 411



DATE	APR 9 1983
K	OPER.
TIME	M

LOCATION	ST JOSEPH
TO	
TO	C&E WESTWARD TRAINS VIA NAPIER
TO	
TO	
TO	

AT NAPIER DO NOT EXCEED 25 MPH OVER JCT SWITCH BETWEEN MP 97.35 AND MP 97.40 NO TRACK FLAGS DISPLAYED

RLD

TIME COMPLETED	1056PM	OPERATOR	SALMON
----------------	--------	----------	--------

FORM 11-704 1-77 READ TRAIN ORDERS PROMPTLY - DISCUSS UNDERSTAND AND COMPLY WITH THEM

TRAIN ORDER NO. 413



DATE	APR 12 1983
OPER	
TIME	

LOCATION	ST JOSEPH
TO	
TO	C + E WESTWARD TRAINS VIA NODAWAY
TO	
TO	
TO	

OCCUPIED OUTFIT CARS ON SIDING
 NODAWAY MUST NOT BE COUPLED
 INTO OR MOVED AND ALL TRAINS
 WHISTLE FREELY WHEN APPROACHING
 NODAWAY
 CR

-57-

TIME COMPLETED	6:31am	OPERATOR	C. PEARSON
----------------	--------	----------	------------

READ TRAIN ORDERS PROMPTLY - DISCUSS UNDERSTAND AND COMPLY WITH THEM

TRAIN ORDER NO. 416



DATE	APR 12 1983
R	OPR.
TIME	M

LOCATION	STJOSEPH
TO	
TO	C&E WESTWARD TRAINS VIA NODAWAY
TO	
TO	
TO	

SIDEWALK ON BRIDGE 64.76 BETWEEN STJOSEPH AND WATER WORKS
IS OUT OF SERVICE

TRM

TIME COMPLETED	OPERATOR
1232PM	BIDDINGER

FORM 18106 3 76

READ TRAIN ORDERS PROMPTLY - DISCUSS UNDERSTAND AND COMPLY WITH THEM

APPENDIX D

EXCERPTS FROM 49 CFR PART 228
HOURS OF SERVICE OF RAILROAD EMPLOYEES

Chapter II—Federal Railroad Administration

§ 228.3

CONSTRUCTION OR RECONSTRUCTION OF EM-
PLOYEE SLEEPING QUARTERS: INTERIM RULES
ON DETERMINATION OF "IMMEDIATE VICINI-
TY"

Rule

- Rule 1 Distance requirement; definitions
- Rule 2 Approval procedure: construction between one-third and one-half mile (1,760 to 2,640 feet) (536 to 804 meters)
- Rule 3 Approval procedure: construction within one-third mile (1,760 feet) (536 meters)
- Rule 4 Action on petition

Appendix A—Requirements of the Hours of Service Act: Statement of Agency Policy and Interpretation

AUTHORITY: Sec 12, 24 Stat. 383, as amended, sec 20, 24 Stat. 386, as amended, 49 USC 12, 20; sec. 6, 80 Stat. 937, 49 USC 1655; sec 1-4, 34 Stat. 1415, as amended, 45 USC 61-64b; and sec 1.49(d) of the regulations of the Office of the Secretary of Transportation, 49 CFR 1.49(d)

SOURCE: 37 FR 12234, June 21, 1972, unless otherwise noted

PART 228—HOURS OF SERVICE OF RAILROAD EMPLOYEES

Subpart A—General

- Sec
- 228.1 Scope
- 228.3 Application
- 228.5 Definitions

Subpart B—Records and Reporting

- 228.7 Hours of duty
- 228.9 Railroad records; general.
- 228.11 Hours of duty records
- 228.13 Train delay records
- 228.15 Record of train movements kept at reporting station
- 228.17 Dispatcher's record of train movements
- 228.19 Monthly reports of excess service.
- 228.21 Civil penalty.
- 228.23 Criminal penalty.

Subpart C—Construction of Employee Sleeping Quarters

- 228.101 Distance requirement; definitions
- 228.103 Approval procedure: construction within one-half mile (2,640 feet) (804 meters)
- 228.105 Additional requirement: construction within one-third mile (1,760 feet) (536 meters) of certain switching
- 228.107 Action on petition

Subpart A—General

§ 228.1 Scope

This part—

(a) Prescribes reporting and record keeping requirements with respect to the hours of service of certain railroad employees; and

(b) Establishes standards and procedures concerning the construction or reconstruction of employee sleeping quarters.

