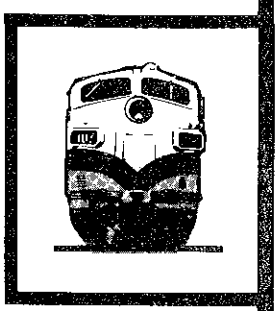
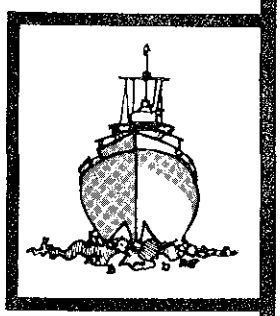
PB88-916303

NATIONAL TRANSPORTATION SAFETY BOARD

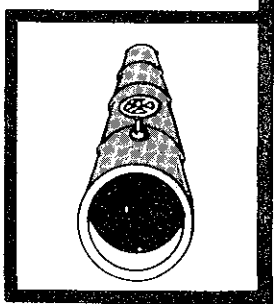


WASHINGTON, D.C. 20594

RAILWAY ACCIDENT REPORT



HEAD-ON COLLISION OF SOUTHERN PACIFIC TRANSPORTATION COMPANY FREIGHT TRAINS YUMA, ARIZONA JUNE 15, 1987



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15 Supplementary Notes

16 Abstract

About 1 15 a m on June 15, 1987, Southern Pacific Transportation Company (SP) freight train Extra 7791 West collided head-on with SP freight train Extra 7267 East near Yuma, Arizona The yardmaster had instructed Extra 7791 West to proceed westward on the westbound main track to the subway, stop, wait for an eastbound train to pass, cross over to the westbound main track, and proceed to the yard office Meanwhile, the yardmaster had planned for Extra 7267 East to depart the yard office and proceed eastward on the eastbound main track to the subway, stop to align the crossover switches, and proceed eastward on the eastbound main track However, Extra 7267 East crossed over to the westbound main track at the subway, and the trains collided head-on The engineer of Extra 7267 East was killed

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Abstract (continued)

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer of Southern Pacific Transportation Company Extra 7267 East to operate his train at restricted speed, while he was under the influence of alcohol, and the failure of the conductor to assure the safe operation of the train Contributing to this accident was the failure of the Southern Pacific Transportation Company to properly supervise its operating employees Contributing to the severity of the accident was the lack of compatability between the sill height of the locomotives

CONTENTS

EXECUTIVE SUMMARY

About 1 15 a m on June 15, 1987, Southern Pacific Transportation Company (SP) freight train Extra 7791 West collided head-on with SP freight train Extra 7267 East near Yuma, Arizona The yardmaster had instructed Extra 7791 West to proceed westward on the westbound main track to the subway, stop, wait for an eastbound train to pass, cross over to the westbound main track, and proceed to the yard office Meanwhile, the yardmaster had planned for Extra 7267 East to depart the yard office and proceed eastward on the eastbound main track to the subway, stop to align the crossover switches, and proceed eastward on the eastbound main track However, Extra 7267 East crossed over to the westbound main track at the subway, and the trains collided head-on The engineer of Extra 7267 East was killed

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer of Southern Pacific Transportation Company Extra 7267 East to operate his train at restricted speed, while he was under the influence of alcohol, and the failure of the conductor to assure the safe operation of the train Contributing to this accident was the failure of the Southern Pacific Transportation Company to properly supervise its operating employees Contributing to the severity of the accident was the lack of compatability between the sill height of the locomotives

This accident report discusses the following safety issues

- Federal Railroad Administration rules on toxicological testing and the application of those rules ;
- supervisory oversight at Yuma by the SP,
- crashworthiness of locomotive operating compartments in low-speed collisions;
- application of Hours of Service designations, and
- the performance of the signal system in the Yuma rail yard

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20594

RAILROAD ACCIDENT REPORT

HEAD-ON COLLISION OF SOUTHERN PACIFIC TRANSPORTATION COMPANY FREIGHT TRAINS YUMA, ARIZONA JUNE 15, 1987

INVESTIGATION

Events Preceding the Accident

At 8.35 p m , mountain standard time, 1/ on June 14, 1987, Southern Pacific Transportation Company (SP) cabooseless unit freight train Extra 7791 West departed Tucson, Arizona, westbound The four-member traincrew consisted of an engineer and conductor, who were in the lead locomotive unit, and two brakemen, who were in the third locomotive unit The traincrew reported that the trip was uneventful from Tucson to Yuma They passed three westbound trains and several eastbound trains that had been pulled into sidings to allow Extra 7791 West to pass

Extra 7791 West was about 6 miles from Yuma when the Yuma yardmaster informed the traincrew by radio that they would be routed on the westbound main track (see figure 1) The train was then to proceed to the "subway" 2/ (see figure 2), stop, and wait for an eastbound train to pass Extra 7791 West was to then line through the crossovers to the eastbound main track and travel against the current of traffic to the yard office Extra 7791 West had to cross over to the eastbound main track because another train was tied down on the westbound main track west of the subway.

After entering Yuma yard and reducing the train to restricted speed, the engineer of Extra 7791 West unsuccessfully attempted to contact the yardmaster to notify her of his train's arrival The head brakeman on the third locomotive unit heard the attempt and made contact with the yardmaster The previous instructions were reiterated with the additional information relayed that the eastbound train was "Extra 7264"and that it was departing the yard office at that time

As Extra 7791 West approached the subway, the engineer and conductor realized that the eastbound train approaching them was on the same track The conductor shouted a warning to the engineer, placed the train airbrakes in emergency from the auxiliary valve, exited the locomotive control compartment through the forward door, and jumped from the train The engineer placed the train airbrakes in emergency from the control stand, exited the locomotive control compartment through the rear door, and jumped from the train Neither brakemen was aware of the impending collision A few seconds later at about 1 15 a m , June 15, 1987, SP Extra 7791 West collided head on with SP Extra 7267 East (see figure 3)

1/ Arizona does not observe daylight savings time

2/ Crossovers at the westward end of multiple main track and the eastward end of double track in Yuma yard (See **Method of Operation** for a further explanation of multiple main track and double track)

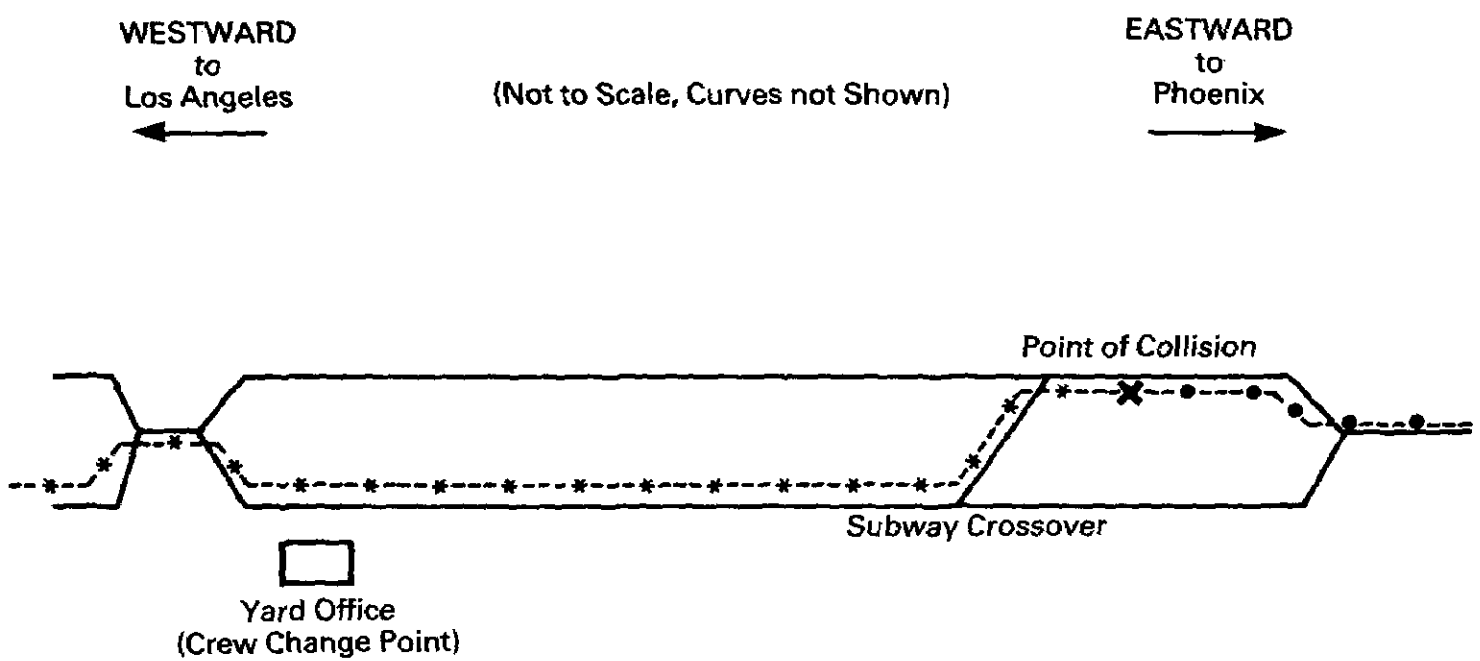

Figure 1 –Train routes to point of collision.

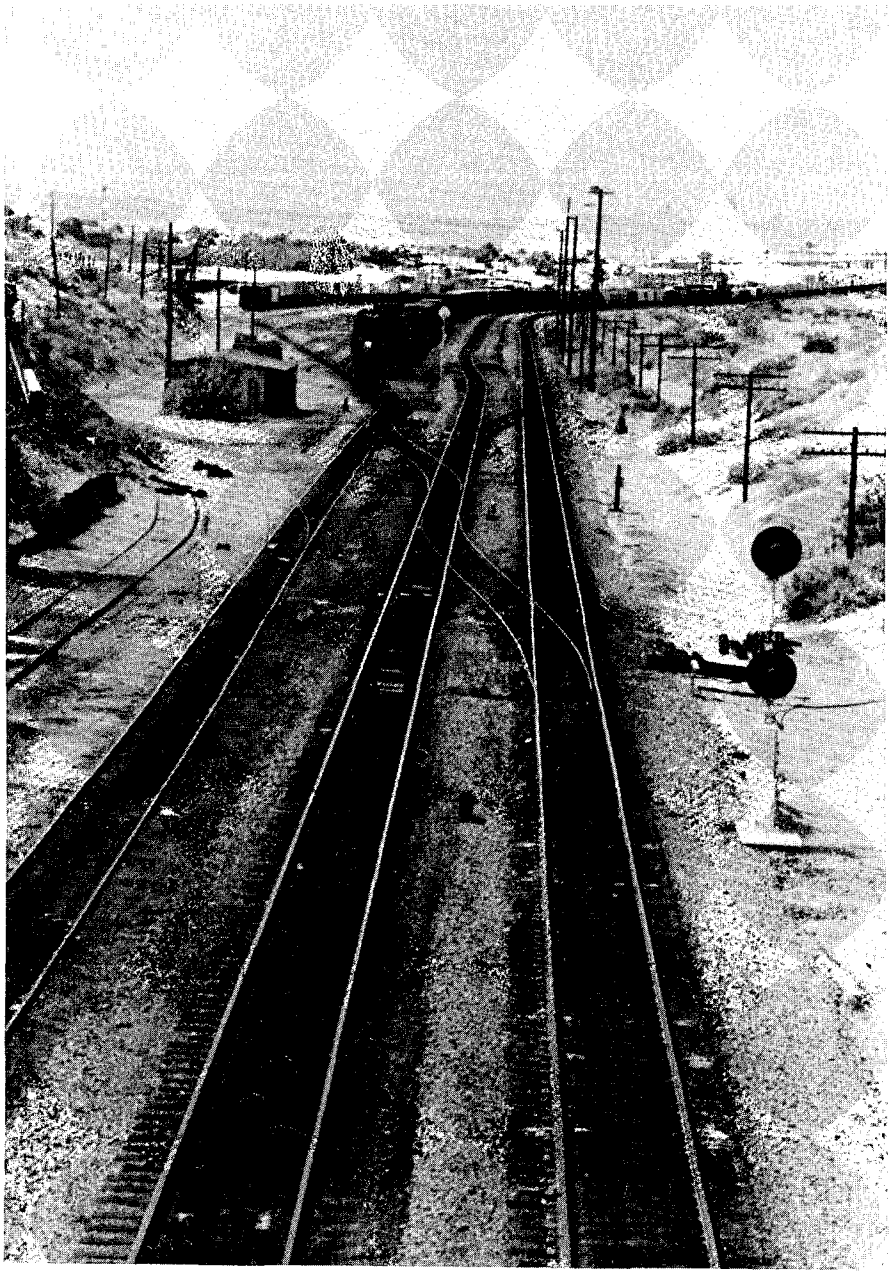

Figure 2.--Westward view of the subway crossovers.

