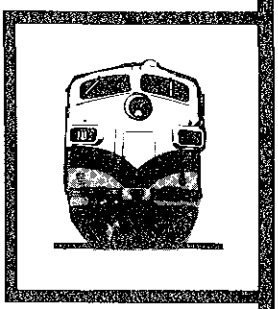
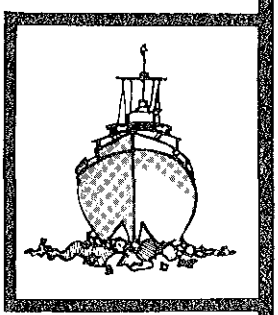
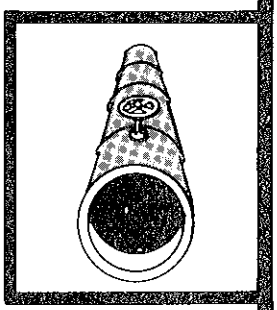
PB87-916303

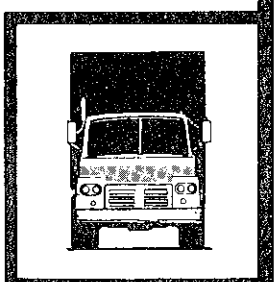
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594









RAILROAD ACCIDENT REPORT

REAR END COLLISION AND DERAILMENT OF TWO UNION PACIFIC FREIGHT TRAINS NEAR NORTH PLATTE, NEBRASKA ON JULY 10, 1986

NTSB/RAR-87/03

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB/RAR-87/03.	2. Government Accession No. PB87-916303	3. Recipient's Catalog No.
4. Title and Subtitle Railroad Accident Report--Rear End Collision and Derailment of Two Union Pacific Freight Trains Near North Platte, Nebraska, on July 10, 1986		5. Report Date July 23, 1987 6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 4463B 11. Contract or Grant No. 13. Type of Report and Period Covered Railroad Accident Report July 10, 1986
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

On July 10, 1986, Union Pacific Railroad (UP) eastbound freight train No. CLSA-09 struck standing UP freight train No. WPX-08, 8 miles west of North Platte, Nebraska. Due to unusually heavy fog, visibility was limited to about 300 to 400 feet. Train No CLSA-09 was traveling about 40 mph as it approached the area where train WPX-08 was stopped. The engineer applied the brakes when the caboose of the standing train became visible, but the train's speed was reduced to only about 32 mph, when the trains collided. Three locomotives and 11 cars from both trains were derailed. The rear brakeman of train WPX-08 was killed and the conductor injured. The engineer and head brakeman of train CLSA-09 were injured when they jumped from the train.

The major safety issues concern factors that permitted the engineer of train CLSA-09 to ignore weather conditions and signal indications, including the adequacy of the signal system, the adequacy of UP's monitoring of its traincrews, the environment in which the engineer was working, and the engineer's experience, training, and judgment.

17. Key Words	18. Distribution Statement
Rear end collision; multi main track; freight trains; event recorders; cab signals; signal acknowledgement; supervision, crashworthiness	This document is available through the National Technical Information Service, Springfield, Virginia, 22161

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	39	

NTSB Form 1765.2 (Rev. 9/74)

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the engineer of train No. CLSA-09 to recognize the dangerous operating conditions imposed by dense fog and reduce speed accordingly and his failure to reduce speed in accordance with the signal indications as required by the operating rules. Contributing to this accident was the failure of the Union Pacific Railroad to properly supervise operating employees and its failure to correct the false restrictive signals on the North Platte subdivision, which resulted in the engineer disregarding the valid signal indications on the main track.

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EXECUTIVE SUMMARY

On July 10, 1986, Union Pacific Railroad (UP) eastbound freight train No. CLSA-09 struck standing UP freight train No. WPX-08, 8 miles west of North Platte, Nebraska. Due to unusually heavy fog, visibility was limited to about 300 to 400 feet. Train No. CLSA-09 was traveling about 40 mph as it approached the area where train WPX-08 was stopped. The engineer applied the brakes when the caboose of the standing train became visible, but the train's speed was reduced to only about 32 mph when the trains collided. Three locomotives and 11 cars from both trains were derailed. The rear brakeman of train WPX-08 was killed and the conductor injured. The engineer and head brakeman of train CLSA-09 were injured when they jumped from the train.

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As a result of its investigation, the Safety Board issued recommendations to the UP to install a system that will enforce the restrictions of the signal system if the engineer fails to do so; and to evaluate the effectiveness of its supervisory checks for employee rule compliance. The Safety Board also issued a safety recommendation to the Federal Railroad Administration to require locomotive operating compartments to be designed to provide adequate crash protection for occupants of locomotive cabs.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20594

RAILROAD ACCIDENT REPORT

Adopted: July 23, 1987

REAR END COLLISION AND DERAILMENT OF TWO UNION PACIFIC FREIGHT TRAINS NEAR NORTH PLATTE, NEBRASKA ON JULY 10, 1986

INVESTIGATION

The Accident

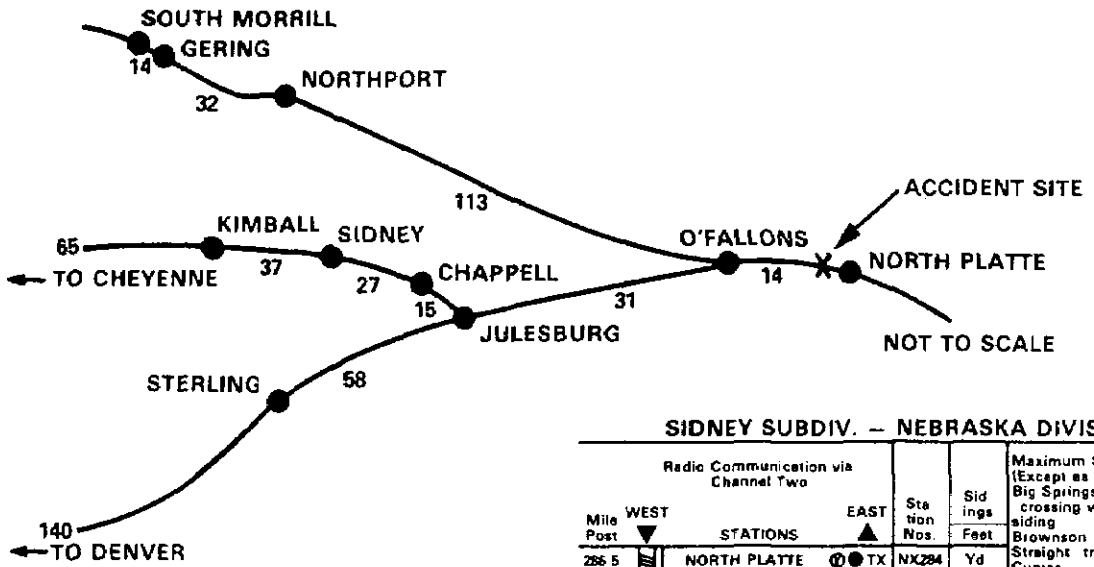
At 12:30 a. m., mountain daylight time (MDT), on July 10, 1986, eastbound Union Pacific Railroad (UP) freight train No. CLSA-09, consisting of 3 locomotive units, 106 cars of coal, and a caboose, departed South Morrill, Nebraska, for North Platte, Nebraska, a distance of about 172 miles. North Platte was an intermediate terminal for the train but was the terminus for the traincrew. Because this was the transfer point from the Chicago and North Western (C&NW), it was standard practice for the C&NW mechanic in charge to test and certify the locomotive cab signal before departure; the signal was found to be functioning as designed. The engineer stated that he tested the train brakes before departure and found no problems with them. The engineer and the head brakeman were in the lead locomotive unit, and the engineer, qualified by UP standards, continually operated the train after it left South Morrill. The train's conductor and rear brakeman were in the caboose.

Train crewmembers stated that there was very thick fog along the entire route. They further stated that visibility in certain areas was limited to the area immediately ahead of the locomotive. The engineer of train No. CLSA-09 stated that it was not unusual to operate trains in dense fog on the division.

Another eastbound UP coal train, No. CLHS-09, departed South Morrill 30 minutes ahead of train No. CLSA-09. It was necessary for train No. CLHS-09 to stop twice and receive permission to pass stop signals because the dispatcher was unable to clear those signals. These were control point signals operated by the train dispatcher rather than intermediate automatic signals governed by the location of trains. Because of this delay to train No. CLHS-09, train No. CLSA-09 closed separation to 20 minutes.

At 5:45 a.m., train No. CHLS-09 was switched to the number 1 main track at O'Fallons and continued east. (See figure 1.)

A preceding eastbound train, No. WPX-08, which was on the number 2 track from Cheyenne, Wyoming, had been allowed to continue on the number 2 track. The engineer of that train stated that he thought he began to encounter fog at Lodgepole, 25 miles west of Julesburg, en route from Cheyenne. He further stated that he began to receive more restrictive signals (flashing yellow) at signal 302. Because of the fog and restrictive signals, he reduced the train's speed to about 22 mph, expecting to stop at the next signal.



NORTH PLATTE SUBDIV – NEBRASKA DIVISION

Radio Communication via Channel One MP 0 0 to MP 217 2, via Channel Two MP 217 2 to MP 244 4

Mile Post	WEST ▼ STATIONS EAST ▲		Station Nos.	Sidings Feet
0 0	O FALLONS	CPOT	NX301	
	19 5			
19 5	NEVENS		NP019	8000
	31 9			
51 4	RUTHTON		NP052	8000
	16 2			
67 6	NEW OSHKOSH		NP068	8000
	3 2			
70 8	OSHKOSH		NP071	2025
	26 0			
96 8	EASTWOOD		NP097	8000
	16 9			
113 7	NORTHPORT	●	NP114	6936
	1 8			
115 1	Ⓓ BN Ⓓ	CP115	NP115	
	25 6			
140 7	BROCKHOFF		NP141	8000
	5 2			
145 9	GERING	Ⓣ● T	NP146	3132
	13 8			
159 7	SOUTH MORRILL	●Ⓣ	NP162	8000
	4 5			
164 2	JOYCE	Ⓣ	NP164	
	17 4			
181 6	YODER	T	NP182	2250
	41 2			
222 9	ALBIN		NP422	2563
	21 5			
244 4	EGBERT	T	NX478	

Maximum Speed (Except as below) MPH 40

Between Mile Posts –
182 1 and 182 5 5
193 3 and 193 9 30
196 8 and 197 8 30
205 7 and 206 0 30
211 0 and 217 1 25
217 1 and 217 2 20
217 2 and 220 6 25
223 3 and 223 5 30
226 0 and 226 3 30
232 4 and 235 3 30
236 3 and 238 7 30

ACS in effect O Fallons to CP113

Yard Limits
MP 144 0 to MP 146 1
MP 156 8 to MP 164 4
All westward trains must secure clearance before leaving Northport