[43 FR 31012, July 19, 1978]

§ 228.3 Application.

(a) This part applies to each common carrier engaged in the transportation of passengers or property by railroad—

(1) In the District of Columbia or any territory of the United States;

(2) From a State or territory of the United States or the District of Columbia to another State or territory of the United States or the District of Columbia,

(3) From any place in the United States to an adjacent foreign country, or

§ 228.5

(4) From any place in the United States through a foreign country to another place in the United States.

§ 228.5 Definitions.

In this part—

“Administrator” means the Administrator of the Federal Railroad Administration or any person to whom he has delegated authority in the matter concerned.

“Employee” means an individual employed by the common carrier who (1) is actually engaged in or connected with the movement of any train, including a person who performs the duties of a hostler, (2) dispatches, reports, transmits, receives, or delivers orders pertaining to train movements by the use of telegraph, telephone, radio, or any other electrical or mechanical device, or (3) is engaged in installing, repairing or maintaining signal systems.

“Railroad” includes all bridges, ferries, and roads, whether owned or operated under a contract, agreement, or lease, used in connection with that railroad.

[37 FR 12234, June 21, 1972, as amended at 43 FR 3124, Jan. 23, 1978]

Subpart B—Records and Reporting

§ 228.7 Hours of duty.

(a) For purposes of this part, time on duty of an employee actually engaged in or connected with the movement of any train, including a hostler, begins when he reports for duty and ends when he is finally released from duty, and includes—

- (1) Time engaged in or connected with the movement of any train;
- (2) Any interim period available for rest at a location that is not a designated terminal;
- (3) Any interim period of less than 4 hours available for rest at a designated terminal;
- (4) Time spent in deadhead transportation en route to a duty assignment, and
- (5) Time engaged in any other service for the carrier.

Time spent in deadhead transportation by an employee returning from duty to his point of final release may

Title 49—Transportation

not be counted in computing time off duty or time on duty.

(b) For purposes of this part, time on duty of an employee who dispatches, reports, transmits, receives, or delivers orders pertaining to train movements by use of telegraph, telephone, radio, or any other electrical or mechanical device includes all time on duty in other service performed for the common carrier during the 24-hour period involved.

(c) For purposes of this part, time on duty of an employee who is engaged in installing, repairing or maintaining signal systems includes all time on duty in other service performed for a common carrier during the 24-hour period involved.

[37 FR 12234, June 21, 1972, as amended at 43 FR 3124, Jan. 23, 1978]

§ 228.9 Railroad records; general.

(a) Records maintained under this part shall be—

- (1) Signed by the employee whose time on duty is being recorded or, in the case of train and engine crews, signed by the ranking crew member;
- (2) Retained for 2 years; and
- (3) Available for inspection and copying by the Administrator during regular business hours.

§ 228.11 Hours of duty records.

(a) Each carrier shall keep a record of the following information concerning the hours of duty of each employee:

- (1) Identification of employee.
- (2) Place, date, and beginning and ending times for hours of duty in each occupation.
- (3) Total time on duty in all occupations.
- (4) Number of consecutive hours off duty prior to going on duty.
- (5) Beginning and ending times of periods spent in transportation, other than personal commuting, to or from a duty assignment and mode of transportation (train, track car, carrier motor vehicle, personal automobile, etc.).

[37 FR 12234, June 21, 1972, as amended at 43 FR 3124, Jan. 23, 1978]

Chapter II—Federal Railroad Administration**§ 228.19****§ 228.13 Train delay records**

Each carrier shall keep a record of time delays of 10 or more minutes experienced at a single location by train and engine service crews. The location, date, beginning and ending times, and cause of the delay shall be set forth in the record.

§ 228.15 Record of train movements kept at reporting station.

Each carrier shall keep a record of train movements at each station, tower, office, or other place where information about the movement of trains is reported or relayed by employees through the use of telegraph, telephone, radio, or any other electrical or mechanical device. The direction of travel and time of passing, or times of arrival and departure, shall be set forth in the record.