Extra 7267 East was a cabooseless freight train. The traincrew consisted of an engineer, conductor, and two brakemen. The crew for Extra 7267 East was notified at about 11:30 p.m. on June 14 that they were to report for duty at 12:45 a.m. on June 15. All four members of the

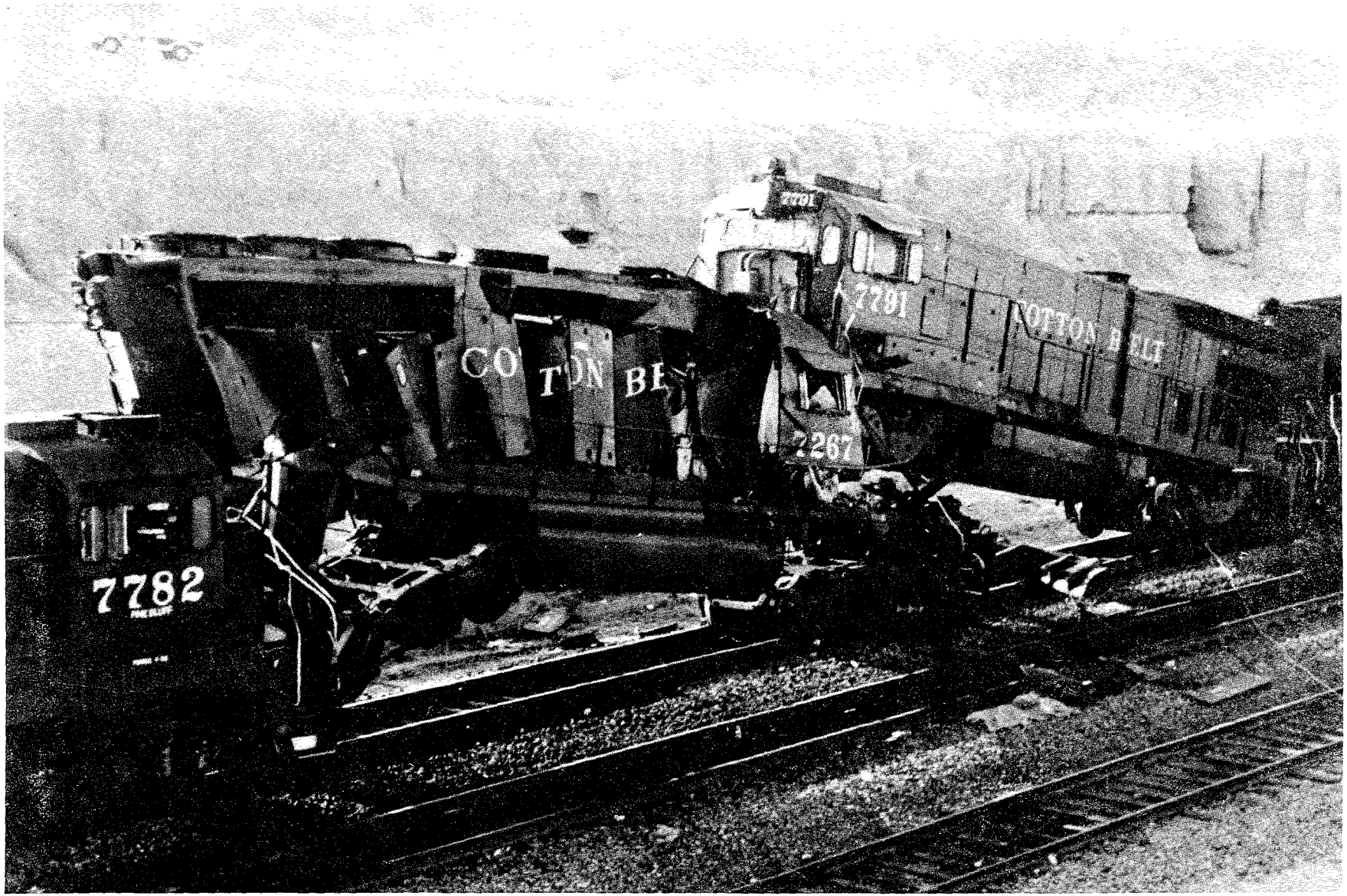

Figure 3.--Point of collision.

traincrew were in their respective rooms at the SP modules 3/ when they received their calls for duty The maid at the modules testified that all four beds appeared to have been slept in and that the shower in the engineer's room had been used

About 12 30 a m , the engineer and conductor arrived separately at the yard office, the brakemen arrived together a few minutes later Both brakemen said they spoke briefly to the engineer when they arrived The conductor spoke to the engineer in more detail, asking the engineer his Social Security and crew numbers to complete the call sheet The conductor stated that he then distributed a copy of the call sheet, train orders, and train profile 4/ to the engineer The conductor and both brakemen stated that they did not smell alcohol on the engineer when they were talking to him and that he did not stagger when he walked or slur his speech

The yardmaster said that she greeted the engineer as she passed him outside on the steps between the locker room and the yard office She further said that she did not speak to him again during the evening

The head brakeman arrived in the yard office about 7 minutes before the crew's scheduled time on duty and inquired what the yardmaster's intentions for his train were and if he had time to put fuel in his automobile The yardmaster testified that she told the head brakeman that the inbound crew on his train was short on available remaining working time under the Hours of Service law 5/ and that she did not think it was a good idea for him to get fuel for his automobile She further stated, "I also told him at that time what the plans [were] about lining the switches at the subway for straight track " According to the yardmaster, the planned departure of Extra 7267 East was to proceed eastward on the eastbound main track from the yard office to the subway, to stop at the subway to align the crossover switches to their normal position, and then to proceed eastward on the eastbound main track The crossover switches had been left in reverse position by the crew of a cabooseless train that had passed previously The head brakeman testified that he recalled the conversation with the yardmaster, but he did not recollect the yardmaster giving him or any other member of the crew any departure instructions

The Yuma night crew dispatcher was at her desk when Extra 7267 East's outbound crew arrived at the yard office She testified she was " very busy" at the time, however, she saw the head brakeman speak to the yardmaster while they were inside the yard office but could not hear the conversation She further testified that a few minutes later she heard the yardmaster inform Extra 7267 East's conductor that "his train would be coming across the river and they would go to the subway, line the switches, and go eastward " According to the night crew dispatcher the conductor replied,"Okay "

After running a computer query 6/ about a restricted car in the inbound Extra 7267 East, the yardmaster stepped outside the door and gave the conductor a computer printout She informed the conductor that the car in question was properly placed to operate eastward to Tucson The yardmaster said that she instructed the conductor at that time about the crossover switches at the subway, and the conductor verbally acknowledged the instructions with an expletive The head brakeman did not acknowledge the instructions, but the yardmaster stated that she assumed he heard them The rear brakeman stated that he was walking up the stairs at the time the instructions were issued and that the engineer was not standing with the group The conductor testified that he did not recall the yardmaster giving him any instructions concerning the position of the switches at

3/ Modules are lodging facilities provided by SP in Yuma at no cost to crewmembers who are away from their home terminal

4/ A train profile is a graphic representation of a given train's weight distribution

5/ U S Code, Title 45, Chapter 3, Railroads, Hours of Service of Employees, a Federal law that specifies the maximum amount of time certain railroad employees may perform service

6/ TCC Format 204--SP computer program designed to match the physical geography and geometry of specific track sections to train makeup restrictions

the subway According to the yardmaster, the last thing the yardmaster said to the crewmembers as she turned to go back into the yard office was, "Don't forget about the switches " This was spoken to the group as a whole and not to any individual

The head brakeman took the computer printout information, called the train dispatcher in Tucson, and identified himself as the conductor of Extra 7267 East The head brakeman told the dispatcher, " this train had no restrictions on it, no restricted cars, and we'd like the speed raised to 55 " The dispatcher informed the head brakeman that he would authorize Extra 7267 East to run 55 miles perhour (mph) if there was no restricted car entrained The head brakeman then informed the engineer that their train speed had been increased to 55 mph, and the engineer acknowledged with a wave of his hand

The crew then proceeded to board Extra 7267 East, which had just arrived outside the yard office on the eastbound main track During several initial interviews, the conductor and both brakemen informed the Safety Board, the Federal Railroad Administration (FRA), the Arizona Corporation Commission (ACC), 7/ and SP that the engineer, conductor, and head brakeman boarded the lead locomotive unit, and the rear brakeman boarded the second locomotive unit in accordance with SP operating rules However, both brakemen recanted their initial statements and testified at the Safety Board public hearing (see appendix A) that the engineer and head brakeman boarded the lead locomotive unit and the conductor and rear brakeman boarded the second locomotive unit

The yardmaster stated that as Extra 7267 East started to depart, she heard the radio transmission "See you later," which she believed to be from the departing train The yardmaster also said she observed the engineer give "kind of a little high ball wave of his hand " She said she responded with a wave of her hand which she believed satisfied the requirement for an outbound engineer to have authority to depart the yard The Yuma trainmaster testified that this procedure was contrary to his understanding of the operating rule requirement for departure authority but that it was the past practice in Yuma

The first wayside signal (signal 7332) that Extra 7267 East encountered was about 1,000 feet eastward on the east main track from the yard office The head brakeman testified that the signal displayed a yellow aspect 8/ which both he and the engineer called The head brakeman further testified that he and the engineer discussed that the signal system was " probably messed up again tonight " The head brakeman also stated that the signal system at that location was often faulty and that it displayed restrictive signals without apparent reason

The head brakeman testified that both he and the engineer observed signal 7340 displaying a red over red aspect, 9/ which they both called as Extra 7267 East approached the subway As the train was coming to a stop, the rear brakeman entered the control compartment of the lead locomotive unit, called the red over red signal, and requested the assistance of the head brakeman in getting the second locomotive unit to load 10/ According to the rear brakeman a red "hot engine" alarm light was illuminated, and he was unfamiliar with the electrical panel on that type of locomotive unit As the head brakeman started to follow the rear brakeman out the door, the engineer requested that the head brakeman " check the water on that unit " After the brakemen left the compartment, the engineer was by himself in the control compartment of the lead locomotive unit

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7/ The ACC is a State agency charged with enforcing Arizona railroad statutes and acting on behalf of FRA to enforce applicable portions of the Code of Federal Regulations

8/ The appearance of a fixed signal conveying an indication as viewed from the direction of an approaching train

9/ A signal displaying a red over red aspect requires a train to stop, then proceed at restricted speed

10/ A locomotive unit which will not respond to throttle increases to provide mechanical energy for use by the main generator

An SP special agent (railroad police officer) on patrol in the vicinity of the subway saw Extra 7267 East stop west of signal 7340, he stated to the Safety Board that the signal was displaying a red over red aspect He further stated that he observed a man leave the operating compartment of the lead locomotive unit as the train was coming to a stop and walk back along the catwalk toward the rear locomotive units The special agent said that he waved to the engineer and that the engineer returned the wave As the train started to move shortly afterward, the special agent began conducting a roll-by inspection

The head brakeman testified that as he was going through the control compartment of the second locomotive unit, he spoke to the conductor about the problem with the unit and how he was attempting to solve the problem Neither the conductor, who was seated in the engineer's seat, nor the head brakeman mentioned that the engineer was alone on the lead locomotive unit or the position of the crossover switches at the subway When the head brakeman was unable to resolve the problem from the electrical panel of the second locomotive unit, he exited the control compartment and went to join the rear brakeman on the catwalk

The brakemen testified that the water sight glass 11/ indicated sufficient water in the locomotive unit, so they began closing the engine compartment doors The head brakeman was closing the doors on the fireman's side of the unit when he heard the airbrakes apply in emergency He said that he looked up, saw a red oscillating light, 12/ and immediately jumped from the train The rear brakeman had started around to the engineer's side of the locomotive after leaving the head brakeman, he was at the trailing end of the second locomotive unit when he heard the airbrakes apply in emergency and saw the reflection of a red oscillating light The rear brakeman testified that he got off the train at that time and ran across the tracks He estimated he was 30 to 45 feet from the train when Extra 7267 East collided head-on with Extra 7791 West about 933 feet east of the subway crossover The head brakeman estimated that the train had traveled about 100 feet between the time he jumped and the collision Both brakemen testified that they were unaware that their train had passed through the crossovers at the subway

The Accident

The conductor testified (see appendix A) that, although he was in the engineer's seat on the second locomotive unit, he was not able to tell that his train had passed through the crossovers at the subway He estimated his train's speed to be 10 mph by "feel" at the time of the collision and that he had no idea where the speedometer was located on the unit he was riding (The speedometer is located directly in front of the engineer's seat on all SP locomotive units) The conductor stated he did not recall hearing the train airbrakes apply in emergency and that he was not aware a collision was imminent The conductor further testified that he believed a conductor was in charge of a train but that he did not discuss train orders, maximum authorized train speed, standard time, entrained hazardous materials, TCC Format 204, departure route, departure authority, crew placement, or the restricted car with the engineer or brakemen Although the conductor was aware that the second locomotive unit was not operating properly, he neither took action nor did he instruct the brakeman to check into the problem He did not offer any assistance when the brakeman began to try and determine the locomotive's problem The conductor testified that he did not issue any instructions to any crewmember on the night of the accident

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11/ A water sight glass is a gage that displays visual measurement of the volume of engine cooling fluid

12/ A red oscillating light is a warning light, mounted on the outside of the locomotive, that is displayed when a train is stopped suddenly under circumstances in which adjacent tracks may be fouled This light is designed to automatically activate when an emergency application of the train airbrakes is made

The SP Yuma trainmaster arrived at the yard office and spoke with the yardmaster within 15 minutes after the accident At that time, the yardmaster informed the trainmaster that she had told the conductor twice about the crossover switches

About 5:31 p m , June 15, the yardmaster raised the question in a tape-recorded interview with an SP official as to whether or not the engineer had been drinking She said twice that she had detected the odor of (what she believed was) alcohol on the engineer, she took no further action to either confirm or deny her suspicions She did not withhold the engineer from service or inform her supervisor before the accident about the engineer's condition She further said that during the 7 months she had been a yardmaster at Yuma, she had observed the engineer about "half a dozen times" and that she considered the engineer to have been drinking "four or five out of the six times " The maid at the modules testified that she had not seen the engineer on the night of the accident, but that on other occasions, within 6 months preceding the accident, she had observed the engineer to be in a condition that she considered "drunk" while he was at the modules According to the maid, the engineer staggered when he walked, had red eyes, and smelled of alcohol on those occasions She further testified that she only observed the engineer in this condition when he checked into the modules, that he was usually by himself, and he would always go straight to his room, and " .when he was leaving to go to work, I never [saw] him drunk "

Later on the evening of June 15, the yardmaster stated to FRA inspectors, in the presence of a Safety Board investigator, that she had smelled alcohol on the engineer as they passed on the steps In her initial statement to the Safety Board, the yardmaster declined to discuss whether or not she had smelled alcohol on the engineer At the Safety Board public hearing, she was inconclusive in determining the nature of the odor that was coming from the engineer

Injuries

Injuries	Extra 7267 East	Extra 7791 West	Total
Fatal	1	0	1
Serious	0	0	0
Minor/None	3	4	7
Total	4	4	8