SIDNEY SUBDIV. – NEBRASKA DIVISION

Radio Communication via Channel Two

Mile Post	WEST ▼ STATIONS EAST ▲		Station Nos.	Sidings Feet
286 5	NORTH PLATTE	Ⓣ● TX	NX284	Yd
	4 5			
291 0	CP291	Ⓣ I		
	5 5			
296 5	HERSHEY	X	NX297	n3388
	2 6			
297 7	CP298	I	NX298	
299 1	O FALLONS CP 300T	I	NX301	n10600
	4 5			
303 7	SUTHERLAND	X	NX303	
	7 8			
311 5	CP312	I	NX312	
	11 0			
322 5	CP322	I		
	12 3			
332 3	CP332			n11600
334 8	OGALLALA CP335	I	NX335	s7079
	14 9			
349 7	CP350	I	NX350	
	4 6			
354 3	BIG SPRINGS	X	NX354	
	11 0			
363 0	CP363	I	NX363	n9500
365 3	JULESBURG CP365 ●T	I	NX365	s9500
	12 2			
377 5	CP378	I		
	2 8			
380 3	CHAPPELL	X	NX380	
	11 7			
392 0	CP392	I		
	15 5			
407 5	SIDNEY CP408 ●T	I	NX408	n12280 s12280
	8 0			
415 5	BROWNSON	T	NX416	c4169
	8 4			
423 9	CP424	I		
	14 5			
437 2	CP437	I		
438 4	OWASCO		NX440	n9550
	6 1			
444 5	KIMBALL		NX445	c6324
	4 0			
448 5	CP448	I		
	7 7			
456 2	BUSHNELL	X	NX457	
	3 3			
459 5	CP459	I	NX459	
	10 0			
469 5	CP469	I	NX469	
	7 0			
475 4	CP 475			n10550
476 5	EGBERT	T	NX478	
477 5	CP 478			
	3 3			
480 8	CP481	I	NX481	
	10 2			
491 0	CP491	I	NX491	
	9 6			
500 6	ARCHER CP 501	I	NX501	s5956
	5 7			
506 3	BARNETT CP506	I	NX506	
	3 2			
508 3	CP 508	I		
509 5	CHEYENNE	● T	WX510	Yd

Maximum Speed (Except as below) MPH 70

Big Springs over highway crossing when using siding 5

Brownson industrial area
Straight track 10
Curves 5
Hillsdale on industry track 5
Between Mile Posts –
283 2 and 291 5 40
South Running Track (CP 291 to CP 296) 40
O'Fallons Siding 40
323 5 and 324 4 60
Ogallala North Siding 40
Julesburg Sidings 40
407 5 60
422 6 and 423 5 60
456 9 and 457 2 65
462 8 and 463 0 65
466 5 60
Wypo Trks. 5
486 2 and 486 5 60
493 7 and 494 0 60
497 7 and 498 2 60
502 2 and 503 0 50
506 3 and 506 3 (No 3 trk) 40
508 3 and 509 1 35
509 1 and 510 5 Ⓔ 20

Figure 1.--Sketch of the North Platte and Sidney Subdivisions.

However, he stated that he did not receive a stop signal until he reached signal 293, 9 miles further down the track and approximately 2 miles from the yard at North Platte. The yardmaster held train No. WPX-08 at this point for about 50 minutes, behind another eastbound train that had been stopped at signal CP 291. The conductor and flagman disembarked and stood near the caboose for about 20 minutes.

The conductor stated that, when the train stops, he normally walks along the train, inspecting as many cars as possible, but that he did not walk forward that morning because of the fog and limited visibility. He further stated that he had a portable radio, and heard a message to the train ahead to move into the train yard. The conductor thought that his train would also soon receive permission to move forward, so he and the flagman reboarded the caboose. The conductor took a seat but did not fasten the lapbelt that was provided. The conductor thought the flagman was standing behind him and looking out the rear door window.

On the morning of July 10, 1986, trains were being held on the main track because a minor collision and derailment had occurred earlier that day in the yard at North Platte. The yardmaster advised that it was necessary to hold inbound trains on the main track until the derailed cars could be rerailed. However, each of the crewmembers on the locomotives of the three held trains stated that it was not unusual to be held on the main track to await a track assignment in the yard.

The engineer of the first train, train No. CLHS-09, which was located on track No. 1, stated that he continued to maintain a speed of 40 mph after passing O'Fallons and that the next two signals were clear (green). At the third signal, he received a less favorable signal (flashing yellow) and he anticipated slowing his train. At the fourth signal (red), he slowed the train to 20 mph. He further stated that, when he passed the caboose of the stopped train (train No. WPX 08) on adjacent track number 2, he was startled because it appeared out of the fog so suddenly. He did not recall seeing any light on the standing caboose. He proceeded with caution, because of the diminished visibility, until he brought his train to a stop at the stop signal at CP 291.

When train CLSA-09 arrived at O'Fallons at 6 a.m., it was switched to the number 2 track. The engineer stated that as the train approached the crossover, he received a low flashing green signal (diverging clear limited), which limited the train to a speed not to exceed 40 mph. The engineer stated that after crossing over onto the No.2 track, his cab signal went to a green (clear) indication. The engineer then switched from the train dispatcher's to the yardmaster's radio frequency at North Platte yard, and inquired as to the track on which the train would be yarded. The yardmaster responded that he would get back to them; the head brakeman stated that this response usually meant that the train would be held on the main track, and that he expected that to happen. He further stated that he left his seat on the left side of the locomotive (his normal operating position), stood near the engineer, and talked with him about what they would do when they went off duty.

From the crossover at O'Fallons to the point of collision, there are four signals: one at milepost (m.p.) 300, which the engineer stated was green; one at m.p. 298; another at m.p. 296.5; and one before the point of collision, at m.p. 294.8. (See figure 2.) The engineer stated that he did not remember what the last three signals indicated, and that he did not know what was displayed on the cab signal indicator for signals CP 298 and 296.5. The head brakeman said he recalled seeing a yellow signal (approach). The engineer said that for signal 294.8 the cab signal indicator bounced up and down and stayed at the red over yellow indication (restricting). He also stated he "...knew something was

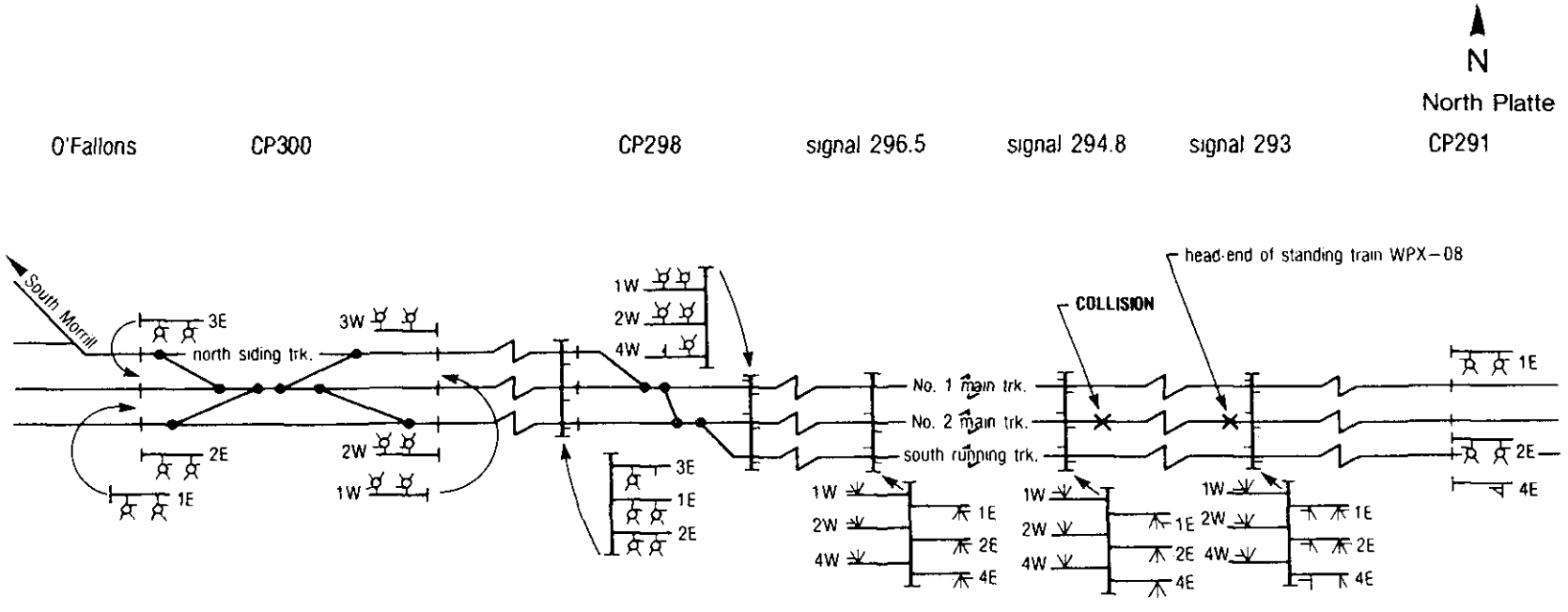


Figure 2. — Signal arrangement O'Fallon's to North Platte.

wrong..." and began to apply the train brakes to reduce the speed of the train, which he said was traveling about 40 mph. The engineer said that he then saw the silhouette of a caboose in the fog ahead. Realizing the train could not be stopped in time to avoid a collision, he shouted a warning to the head brakeman to jump. He said he put the train brakes in emergency, sounded the locomotive horn for a moment, left the operating cab, and jumped from the locomotive.

Meanwhile, the flagman on train WPX-08, apparently looking to the rear, shouted a warning to the conductor: "Dode, there is a train coming and he ain't gonna stop." The conductor stated that the flagman ran forward trying to get to the seat in the middle of the caboose but was unable to reach the seat before the collision.

Train CLSA-09 struck the rear of train WPX-08 at about 6:12 a.m. Immediately after the collision, the conductor of train CLSA-9 stated that he did not know what had occurred, but took a portable radio with him, and walked towards the head end of his train. He instructed the flagman to remain on the caboose, which was equipped with a permanently mounted radio. If he needed any tools, the conductor said he would contact the flagman and have him bring them forward. As he proceeded forward, the conductor realized that a collision had occurred and he radioed the flagman to contact the train dispatcher to provide protection for trains on the adjacent track. The train dispatcher instructed the flagman to provide protection for his train so the flagman left the caboose and walked back to flag any trains coming from the rear on the adjacent tracks. The crewmembers on the locomotive of train WPX-08 did not know that the collision had occurred; they only knew that the train brakes had gone to emergency. The engineer sent the head brakeman forward to flag the adjacent track, secured his train, and went to the rear of the train to determine what had occurred.

Injuries to Persons

Injuries	Train WPX-08	Train CLSA-09	Total
Fatal	1	0	1
Nonfatal	1	2	3
None	2	2	4
Total	4	4	8

Damage

Three locomotives and 11 cars from both trains were derailed. The lead locomotive unit on train CLSA-09 was destroyed. The body of the locomotive was crushed and torn loose from the front to the engine compartment. The fireman's seat area was completely torn off the underframe. (See figure 3.) The operating console and seat were all that remained on the engineer's side of the operating compartment. All side panels and doors in the engine area and the roof panels were bent and buckled. (See figure 4.) The 11 derailed cars included the caboose of train WPX-08, 4 cars that were destroyed, and 6 cars that were moderately damaged.