§ 228.17 Dispatcher's record of train movements.

(a) Each carrier shall keep, for each dispatching district, a record of train movements made under the direction and control of a dispatcher who uses telegraph, telephone, radio, or any other electrical or mechanical device to dispatch, report, transmit, receive, or deliver orders pertaining to train movements. The following information shall be included in the record.

(1) Identification of timetable in effect.

(2) Location and date.

(3) Identification of dispatchers and their times on duty.

(4) Weather conditions at 6-hour intervals.

(5) Identification of enginemen and conductors and their times on duty.

(6) Identification of trains and engines.

(7) Station names and office designations.

(8) Distances between stations.

(9) Direction of movement and the time each train passes all reporting stations.

(10) Arrival and departure times of trains at all reporting stations.

(11) Unusual events affecting movement of trains and identification of trains affected.

§ 228.19 Monthly reports of excess service.

(a) Each carrier shall report to the Associate Administrator for Safety, (RRS-1), Federal Railroad Administration, Washington, D C 20590, each of the following instances within 30 days after the calendar month in which the instance occurs:

(1) A member of a train or engine crew or other employee engaged in or connected with the movement of any train, including a hostler, is on duty for more than 12 consecutive hours.

(2) A member of a train or engine crew or other employee engaged in or connected with the movement of any train, including a hostler, returns to duty after 12 hours of continuous service without at least 10 consecutive hours off duty.

(3) A member of a train or engine crew or other employee engaged in or connected with the movement of any train, including a hostler, continues on duty without at least 8 consecutive hours off duty during the preceding 24 hours.¹

(4) A member of a train or engine crew or other employee engaged in or connected with the movement of any train, including a hostler, returns to duty without at least 8 consecutive hours off duty during the preceding 24 hours.¹

(5) An employee who transmits, receives, or delivers orders affecting train movements is on duty for more than 9 hours in any 24-hour period at an office where two or more shifts are employed.

(6) An employee who transmits, receives, or delivers orders affecting train movements is on duty for more than 12 hours in any 24-hour period at any office where one shift is employed.

¹Instances involving tours of duty that are broken by four or more consecutive hours off duty time at a designated terminal which do not constitute more than a total of 12 hours time on duty are not required to be reported, provided such tours of duty are immediately preceded by 8 or more consecutive hours off-duty time. Instances involving tours of duty that are broken by less than 8 consecutive hours off duty which constitute more than a total of 12 hours time on duty must be reported.

§ 228.21

(7) An employee engaged in installing, repairing or maintaining signal systems is on duty for more than 12 hours in a twenty-four hour period

(8) An employee engaged in installing, repairing or maintaining signal systems returns to duty after 12 hours of continuous service without at least 10 consecutive hours off duty.

(9) An employee engaged in installing, repairing or maintaining signal systems continues on duty without at least 8 consecutive hours off duty during the preceding 24 hours.

(10) An employee engaged in installing, repairing or maintaining signal systems returns to duty without at least 8 consecutive hours off duty during the preceding 24 hours.

(b) Reports required by paragraph (a) of this section shall be filed in writing on FRA Form F-6180-3² with the Office of Safety, Federal Railroad Administration, Washington, D C 20590. A separate form shall be used for each instance reported.

[37 FR 12234, June 21, 1972, as amended at 43 FR 3124, Jan 23, 1978]

§ 228.21 Civil penalty.

(a) A carrier which fails or refuses to keep a record as required by this part or refuses to make such a record available to the Administrator or any authorized agent of the Administrator for inspection or copying is liable for a civil penalty of \$500 for each such offense and for each day during which such failure or refusal continues, as prescribed by section 20, paragraph (7)(a) of the Interstate Commerce Act (49 U.S.C. 20, paragraph (7)(a))

(b) A carrier which fails or refuses to report an instance of excess service as required by this part is liable for a civil penalty of \$100 for each such offense and for every day such failure or refusal continues, as prescribed by section 20, paragraph (7)(d) of the Interstate Commerce Act (49 U.S.C. 20, paragraph (7)(d)).