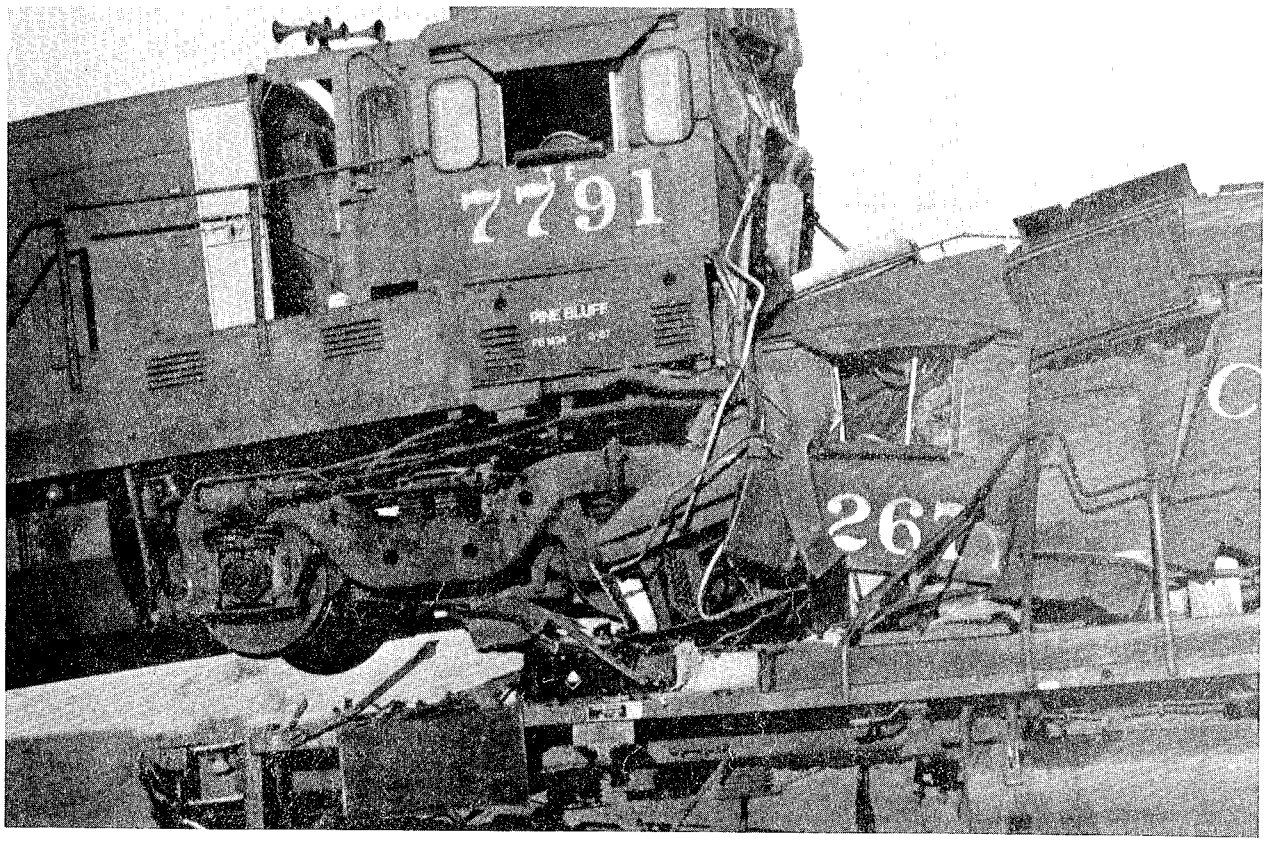
Damage

During the collision, the lead unit (SP 7267) from train Extra 7267 East underrode the lead unit (SP 7791) from train Extra 7791 West SP 7791 penetrated 22 feet into SP 7267 (see figure 4) The penetration was completely through the operating compartment of SP 7267 The collision posts of SP 7267 were bent during the collision on the locomotive unit where the fatality occurred in this accident

SP locomotive unit 7267 was destroyed in the accident Three other locomotive units sustained moderate to severe damage The 28th and 29th head cars in train Extra 7267 East were destroyed, the 30th head car was moderately damaged, and the 60th head car derailed one wheel

Damage was reported by SP to be .

Equipment	$1,681,150
Wreckage/Clearance	25,000
Track	5,000
Signal	2,000
Total	$1,713,150



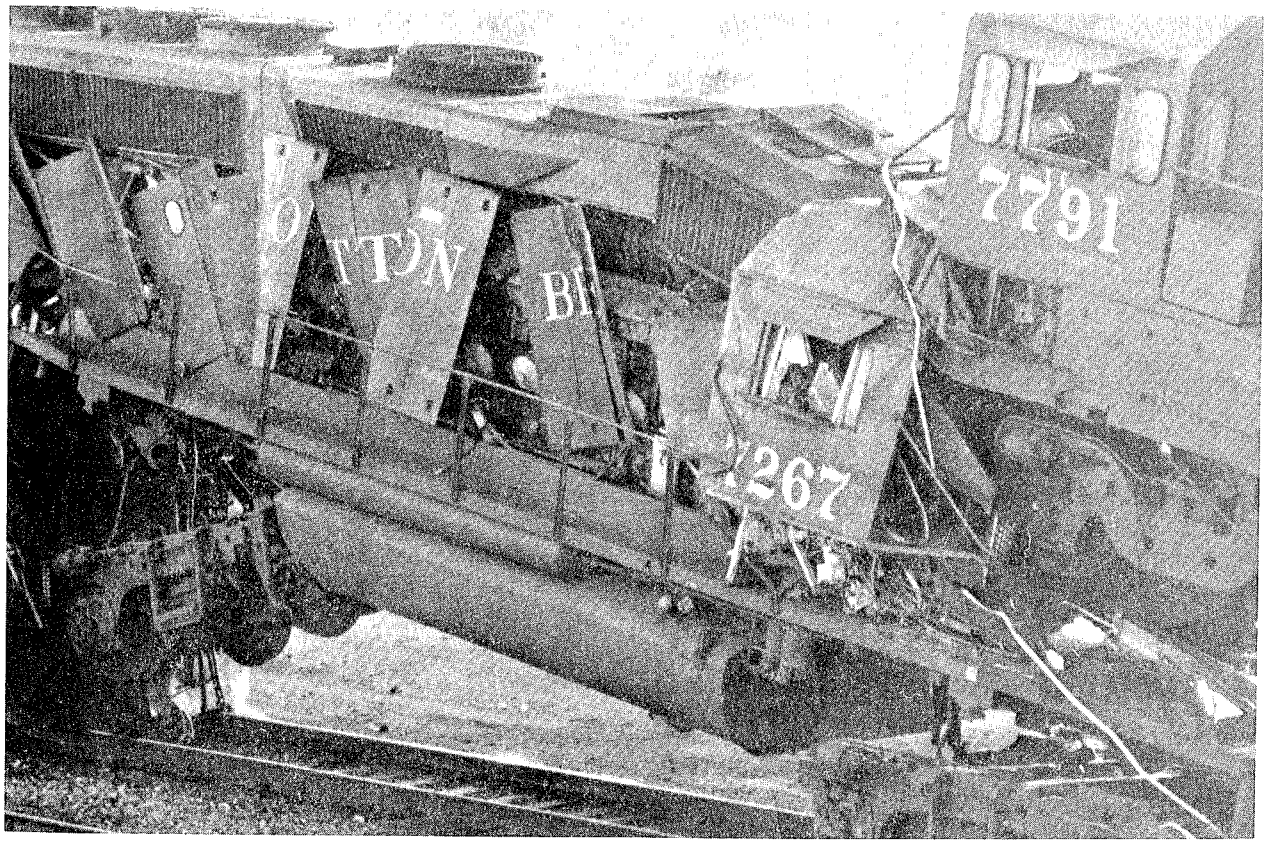


Figure 4.--Over/underride viewed from opposite sides.

Personnel Information

The Traincrews.--The engineers, conductors, and brakemen on trains Extra 7267 East and Extra 7791 West were qualified by SP for their respective positions, and all were current on the General Code of Operating Rules (See appendix B) Extra 7267 East's engineer had been dismissed from service on October 13,1983, for violation of SP's rule G He was conditionally reinstated to service on January 15, 1984 Before being reinstated the engineer passed a physical examination that included toxicological analysis Negative results were also obtained from the engineer for toxicological analysis performed on October 25, 1984, and April 30, 1987

The Yardmaster.--The yardmaster had been employed by SP for about 10 years at the time of the accident She had held several positions including brakeman/switchman, conductor, and yardmaster (see appendix B) On November 17, 1982, she injured her left knee during a derailment, she ultimately underwent surgery and was returned to unrestricted duty on August 23, 1984 On October 8, 1986, she injured her hand while off-duty The injury resulted in a medical restriction from SP which precluded her from performing duty as a switchman/brakeman or conductor At the time of the accident, the only duties SP would allow her to perform were those of yardmaster The yardmaster was contesting the restriction

Other Personnel --On the date of the accident, there were two SP operating officers assigned to Yuma, a road-foreman-of-engines and a trainmaster The road-foreman had been assigned to Yuma in June 1987; he had no previous experience as an operating officer The trainmaster had been assigned to Yuma in March 1987, he had previous experience as an SP operating officer in other locations The trainmaster testified that he tried to be at the Yuma yard office "once or twice a week" between midnight and 4 a m to check on the train crews arriving and departing during those hours There had been about a 4-month period with no resident trainmaster at which time SP rotated operating officers from various locations into Yuma for temporary duty for about 1 week

The night crew dispatcher testified that " very seldom was there ever any officer or anybody around at midnight We sort of ran things by ourselves at midnight " The crew dispatcher further testified that periods of 3 weeks would pass without seeing a trainmaster " in case of emergency we could always get a hold of somebody Otherwise we were our own supervisors "

The night yardmaster testified that the interim operating officers did not come to the yard at night when she was working The yardmaster further testified, "I guess I'm considered a supervisor by the company, but I don't consider myself a supervisor "

Train Information

The locomotive of train Extra 7267 East consisted of four diesel-electric locomotive units The first, third, and fourth locomotive units were model GP 40-2, four-axle, 3,000 hp freight units, weighed 278,000 pounds each, and were manufactured by the Electro Motive Division (EMD) of General Motors Corporation The second locomotive unit was a model B 30-7, four-axle, 3,000 hp freight unit, weighing 276,000 pounds, and was manufactured by General Electric (GE) The cabooseless train had 28 loaded and 102 empty freight cars and was 8,463 feet in length with a trailing weight of 6,834 tons

The locomotive of train Extra 7791 West consisted of five diesel-electric locomotive units The first and second locomotive units were GE model B 30-7, four-axle, 3,000 hp freight units, and weighed 280,000 pounds The third locomotive unit was an EMD model GP 40-2, four-axle, 3,000 hp freight unit, weighing 278,000 pounds The fourth locomotive unit was an EMD model SD 40-2, six-axle, 3,000 hp freight unit, and weighed 411,000 pounds The fifth locomotive unit was an EMD model SD 45-2, six-axle, 3,600 hp freight unit, and weighed 411,000 pounds The cabooseless train had 60 loaded freight cars and was 5,868 feet in length with a trailing weight of 4,388 tons

The second locomotive unit (SP 7782) on train Extra 7267 East was idling when it arrived at Yuma During the wreckage removal process, the unit was put on line without incident and then used for about 14 hours to clear the wreckage and to charge the train line for the airbrake tests No defects were noted with the operation of the unit at that time The unit was later mechanically inspected at the SP locomotive plant in Sacramento, California No defects were discovered during that inspection that were relative to the unit's loading capabilities

SP's Los Angeles division mechanical officer testified that since 1972, all locomotive units purchased by SP have had manufacturer installed anticlimbers on the front and rear According to the division mechanical officer, the anticlimber is designed to keep the coupler down and withstand the longitudinal forces generated during a collision with a caboose He knew of no anticlimber that would withstand the longitudinal forces generated by the head-on collision of two freight trains There are no Federal standards or requirements for anticlimbers

SP locomotives are equipped with collision posts which are located in the short hood forward of the control compartment SP's Los Angeles division mechanical officer stated that the design specifications for the shear value of the collision posts were 297,000 pounds for the left side and 249,000 for the right side These values are measured at a point even with the top of the underframe member to which they are attached In addition, the collision posts are designed to resist a bending force of 166,600 pounds on the left side and 95,700 pounds on the right side This bending force is to be applied at a point 18 inches above the top of the underframe There are no Federal standards or requirements for collision posts

SP's freight locomotive fleet consists primarily of GE and EMD locomotives The division mechanical officer further said that the main frame is the strongest part of the locomotive The main frame is designed to withstand the load of routinely pulling 15,000-ton trains On GE locomotives, the main frame sill members are located 67 75 inches above the top of the rail (ATR), on EMD locomotives the sill members are located 61 75 inches ATR There are no Federal standards for main frame height ATR

Track and Signal Information

Track.--The collision occurred at about milepost (MP) 734 5 on main track No 1 This track was constructed of 132-pound RE section 13/ continuous welded rail The rails were laid on double-shouldered tie plates atop 7-inch by 9-inch by 8-foot 6-inch treated hardwood crossties The crossties were laid in crushed rock and slag ballast with compacted full tie cribs The ballast section extended 10 inches below the tie bottoms and more than 12 inches beyond the tie ends Approaching the accident site in a westward direction, the track progressed through a 1° 17' curve to the right The track profile was 0 575 percent descending for westward trains

On the day of the accident, an inspector for the ACC, Railroad Division, inspected the main tracks in Yuma yard between MP 734 0 and 737 8 The ACC inspector noted 11 track defects during the inspection Item nos 2 and 3 on the Track Inspection Report described a "Point open 1/4 inch" and "Heel of switch insecure" on the crossover at MP 734 0 The SP Yuma roadmaster signed the Track Inspection Report to acknowledge receipt

SP authorizes both passenger and freight trains to operate at 25 mph on either main track between MP 734 5 and 732 1 in Western Region timetable No 1 In order to authorize that speed, the track must be maintained to meet or exceed the standards set forth by FRA in Title 49 Code of

13/ An 132-pound RE section refers to rail which nominally weighs 132 pounds per linear yard and is a standard rail section recommended for use by the American Railway Engineering Association

Federal Regulations Part 213 for class 2 track The maximum authorized speed through the No 10 hand throw crossover between No 1 and No 2 tracks at the subway was 10 mph

Signals.--Yuma yard is equipped with an automatic block signal system. The wayside signals had 8 3/8-inch-diameter clear lenses with single filament, 25-watt, 10-volt bulbs Power was supplied by commercial 110-volt alternating current that continuously charged storage batteries Direct current from the 10-volt batteries provided operational power to the signal system Signal color change occurred as a result of colored roundels that were electrically moved in front of a clear bulb in the signal head

The double main tracks are signaled with the current of traffic between MP 732 5 and 734 3; there are no signals for movement against the current of traffic Both multiple main tracks are signaled for movement in either direction between MP 734 3 and 737 4 There are block occupancy indicators 14/ associated with the crossovers at the subway (see figure 5)

On June 18, 1987, a Safety Board investigator was accompanying an SP official in Yuma yard when they both observed signal 7332 displaying erratic aspects The signal was repeatedly cycling through red, yellow, and green aspects The SP official contacted the Yuma signal department and ordered an immediate inspection of the signal During the Safety Board's on-scene investigation, several SP operating personnel reported that they had observed erratic signal displays in Yuma yard for an extended time The Yuma trainmaster testified that while he had only been assigned to Yuma since March 1987, he had reported the signal system "pumping [displaying cycling aspects] three or four times" to the signal supervisor These reports were a result of personal observations and incidents reported to him by various Yuma yardmasters and traincrews The trainmaster further testified that he had accompanied an FRA signal inspector and SP signal supervisor during an FRA audit of the Yuma signal system in April 1987 Defects in track hardware were observed during the audit, those defects determined to be adversely affecting the signal system were corrected that day