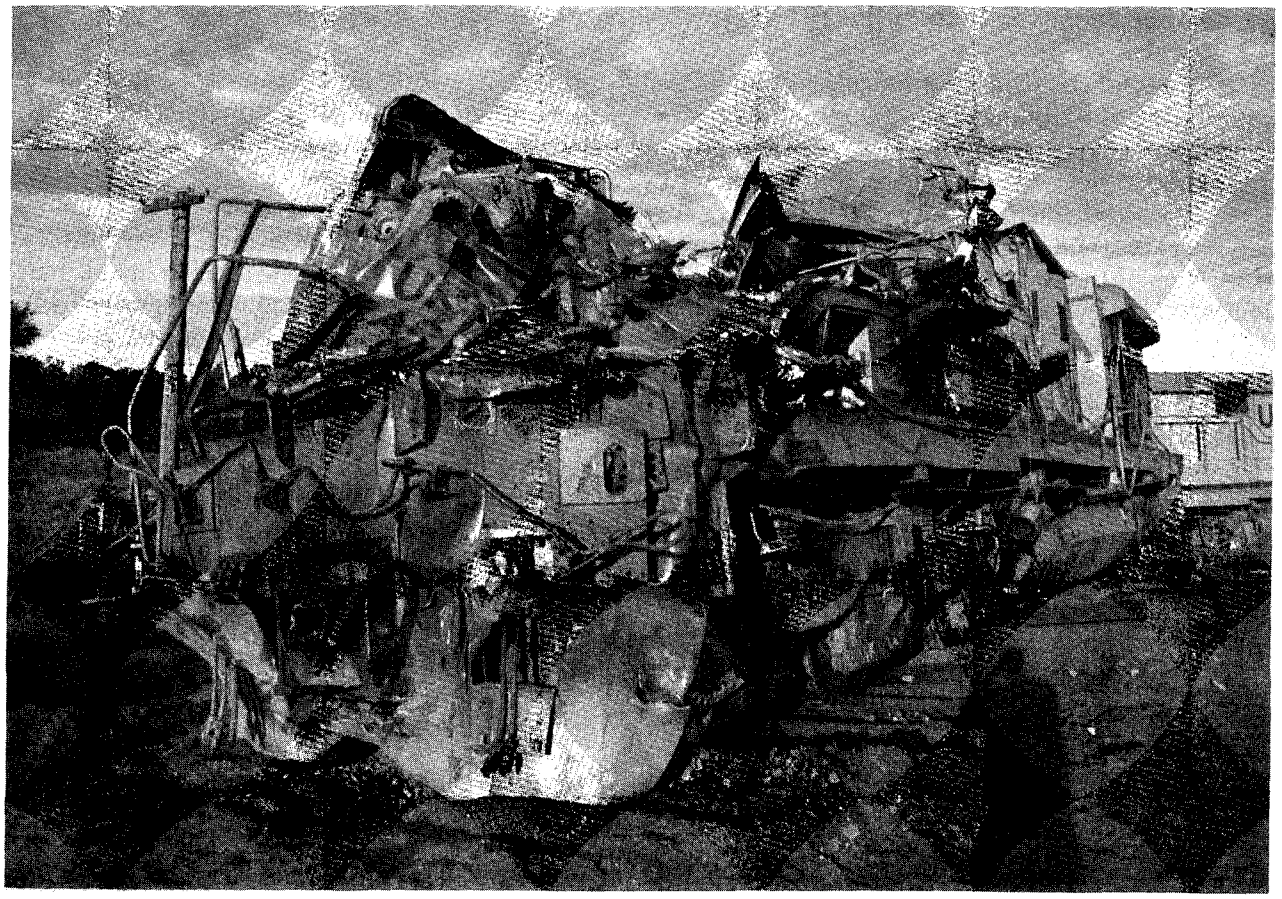


Figure 3.--Damage to locomotive of train No. CLSA-09.

On impact, the caboose of train WPX-08 was pushed forward under the car ahead; the steel end sheets of the caboose were crushed inward, and the roof was buckled and crushed into the interior of the caboose. (See figures 5 and 6.) The seats for the conductor and rear brakeman were located in the middle of the caboose. The backrest of the conductor's seat was deformed, but the rear brakeman's seat was not damaged. (See figure 7.) Track was destroyed for 400 feet on each of the three tracks for a total of 1,200 feet.

Personnel Information

The crewmembers of each train were qualified for their assignment by the UP. Each of the crewmembers had successfully passed the company operating rules examination and a physical examination, and were qualified in the physical characteristics of the railroad to which they were assigned.

Figure 4.--Damage to locomotive of train No. CLSA-09.

The engineer of train CLSA-09 had been an engineer for 10 years and had been continually operating trains on this division. He had had a physical examination within the past year, had no medical problems, and was not required to wear glasses.

The engineer stated that he arrived at Gering, Nebraska, his away-from-home terminal, at 8:30 a.m., retired about 9:30 a.m., and slept until about 3 p.m. After he awoke he ate, and, because he knew he would be going to work later, returned to the motel and took a nap. He was notified at 7:15 p.m. to report to work at 9:35 p.m. He stated he slept well and was well rested when he reported for duty.

The head brakeman on train CLSA-09 had been employed by the UP for 15 years. In 1978, he was promoted to conductor, but on the day of the accident was working as a brakeman. He was also the head brakeman on the trip to Gering, Nebraska, with the same engineer as on the return trip. He went off duty at 8:30 a.m. on July 9, 1986, and retired at 9 a. m. He slept until 2 p. m. and ate dinner at 5 p.m. He was notified at 7:30 p.m. that he was to report for duty at 9:35 p.m. He stated that he slept well and was well rested when he reported for duty. He had had a physical examination within the past 2 years; the only physical restriction he had was to wear glasses when on duty.

Figure 5.--Caboose of train No. WPX-08.

Figure 6.--Caboose of train No. WPX-08.

Figure 7.--Interior of caboose of train No. WPX-08.

The conductor of train CLSA-09 had been employed by the UP for 16 years. He worked as a switchman/brakeman and in 1974 was promoted to conductor. He was also the conductor going to Gering, Nebraska, with the same engineer as on the return trip. He went off duty at 8:30 a.m. on July 9, 1986. He was notified at 7:30 p.m. to report for duty at 9:35 p.m. He stated he had received sufficient rest and was well rested when he went on duty. He had received a physical examination within the past 2 years and had no medical restrictions.

The rear brakeman on train CLSA-09 had been employed by the UP for 10 years. He worked as a switchman/brakeman and in 1976 was promoted to conductor; on the day of the accident, however, he was performing flagman duties. He had also performed flagman duties on the trip to Gering, Nebraska, with the same crew as on the return trip. He went off duty at Gering, Nebraska, at 8:30 a.m. and slept until about 2 p.m. He then ran for about 30 minutes, showered, and ate dinner. He remained in his motel room until he was called at 7:30 p.m. to report for duty at 9:35 p.m. He stated that he had received sufficient rest and was well rested when he went on duty. He had received a physical examination within the past 2 years and had no medical restrictions.

The train dispatcher, located in the control center at North Platte, had been working for the UP for 13 years and had been a dispatcher since 1979. On July 9, 1986, he went on duty at 11:30 p.m. The train dispatcher stated he had been off duty a sufficient amount of time and was well rested when he reported for duty.

Dispatchers handling trains between North Platte and Cheyenne supervise the movement of trains on 215 miles of UP tracks, and they supervise the employees connected with the movement of those trains. There are three shifts. On two of the shifts, two dispatchers are on duty; one has 101 miles to supervise and one has 114 miles.

The dispatcher on duty at the time of the accident, however, supervised the full 215 miles by himself. He normally handled 27 trains and performed all the tasks performed by two dispatchers on the other shifts.

Any dispatcher must constantly deal with events as they happen and has little time to plan ahead. A dispatcher is required to keep trains moving safely and efficiently. He must, therefore, know the location of trains, irregularities in equipment, and any movements of trains being made that are not authorized by signal indication. He must also issue train orders, monitor warrants, and monitor bulletins affecting trains. When asked at the deposition if enough qualified personnel were available to allow him to take breaks, the dispatcher answered, "Once in a while, no; most of the time, yes."

The dispatcher is also responsible for operating the control machine, remotely operating switches, or issuing instructions for any train entering the main tracks where switches are manually operated.

Train Information

Train CLSA-09 was 5,966 feet long, and consisted of 106 loaded cars of coal with a trailing weight of 13,909 tons. The locomotive and caboose were equipped with operable radios.

The lead locomotive unit was being operated with the short hood forward and the engineer's controls on the right hand side. The three locomotive units were the C30-7 type, built by General Electric in October 1980. Each locomotive unit was rated at 3,000

horsepower and weighed about 395,000 pounds. each was equipped with 26L AIR BRAKE equipment, a dead-man safety control pedal, dual brightness headlight, and air horn. All locomotive units had cab signal equipment that included two track circuit signal code rate receivers mounted on each locomotive over the rails in front of the leading truck. An equipment box, which contained the amplifier, decoding units, control relays, fuses, and terminal board, was also mounted on each locomotive unit. A warning whistle was mounted on the forward wall of the locomotive cab, and a cab signal indicator was located above the center of the windshield. The cab signal indicator provides a visual indication of the wayside signal aspects. The cab signal indicator was visible to the members of the locomotive crew from their respective stations in the cab. Each locomotive unit was also equipped with a cab signal acknowledging lever.

The UP has equipped each locomotive unit with a "Pulse" event recorder and the cab signal indications are recorded on the recorder in the lead unit. In addition to the cab signal indications, the "Pulse" event recorder continually records the speeds, amperage, distance and elapsed time, and every 8 seconds records brake application and throttle position. All of the locomotive units also had speed indicators.

As a result of its investigation of the rear-end collision of UP freight trains near Hermosa, Wyoming, on October 16, 1980, the National Transportation Safety Board issued Safety Recommendation R-81-45, which called for the UP to "modify event recorders to record activation of the cab signal acknowledging lever." The Safety Board stated in its report of that accident investigation that if movement of the acknowledging lever had been recorded, it would have been possible to confirm which signals had restrictive aspects. In its June 25, 1981, response to the recommendation, the UP indicated that it was testing an interface module that would enable the event recorder to record the cab signal indications displayed in the cab. The circumstances of this accident have revealed that the intent of the recommendation has been met since the event recorders now record the cab signal indications displayed in the cab. The Safety Board considers this not only an acceptable alternative but also more useful in terms of information recorded.

Train WPX-08 was a mixed merchandise freight train and consisted of 3 locomotive units, 43 loaded and 44 empty cars, and a caboose. The train had a trailing weight of 5,516 tons and was 5,711 feet long.

The caboose was built in 1980 and was approximately 40 feet long. It was a bay window type caboose with a modified short body over the inside wheel axles of the trucks, giving each end an extensive platform not covered by the roof. Small fuel tanks for a winter heating stove were located on the leading end platform. Inside, the caboose was equipped with two reversible high- back seats with lapbelts. The seats were located next to the bay windows to allow the conductor and flagman to observe the train. The caboose was also equipped with a stove for heating, a storage closet, cooler, water tank, table/desk, and toilet.