[43 FR 3124, Jan 23, 1978]

²Form may be obtained from the Office of Safety, Federal Railroad Administration, Washington, D C 20590. Reproduction is authorized

Title 49—Transportation

§ 228.23 Criminal penalty.

(a) Whoever knowingly and willfully—

(1) Makes, causes to be made, or participates in the making of a false entry in reports required to be filed or records required to be kept by this part;

(2) Destroys, mutilates, alters, or otherwise falsifies such records;

(3) Neglects or fails to make full, true, and correct entries in such records; or

(4) Keeps a record contrary to the requirements of this part;

Is subject to a \$5,000 fine and 2 years' imprisonment as prescribed by section 20 of the Interstate Commerce Act, 49 U.S.C. 20.

* * *

APPENDIX E

EXCERPTS FROM THE
CONSOLIDATED CODE OF OPERATING RULES
USED BY THE BURLINGTON NORTHERN

* * *

34 Employees located in the cab of engine must communicate to each other in an audible and clear manner the name or aspect of each signal affecting movement of their train or engine, as soon as the signal is clearly visible or audible. It is the responsibility of the engineer to have each employe comply with these requirements, including himself.

It is the engineer's responsibility to have each employe located in the cab of engine maintain a vigilant lookout for signals and conditions along the track which affect the movement of the engine or train

If a crew member becomes aware that the engineer has become incapacitated or should the engineer fail to operate or control the engine or train in accordance with the signal indications or other conditions requiring speed to be reduced, other members of the crew must communicate with the crew member controlling the movement at once, and if he fails to properly control the speed of the train or engine, other members of the crew must take action necessary to ensure the safety of the train or engine, including operating the emergency brake valve

* * *

91. In Non-ABS territory, trains in the same direction must keep not less than ten minutes apart, except in closing up at stations

The crew of the following train will be responsible for keeping trains not less than ten minutes apart when passed by another train or before following a train which has been overtaken

91 (A) Unless otherwise provided, in Non-ABS territory, operator on duty must space trains not less than ten minutes apart

When train order signal is used to space trains it must be placed to indicate Stop immediately after rear of train has passed signal. When clearance is used to space trains, operator must show on clearance the time train may go and train must not leave before that time.

* * *

93. Yard limits will be indicated by yard limit signs. Stations where yard limits are in effect will be designated by timetable, train order, bulletin, general order or special instructions

The main track(s) within yard limits may be used clearing the time of first class trains when due to leave the last station where time is shown. In Non-ABS territory, in case of failure to clear the time of first class trains, protection must be provided as prescribed by Rule 99. Protection against second and third class trains, extra trains and engines is not required

All trains and engines, except first class trains, must move within yard limits prepared to stop short of train, engine, car, stop signal, derail or switch not properly lined and prepared to stop in one-half the range of vision but not exceeding 20 MPH, unless main track is known to be clear by block signal indication.

When moving against the current of traffic or on portion of double or two or more tracks used as single track within yard limits, all trains including first class trains must move prepared to stop short of train, engine, car, stop signal, derail or switch not properly lined and prepared to stop within one-half the range of vision but not exceeding 20 MPH

Movements against the current of traffic within yard limits must not be made unless authorized by train order or protected by yardmaster or other authorized employe

In yard limits in ABS territory, protection as prescribed by Rule 99 is not required in case of failure to clear the time of first class trains. Information on delayed first class trains may be issued by the train dispatcher either verbally or by message to yardmaster or member of a crew.

Yard limits do not relieve trains from complying with Rules 86 and S-87

* * *

APPENDIX F

STOPPING DISTANCE CALCULATIONS

$$S = \frac{V^2}{30 (BR \times e \times fs)}$$

S= Stopping Distance (ft)
V= Speed (mph)
30= Acceleration Constant O
BR= Brake Ratio
e= Brake Efficiency
fs= Brake Shoe Coefficient

$$S = \frac{49^2}{30 (.36 \times .56 \times .33)}$$

V= 49 mph
BR= .36 Average Value
e= .56 Average Value
fs= .33 Average Value

$$S = \frac{2,401}{1.99}$$

$$S = 1,206 \text{ ft}$$

Emergency Application

Engineer reaction time would increase stopping distance by 71.5 feet for every second delay.