On the evening of June 20, 1987, another Safety Board investigator observed signal 7340 displaying a double flashing red aspect The on-duty Yuma yardmaster indicated that it was not a proper aspect for the signal to display, and the investigator reported the defective signal to the SP. A short while after the report, an SP signal supervisor arrived at signal 7340 Both the investigator and the signal supervisor observed signal 7340 displaying intermittent double red aspects At that time, there was no train in the block approaching signal 7340, there was a train moving on an adjacent track During the signal supervisor's attempts to determine the source of the problem with signal 7340, he discovered that the signal mechanism housing for signal 7342 was open which was contrary to the requirements of Part 236 After securing the housing, the signal supervisor continued to search for the problem with signal 7340 when he discovered signal 7344 displaying a yellow aspect According to the SP signal supervisor, track conditions at that time should have caused signal 7344 to be dark The signal supervisor determined that signal 7344 was in a "fail safe" mode and informed the Safety Board investigator that he would attend to it after attending to signal 7340

While trying to resolve the problem with signal 7340, the signal supervisor discovered the switch point gapped in excess of 1/4 inch on the east end of the crossover between No 2 track (eastbound main) and the yard lead track This resulted in signal 7342 displaying a red aspect The signal supervisor removed the switch from service for reverse movement and spiked it in normal position This was the crossover switch that the ACC had reported "Point open 1/4 inch" in the inspection made after the accident on June 15, 1987 With the switch spiked in the normal position,

14/ The block occupancy indicators are part of the signal system that uses an enclosed wayside semaphoric indicator to convey information regarding block occupancy

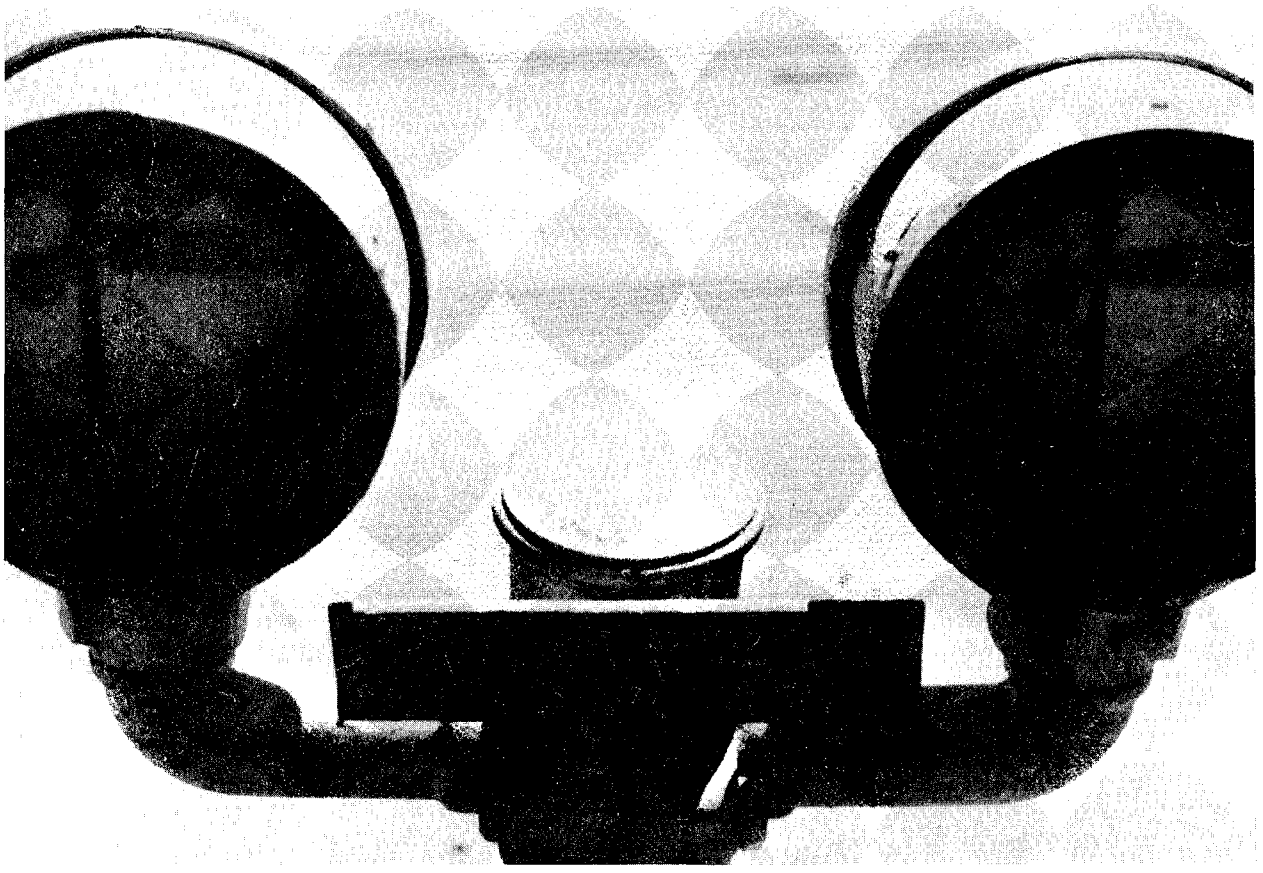


Figure 5---Block occupancy indicator displaying aspects that the track to be entered is occupied in both directions.

trains could not be assembled for departure from Yuma yard so the signal supervisor called an SP operating officer to assist him.

While waiting for the operating officer to arrive, the signal supervisor continued with electrical checks of signal 7340. During these checks, SP train Extra 7803 East stopped at the subway crossovers and the head brakeman reported that signal 7332 was malfunctioning. The brakeman stated that the signal was repeatedly cycling through the red-yellow-green aspects. In addition, the brakeman stated that it had been malfunctioning for 5 years. This was the same signal that had been observed malfunctioning by the Safety Board investigator and SP official on June 18, 1987.

The Yuma road-foreman-of-engines arrived and arranged through the SP train dispatcher for track repair forces to repair the crossover switch. After adjustments were made to the switch hardware, the signal still would not clear. The track repair forces determined that metal flow from the stock rail was forcing the switch point open. The track forces ground the stock rail to allow the switch points to close. Then the signal supervisor adjusted the switch signal circuitry and signal 7342 cleared.

When control of the crossover was returned to the Yuma yardmaster, the yardmaster on-duty at that time orally reported to the signal supervisor that signal 7332 was malfunctioning "like it always does." The signal supervisor testified that during the 3 years he had been assigned at Yuma, signal 7332 had been reported to him "probably 15, 20 different times." The signal supervisor further testified that he electronically rechecked signal 7340 on June 22, 1987, and discovered the

values on two relays were off Both relays were subsequently replaced Safety Board investigators observed four signals malfunction--7332, 7340, 7342, and 7344 In each instance, the respective signal displayed a more restrictive aspect than actual track conditions required

Method of Operation

Yuma yard is the division point between the Los Angeles Division and the Tucson Division Yard limits extend between MP 732 5 and MP 737 4, and the train movements within these limits are directed by the Yuma yardmaster, applicable operating rules, and block signal indication. Train operations on either side of the Yuma yard are governed by centralized traffic control The Los Angeles train dispatcher controls from MP 732.5 westward, the Tucson train dispatcher controls from MP 737 4 eastward

Applicable portions of operating rule 93 prescribe·

Yard Limit Rule Within yard limits, the main track may be used by trains or engines, not protecting against other trains or engines

Movements within yard limits must be made at restricted speed, unless the main track is known to be clear by a Clear, Approach Limited, Advance Approach or Diverging Clear signal

Movements against the current of traffic must not be made unless authorized and protected by yardmaster or other authorized employee

Multiple main tracks extend from MP 737 4 to MP 734 3 (subway) The westward main track is designated track No 1, the eastward main track is track No 2 and is detailed in the timetable per operating rule 153 Timetable instructions specify "Yuma Between MP 734 3 and MP 737 4 trains and engines may use main tracks in either direction, being governed by signal indication " Both tracks are equipped with ABS that govern train movement in either direction (See figure 6)

Operating rule 153 states

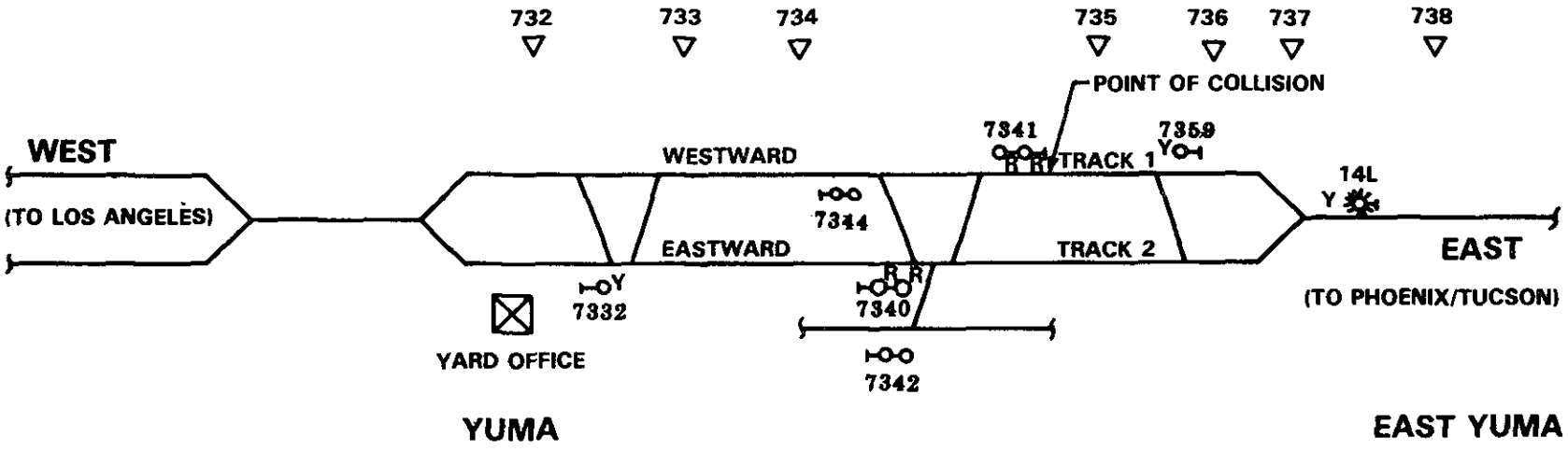
Multiple Main Tracks Where multiple main tracks are in service, each main track will be designated by name and number When necessary the use of tracks will be indicated in the timetable

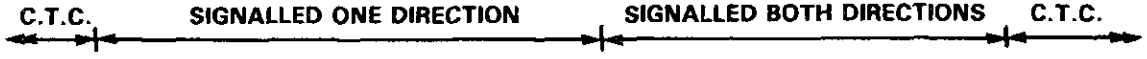
Double track extends from MP 732 5 to MP 734 3 (subway) Both tracks are equipped with ABS that govern trains moving with the current of traffic, there are no signals for trains moving against the current of traffic The General Code of Operating Rules adopted by SP on October 28, 1985, include the following definitions·

Current of Traffic The movement of trains on a main track, in one direction, specified by the rules

Double Track Two main tracks, on one of which the current of traffic is in a specified direction, and the other in the opposite direction

Restricted Speed 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





Situation at Accident

NOT TO SCALE

SOURCE: SOUTHERN PACIFIC

Figure 6---Plan view of Yuma (curves not shown).

Operating rule 80(A) states

Repeat Instructions Instructions or information received verbally relating to train or engine movements must be repeated by the employee receiving such instructions or information

Operating rule 104(C) states in part

Crossover Switches and Switches in Sidings The normal position of crossover switches is lined for other than crossover movement They must be lined in normal position except when changed for immediate movement through them

The crossover switches at the subway had been left unattended in reverse position when a previous cabooseless train had passed through them about 45 minutes before the accident The crossover switches were left reversed on instructions from the Yuma yardmaster Both the manager of rules and safety for the SP system and the Yuma trainmaster stated that a yardmaster did not have the authority to instruct a traincrew to leave crossover switches reversed at Yuma The Yuma trainmaster further testified " it has been past practice in Yuma yard not to line behind" and that this practice was contrary to the prescribed operating rules

According to SP, operating rules can be modified to allow for site specific circumstances either through the applicable timetable or a general order There are several places in Western Region Timetable No 1, which was in effect at the time of the accident, where rule 104(C) has been modified to allow trains to leave crossover switches reversed, however, the rule had not been modified at Yuma

Operating rule 106 states in part

Responsibility of Trainmen and Enginemen. The conductor and the engineer are responsible for the safety and protection of their train and the observance of the rules, and under conditions not provided for by the rules, must take every precaution for protection

(1) The general direction and government of a train is vested in the conductor and all persons employed on the train must obey his instructions, except they will not comply with any instructions which imperil the safety of the train or involve a violation of the rules Should there be any doubt as to authority for proceeding, or safety, the conductor must consult the engineer who will be equally responsible for the safety and proper handling of the train

Operating rule 212 (regarding train orders) states in part :

Checking Correctness· Immediately upon receipt of clearances and train orders, they must be carefully checked for correctness by those addressed and then by other crew members It must be known that they are properly addressed and that order numbers on the clearance correspond with the orders received All crew members are responsible for complying with the requirements of train orders and reminding each other of their contents

Operating rule 106(A) states in part.