A marker light was mounted at each end of the caboose roof slightly below the roof line. The marker lights were Stratolite No. 62, containing a 12-volt, 32-candlepower bulb with a spare bulb and a red lens. When activated, the light would blink steadily on and off. A slightly smaller white light located next to the marker light was used by the crew to illuminate the platform and steps area and to inspect track behind the train.

Signal System

South Morrill is on the North Platte subdivision of the Nebraska division. When trains depart South Morrill, their movement is controlled by the wayside signals of an

automatic block signal system (ABS) 1/ for about 45 miles. At that point, the trains enter a centralized traffic control system (CTC), 2/ also with wayside signals. The CTC system has two types of signals: controlled signals, which are absolute signals controlled remotely by a control operator or train dispatcher, and intermediate automatic signals, which are controlled by train movements. A train dispatcher located in North Platte operates the controlled signals in the area of the accident. Controlled signals are located at control points, while intermediate automatic block signals are located between control points. In this accident, the dispatcher controlled signals 300, 298, and 291.

In CTC systems, the main tracks are signaled in both directions to allow the train dispatcher to route trains in either direction on each of the main tracks. In the area of the accident, no train can enter any track where the CTC is in effect unless a controlled signal is displaying a proceed indication, or unless permission to proceed has been obtained from the train dispatcher in North Platte.

For a train to enter the main line at O'Fallons from the North Platte subdivision, the train dispatcher must select the track and align the switches, and a proceed signal indication must be displayed before the train reaches the switch. A flashing green signal (diverging clear limited) indicates that the train can proceed on the diverging route but that the speed through the turnout must not exceed 40 mph. After a train enters the main line and thus the signal block, the first automatic signal behind the train will display a red aspect (stop), indicating that a following train should be stopped before any part of the train or engine passes that signal. The second signal behind a preceding or standing train will display a yellow aspect (approach), indicating to the following train's engineer that he should proceed but be prepared to stop before any part of the train or engine passes the next signal and that he must immediately reduce the train's speed to no greater than 30 mph as specified in operating rule 245D. In a deposition proceeding taken in connection with this accident, the head brakeman of train CLSA-09 interpreted the restriction required by a yellow signal indication as follows: "Proceed to the next block, proceed prepared to stop; the speed passing the next signal must not exceed 30 mph".

As a train proceeds, the third signal behind the train will display a flashing yellow aspect (approach limited), indicating that a following train can proceed and that the speed passing the next signal must not exceed 40 mph. The fourth signal behind the train will display a green aspect, to indicate that the way ahead is clear and that a following train can proceed at the authorized speed.

In the area of this accident, the wayside signal system is both reinforced and supplemented by an automatic cab signal (ACS) system. 3/ The cab signal indicator provides a visual indication of the wayside signal aspects to the engine crew. The ACS system provides a continuous display of the wayside signal aspects, thereby informing the engine crew of conditions and changes in the signal block ahead.

1/ A series of consecutive blocks governed by block signals that are activated by a train, engine, or by certain conditions affecting the use of a block. A block is a length of track between two block signals or from a signal to the end of signal limits. A block's signal is a fixed signal at the entrance of a block to govern trains and engines that enter and use that block.

2/ A system in ABS territory under which trains or engine movements are authorized by block signals whose indications supersede the superiority of trains for both opposing and following movements on the same track.

3/ A system which provides for automatic operation of the cab signals and cab warning whistle. This system incorporates a signal located in the engineer's compartment or cab, indicating a condition affecting the movement of a train or engine and used in conjunction with interlocking signals and in conjunction with or in lieu of block signals.

When the signal aspect in the cab changes to a more restrictive aspect, the warning whistle will sound and the engineer must acknowledge by means of a lever. If the engineer fails to acknowledge the warning within 6 seconds, a penalty full service brake application will automatically result. Once the brake application has been initiated, a penalty stop must be made before the brake application can be released.

The ACS system is interconnected with the block signal system so that the cab signal indication must conform with the wayside signal governing entrance into the block in the direction for which the track and engine are equipped. If the two do not agree, the operating rules state that the engineer must comply with the most restrictive indication, and then report the incident to the train dispatcher. The ACS aspects correspond to the display of the wayside signal just passed as follows:

ACS	Name	Wayside
Green	Clear	Green
Yellow over green	Approach limited	Flashing yellow
Yellow	Approach	Yellow
Red over yellow	Restricting	Red (stop)

At the time of the accident, the CTC for the North Platte subdivision had been in place for about 18 months. Six engineers stated in interviews that it was not unusual to receive 14 to 15 restrictive cab signals between wayside signals on an entire trip on the North Platte Subdivision. The engineer of train No. CLSA-09 stated that on the day of the accident, the restrictive cab signals ". . . happened quite a few times. . . . The engineer further stated that this was a common occurrence and happened "10, 15 times every trip." No bulletin or notice had been issued by the UP with instructions to the engineers regarding the cab signal problems. It was the position of the UP that engineers were to comply with the signal indications in accordance with the operating rules. The engineer of train CLSA-09 stated that no deficiencies were noted to the cab signal equipment or indications displayed on the locomotive on the North Platte subdivision. He also stated that, because he encountered so many restrictive cab signal indications during each trip on the North Platte subdivision, he did not adhere to those restrictive signals. To override the signals, however, the engineer had to acknowledge the restrictive cab signal by moving the acknowledging lever on the control console. The operation of the acknowledging lever had no control purpose other than to indicate to the cab signal system that the engineer had observed the restricted signal. After acknowledging the signal, he could then operate the train without restriction. A UP signal engineer stated at a deposition hearing conducted by the Safety Board that the undesired, more restrictive cab signal indications on the North Platte subdivision, as repeatedly reported by the locomotive engineers, were caused by excess ballast 4/ between the rails from track maintenance and also from a number of loose or broken bond wires. The signal engineer further stated that since the accident, the UP was attempting to identify each of the areas where improper cab signal indications were being received and to correct them.

The train dispatcher routes trains to North Platte at O'Fallons, about 160 miles east of South Morrill, to the Sidney subdivision of the Nebraska division, and onto the east/west main line of the UP. Trains entering the main line at O'Fallons can be switched by the train dispatcher either to tracks 1 or 2 or to the north siding track to continue east to North Platte. All of the engineers questioned, as well as the signal engineer, stated that the undesired cab signal indications did not exist on the main line tracks between O'Fallons and North Platte, a distance of 14 miles.

4/ Material selected for placement on the road bed for the purpose of holding the track in line and at surface.

Method of Operation

The cars of coal of train CLSA-09 had originated in the southern half of the Powder River coal basin. After being loaded, the cars were taken by the C&NW Railroad south to Bridger Junction and then to South Morrill for further movement by the UP. The final destination for these coal cars was a powerplant near San Antonio, Texas.

From South Morrill to Northport on the North Platte subdivision, train movements are controlled by an ABS system, while trains operated from Northport on the North Platte subdivision to O'Fallons and from O'Fallons to North Platte on the Sidney subdivision, including those operated through the accident area, are controlled by signal indications of the CTC system. Through this area the signals at CP291, CP298, and CP300 are controlled by the dispatcher in charge of train movements on the Sidney subdivision. The Sidney subdivision (the main line) extends from Cheyenne, Wyoming, east to North Platte, Nebraska, a distance of 220 miles, and is under the direction of the train dispatcher at North Platte. The North Platte subdivision (a branch line) extends from South Morrill to O'Fallons, a distance of 160 miles. Trains on the North Platte subdivision are under the direction of a separate train dispatcher.

The train dispatcher on the Sidney subdivision operates the switches and signals to allow a train to enter the main line at O'Fallons. Trains leaving the North Platte subdivision remain on the cab signal system. On the North Platte subdivision, the traincrew would have received instructions from the train dispatcher on radio channel 1. Although the timetable designates channel 2 for use on the Sidney subdivision, the practice is for traincrews to switch to the yard radio channel, to receive instructions for entering the yard from the yardmaster at North Platte yard.

Operating rule 34 requires:

> Crew members in control compartment of engine must be alert for and communicate to each other in a clear and audible manner, the name or aspect of each signal affecting the movement of their train as soon as it becomes visible or audible. They must continue to observe signals and call any change of indication until passed.
>
> If prompt action is not taken to respect signal, other crew members must remind engineer and/or conductor of rule requirement, and if no response, or engineer is incapacitated, other crew members must take immediate action to ensure safety, using emergency brake valve to stop the train if necessary.

Signal rule 245F requires that when a flashing yellow wayside signal is displayed with a corresponding yellow over green cab signal indication, the meaning is as follows:

> Approach limited, proceed. Speed passing next signal must not exceed 40 mph.

Signal rule 245D requires that when a yellow signal is displayed with a corresponding yellow cab signal indication, the meaning is as follows:

> Approach. Proceed prepared to stop before any part of the train or engine passes the next signal. Trains exceeding 30 mph must immediately reduce to that speed.

Rule 245B requires that when a red signal indication is displayed with a corresponding red over yellow cab signal indication, the meaning is as follows:

Stop and Proceed. Stop before any part of the train or engine passes the signal, then proceed at restricted speed through entire block.

The General Code of Operating Rules defines restricted speed as:

A speed that will permit stopping within one half the range of vision; short of train, engine, railroad car, stop signal, derail or switch not properly lined, looking out for broken rail, not exceeding 20 mph.

Rule 369 states:

The cab signal system is interconnected with the block signal system so that the cab signal must conform with the fixed signal indication within 8 seconds after the engine passes fixed signals governing entrance into the block in the direction for which the track and engine are equipped. If cab signal indication does not correspond with block signal indication, engineer must be governed by the most restrictive indication displayed by either signal. The engineer must notify the train dispatcher by quickest means of communication available, giving location, signal number and track on which nonconformity occurred.

Rule 101 requires:

When conditions exist which may impair visibility or affect condition of track or structure, speed must be regulated to ensure safe passage and to ensure observance and compliance with signal indications.

The train dispatcher must be advised of such conditions by the first available means of communication.

Rule 109(A) requires:

When practicable, walking and/or roll-by inspection of as much of train as is possible must be made.

When train stops en route, such walking inspections of train must be made as time will permit.

Rule 102 requires:

When a train or engine is stopped by an emergency application of the brakes, or has had severe slack action incidental to stopping, the following action must be taken:

(1) If there is an adjacent track which may be obstructed an immediate warning must be given by radio, stating the exact location and status of train or engine. At each end of the train or cars, a lighted fuse must be immediately displayed on the adjacent track . . . and flag protection provided in both directions on that track as prescribed by rule 99, going at least 2 miles if flagging distance is not known.

In the UP book on Safety, Radio and General Rules for All Employees, Rule 4057 states:

> Riding in Cabooses . . . Employees must remain seated and when necessary to move around must be braced and maintain firm hold. Employees must remain seated in cabooses and must use seat belts and restraining harnesses fastened when cabooses are so equipped.

During the investigation, the road foreman of engines (first line supervisor of engineers) was questioned about his monitoring of train operations, particularly on the North Platte subdivision, and the review of the event recorder readout tapes. He testified:

> Unfortunately, to date, the tapes that I have pulled off of the trains, the locomotives were not equipped with the cab signal function on the tape."

Asked how frequently he reviewed pulse event recorder tapes, he responded:

> I try to pull 5 to 6 tapes a month, in between my riding, to review the tapes.