Maximum Speed Conductors and engineers are jointly responsible for ascertaining the maximum authorized speed for the operation of their train or engine and such speed must not be exceeded

As Extra 7267 East was traversing the crossover at the subway before the collision, it reached a recorded speed of 16 mph The timetable specifies the maximum authorized speed through that crossover is 10 mph

Western Region timetable special instructions, Section C-2, restricts train speed to 45 mph if an empty gondola with an SP computer identity of "GP" is entrained The 76th head car on Extra 7267 East was an empty GP gondola The train consist was annotated, "Unsafe car location in train BO 363116 GP may not be properly entrained has a 45-mph speed restriction - see timetable "

Section E of the Western Region timetable special instructions governs train makeup restrictions Trains may be exempted from compliance with certain restrictions by an SP division officer or train dispatcher if "that train has passed TCC Format 204 " This method of exemption does not apply to conditions covered under Section C

Western Region timetable special instructions, Tucson Division, Gila Subdivision, states in part

> Yuma Between MP 734 3 and MP 737 4 trains and engines may use main tracks in either direction, being governed by signal indication
>
> Rule 313 Yuma When signal 7343 adjacent to No 2 Track displays red aspect, train or engine may pass this signal without stopping to move against current of traffic after authorized

Operating rule 317 states in part

> Entering Main Track at Hand Operated or Spring Switch within block system limits, crew member or switch tender must open switch and wait 5 minutes at the switch to establish block signal protection before train enters main track The 5 minute wait is not required
>
> (2) Where block occupancy indicator indicates block clear,
>
> (3) When block signal governing movement to main track displays a proceed indication,
>
> (4) When signals governing movements on main track indicate no train is approaching from either direction,

Operating rule 620 states in part

> When practicable, crew members on head end of freight trains must ride in control compartment of the engine When the conductor is riding the head end, he will ride in the control compartment

The manager of rules and safety for the SP system testified that the "when practicable" portion of rule 620 was interpreted to mean that if the controlling locomotive unit was equipped with three seats, then the conductor and one brakeman were required to ride in the control compartment of that unit The conductor of Extra 7791 West testified that while there were three seats available in the controlling locomotive unit of his train, both of his brakemen were riding in the third locomotive unit He further testified that this was a common practice The conductor of Extra 7267 East testified that he believed a conductor could ride "anywhere he wanted to" on a cabooseless train

SP General Rule D states.

> Employees must cooperate and assist in carrying out the rules and instructions and must promptly report to the proper officer any violation of the rules or instructions, any condition or practice which may imperil the safety of trains, passengers or employees, and any misconduct or negligence affecting the interest of the Company

SP's Rule G, as revised in the timetable, states

> The use of alcoholic beverages or intoxicants by employees subject to duty, or their possession, use, or being under the influence thereof while on duty or on Company property, is prohibited Employees shall not report for duty under the influence of, or use while on duty or on Company property any drug, medication or other substance, including those prescribed by a doctor, that will in any way adversely affect their alertness, coordination, reaction, response or safety Questionable cases involving prescribed medication shall be referred to a Company Medical Officer The illegal use, possession or sale while on or off duty of a drug, narcotic, or other substance which affects alertness, coordination, reaction, response or safety, is prohibited

SP policy requires that conductors complete a written certification to the effect that neither the conductor nor any crewmember are in violation of rule G (see appendix B) This certification was known as a "rule G slip." The conductor of Extra 7791 West completed a rule G slip before his train departed Tucson The conductor of Extra 7267 East testified that no blank forms were available when he went on duty in Yuma so he did not complete a rule G slip He further testified that although there was clerical staff on duty at the time, he did not make a request for a blank form SP conductors are not trained to recognize the signs of drug intoxication in another employee

A review of the records from June 12, 1987, through June 14, 1987, revealed that 40 trips had originated from Yuma There were 27 completed rule G slips associated with those 40 trips, none of the completed rule G slips were from Tucson crews The Yuma crew dispatcher testified that she had experienced refusals from Tucson conductors to accept rule G slips before the accident The Yuma trainmaster testified that the crew dispatcher had told him of such instances and that he had informed the conductors involved that it was their responsibility to complete a rule G slip

Tests and Research

No meaningful postaccident inspection of the control settings on the lead locomotive unit of Extra 7267 East could be made because of the severity of the collision and the emergency response efforts that were made to extract the engineer The SP division mechanical officer, Los Angeles Division, testified that he inspected the control settings on the lead locomotive unit of Extra 7791 West before the locomotive was separated from the Extra 7267 East The throttle was in the off position, and the automatic airbrake handle was in emergency

The locomotive sanding systems of both locomotives involved in this accident were tested and observed to release sand immediately on an emergency airbrake application There was sand in the hoppers of the trailing units on each locomotive Locomotive sand was observed on the rail 69 feet to the rear of the rear truck on the trailing locomotive unit of Extra 7267 East and 179 feet to the rear of the rear truck on the trailing locomotive unit of Extra 7991 West

Sight Distance Tests.--Sight distance tests were performed between 9.45 p m and 11.42 p m on June 18, 1987 The weather at the time was dark and clear The tests were performed using an eastbound GE locomotive (SP 7759) and a westbound EMD locomotive (SP 7621) with the short hoods forward which were similar to the locomotive units involved in the accident The headlights on both locomotives were illuminated during the tests Representatives from the Safety Board, SP, Brotherhood of Locomotive Engineers, and the United Transportation Union were present in the operating compartments of the locomotives during the tests

For the first test, the locomotives were positioned where sand had been discovered on the rails after the collision--eastbound 69 feet from the point of impact westbound 179 feet from POI The occupants of both locomotives agreed that the opposing locomotive was on the same track

During the wreckage removal process, SP had moved the lead locomotive unit from the westbound train involved in the collision into the clear on the inside of the curve This presented a sight distance obstruction during the testing that did not exist at the time of the accident

Ten tests were performed with the locomotives positioned with separations ranging from 490 feet to 1,350 feet At the 1,275-foot separation, the occupants in each locomotive could determine that an opposing train was approaching, but they could not determine which track the opposing train was on At the 800-foot separation, the occupants in each locomotive could determine that the opposing train was on the same track

When the eastbound locomotive went through the crossover from track No 2 to track No 1 during the sight distance testing, the occupants observed that the maneuver could be detected by direction, sight, and sound The test locomotive was traveling 5 mph through the crossover

Event Recorder.--The lead locomotive unit on train Extra 7267 East was equipped with a multi-event recorder SP's Los Angeles division mechanical officer testified that 300 of their 1,600 locomotive units (about 19 percent) were equipped with multi-event recorders In addition, approximately 100 locomotives a year are being equipped as they are processed through rebuild programs Although SP 7267's recorder was destroyed in the collision, the data pack was intact Following the recovery of the data pack, SP transcribed the information onto a strip chart for readout The strip chart indicated readings for time, speed, and load (amps); there were no readings for throttle position, dynamic brake, or automatic brake The Safety Board took possession of the tape and subsequently took it to the manufacturer for a readout The strip chart produced from this readout duplicated SP's results

The entire data pack playback indicated that the automatic brake, locomotive brake, throttle, dynamic brake, and direction of travel elements (all recorded on the digital word channel of the data pack) were working improperly throughout the readout To determine the reason for the absence of these elements, the contents of the data pack were recorded onto a four-track audio reel-to-reel tape at the Safety Board's laboratory in Washington, D C To visually display the signals (data) recorded, a four-channel visacorder and the copy tape were used to plot the wave forms corresponding to each of the four data channels A strip chart was prepared from the data (see appendix C) The output from observation of the visacorder indicated that, although data were being recorded onto the digital data word channel, the data recorded were erroneous In other sections of the data pack, the digital word signal was weak and intermittent, preventing the playback unit from reading the data It was determined that the digital word channel was inoperative while the data were recorded on the data pack, and all data recorded via the digital word channel were unusable However, the digital word channel malfunction does not affect the reliability of the data recorded on the other three channels, time, speed, distance, and current elements were all recorded normally The data indicated that Extra 7267 East was traveling 16 mph through the crossover

Airbrake Inspections.--The airbrakes were inspected on both trains after the collision Piston travel was checked on Extra 7791 West and it was determined that no piston had travel in excess of that allowed by Part 232 The airbrakes were applied and released, operating as designed, without any binding or fouling being observed All brake shoes were inspected and found to be within tolerance as set by the Association of American Railroads (AAR) in Interchange rule 12 During the train brake pipe leakage and continuity test, it was discovered that the auxiliary reservoir pipe was broken on car RTTX 156429 and that the brakes were cut out on ATSF 296201 After isolating the broken pipe, a successful train brake pipe leakage test was made The train brake pipe held at 1 psi per minute, Part 232 allows a maximum of 5 psi per minute The fractured surfaces of the auxiliary reservoir pipe were not oxidized or corroded

Extra 7791 West received a 1,000-mile intermediate road train airbrake test before departing Tucson The train did not stop between Tucson and the point of collision Part 232 requires that all " cutout cocks must be properly positioned " during an intermediate road train airbrake test The FRA took exception with SP for the brake system on ATSF 296201 being cutout

Piston travel was checked on Extra 7267 East and it was determined that no piston had travel in excess of that allowed by Part 232 The airbrakes were applied and released, operating as designed without any binding or fouling being observed with the exception of the 28th (SOU 16263) and 29th (TTLX 905733) cars These two cars had derailed in the accident and had sustained major underframe damage, rendering the braking system inoperative All brake shoes were inspected and found to be within tolerance of AAR Interchange rule 12 During the train brake pipe leakage and continuity test, it was discovered that the 123rd car (SSW 62559) leaked 15 psi brake pipe pressure in 12 seconds from an air fitting The fitting was repaired and a successful leakage test was then completed FRA took no exception with SP over the condition of Extra 7267 East's brakes

Signal System.--At about 5 30 a m on June 15, 1987, the positions of the signal relays of those signals associated with the accident were observed and recorded The relay cases were then secured with padlocks During the day, the FRA signal inspectors and SP signal personnel made extensive tests of the signal system for resistance to ground and crossed circuitry All the tests were negative for improper grounds or any crossed circuits

On the evening of June 15, after the trains and wreckage were removed from the tracks, a complete signal operations test was made This test consisted of shunting the various signal blocks and observing signal aspects, operating every hand-thrown switch associated with the signal blocks and observing signal aspects, and simulating train movement with rolling shunts while observing signal aspects The testing did not simulate vertical load on the rail nor were the aspects of the block occupancy indicators at the subway observed All signals displayed the proper aspect for the various simulated track occupancy conditions Signal relays positioned as described resulted in the following signal aspects

Extra 7791 West

Signal	Aspect	Name	Indication
14L	Flashing yellow	Approach medium	Proceed prepared to pass next signal not exceeding 40 mph
7359	Yellow	Approach	Proceed prepared to stop at next signal, trains exceeding 40 mph immediately reduce to that speed
7341	Red over red	Stop and proceed	Stop, then proceed at restricted speed

Extra 7267 East

7332	Yellow	Approach	Proceed prepared to stop at next signal, trains exceeding 40 mph immediately reduce to that speed
7340	Red over red	Stop and proceed	Stop, then proceed at restricted speed

In addition, these are the signal aspects that all surviving train crewmembers who observed signals stated were displayed at the described locations

In conjunction with the signal testing, the FRA inspected the documentation required to be kept in each signal case The FRA noted two defective conditions in that inspection In one instance, the plans were not correct, in the other instance, the plans were deteriorating and difficult to read The FRA took exception with SP for both defective conditions, however, the FRA stated that the exceptions were administrative in nature and would not have effected the operations of the signal system

Medical and Pathological Information

Following the accident, the surviving crewmembers from both trains were required to submit blood and urine samples for toxicological testing in accordance with Part 219 Tissue samples from the deceased engineer were also obtained Since the yardmaster's position at Yuma was not covered under the Hours of Service law, the FRA requirement for postaccident toxicological testing did not apply, however, SP policy regarding toxicological testing requires any employee in a safety sensitive position to be tested SP considered the yardmaster's position to come within this area and, therefore, it obtained urine samples

The surviving crewmembers were transported to the Yuma Regional Medical Center (YRMC) at about 2.30 a m on June 15 for medical evaluation and the collection of blood and urine samples for later toxicological testing The YRMC provided medical treatment but refused to collect the samples, even though none of the crew objected to giving the samples

Following YRMC's refusal to collect the samples on June 15, the SP immediately searched for a medical facility in Yuma that would open early to collect the samples A local doctor agreed and opened his office at 7 a m The surviving crewmembers were taken there and blood and urine samples were collected At about 9 30 a m , the surviving crewmembers were taken to a third medical facility (Urgent Care) where they gave urine samples for SP's toxicological testing program The yardmaster also gave a urine sample at Urgent Care

The body of the deceased engineer was removed from the wreckage at approximately 11 50 a m on June 15 and was taken to YRMC Samples of lung, liver, kidney, bowel liquid, vitreous humor, and blood clot were collected

This was the second time in 2 weeks that the YRMC had refused such a request from the SP The first instance, a derailment near Yuma on June 3, required the implementation of the FRA's postaccident toxicological testing requirement Both accidents occurred during the evening hours and YRMC was the only medical facility open at night When the YRMC refused to collect the samples following the June 3 accident, SP made YRMC aware of the Federal regulation, YRMC still refused to conduct the sample collection SP then notified the Safety Board railroad duty officer of their problem and requested assistance The duty officer referred SP to the toll-free number published in Part 219 and informed SP that the FRA was the proper authority to handle the situation During the several hour delay SP encountered in attempting to contact the responsible authority in the FRA, the SP decided to send the crewmembers to another medical facility about 60 miles away When the FRA did respond, the FRA's position was that the matter was resolved since the SP had made a "good faith" attempt to collect the samples at the nearest medical facility and had ultimately succeeded in collecting samples In subsequent telephone conversations on June 4, SP requested the FRA to intervene in the situation since YRMC was the only facility available in the immediate Yuma area at night and the possibility of future need existed According to SP, the FRA did not respond to the request SP officials testified that following a similar incident in California where a medical facility refused to collect samples, the FRA had advised SP to make arrangements at a different facility The FRA described an incident where a railroad requested assistance following a medical facility's refusal to collect samples from an employee who had been fatally injured in Nebraska In that incident, FRA arranged through local authorities to have the body released to the

railroad who then transported it to another medical facility about 50 miles away where samples were collected; the railroad then returned the body to the original location

YRMC maintained the position that their facility incurred increased liability by participating in sample collection Arizona has a statute in effect that indemnifies a medical facility when that facility is required to collect body fluid samples in connection with possible criminal proceedings YRMC did not believe that protection of this nature was afforded them in collecting samples from railroad employees SP opened negotiations with YRMC following the June 3 accident to privately provide indemnification, however, the negotiations were not completed before the second accident SP further reported to the Safety Board on May 23, 1988, that the negotiations were on-going

The blood and urine samples from the surviving crewmembers and the various samples from the deceased engineer were sent to the Center for Human Toxicology (CHT) in Salt Lake City, Utah, for toxicological analysis according to the FRA regulation The samples collected under SP policy were sent to Roche Biomedical Laboratories, Inc , (Roche)

Toxicological testing results from Roche on the seven surviving crewmembers were negative for the presence of ethanol, amphetamine, barbiturates, benzodiazepine, cannabinoid, cocaine, methaqualone, opiates, phencyclidine, methadone, propoxyphene, meperidine, tricyclic, and dilantin (phenytoin) The yardmaster's test results for the same compounds were positive for the presence of benzodiazepine, which was confirmed by gas chromatography/mass spectrometry to be 309 ng/ml oxazepam Oxazepam is a type of sedative-hypnotic drug The yardmaster listed the medications she was taking as thyroid medication, Naprosyn, Tylenol with codeine, and estrogen In addition, the yardmaster testified she was taking a drug, "paxate "

Test results from CHT for the seven surviving crewmembers were negative Ethanol was detected in four of the samples from the deceased engineer. vitreous humor at 0 16 g/100 ml; liver at 0 02 g/100 g, kidney at 0 11 g/100 g, and the lung at 0 03 g/100 g, no other drugs were identified

The medical examiner who collected the tissue samples from the deceased engineer informed the Safety Board that

> there was extensive trauma to the trunk and extremities . .Removal of vitreous fluid from both eyes revealed no evidence of hemorrhage or other contamination Because of this, it would seem that the viterous fluid toxicology would be considerably more reliable than the blood clot from the ventricle, the bile or the sections of kidney, liver, and lung

The cause of death was reported to be "massive trauma to parenchymal organs of abdominal and thoracic cavities with marked compression of trunk and extensive evisceration of truncal organs Extensive bony and soft tissue trauma "

Hours of Service

The FRA and SP did not consider the yardmaster to be performing services under the Hours of Service law, however, SP yardmasters who performed similar service at Sparks, Nevada, were covered The yardmasters in Sparks had been covered under the Hours of Service law following an FRA analysis, which was initiated by a labor action filed on behalf of the Sparks yardmasters In a letter to SP, the FRA's associate administrator for safety stated

> You should not construe FRA's determination as to SP's yardmasters at Sparks as an indication that FRA has reached a conclusion on the Act's coverage of yardmasters at other points on your railroad The yardmaster's duties at each location would have to be analyzed to make such a determination

The FRA conducted an analysis of the Yuma yardmaster's duties after the June 15, 1987, accident that resulted in the yardmasters at Yuma being covered under the Hours of Service law

Meteorological Information

At 1.15 a m , June 15, 1987, at Yuma, Arizona, it was clear and dry with a temperature of 87°F There was a 7-mile per hour wind with 7 miles of visibility

ANALYSIS

The Accident

The yardmaster could have brought Extra 7791 West into Yuma on the eastbound main track, had them stop at the subway, and wait for the eastbound train to cross over to the westbound main track, line the crossover switches for straight through movement after the eastbound train was clear, then proceed to the yard office on the eastbound main track This maneuver would have required the repositioning of the switches only one time (by the westbound train) and would have left the switches in position for straight through movement The maneuver the yardmaster apparently planned, if it had been successful, would have required the repositioning of the crossover switches by both trains and would have left the switches in reverse position However, even with both trains on the same track, the accident was still avoidable if both trains were being operated at restricted speed

Since there were no multi-event or speed recording devices on Extra 7991 West, the Safety Board cannot conclusively determine at what speed Extra 7991 West was operating or if it was stopped at the time of collision Based on the nature of the injuries sustained by the crewmembers who jumped from the train and by those who remained aboard and by the length of time the train airbrakes were applied in emergency, the Safety Board believes that Extra 7791 West was either stopped or nearly stopped at the time of collision In either case, the Safety Board believes Extra 7791 West was being operated at restricted speed before the collision

As Extra 7267 East approached signal 7340, both the engineer and the brakemen observed the signal displaying a red over red aspect which requires a train to stop and then to proceed at restricted speed The basic tenet of restricted speed is that a train be able to stop within one-half the range of vision, but in no case should its speed exceed 20 mph In addition to the requirements of restricted speed, Extra 7267 East was passing through a 10-mph crossover This combination required the train to be able to stop within one-half the range of vision, but in no case should its speed exceed 10 mph After extensive laboratory analysis of the multi-event recording data pack from SP locomotive unit 7267, the Safety Board concludes that Extra 7267 East was operating at 16 mph through the 10-mph crossover The Safety Board also concludes that Extra 7267 East was not operating at restricted speed before the collision If Extra 7267 East had been operated at restricted speed, the accident would not have occurred

The Safety Board believes Extra 7267 East's conductor abdicated his responsibilities toward the movement of his train By his own admission, as well as by the testimony of others, the conductor did not perform such basic duties as comparing train orders; determining maximum authorized train speed, insuring the proper entrainment of hazardous materials cars, train makeup, or empty car restrictions, determining crew placement, assuring departure authority; or preparing a rule G slip The conductor should have performed each of these duties, then he should have monitored the engineer and brakemen to ensure that the traincrew understood what was required of them for the safe movement of their train and that they were in compliance with all applicable operating rules and instructions The conductor's failure to perform these duties deviates from SP operating rules and policy

When the yardmaster informed the conductor and head brakeman of Extra 7267 East that the GP gondola was properly entrained for movement eastward to Tuscon, she acted without authority Yardmasters are not listed in Section E of the Western Region timetable special instructions (train makeup restrictions), which contains provisions for certain computer queries to allow specified SP officials to make exceptions to train makeup requirements

The yardmaster's error was compounded when the head brakeman acted on the incorrect information and used it to inaccurately describe his train to the train dispatcher when he requested the speed be increased This resulted in the dispatcher provisionally increasing the speed of Extra 7267 East from 45 mph to 55 mph The conductor neither verified the information supplied by the

yardmaster nor did he monitor what the head brakeman did with that information relative to Extra 7267 East's movement The Safety Board concludes that Extra 7267 East was improperly cleared to operate at 55 mph based on the actions of the yardmaster and head brakeman and the lack of action of the conductor

The Yuma yardmaster also acted contrary to established SP operating rules when she instructed the crew of the cabooseless train crossing over at the subway before the accident to leave the crossover switches reversed SP operating officials stated that a yardmaster does not have the authority to issue instructions that are contrary to an operating rule However, the Safety Board determined that it was standard practice in Yuma for all yardmasters to issue such instructions The Yuma trainmaster knew of the practice but had not taken action to either make it a legitimate procedure by a special instruction in the timetable as was done at other SP locations or to bring the practice into compliance with the rule The Safety Board believes that for operational rules to be effective, the rules must be uniformly and consistently enforced When supervisors ignore or condone violations of rules, employees are sent a message that casts doubt on the credibility and applicability of the entire rules system

The Safety Board believes that the yardmaster gave the information concerning position of the subway crossover switches and the intended route of Extra 7267 East to the conductor Due to the conflicting nature of the testimonies, the Safety Board concludes that the yardmaster assumed Extra 7267 East's head brakeman had heard and understood the departure instructions when he apparently did not The task of lining the crossover switches would have been delegated to one of the brakemen by either the conductor or the engineer Both brakemen were with the engineer in the lead locomotive control compartment as Extra 7267 East stopped at the subway Since their primary consideration centered around the mechanical operation of the second locomotive unit, without apparent concern for the position of the switches at the subway, the Safety Board believes that neither the engineer nor the brakemen understood the yardmaster's intended departure route for their train According to rule 93, Extra 7267 East should have been operating at restricted speed when it departed the Yuma yard office When the engineer encountered the crossover switches reversed at the subway, he could have stopped, had both switches lined for normal movement, and then proceeded, the engineer also could have stopped, waited 5 minutes, then proceeded through the crossovers In neither instance is the yardmaster's authority needed to proceed Both instances required the train to operate at restricted speed

Crew placement requirements on SP freight trains require crewmembers to ride in the control compartment of the locomotive, subject to available seating, and they require the conductor to ride in the control compartment when the conductor is on the head end of the train Since three seats were available in the locomotive control compartment of both Extra 7267 East and Extra 7791 West, and the conductor and engineer of Extra 7791 West were in the control compartment with the brakemen in a trailing unit, the traincrew of Extra 7791 West was improperly placed Moreover, the engineer of Extra 7267 East was alone in the control compartment with the conductor in a trailing unit This crew placement was also in violation of SP operating rules All the surviving crewmembers of Extra 7267 East initially gave several false statements concerning crew placement, the Safety Board believes those crewmembers understood what was required of them but chose, before the accident, not to comply with that requirement The surviving crewmembers recanted their initial statements when questioned under oath at the Safety Board's public hearing

The Safety Board supports SP's policy to have conductors and certain other personnel complete written certification that crewmembers in their charge are in compliance with rule G Further, the Safety Board believes that to fully comply with this policy, employees required to complete the certification should be trained to recognize signs of drug intoxication However, for any policy to be effective it must be consistently implemented When the Yuma trainmaster became aware that Tucson-based conductors were refusing to complete the rule G slips, he reportedly informed the involved conductors that it was their responsibility to do so Despite his discussions with the conductors, the Safety Board did not find any rule G slips completed by Tucson conductors The Safety Board can only conclude that either the trainmaster was not vigorous in his pursuit of

compliance or that he was overburdened with other responsibilities and did not have sufficient time to follow up his discussions to ensure compliance with the policy.

On the day of the accident, the Yuma yardmaster raised the question of the sobriety of Extra 7267 East's engineer and stated that she believed the engineer had been drinking alcohol before assuming duty Later that evening, she made statements to FRA officials in the presence of a Safety Board investigator to that effect The Safety Board believes the maid's testimony confirms that the engineer had an unresolved alcohol problem Based on the yardmaster's statement that she had suspected the engineer of drinking four or five times in about a 7-month period before the accident without taking any corrective action, the Safety Board concludes that the engineer's drinking and the yardmaster's inaction had been a continuing uncorrected problem at Yuma

Survival Aspects

The locomotive control compartment of Extra 7267 East was crushed and pushed rearward about 22 feet by impact forces The Safety Board determined that all occupiable space was eliminated, thus rendering the accident unsurvivable from any position within the locomotive control compartment

Following an investigation of an accident at Riverdale, Illinois, on September 8, 1970, the Safety Board issued a safety 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 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 posts and pilots

Since 1973, however, the Locomotive Control Compartment Committee (LCC) has not published any criteria for the structural design of locomotives. The Safety Board has investigated numerous accidents in which the locomotive control compartments have been identified as inadequate to protect its occupants There is currently no Federal standard for locomotive sill height nor is the Safety Board aware of any effort by the FRA to establish such a standard Since the sill is the strongest section in the structural design of a locomotive, the Safety Board believes the FRA should establish a standard for compatible locomotive sill heights

As a result of its investigation of an accident at Pacific Junction, Iowa, on April 13, 1983, 15/ the Safety Board issued Safety Recommendation R-83-102 to the FRA requesting that it 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

In a followup letter to the FRA on July 5, 1984, the Safety Board pointed out 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 The Safety Board is not aware of any evidence that the FRA is making any effort to resolve this problem.

15/ Railroad Accident Report--"Rear-End Collision of Two Burlington Northern Railroad Company Freight Trains, Pacific Junction, Iowa, April 13, 1983" (NTSB/RAR-83/09).

In its investigation of an accident near North Platte, Nebraska, on July 10, 1986, 16/ the Safety Board noted that the time for studying the problem has long since passed and the head-end crew should be afforded more protection than is the case with the current design of locomotive operating compartments As a result of the North Platte, Nebraska, accident investigation, the Safety Board classified Safety Recommendation R-83-102 "Closed--Unacceptable Action/Superseded" and issued Safety Recommendation R-87-23 on September 9, 1987, which called on the FRA to require locomotive operating compartments to be designed to provide crash protection for occupants of locomotive cabs

On April 20, 1988, in response to Safety Recommendation R-87-23, the FRA replied that both American locomotive manufacturers would be considering major design modifications to their products in the late 1980s and that the FRA was seeking to promote an agreement between the two manufacturers to include a series of design improvements in the cabs of their new basic models The FRA also replied that its LCCC has proposed a list of specific design improvements in which near-term improvements may be achievable and that the FRA intended to schedule hearings on this issue during September and October 1988 While the Safety Board agrees that an agreement between the two manufacturers would be desirable, in view of the fact that no agreement has been made over the many years, the Safety Board questions the ability of the FRA to accomplish this objective without regulatory action Further, while the Safety Board also agrees that the proposals of the LCCC are desirable, these proposals do not address the issue of cab crashworthiness Moreover, the Safety Board questions the need to study this issue through a special safety inquiry

The circumstances of the Yuma accident again highlight the need for improved and standardized locomotives designed to provide protection to on-board personnel Therefore, the Safety Board reiterates its position that the FRA should promptly require locomotive operating compartments to be designed to provide crash protection for occupants of locomotive control compartments In the meantime, Safety Recommendation R-87-23 is being held in an "Open--Unacceptable Action" status

Tests and Research

The braking capability of Extra 7791 West was not significantly reduced by the single car with the airbrakes cut out However, the Safety Board is concerned that Extra 7791 West had just left an SP intermediate inspection point without the train brakes being in compliance with either the FRA or SP requirements Since it is necessary for a train to be stopped for the airbrake system on a car to be cutout and both the engineer and conductor testified that Extra 7791 West did not stop after departing Tucson, the Safety Board can only conclude that the airbrake was cut out before the departure. The Safety Board will continue to closely monitor the FRA's easing of regulatory requirements for intermediate airbrake inspections from 500 to 1,000 miles

Medical and Pathological Information

The toxicological analyses for drugs of abuse and alcohol performed on the various tissue samples from the fatally injured engineer were done by the CHT Alcohol was the only drug identified in these analyses

Severe traumatic injuries and delay in obtaining tissue samples may have resulted in either post mortem ethanol generation or ethanol loss due to exposure to air Consequently, the Safety Board relied on vitreous humor for ethanol determination

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16/ Railroad Accident Report--"Rear-End Collision and Derailment of Two Union Pacific Railroad Freight Trains, North Platte, Nebraska, July 10, 1986" (NTSB/RAR-87/03)

Forensic investigators have performed various studies to determine the correlation between the concentration of alcohol in blood, other body fluids, and tissues 17/ In summary, post mortem data support the general thesis that the concentration of ethanol in various tissues partitions according to the relative water content of the respective tissues, provided equilibrium between the blood ethanol and tissue or fluid has been established 18/ The most obvious reason that the ratio of measured blood ethanol to other fluids or tissue ethanol concentrations does not agree with the water content ratio of the blood to tissue or fluids is due to insufficient time for equilibrium to occur before death

Post mortem studies have determined the relationship of vitreous humor ethanol concentration to blood ethanol concentration 19/ These post mortem studies support the thesis that the vitreous-to-blood ethanol concentration at equilibrium should conform to the ratio of vitreous-to-blood water, which is about 1 27, with the actual ratio of vitreous humor alcohol /blood alcohol varying between 1 38 and 1.04 20/ The principal reason for the spread is due to insufficient time for equilibrium to be established Due to its relative isolation, the concentration of drugs, such as alcohol, in the vitreous humor will lag behind the blood concentration (ratio of vitreous to blood will be less that 1 27) during the absorptive phase The post mortem ethanol concentration in vitreous humor has been reported to remain constant for prolonged post mortem periods and since it is anatomically isolated, it is less subject to contamination 21/ In addition, since the vitreous humor is low in glucose and protein, it is less subject to microbial production of ethanol.