Following the accident, the road foreman stated the UP management had instructed him to contact engineers and clarify the cab signal rules with them and that this was a result of the UP findings that some engineers were misinterpreting the cab signal rules.

He further testified that this situation had not been reported by engineers before the accident, but during the investigation, he and the UP management became aware that some engineers misunderstood the cab signal rules.

Meteorological Information

The following observations were made by the National Weather Service at the Lee Bird Field, the airport at North Platte, Nebraska, 14 miles east of the accident site, at 5:49 mountain daylight time: an indefinite ceiling 0 feet, sky obscured, visibility 1/16 mile, fog, temperature 56° F, and wind calm. The following visibility data were determined from the North Platte Surface Weather Observations Form:

Time	Visibility (miles)	Weather
0024	1/4	fog
0049	1/4	fog
0148	3/16	fog
0248	1/16	fog
0355	1/16	fog
0448	1/16	fog
0549	1/16	fog
0650	1/16	fog
0747	1/16	fog
0802	3/16	fog
0804	1/2	fog
0836	1	fog

Sunrise - 0519

Forecasts

The following forecast was made at 4:30 a.m. central daylight time on July 10, 1986:

. . . Today . . . Partly cloudy . . . areas of dense fog this morning . . . .

Local Climatogical Data

Because the engineer said that he frequently operated in fog, the following information was collected from the National Climatic Data Center, Asheville, North Carolina, to determine the number of days fog is present on this division. Local climatological data (monthly summaries) for North Platte, Nebraska (Lee Bird Field) are, in part, as follows:

Number of Days of Heavy Fog 5/

November	1985	1
December	1985	0
January	1986	0
February	1986	7
March	1986	1
April	1986	0
May	1986	1
June	1986	1

Survival Aspects

The conductor and rear brakeman on train WPX-08 were in the caboose at the time of collision. Following the accident, there was livable space in the area of the seats. The conductor was seated on the left side of the caboose with the lapbelt unfastened. Inspection of the seat following the accident indicated that on impact, the conductor was first thrown back into the seat but then forward out of the seat and into the desk in front of him, and then to the floor. The conductor received a broken arm, broken neck, broken thumb, and cuts and bruises. According to the conductor, the rear brakeman was attempting to get to the seat on the right side of the caboose when the collision occurred. The conductor stated he did not see what happened to the rear brakeman during the accident, but the rear brakeman was found on the floor of the caboose in front of the seat on the right side. He died as a result of massive injuries.

The engineer of train CLSA-09 tore the ligament of his right knee, and sustained injuries to his left arm and elbow when he struck the ground after jumping from the locomotive. The engineer stated he left the operating cab of the locomotive through the door behind the engineer's seat before the head brakeman. He further stated that he did not attempt to reach the rear steps of the locomotive but jumped from the running board (walkway). The head brakeman stated that as he moved towards the door he struck his leg on the engineer's seat. He also stated he could not remember if he jumped from the locomotive walkway before or at the time of collision or was thrown from the locomotive walkway at the time of collision.

Tests and Research

The locomotive units were inspected after the accident; two of the three locomotive units were extensively damaged, but no pre-accident defect was found on any of the locomotive units.

5/ Heavy Fog - Visibility 1/4 mile or less.

The Pulse event recorder cassette from the lead locomotive indicated nothing unusual in the coded cab signal system. The Pulse tape readout indicated that the cab signal equipment in the lead locomotive received a yellow over green (advance approach) indication at wayside signal 298, a yellow (approach) indication at wayside signal 296, and a red over yellow (restricting) indication at wayside signal 294. The Pulse readout tape also indicated that the speed of the train was 40 mph as it passed signals 298, 296.5, and 294.8. It also indicated that beyond signal 294.8, the train speed was being reduced and that the speed at time of impact was 32 mph. The readout tape also indicated that dynamic braking was begun at 6:09:01 a.m. at milepost 296 and was continually increased to about 650 amps at the time of collision, 6:12:29 a.m. (The amps were read from the readout tape on the second locomotive.) The air brakes were used beginning at 6:11:55 a.m. when a 14-psi reduction in brake pipe pressure was made. The readout tape indicated that at 6:12:19 a.m., the train brake pipe reduction was increased to 18 psi and the brake pipe pressure was reduced to 0 psi.

The brake handle was found in the handle off position, which will reduce the brake pipe pressure to 0 psi but at a slower rate than if the brake handle is placed in the emergency position.

The mechanical committee inspected the remaining 102 coal cars, and conducted a set and release test of the air brakes from the west end; no exception was taken to the equipment. All brakes applied and released as designed. A second test of the air brakes was conducted after the cars were moved into the train yard at North Platte, where brake cylinder piston travel could be measured. Ninty-one cars had truck-mounted brake cylinders and the test indicated that 34 exceeded Union Pacific Railroad standards but were within Federal Railroad Administration (FRA) standards. They required readjustment in the amount of stroke required to apply the brakes.

The caboose marker light from train number WPX-08 was tested; the bulb and the marker circuitry were still working. The three-position toggle switch in the caboose was in the down (on) position for the rear of the train. The bulb filament was bent, indicating that an abrupt force was applied while the filament was hot and the light on. The conductor of train WPX-08 stated that when the train arrived at Cheyenne, it did not have a caboose, but because Nebraska at that time required a caboose on trains operating in the state, a caboose was placed on the train and the rear marker light was operating at that time.

A train dynamics "analyzer" was used to simulate train stopping distances with the following results:

> Distance from signal 294.8 to the point of the standing caboose of train WPX-08 was 3,428 feet.
>
> At a speed of 41 mph, the train brakes were applied with full dynamic and full service braking. This test indicated that the speed at the time of impact would have been 20 mph and the train would have stopped 3,860 feet from signal 294.8.
>
> At a speed of 36 mph, the train brakes were applied with full dynamic and full service braking. The train stopped 3,064 feet from signal 294.8, 364 feet short of impact.
>
> At a speed of 41 mph, the train brakes were applied in emergency at a point 340 feet beyond signal 294.8, the train stopped in 2,080 feet, 1,008 feet before impact.

An examination of the Pulse event recorder tape indicated that, during the eastbound trip on the date of the accident, the engineer of train CLSA-09 had often failed to reduce the speed of the train when restrictive cab signal indications were received on the locomotive. The Pulse readout tape also indicated that at locations where speed restrictions existed, as required by the train orders the engineer had received, the engineer of train CLSA-09 had not slowed the train to comply with those speed restrictions. The following are the locations noted:

> From mp 146.75 to mp 146.5, a 15 mph speed restriction was in effect; the train entered the restricted area at 25 mph and exited at 18 mph.
>
> From mp 143.50 to mp 139.50, a 25 mph speed restriction was in effect; the train entered the restricted area at 30 mph and exited at 27 mph.
>
> From mp 2.75 to mp 2.50, a 30 mph speed restriction was in effect; the train maintained a speed of 41 mph through the entire restricted area.

The track in the area of the derailment was constructed with continuous welded rail (CWR), which provided continuity for the signal system. Code rates were sent through the rails to the trains. Following the derailment, all circuits and control boxes in the signal system were examined and all components were found to be installed according to the diagrams of the signal system design. After the accident, jointed rail was placed to restore railroad operations as soon as possible. It was necessary to operate trains over the replaced sections of track to check for continuity and make adjustments to regain the necessary continuity. The signal system was then tested and was found to function as designed.

Medical and Pathological Information

Following the accident, blood and urine samples were taken from all crewmembers of both accident trains and from the dispatcher on duty at the time the accident occurred.

The samples were obtained by and under the authority of the Federal Railroad Administration (FRA) in compliance with FRA postaccident toxicology testing requirements (49 CFR 219, Subparts B through F, as of October 1, 1985). The samples were sent for analysis to the Forensic Toxicology Research Unit of the Federal Aviation Administration's Civil Aeromedical Institute (CAMI) in Oklahoma City, Oklahoma. Results were released by CAMI on July 28, 1986, reporting negative findings for all drugs (cannabinoids, barbiturates, benzo-diazepines, amphetamines, opiates, cocaine, methaqualone, phencyclidine, and propoxyphene) and alcohol on each sample tested, except for that of the dispatcher. Drug screening of the dispatcher's urine sample was reported by CAMI as positive for the presence of cannabinoids. The result was based on the urine sample drug screen only. Additional quantifying tests on the dispatcher's blood sample were not performed.

CAMI initially reported a result of 107 nanograms per milliliter (ng/ml) cannabinoids on urine and 5 ng/ml on the blood screen. However, in May 1987, it was learned that no testing was actually performed on the blood sample. Therefore, the results reported by CAMI were not valid. As a result, crewmember samples were sent to the Center for Human Toxicology in Salt Lake City, Utah, for reanalysis. On June 11, 1987, the Center for Human Toxicology reported that the dispatcher's urine had a positive reading of 67 ng/ml for the cannobinoid metabolite THE-COOH (carboxy). The dispatcher's blood sample was found to be positive for carboxy at 50 ng/ml. Both samples were analyzed by the gas chromatography-mass spectrometry (GCMS) chemical ionization method. There was a negative finding in the blood for Delta 9 THC, the primary psychoactive ingredient

in the cannabinoid mixture. The dispatcher's blood and urine samples were taken at 10:34 a.m. central standard time, approximately 3 hours 15 minutes after the accident and 3 hours after the dispatcher had left work.

Drug tests on samples from the engineer and head brakeman of train CLSA-09 were also performed by the Center for Human Toxicology to verify the negative findings previously reported by CAMI; these findings were confirmed on June 17, 1987.

ANALYSIS

The Accident

The fog on the morning of July 10, 1986, was not an intermittent pocket of fog; the National Weather Service and all train crewmembers interviewed indicated that heavy fog conditions existed from the time the two trains left South Morrill, shortly after midnight, until the accident at 6:12 a.m. Therefore, the two coal train (CLHS-09 and CLSA-09) engineers operated through the fog for about 6 hours before the accident. The engineer of train WPX-08 stated that, because of the limited visibility, he recognized the need to operate his train at a slower speed in order to see the signal indications.

Trains can be operated safely in fog, but only at speeds that permit time to see and respond to the signals. However, the Safety Board believes that in the existing foggy condition of July 10, 1986, a speed of 40 mph (the speed of train CLSA-09) was too fast for the engineer to see and interpret wayside signal indications. The head brakeman of train CLSA-09 did state that the last signal indication he observed was a yellow (approach), which required that the speed of the train be reduced to 30 mph in preparation to stop before any part of the train or engine passed the next signal. However, the Pulse tape readout indicated the engineer did not slow down. With reported visibility at the time of the collision at 1/16 of a mile and the train's recorded speed at 40 mph, the signal would have been visible from the locomotive cab for slightly less then 6 seconds. Since UP operating rule 101 requires engineers to reduce the speed of their trains in limited visibility, and since the engineer knew and had been operating the train through dense fog conditions, it would be expected that he would slow down in order to observe the signals more carefully. Had he seen and complied with the yellow signal at milepost 296.5, he would have reduced the speed of the train to 30 mph and been prepared to stop. The engineer's statement that he operated in fog on a regular basis is not supported by the records of the weather conditions in this area. His actions indicated poor judgment and little appreciation for the dangers posed by the limited visibility.

In addition to the fog, another factor that should have caused the engineer to reduce the train's speed was the North Platte Yardmaster's comment that he would get back to them. The crew interpreted the comment to mean that the train was going to be held on the main line track. The engineer should have realized from those instructions that other trains were probably being held out of the yard ahead of his train on the main line since he had been following another coal train for the entire trip. In addition, he should have anticipated being held since he stated it was not unusual to be held out of the yard at North Platte.

At a speed of 40 mph in dense fog, the MP294 signal indication was visible for about 6 seconds, but seeing it would have required vigilant observations ahead. Apparently, however, neither the engineer nor the head brakeman of train CLSA-09 was as vigilant as necessary. Several factors may have affected the engineer's attentiveness. The engineer had been operating the train in the limited visibility for 6 hours, which required intense concentration, and he may have become fatigued and less vigilant than the environment required. In addition, the conversation between the head brakeman and the engineer as

the train approached signal 294 may have caused the engineer to turn away from his observation ahead, and in the 6 seconds that the signal would have been visible, he may have missed seeing the signal. These assumptions are borne out by the engineer's statement that, although he was maintaining a lookout ahead, he did not remember seeing the previous signal indication, which the head brakeman saw as a yellow. For these reasons, the Safety Board could not determine whether distraction, inattentiveness, fatigue, or a combination of these caused him to miss the red signal indication of signal 294.8.

However, it is possible that the numerous restrictive signals received on the North Platte subdivision conditioned the engineer to disregard the requirement to operate the train in accordance with their indications. This was demonstrated by the engineer's statements that he disregarded restrictive cab signals on the North Platte subdivision because they occurred 10 to 15 times on every trip, and that restrictive cab signals happened quite a few times on the trip on the day of the accident. Thus, while he apparently operated the cab signal lever to acknowledge a restrictive signal, he continued to operate the train at speeds greater than authorized by the signal indications. Having done this for quite some time, it is likely that he continued to do so after entering the main track, which did not have a history of signal problems. The engineer may have attended solely to cab signal indications and neglected to correlate them with wayside signals, since he said he did not remember seeing any of the wayside signal indications from the time he passed O'Fallons and traveled the 5.2 miles to the point of collision.

Research on signal detection and operator behavior 6/ can help to explain this type of conditioned response to a high number of restrictive signals. When an operator receives numerous restrictive signals that he interprets as false alarms (i.e., there is no penalty for noncompliance), his sensitivity to their meaning changes. Where once he may have responded conservatively, he gradually relaxes his behavior and takes greater risks. As a consequence, when there is legitimate reason to comply with a restrictive signal, as in this case with WPX-08 stopped ahead, the operator is not prepared to make the appropriate response.

The UP's failure to correct the frequent restrictive signal indications on the North Platte subdivision, caused by track maintenance conditions that were unrelated to train movements, and their failure to notify engineers of these conditions, could have diminished the engineer's sense that complying with cab signal indications was important. During the Safety Board's investigation, each of the engineers interviewed with experience on the North Platte subdivision stated that they could not rely on the cab signal indications along that subdivision. Since typical operation is 160 miles on the North Platte subdivision and only 14 on the main line, those learned operating practices would be reinforced by the preponderant division miles and hours of service, with a corresponding tendency to apply them after leaving the subdivision for the main line.

Method of Operation

The Safety Board believes that the engineer and head brakeman were not maintaining a vigilant observation ahead for signal indications as required by UP operating rule 34. Such vigilant observation of signal indications, which is required at all times, is especially important under conditions of limited visibility, as in this accident.

6/ Wickens, Christopher D. (1984). Engineeering Psychology and Human Performance, Columbus, Ohio: Charles E. Gerrill Publishing Company.

The head brakeman moved from his seat on the left side of the locomotive, where he could see the signals, and was talking to the engineer immediately before the accident. Therefore, he did not support the engineer as intended by rule 34, which requires that the head brakeman and engineer inform each other of signal indications. When the head brakeman moved, he also restricted his ability to monitor the operation of the train and to take action to bring the train within signal and speed requirements as prescribed by UP rule 34. The rule states in part, "... that other crewmembers must take immediate action to ensure safety, using emergency brake valve to stop the train if necessary." The head brakeman also probably did not act to slow the train to the speed required by the yellow signal indication he observed because he did not understand that the speed of the train was to be reduced to 30 mph immediately. After sighting the yellow signal, the head brakeman moved about the locomotive cab and conversed with the engineer. It is likely that the yellow signal he saw was signal 296.5 since this would have been the only yellow signal displayed on the main line. While conversing with the engineer, the head brakeman was not looking ahead as the train approached signal 294.8; therefore, since he saw the yellow signal indication at 296.5, it would indicate that the signal system was functioning as designed. Testing of the signal system later verified that the signal system was functioning as designed.

Several preceding trains had operated without incident through the area where the accident occurred, providing further evidence that the signal system was functioning properly. The engineers of the preceding trains took no exception to the signal system that morning. They had been operating in the same limited visibility caused by the fog, and had been on duty about the same length of time as the crewmembers of train CLSA-09, yet had operated their trains safely. Therefore, the Safety Board concludes that the engineer and head brakeman on train CLSA-09 were distracted, inattentive, and/or fatigued, or the engineer may have assumed that another moving train was ahead of him and that he had another block ahead that he could run before having to stop outside the North Platte yard. Since the engineer did not make an emergency stop of his train when he received the red over yellow cab signal indication, but instead made a brake application for slowing the train, it is possible that he did realize that a train was ahead in the block but assumed it was moving and expected to bring his train to a stop at the next signal.

The only way to prevent this type of failure to comply with signal indications is to have a system in place that enforces the restrictions of the signal indication. Since 1967, the Safety Board has investigated 50 major railroad collision accidents including 24 head-on and 26 rear-end collisions. Most of these accidents could have been prevented had a system that mandated train separation been in effect. Four recent railroad collisions, including this UP collision on July 10, 1986, resulted in a total of 19 fatalities, 356 injuries, and total estimated damages of $21.1 million. These figures emphasize the need for an operating system that will provide positive train separation.

The Safety Board is aware that the railroad industry is joined in an effort known as the Advanced Train Control Systems (ATCS) Project, which is adapting modern technology to train operating problems. The project involves designing and testing systems that could be applied to U.S. railroads regardless of their length or present method of operation. This would allow railroads to select the system that best suits their operational and economic needs. A safety aspect of the ATCS system is enforced train separation, which includes the ability of the system to stop trains when they exceed authorized limits.

The Safety Board is aware that the UP is involved in the ATCS Project and that the North Platte subdivision is one of the areas selected to test the system. The Safety Board believes that the railroad industry and the FRA should formulate the operational and

safety aspects of these systems to provide the needed train control system on mainline tracks that would provide for positive separation of all trains. The Safety Board on April 28, 1987, recommended that the FRA:

R-87-16

> Promulgate Federal standards to require the installment and operation of a train control system on mainline tracks which will provide for positive separation of all trains. 7/

On train WPX-08, the conductor and rear brakeman failed to follow UP rule 109, which requires that a walking inspection be conducted while the train is standing. Instead of walking forward and inspecting the cars while the train was stopped, they reboarded the caboose. The conductor stated he did not inspect the cars because of the limited visibility. However, UP management informed Safety Board investigators that the inspection must be conducted regardless of conditions.

This accident occurred on a middle track of a three-track section of the UP railroad. For the conductor and rear brakeman to conduct their inspection, they would have had to walk between two tracks or outside the three tracks. In the first instance, a train passing on the adjacent track would have placed them between the two trains. In the second instance, a train passing on an adjacent track would have separated them from their train. In the foggy conditions that prevailed on the morning of the accident, conducting such an inspection in a multiple track location would be dangerous.

In addition, the crewmembers faced the possibility of having their own train move forward. In view of the limited visibility, the Safety Board believes that conducting such an inspection would have been dangerous and that the conductor's decision was prudent.

Survival Aspects

The Safety Board believes this accident was survivable 8/ for crewmembers in the caboose of train No. WPX-08. Even though the leading end of the caboose was extensively damaged, sufficient livable volume remained in the seat area. The speed at the time of the collision was recorded at 32 mph, and had the rear brakeman been seated with the lapbelt fastened, he may have received injuries from a dynamic rebound 9/ in the seat and lapbelt-induced abdominal injuries, but these injuries may not have been fatal. In any case, because the rear brakeman was not seated, he was thrown forward and sustained fatal injuries.

7/ For more detailed information, read Railroad Accident Report--"Read-End Collision between Boston and Maine Corporation Commuter Train No. 5324 and Consolidated Rail Corporation Train TV-14, Brighton, Massachusetts, May 7, 1986" (NTSB/RAR-87/02).
8/ An accident in which the forces transmitted to the occupant through the seat and restraint system do not exceed the limits of human tolerance to abrupt accelerations and in which the structure in the occupant's immediate environment remains substantially intact, to the extent that a livable volume is provided for the occupants throughout the crash sequence (USARTL-TR-79-22D Aircraft Crash Survival Design Guide).
9/ Rapid return toward the original position upon release or rapid reduction of the deforming load, usually associated with elastic deformation.

The conductor in train WPX-08 also did not have the lapbelt fastened when the collision occurred and he was thrown back into the seat and then ejected forward. When he struck the desk, he sustained serious injuries. If the conductor had been seated in the caboose with the lapbelt fastened, he would have avoided impact with the desk, and his injuries may have been less severe.

The locomotive cab section of train CLSA-09 was destroyed on impact. Had the engineer remained in his seat, he could have been thrown forward over the control stand and into the area that was totally destroyed. Even had he not been thrown over the control stand, the roof and front of the locomotive at the engineer's location was torn away and would have exposed any occupant. The area where the head brakeman had been standing was completely destroyed. The engineer stated that he jumped from the locomotive before the collision occurred, and the head brakeman stated he either jumped or was thrown off the side of the locomotive as he attempted to jump at the time of the collision. This accident, which probably would have resulted in fatal injuries to the engineer and head brakeman on train CLSA-09 had they not jumped from the cab before the collision, further demonstrates the need for improved crashworthiness on locomotive cabs.

The Safety Board identified the lack of crash protection provided the occupants of locomotives in an accident at Riverdale, Illinois, on September 8, 1970. At that time, the Safety Board made a recommendation to the FRA for timely improvement of the crashworthiness of railroad equipment, particularly to protect the occupants of locomotive control compartments. In a letter to the Safety Board dated May 3, 1971, the FRA outlined its concern for this problem and set up a meeting with locomotive builders, labor organizations, rail carriers, and the Association of American Railroads (AAR). On January 16, 1973, the FRA advised the Safety Board that it was planning a program to test locomotive control compartments to determine locomotive cab crashworthiness, and that the test program would set requirements for anticlimbing devices and design requirements for locomotive crash post and pilots.

In the interval since 1973, however, this committee has not published any criteria for the structural design of locomotives. Since the original meeting in 1971 with the FRA, the Safety Board has investigated numerous accidents in which crashworthiness has been identified as inadequate to protect the occupants of locomotive control compartments.