The medical examiner noted that the fatally injured engineer's eyes were free of trauma. He reported no evidence of hemorrhage or other contamination of the vitreous The concentration of ethanol in the engineer's vitreous was 0 16 percent If equilibrium between the vitreous and the blood alcohol had occurred, the blood alcohol concentration will be about 0 13 percent based on vitreous/blood water ratio of 1 27 From animal studies, it appears that the alcohol elimination rate from the blood is considerably less than the diffusion rate of ethanol from the vitreous 22/ The decrease in alcohol concentration in the vitreous will be controlled by and will decrease at the same rate as the decrease in the blood level Consequently, the vitreous-to-blood ethanol ratio should never exceed the 1 27 vitreous-to-blood water ratio. Under such circumstances, the calculated blood alcohol level based on the vitreous concentration should be a lower limit If equilibrium had not occurred (the engineer was in the absorption phase), the blood concentration could be higher than the calculated 0 13 percent, but not lower

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17/ Winek, C L and Esposito, F , "Antemortem and Postmortem Alcohol Determinations in Forensic Science," Published by Matthew Bender, New York, 1981; Avbel, "Some Factors Affecting the Analytical Determination of the Concentration of Ethanol in Human Blood and Tissues," Master's Thesis, Duquesne University, Pittsburgh, Pennsylvania, 1972; and Dubowski, K M , "Manual for Analysis of Ethanol in Biological Liquids," Final Report U S Department of Transportation, DOT-TSC-NHTSA-76-4, January 1977

18/ Felby, S and Olsen, J , "Comparative Studies of Postmortem Ethyl Alcohol in Vitreous Humor, Blood and Muscle," Journal for Science, Vol 4, pp"93-101, 1969

19/ Budd, R D , "Ethanol Levels in Postmortem Body Fluids," Journal of Chromatography, Vol 252, pp 315-318, 1982; and Sturner, W Q and Coumbis, M S , "The Quantitation of Ethyl Alcohol in Vitreous Humor and Blood by Gas Chromatrography," American Journal of Clinical Chemistry, Vol 46, pp 349-351, 1966

20/ Ibid; Felby and Olsen, op cit

21/ Dubowski, op cit

22/ J E Olsen, "Penetration Rate of Alcohol into Viterous Humor Studies with a New in V O Technique," Aeta Ophthanol 49, pp 585-588 (1971)

The liver pathology in the autopsy report showed a moderate degree of fatty metamorphosis In the absence of other diseases, the most likely cause of this pathology is excessive use of alcohol This information, together with the engineer's previous dismissal for the abuse of alcohol, suggests that the use of alcohol was a continuing problem for the engineer The Safety Board concludes that the engineer's blood alcohol concentration was 0 13 percent or higher at the time of the accident The Safety Board further concludes that at that blood alcohol concentration the engineer was intoxicated and impaired.

Toxicological analysis of the urine sample provided by the yardmaster defined the presence of 309 ng/ml oxazepam, which was marginally above the test's detection limit of 300 ng/ml Oxazepam is both a metabolite of benzodiazepines and a prescription drug that acts as an anti-anxiety agent None of the medications that the yardmaster described as taking contain oxazepam The Safety Board was unable to identify "paxate" as a prescription medication, however, the drug, paxipam, does metabolize to oxazepam The yardmaster did not provide a medical prescription for the Oxazepam However, without quantitative blood sample values, the Safety Board cannot determine what the drug's effect on her performance might have been

If the yardmaster had been tested under the FRA's postaccident toxicological testing requirements, in the absence of an authorized medical prescription, her test results would have been considered positive by the FRA Since, at the time of the accident, the yardmaster's position was not covered by the Hours of Service law, toxicological testing was not required by the FRA The Safety Board believes that restricting postaccident toxicological testing to employees covered under the Hours of Service law severely limits the effectiveness of the testing programs

The medical facility's hesitancy to collect samples from the surviving crewmembers for toxicological testing stemmed from concerns over possible liability The medical facility did allow samples to be collected on its premises from the deceased engineer and allowed samples to be collected in instances where indemnification is provided by Arizona The FRA's regulation is not specific concerning obtaining the cooperation of a medical facility in collecting samples for toxicological testing from uninjured employees The regulation is more specific for an injured and unconscious employee (49 CFR 219 203 (d)(2)), or for a fatally injured employee (49 CFR 219 207 (a, b, & c)) The Safety Board does not believe the FRA was responsive to SP's request for assistance in the June 3, 1987, accident The FRA's lack of responsiveness led the SP to immediately seek alternative methods of collecting samples following the June 15, 1987, accident That samples were ultimately collected in both cases and that a sample was collected from the Yuma yardmaster speaks well of the SP's commitment to toxicological testing, however, a more timely collection of the samples could have resulted if the FRA had intervened quickly and vigorously The Safety Board believes that the FRA should extend the same notification and assistance procedures regarding obtaining the cooperation of a medical facility that it currently has for unconscious and fatally injured employees to include uninjured, nonrefusing employees The delay in collecting samples for toxicological testing from the yardmaster and the surviving crewmembers precluded any determination as to whether alcohol may have been used by those individuals

The Safety Board will address the implementation of the FRA's regulations regarding the control of alcohol and drug use in a safety study which the Safety Board is currently conducting The safety study will address the implementation of those regulations by the rail industry and the FRA, and the Safety Board will issue safety recommendations deemed necessary

Management Oversight

In a January 22, 1982, letter to the Safety Board, SP's chief executive officer (CEO) detailed action that SP took in regard to Safety Recommendation R-80-4 issued to SP regarding the adequate supervision of operating department employees coming on duty at crew-change terminals to ensure that they are capable of complying with all pertinent operating rules This recommendation was

issued as a result of a collision between two SP trains on July 24, 1979, at Thousand Palms,California 23/ In that accident, the engineer of the striking train had gone on duty at Yuma, Arizona, and was later found to be under the influence of alcohol at the time of the collision The Safety Board found similar circumstances in the events that preceded a collision involving SP trains at Indio, California, on June 25, 1973, where the engineer of the striking train had gone on duty at Yuma, Arizona, and was found to be under the influence of alcohol at the time of the collision In the CEO's letter, he stated·

> Obviously, part of an officer's job involves day-to-day contact during which the officer has the opportunity to casually observe his employees physical condition We agree with the NTSB's findings that this is very important In fact, we have increased our officer force at locations across the system where there is more of a potential for accidents because of geography or because crews at away-from-home-terminal points might be tempted to drink before assuming duty At Yuma where the train and engine crew went on duty, we have added an Assistant Superintendent

Based on SP's assurance that it had increased its officer force and programs at away-from-home terminals, the Safety Board classified Safety Recommendation R-80-4 "Closed--Acceptable Action" on May 26, 1982 SP's assistant general manager testified at the Safety Board public hearing concerning the June 15, 1987, accident that there was an assistant superintendent assigned to Yuma from September 1, 1979, to July 15, 1984 The assistant general manager further testified that during the approximately 5 years that the assistant superintendent had been assigned to Yuma, there had been a marked improvement in operating rules compliance as evidenced by improvements in the accident and injury history and efficiency testing audits in that location Also, there had been a sharp reduction in the number of yard engines and local trains operating within that jurisdiction

In light of SP's agreement with the Safety Board concerning the importance of an officer casually observing the physical condition of employees, the Safety Board is disturbed that SP reduced its officer staff at Yuma Based on the testimony and statements of various SP employees who worked in the Yuma yard office at night, it is evident that an officer was rarely present at night This became especially significant with the night Yuma yardmaster's testimony that she did not consider herself a supervisor The Safety Board agrees with SP's statement that at certain locations "there is more of a potential for accidents because of geography or because crews at away-from-home-terminal points might be tempted to drink before assuming duty " In a February 1, 1988, letter to the Safety Board, SP detailed action taken at Yuma to alleviate the problems experienced there One of those actions was the establishment of a terminal superintendent and three assistant trainmaster positions The Safety Board believes SP should maintain an officer cadre at Yuma sufficient to provide an on-duty officer 24-hours a day, including weekends and holidays

The Safety Board believes that the numerous rules violations and the circumstances of this accident indicate that noncompliance with operating rules was a result of deficient supervisory oversight The following rule violations occurred before the accident

1 The main track crossover switches were routinely being left improperly lined

2 The traincrews of both trains were improperly placed

3 Extra 7267 East was improperly cleared to operate at 55 mph

4 An improper train departure procedure was routinely being practiced at Yuma

5 Extra 7267 East's engineer and the yardmaster were in violation of SP's rule G

23/ Railroad Accident Report--"Rear-End Collision of Southern Pacific Transportation Company Freight Trains 02-HOLAT-21 and 01- BSFMK-20, Thousand Palms, California, July 24, 1979" (NTSB/RAR-80/01)

6. Suspicions of rule G violations were not being acted upon

7 Extra 7267 East's conductor did not compare train orders, standard time, or train makeup with any member of his crew

8 Extra 7267 East was operating in excess of the maximum authorized speed through the crossover and in excess of restricted speed

9 Rule G slips were not being routinely completed

10 Extra 7791 West did not receive a proper airbrake test before departing Tucson

In a February 1, 1988, letter to the Safety Board, SP indicated that a briefing room has been constructed at the Yuma yard office According to SP, all train and engine crews going on duty at Yuma report to this room 10 minutes after assuming duty, and they are met in this room by an operating officer At that time, the operating officer discusses the forthcoming trip with the crew and a three-question rules review questionnaire is administered and immediately corrected Any wrong answer is discussed and an understanding is reached as to the proper answer and application of the rule. A part of this program includes observation of each crewmember to ascertain their fitness for duty Following an acccident on the Missouri Pacific Railroad on October 3, 1982, near Possum Grape, Arkansas, 24/ the Safety Board issued Safety Recommendation R-83-60 to the members of the AAR recommending that they establish supervisory procedures at crew-change terminals to ensure that all operating department employees coming on duty at any hour of the day are physically fit and capable of complying with all pertinent operating rules SP's response to Safety Recommendation R-83-60 centered around its alcohol and drug program, including (1) its pre-employment drug and alcohol testing for all employees, (2) drug and alcohol testing in conjunction with standard, periodic medical examination, and (3) a broad "just cause/reasonable suspicion" testing policy which covers not only Hours-of-Service but other safety critical employees as well Based on SP's response, the Safety Board classified Safety Recommendation R-83-60 as "Closed--Acceptable Action " The Safety Board will monitor this program as it matures to see if such an agenda has potential application elsewhere

Signal Systems

During the investigation, the Safety Board found many instances of signal system malfunctions in the Yuma yard The signals were repeatedly "failing safe" before the accident, and they continued to "fail safe" on at least two occasions during the week after the accident The Safety Board is concerned that traincrews being governed by the Yuma yard signal system may not have had complete confidence in that system because of the numerous malfunctions The Safety Board believes that the signal problems were a result of a lack of coordination between the local SP management responsible for the signal system and the local SP management responsible for track maintenance The Safety Board also believes the SP should take action to develop a reporting system that would alert the division superintendent when a signal has been reported defective more than once

The Safety Board believes that the switch point at the subway, reported by the ACC to SP as violating both State and Federal regulation, should have been repaired or removed from service immediately

24/ Railroad Accident Report--"Side Collision of Two Missouri Pacific Railroad Company Freight Trains at Glasie Junction, near Possum Grape, Arkansas, October 3, 1982" (NTSB/RAR-83/06)

Hours of Service

Yardmasters in Yuma were actively involved in controlling the movements of trains and engines The Safety Board is concerned that yardmasters at Yuma were not covered under Hours of Service requirements until after the FRA initiated an evaluation following the accident The Safety Board is further concerned that the Sparks, Nevada, yardmasters were not covered under Hours of Service requirements until after an FRA evaluation was initiated following a labor action The Safety Board does not believe that either an accident or a labor action should initiate corrective action However, the Safety Board recognizes that the position of yardmaster is unique in that some positions require coverage under the Hours of Service while others may not SP's timetable indicates many instances where trackage situations similar to both Sparks and Yuma exist The Safety Board believes that the FRA should conduct an evaluation of the duties of all SP non-Hours of Service yardmasters to determine their proper status The Safety Board further believes that the FRA should consider extending the scope of this evaluation to include the remainder of the Nation's railroads

CONCLUSIONS

Findings

1 Extra 7267 East was not operated at restricted speed

2 Extra 7791 West was operated at restricted speed

3 The blood alcohol content of the engineer of Extra 7267 East was 0 13 percent or higher at the time of the accident, and he was under the influence of and impaired by alcohol

4 The engineer of Extra 7267 East violated both Federal regulation and SP's rule G at the time of the accident

5 The Yuma yardmaster violated SP's rule G as confirmed by a positive toxicological test result for a detectable amount of benzodiszepine in the absence of an authorized and approved medical prescription

6 The Yuma yardmaster suspected Extra 7267 East's engineer of drinking alcohol before he assumed duty on the night of the accident, and she had previously suspected this engineer of drinking alcohol and yet she took no action on any occasion Each unreported instance was a violation of SP's rule D

7 Extra 7267 East's conductor abdicated his responsibilities by not performing his required duties

8 Main track switches were routinely left improperly lined in the Yuma yard

9 Local SP management knew of the improper switch alignment procedure, and yet, it took no action

10 Neither the Yuma yardmaster nor Extra 7267 East's engineer followed the proper procedure for departure authority

11 Local SP management knew of the relaxed departure authority procedure being employed at Yuma, and yet, it took no action to enforce the proper procedures

12 Local SP management knew conductors were not completing rule G slips and took no effective action which would have resulted in the rule G slips being consistently completed by all of the Tucson conductors

13 The head brakeman acted on improper information without confirming its validity resulting in Extra 7267 East's 45-mph speed restriction being improperly lifted

14 The 1,000-mile intermediate road train airbrake test on Extra 7791 West was improperly performed

15 The braking effectiveness of Extra 7791 West was not substantially reduced by the single car having the airbrakes cut out

16 Following the collision, there was no survivable space left in the control compartment of Extra 7267

17 The crews of both trains involved in this accident were improperly placed according to SP operating rules

18 The FRA was not responsive in dealing with the first refusal of the Yuma medical facility to collect samples for toxicological testing

19 The lack of coordination between local SP track and signal management resulted in a long term signal problems in the Yuma yard

20 The FRA does not require locomotive control compartments to be designed with sufficient crash protection

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the engineer of Southern Pacific Transportation Company Extra 7267 East to operate his train at restricted speed, while he was under the influence of alcohol, and the failure of the conductor to assure the safe operation of the train Contributing to this accident was the failure of the Southern Pacific Transportation Company to properly supervise its operating employees Contributing to the severity of the accident was the lack of compatability between the sill height of the locomotives

RECOMMENDATIONS

As a result of this investigation, the National Transportation Safety Board made the following recommendations.