As a result of its investigation of an accident at Pacific Junction, Iowa, on April 13, 1983, the Safety Board issued Safety Recommendation R-83-102 to the FRA, requesting that they 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. On April 30, 1984, the FRA responded to the recommendation, indicating that it intended to commence a safety inquiry on issues of health and safety in the locomotive cab, which would be the subject of one or two major safety efforts for the year ahead.

The Safety Board pointed out in its follow-up letter to the FRA on July 5, 1984, that accident investigations continued to indicate that enginecrews were being injured or killed because the locomotive operating compartments or portions thereof are not structurally designed to withstand the impact forces. The Safety Board urged the FRA to direct its attention to this subject when conducting the safety inquiry. As previously noted, inadequate crash protection for the occupants of locomotive cabs has long been a concern of the Board's. (See appendix C.) The Safety Board has not received a formal response to the July 5, 1984 letter, nor is there any evidence that the FRA is making a concerted effort to resolve this problem. The time for studying the problem has long since passed and the head-end crew should be afforded far more protection than is the case with the current design of locomotive operating compartments. The FRA is urged to act

expeditiously to require this protection. In view of the new recommendation being issued with this report, the Safety Board has classified Safety Recommendation R-83-102 as "Closed--Unacceptable Action/Superseded."

Tests and Research

The 34 cars that exceeded UP standards for brake piston travel were not out of adjustment sufficiently to reduce the braking capability of the train.

The bulb removed from the WPX-08 caboose marker light was apparently illuminated at the time of the collision, as indicated by its bent filament, which could have been caused by an abrupt force applied while the filament was hot. Because of the limited visibility, the engineer of train CLSA-09 apparently did not see the illuminated marker and it may not have become visible until the engineer had evacuated the locomotive cab.

The simulated train stopping distance test indicated that even though the engineer of train CLSA-09 did not slow the train when he received the yellow signal indication, if he had applied the train brakes in emergency at the (red) signal at mp 294, the train would have stopped before the collision.

Medical and Pathological Information

The results of the dispatcher's drug tests were reviewed by a toxicologist at the Center for Human Toxicology and by a toxicologist at the Safety Board. Each toxicologist stated that the absence of Delta 9 THC at the time of sampling indicates the dispatcher had not smoked marijuana for about 3 to 8 hours prior to sampling. In sworn testimony given to the Safety Board, the dispatcher admitted that he had used marijuana during the previous July 4 weekend but had used none since that time. Both toxicologists considered this claim to be questionable, given the relatively high carboxy levels at the time of sampling.

Studies on the effects of marijuana 10/ indicate its effects to be dose related, so that lower doses have smaller effects than larger doses. However, research has shown marijuana to impair motor coordination (for example, hand steadiness, accuracy of executing movements), reaction time, and tracking (that is, the ability to follow a moving stimulus). Even in naive users, tracking impairment has been observed to persist for 4 to 8 hours following use. Impairment of intellectual and cognitive functions has also been noted, particularly in verbal fluency, short-term memory, learning ability, calculation skills, ability to follow complex directions, and time sense. One study 11/ found impairment from marijuana to affect pilot performance of complex tasks for up to 24 hours following use.

The situation is confounded by the dispatcher's work hours. Research 12/ on "midnight" shifts, from 11:30/12 midnight to 7:30/8 a.m., has shown that human metabolic rates, such as body temperature and certain hormone levels, tend to drop as part of a

10/ Division of Health Science Policy, Institute of Medicine, Marijuana and Health, National Academy Press, Washington, D.C. 1982.
11/ Yesavage, J.A., Leirer, V.O., Denari, M., and Hollister, L.E., "Carry-Over Effects of Marijuana Intoxication on Aircraft Pilot Performance: A Preliminary Report," American Journal of Psychiatry 142.11, November 1985.
12/ Alluisi, E.A. and Fleishman, E.A. (Eds.), Human Performance and Productivity, Vol. 3: Stress and Performance Effectiveness, Hillsdale, NJ: Lawrence Erlbaum Associates, 1982.

circadian cycle during the early morning hours. This change exacerbates the natural tendency to sleep and can lead to an overall decrease in productivity, a greater propensity for errors, and a reduced ability to perform tasks that require concentration and vigilance. As a consequence, accidents tend to occur more often during these hours 13/than at other times of the day.

The high risk to safety from operator impairment underscores the need for transportation companies to enforce their drug and alcohol prohibitions. After the accident, the dispatcher entered the UP Counseling Employees Assistance Program. After several weeks in the program, counselors recommended his return to normal duties.

Management Oversight

The UP neglected track conditions for 18 months, which affected the signal indications on the North Platte subdivision. This situation indicates a failure to properly inspect and maintain both the track and signal system. The UP officers at the deposition hearing insisted that the engineers should comply with the signal indications and operate their trains in compliance with the restrictions. However, the UP cannot expect engineers to comply with faulty signals. The UP is obligated to correct conditions that result in more restrictive signal indications than required.

Numerous rule violations occurred before and after this accident. The engineer failed to respond to signal indications and bring the train in compliance with their restrictions. The head brakeman was not in the proper position to observe wayside signal indications and failed to reduce the train speed to that required by the signals when the engineer failed to do so. The conductor and rear brakeman of train WPX-08 failed to inspect cars while the train was stopped as required by the rules. The rear brakeman of train CLSA-09 failed to provide flag protection immediately after the accident, as required by operating rule 102 for following trains, because the conductor ordered him to remain on the caboose. Each of these employees had attended and received passing grades in the UP operating rules classes. The Safety Board believes that the circumstances of this accident indicate that non-compliance with operating rules is a result of deficient supervisory oversight, rather than deficiency in rules training. It is apparent that UP management is deficient in its follow-up of employee performance and should therefore review the present procedure for monitoring employee rule compliance.

A regular monitoring of event recorder tape readouts would have indicated when engineers were violating cab signal restrictions and train order speed restrictions. However, the supervisor in charge of engineers had not been reviewing readout tapes of locomotives with cab signal equipment. It is difficult to understand why engineers misunderstood the cab signal rules when each of them had successfully completed an examination of the operating rules less than a year before the accident. Since the road foreman indicated he was riding with engineers to observe their performance, he should have become aware that engineers were misinterpreting cab signal rules. Other railroads are using the event recorder tape readouts to detect operating rule violations and to correct any misunderstanding that operating employees may have. The event recorder has proven itself to be an excellent tool for this type of monitoring and the UP should establish a mandatory program that requires supervisors involved in train operations to frequently and regularly review event recorder tape readouts and correct any employee violating operating rules.

13/ Langlois, P.H., Smolensky, M.H., Hsi, B.P., and Weir, F.W., "Temporal Patterns of Reported Single-Vehicle Car and Truck Accidents in Texas, U.S.A. During 1980-1983," Chronobiology International, Vol. 2, pp 131-146, 1985.

Another area of failure to comply with UP rules is the train crewmembers' practice of switching from the train dispatcher's radio channel after they leave the North Platte subdivision and enter the main line at O'Fallons. The timetable instructions for the Sidney subdivision are that radio communications should be via channel two (the train dispatcher's channel); instead, the practice is to use channel three (the yardmaster's channel). This violation would have been discovered if UP supervisors assigned to the yard at North Platte had monitored the radio communications. UP management either did not know that timetable rules were being violated or they were condoning the practice. Whatever the reason, the UP failure to correct the violation could have discouraged operating employees from complying with other rules.

As a result of an accident at Granite, Wyoming, on July 31, 1979, the Safety Board made Safety Recommendation R-79-80 to the UP to establish a monitoring system for rule compliance of employees operating trains. 14/ On August 25, 1981, the UP responded that they place extreme importance on monitoring rule compliance of operating employees. They also said that extensive efficiency testing for rules compliance was an ongoing effort throughout the UP with the vice president of operations personally reviewing the results on a monthly basis. As a result of this response, the Safety Board classified Safety Recommendation R-79-80 as "Closed--Acceptable Action." The circumstances of this accident indicate, however, that steps outlined by the UP in 1981 have not proven to be effective or were not adequately implemented. Consequently, as a result of this accident and the numerous rule violations involved, the Safety Board is making a new recommendation for the UP to review again the effectiveness of the supervisory checks of employee performance when operating in train service.

The dispatcher position is critical to safe train operations. A dispatcher must constantly make decisions involving the movement of trains while communicating instructions to trains. Scientists from the Institute for Social Research at the University of Michigan have performed extensive research on job demands, worker health, and occupational differences. 15/ They analyzed data from a broad spectrum of occupations, including variables related to demography, personality, stresses, psychological strains, and health-related behaviors. Results of their analyses were reported as correlations or indices of associations or relationships among variables.

In comparison with other occupations, train dispatchers were found to be older (average age of 45 years) and in their jobs longer. As a group, they reported greater workloads, more work than they preferred, more responsibilities, more boredom, and more requirements to concentrate than a group of air traffic controllers. (The researchers selected these two occupations for comparison because both are involved in the "monitoring and dispatching of major conveyances in the nation's transportation system.") The data also revealed that dispatchers are at a greater risk of coronary heart disease than other workers.

An interesting aspect of this study concerned dispatcher communications and feelings of responsibility. In comparing communications of air traffic controllers with dispatchers, the scientists hypothesized:

14/ For more detailed information, read Railroad Accident Report--"Derailment of Union Pacific Railroad Freight Train, Granite, Wyoming, July 31, 1979" (NTSB/RAR-79/12).

15/ Caplan, R.D., Cobb, S., French, T.R., Van Harrison, R., and Pinneau. S.R., Job Demands and Worker Health. Survey Research Center, Institute for Social Research, Universtiy of Michigan, 1980.

> Differences in the content of communications associated with the jobs may in part account for the high responsibility for persons reported by train dispatchers. The contact between air traffic controllers and pilots is typically extremely brief and limited to work related communications. The contact between dispatchers and engineers and other railroad personnel is often more prolonged. Also, train dispatchers are likely to personally know men on the train crew. These more developed interpersonal relationships may increase the feeling of dealing with real people, and hence, feelings of responsibility for them (pp. 163).

A second important finding concerning dispatcher workload is that as a group, they reported both more work on the job (quantitative workload) and more work than they preferred, as compared with other groups. These dimensions were positively related to job dissatisfaction, job stress, and psychological strains.

Therefore, it is extremely important that dispatchers, because of the high job demands and workloads, be alert and free of any substance that would impair their intellectual and cognitive functions. It is also imperative that UP management monitor the activities and workload of dispatchers to require that they are able to perform their duties since their role is so critical to the safety of train movements.

CONCLUSIONS

Findings

1. The engineer of train CLSA-09 operated the train in limited visibility due to fog for the entire 6-hour trip.

2. The engineer of train CLSA-09 operated the train at speeds greater than the signal indications allowed.

3. The foggy weather conditions were unfavorable for safe train operations at the normal track speed of 40 mph.

4. The engineer failed to reduce train speed in compliance with the operating rule for limited visibility.

5. The UP does not have locomotives equipped with automatic train stop that requires the engineer to operate the train in compliance with the signal indications, nor do they regularly monitor event recorder readout tapes to determine the engineer's compliance with signal indication.

6. The engineer of train CLSA-09 did not see the wayside signals as he approached the accident area, because he was fatigued, distracted, or inattentive.

7. The UP had allowed signal problems on the North Platte subdivision to go unrepaired, affecting the credibility of the signals displayed.

8. The UP provided highback seats and lapbelts in the caboose for use by the crewmembers, but the rear brakeman was not in the seat provided and the conductor did not have the lapbelt fastened, resulting in fatal and serious injuries at the time of the collision.

9. The engineer of train CLSA-09 did not apply the train brakes in time to bring the train to a stop before the collision occurred.

10. The restrictive signal indications that the engineer acknowledged but did not obey conditioned him to respond casually to their requirements, so that he was not prepared when the requirements were legitimate.

11. Toxicology test results from blood and urine samples provided by the train dispatcher suggest that he used marijuana 3 to 8 hours prior to sampling.

12. The train dispatcher's drug use could have influenced his on-the-job performance on the morning of the accident, but he had no direct involvement in the circumstances that caused the accident.

13. Toxicological tests on samples from the engineer and head brakeman on the CLSA-09 were confirmed as negative by the Center for Human Toxicology in June 1987.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the engineer of train No. CLSA-09 to recognize the dangerous operating conditions imposed by dense fog and reduce speed accordingly and his failure to reduce speed in accordance with the signal indications as required by the operating rules. Contributing to this accident was the failure of the Union Pacific Railroad to properly supervise operating employees and its failure to correct the false restrictive signals on the North Platte subdivision, which resulted in the engineer disregarding the valid signal indications on the main track.

RECOMMENDATIONS

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

—the Union Pacific Railroad Company:

Install a train control system which will provide for positive separation of trains. (Class II, Priority Action) (R-87-19)

Review the program presently in use and evaluate the supervisory checks of employee performance in the operating rules for rule compliance, especially on the Nebraska division. (Class II, Priority Action) (R-87-20)

Establish a mandatory program that requires supervisors involved in train operations to frequently and regularly review event recorder tape readouts and correct any employee violating operating rules. (Class II, Priority Action) (R-87-21)

Monitor the activities and workload of dispatchers to determine that they are able to perform their duties, which are critical to the safety of train movements. (Class II, Priority Action) (R-87-22)

--the Federal Railroad Administration:

Promptly require locomotive operating compartments to be designed to provide crash protection for occupants of locomotive cabs. (Class II, Priority Action) (R-87-23)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

/s/ JAMES L. KOLSTAD
Member

Patricia A. Goldman, VICE CHAIRMAN, did not participate.

July 23, 1987

APPENDIXES

APPENDIX A

THE INVESTIGATION

The National Transportation Safety Board was notified on July 10, 1986, that a rear end collision and derailment had occurred on the Union Pacific Railroad at North Platte, Nebraska. Three investigators were immediately dispatched from the Washington, D.C. office to the accident site. The following day two additional investigators from the Washington, D.C. office arrived at the site.

Committees for operations, mechanical, track and signal engineering, emergency response, and human performance were established for conducting the investigation. Depositions to take sworn testimony were conducted to obtain the facts of the accident from all individuals involved in the accident.

The Safety Board was assisted in the investigation by the Union Pacific Railroad Company, the Brotherhood of Locomotive Engineers, the United Transportation Union, and the Federal Railroad Administration.

APPENDIX B

CREWMEMBER INFORMATION

Gary L. Songster, Engineer , Train No. CLSA-09

Engineer Songster (32) was employed by the Union Pacific Railroad in August 1975, as a fireman. He worked as a fireman for 7 months and became an engineer in March 1976.

He qualified for the position of engineer by attending classroom training for 3 weeks. Following the classroom training, he made 40 student trips. He attended an operating rules examination in March 1985 and received a passing grade.

Fred R. Dircksen, Head Brakeman, Train No. CLSA-09

Head brakeman Dircksen (34) was employed by the Union Pacific Railroad in 1971 as a switchman/brakeman. He worked as a switchman/brakeman for 7 years and in 1978, he was promoted to conductor.

He qualified for the position of conductor by taking and passing an examination of the operating book of rules.

Thomas E. Smyth, Conductor, Train No. CLSA-09

Conductor Smyth (35) was employed by the Union Pacific Railroad in 1970 as a switchman/brakeman. He worked as a switchman/brakeman for 4 years and on October 10, 1974, was promoted to conductor.

He qualified for the position of conductor by taking and passing an examination of the operating book of rules. His last rules examination was in March 1985.

Mack S. McConahay, Rear Brakeman, Train No. CLSA-09

Rear brakeman McConahay (35) was employed by the Union Pacific Railroad in 1976, as a switchman/brakeman. He worked as a switchmen/brakeman for 7 years and in June 1983 was promoted to conductor.

He qualified for the position of conductor by taking and passing an examination of the operating book of rules. His last rules examination was in March 1985.

Robert C. Haines, Train Dispatcher

Train dispatcher Haines was employed by the Union Pacific Railroad in November 1973 as a telegraher/clerk. In 1979 he was appointed to an apprentice dispatcher position, and then appointed to train dispatcher.

Train dispatchers on the Union Pacific are management positions.

Leonard S. Harper, Engineer, Train No. WPX-08

Engineer Harper (55) was employed by the Union Pacific Railroad in 1950 as a trucker, then as a janitor in 1951. In 1952 he became a locomotive fireman and worked as a fireman for 25 years. He was promoted to engineer in 1977.

He qualified for the position as an engineer because of his long background as a fireman and because he passed an examination in the operating rules. In 1983, he attended an advanced locomotive engineer's seminar and a course on hazardous materials. His last rules examination was in March 1985. His last physical examination was on December 10, 1985.

Dolan, C. Blumberger, Conductor, Train No. WPX-08

Conductor Blumberger (56) was employed by the Union Pacific Railroad in 1949 as a trucker. He became a brakeman in 1953 and was promoted to conductor in 1977.

He qualified for the position of conductor by taking and passing an examination of the operating book of rules. His last rules examination was in March 1985. His last physical examination was in 1986.

Ronald L. Baker, Head Brakeman, Train No. WPX-08

Brakeman Baker (44) was employed by the Union Pacific Railroad in 1964 as switchman/brakeman. In 1977 he was promoted to conductor.

He qualified for the position of conductor by taking and passing an examination of the operating book of rules. His last rules examination was in March 1985 and his last physical examination was in 1984.

Gerald L. Godbey, Rear Brakeman, Train No. WPX-08

Brakeman Godbey (63) was employed by the Union Pacific Railroad in 1953 and has worked as a brakeman since that time.

His last rules examination was in March 1985 and his last physical examination was in 1986.

APPENDIX C

HISTORY OF RECOMMENDATIONS ON THE CRASHWORTHINESS OF LOCOMOTIVE OPERATING COMPARTMENTS

The Safety Board has long been concerned about the crashworthiness of locomotive operating compartments and has issued several recommendations to the Federal Railroad Administration (FRA) and the industry regarding this issue. As recently as December 22, 1983, the Safety Board recommended that the FRA 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 (Safety Recommendation R-83-102). This recommendation was issued as a result of the Board's investigation of a rear-end collision of two Burlington Northern (BN) Railroad Company freight trains near Pacific Junction, Iowa, on April 13, 1983. The operating compartment of the lead locomotive unit on BN train 64T85 was overriden by the caboose of train 43J05 when the trains collided. The locomotive operating compartment was crushed and distorted, especially on the engineer's side. 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.

As the Safety Board noted in the December 22, 1983, recommendation letter, the FRA has studied the crashworthiness of locomotives and much data have been developed, including publication of a report, "Analysis of Locomotive Cabs," in 1982. However, no significant changes in crashworthiness design standards for locomotives have been recommended by the FRA or voluntarily adopted by the railroad industry.

In response to the Safety Board's Safety Recommendation R-83-102, on April 30, 1984, the FRA announced its intention to begin a safety inquiry on issues of health and safety in the locomotive cab and to make it one of the two major safety efforts that FRA would undertake that year.

The Safety Board's interest in the occupational safety in the locomotive operating compartment dates back as far as 1971 and involves various safety related issues.

On September 8, 1970, a collision between an Illinois Central (IC) yard train and an Indiana Harbor Belt (IHB) train occurred on trackage of the IC at Riverdale, Illinois. The collision caused the IC caboose to override the heavy underframe of the IHB locomotive, demolishing the control compartment of the locomotives. Two following cars continued in the path established by the caboose and completed the destruction of the locomotive control compartment. The IHB engineer was found dead in the wreckage of the control compartment. Following its investigation of this accident, the Safety Board recommended that the FRA and the industry continue to expand their cooperative efforts toward the timely improvement of the crashworthiness of railroad equipment, particularly as related to the protection of the occupants of locomotive control compartments (Safety Recommendation R-71-44).

An accident on October 8, 1970, involving a Penn Central Transportation Company freight train and a passenger train near Sound View, Connecticut, again demonstrated the ineffectiveness of the crew compartment to withstand impact forces. As a result of this accident investigation, the Safety Board recommended that the FRA complete its recently initiated efforts in the improvement of the design of locomotive operator compartments to resist crash damage (Safety Recommendation R-72-005). This recommendation was ultimately classified as "Closed--No Longer Applicable" following

the issuance of Safety Recommendation R-78-27, which addresses the same issue. Over the next few years, the Safety Board continued to voice its concern about the crashworthiness of locomotive cab compartments as the FRA continued its research and tests in this area.

The investigation of the collision of three freight trains near Leetonia, Ohio, on June 6, 1975, again prompted the Safety Board to recommend to the FRA that they continue the investigation of the crashworthiness of locomotive cabs with emphasis on personnel safety and consideration of readily accessible crash refuge (Safety Recommendation R-76-009). Following FRA's assurance that it was continuing its studies in this area, the Safety Board classified Safety Recommendation R-76-009 as "Closed--Acceptable Action" on August 6, 1978.

On September 18, 1978, a Louisville and Nashville (L&N) freight train collided head-on with a yard train inside yard limits at Florence, Alabama. The lead unit of the yard train overrode the lead unit of the freight train. The operator compartment provided no protection for the head brakeman and engineer, who jumped from the compartment but were run over by their units.

On August 11, 1981, a Boston and Maine Corporation freight train and a Massachusetts Bay Transportation Authority commuter train collided head-on near Prides Crossing, Beverly, Massachusetts. The 85,000-pound lead car of the commuter train overrode the 247,000-pound locomotive unit of the freight train and pushed the components of the locomotive into the operating compartment, killing three persons.

The Safety Board's investigations of the above accidents resulted in recommendations to the FRA regarding crashworthiness protection to the locomotive operating compartments (Safety Recommendations R-77-37, R-78-27, R-79-11, and R-82-34, respectively). As a result of the completion of the FRA-sponsored report, "Analysis of Locomotive Cabs," the Safety Board on November 24, 1982, classified these four recommendations as "Closed--Acceptable Action."

The Safety Board was pleased to note in 1984 that the FRA, as previously noted, announced plans to conduct a safety inquiry on issues of health and safety in the locomotive cab, and to make it one of two major safety efforts that year. It is the Safety Board's position that accident investigations continue to demonstrate that improvements are needed in the crashworthiness design standards for locomotives. The head-end crew should be afforded far more protection than is the case with the current design of locomotive operating compartments. The Safety Board urges the FRA to act expeditiously to address this issue.

☆U S GOVERNMENT PRINTING OFFICE:1987-181-101:60025