--to the Southern Pacific Transportation Company

Develop a reporting system that would alert the division superintendent when a signal has been reported defective repeatedly (Class II, Priority Action) (R-88-16)

Issue an advisory to all Southern Pacific Transportation Company operating officers informing them of the anomalous main track switch lining procedures employed in Yuma, Arizona, before this accident with instructions that they ensure all operating employees comply with current applicable timetable instructions and that the applicable timetable be immediately modified to reflect any site-specific locations where main track switches can be safely left unattended in reverse position (Class II, Priority Action) (R-88-17)

Provide training to all employees required to certify another employee's condition relative to rule G on recognizing the standard signs of drug intoxication (Class II, Priority Action)(R-88-18)

--to the Federal Railroad Administration

Provide the same notification and assistance procedures for collecting toxicological samples from uninjured, nonrefusing employees that Title 49 Code of Federal Regulations Part 219 presently has for unconscious and fatally injured employees (Class II, Priority Action) (R-88-19)

Modify Title 49 Code of Federal Regulations Part 229 to require compatible main frame sill height standards (Class II, Priority Action) (R-88-20)

Conduct an evaluation of all Southern Pacific Transportation Company non-Hours of Service yardmasters to determine their proper status (Class II, Priority Action) (R-88-21)

Determine whether the scope of the evaluation conducted on the Southern Pacific Transportation Company non-Hours of Service yardmasters should be extended to include the remainder of the Nation's railroads (Class II, Priority Action) (R-88-22)

Also, as a result of its investigation of this accident, the Safety Board reiterates Safety Recommendation R-87-23 to the FRA:

Promptly require locomotive operating compartments to be designed to provide crash protection for occupants of locomotive cabs

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ JAMES L. KOLSTAD
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

May 24, 1988

APPENDIXES

APPENDIX A

INVESTIGATION

1. Investigation

The National Transportation Safety Board was notified of the accident about 7 30 a m on June 15, 1987 The Safety Board immediately dispatched four investigators from its Washington, D C , headquarters and an investigator from its Fort Worth, Texas, field office

Groups were formed to investigate track and signal, operational, human performance, and vehicular aspects of the accident Parties to the investigation were the Federal Railroad Administration, Arizona Corporation Commission, Southern Pacific Transportation Company, Brotherhood of Locomotive Engineers, Brotherhood of Railway, Airline & Steamship Clerks, and the United Transportation Union

2. Hearing

The Safety Board convened a 3-day public hearing as part of its investigation of this accident on August 25, 1987 Testimony was taken from 16 witnesses and 60 exhibits were accepted into the record The Safety Board reconvened its public hearing for 1 day on October 27, 1987, to take testimony from the conductors of both trains Testimony was taken from the conductor of Extra 8891 West, however, the conductor of Extra 7267 East did not appear despite having received a properly served Safety Board subpoena A court order was subsequently obtained from the Fourth Circuit Court compelling the conductor of Extra 7267 East to appear and give testimony regarding the accident On December 15, 1987, the Safety Board reconvened its public hearing a second time at the Office of the U S Attorney, U S Courthouse, in Phoenix, Arizona, where testimony was taken from the conductor of Extra 7267 East

APPENDIX B

PERSONNEL INFORMATION

Yardmaster, Linda C. George

Yardmaster Linda C George, 37, was employed by SP on April 22, 1977, as a student brakeman/switchman, and was qualified as brakeman/switchman on May 22, 1977 She was promoted to conductor on April 15, 1979, and became a yardmaster at Yuma in November 1986 She was current on the examinations required by SP for the operating rules

Extra 7267 East

Engineer, Byron W. Garrigan

Engineer Byron W Garrigan, 58, was employed by SP on March 13, 1951, as a student fireman He was qualified as a fireman on June 21, 1951, and was promoted to locomotive engineer on October 26, 1961 He was current on the examinations required by SP for the operating rules

Conductor, Ralph M. Miller

Conductor Ralph M Miller, 59, was employed by SP on June 12, 1953, as a student brakeman He was qualified as a brakeman on June 27, 1953, and promoted to conductor on December 9, 1959 He was current on the operating rules

Head brakeman, Robert H. Glasser

Brakeman Robert H Glasser, 46, was employed by SP on April 29, 1959, as a student brakeman He was qualified as a brakeman on June 4, 1959, and promoted to conductor on September 9, 1966 He was current on the examinations required by SP for the operating rules

Rear brakeman, Lawrence E. Ruhl

Brakeman Lawrence E Ruhl, 46, was employed by SP on March 17, 1966, as a student brakeman He was qualified as a brakeman on March 25, 1966, and promoted to conductor on February 13, 1969 He was current on the examinations required by SP for the operating rules

Extra 7791 West

Engineer, Bown K. Litt

Engineer Bown K Litt, 43, was employed by SP on March 13, 1973, as a student fireman He was qualified as a fireman on April 1, 1973, and was promoted to locomotive engineer on February 14, 1974 He was current on the examinations required by SP for the operating rules

Conductor, Chester L. Moore

Conductor Chester L Moore, 55, was employed by SP on April 20, 1959, as a student brakeman He was qualified as a brakeman on May 12, 1959, and promoted to conductor on September 9, 1966 He was current on the operating rules

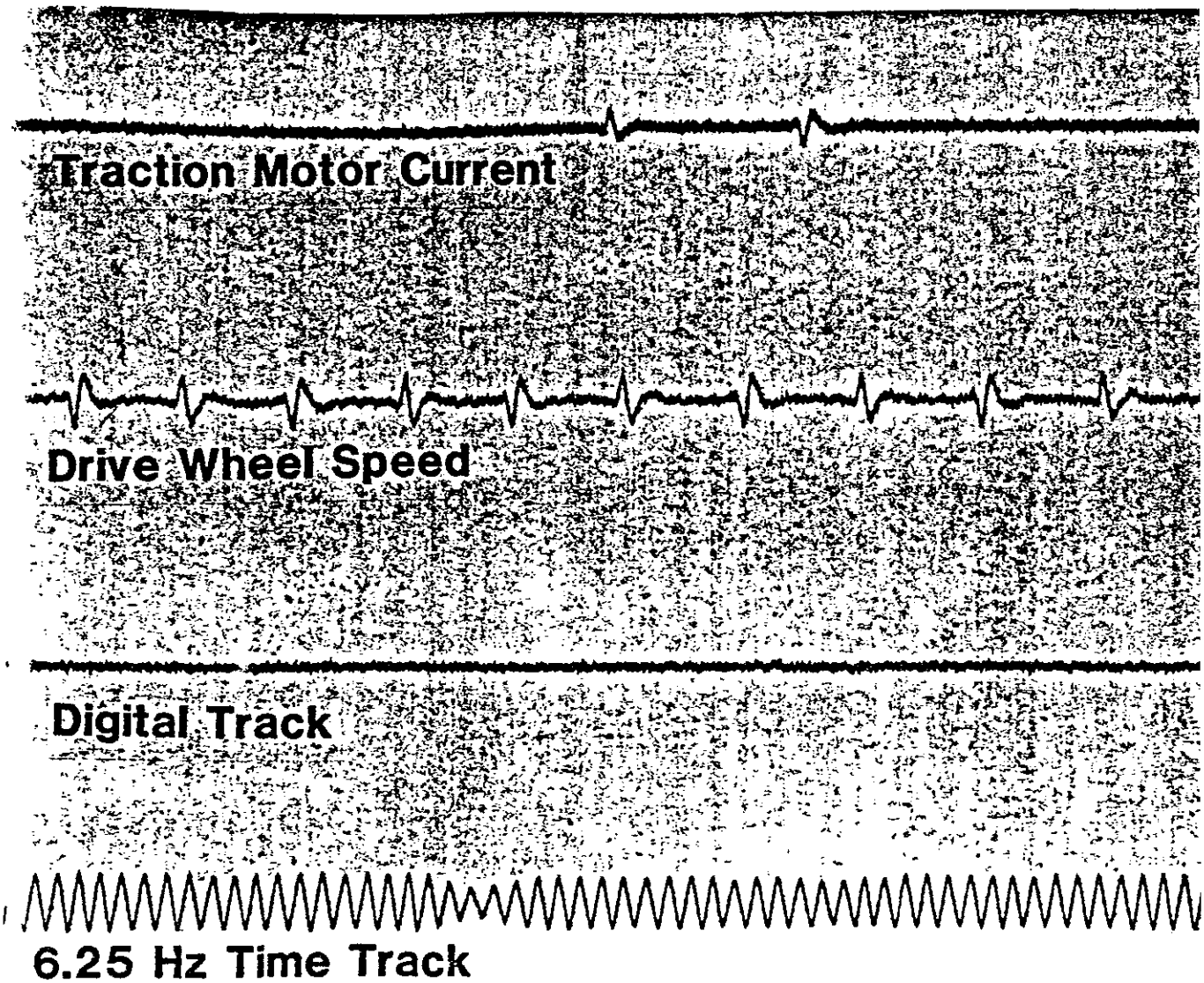
APPENDIX B

Head brakeman, Ronald L. Funk

Brakeman Ronald L Funk, 39, was employed by SP on January 1972, as a student brakeman He was qualified as a brakeman on February 10, 1972, and promoted to conductor on April 15, 1975 He was current on the examinations required by SP for the operating rules

Rear brakeman, Ronald A. Puckett

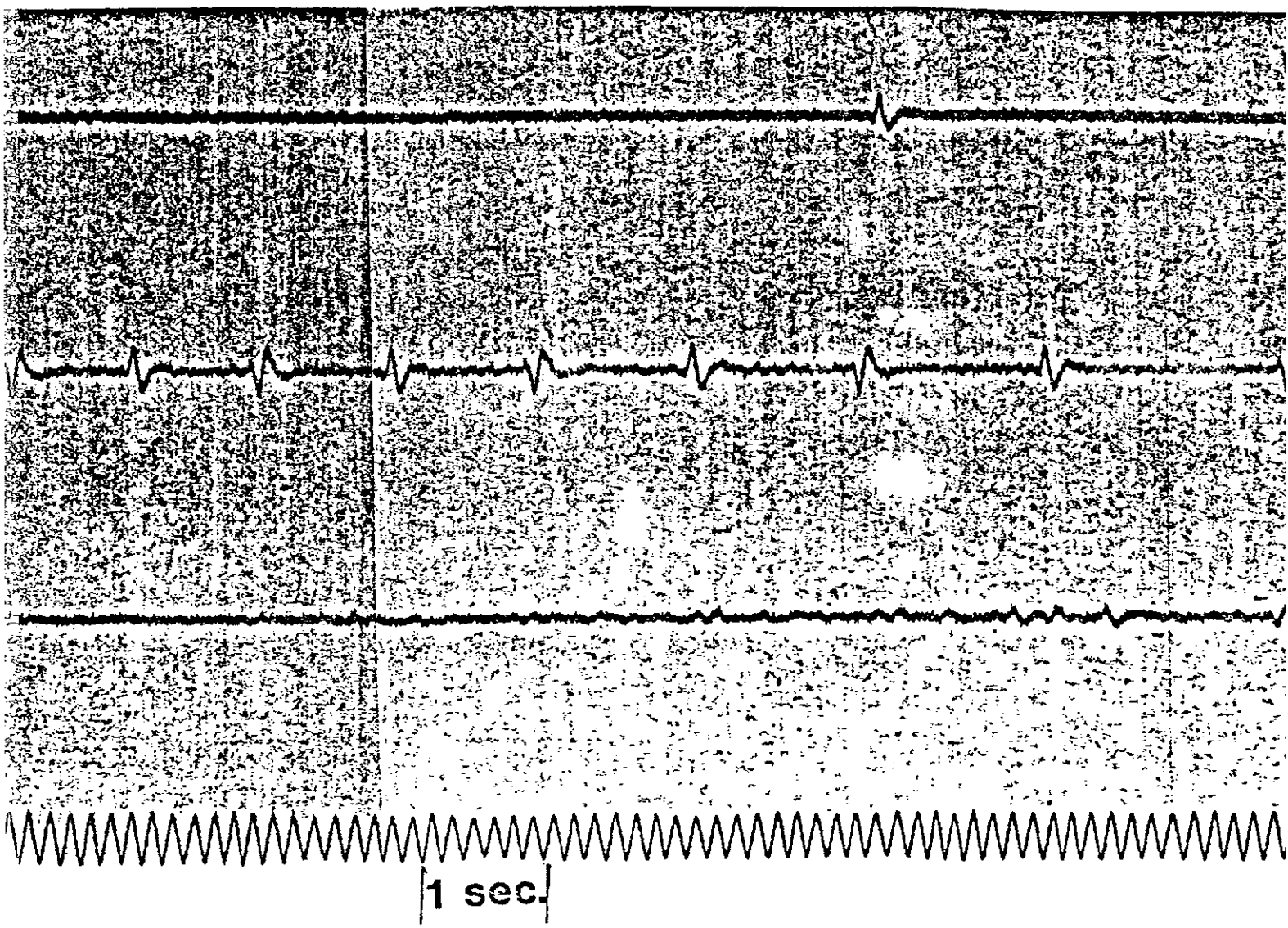
Brakeman Ronald A Puckett, 38, was employed by SP on April 3, 1970, as a student brakeman He was qualified as a brakeman on April 26, 1970, and promoted to conductor on April 15, 1969 He was current on the examinations required by SP for the operating rules


Traction Motor Current
Drive Wheel Speed
Digital Track
6.25 Hz Time Track

APPENDIX C

RDER STRIP CHART

LOCOMOTIVE 7267



→ TIME →

APPENDIX D

CERTIFICATION OF COMPLIANCE WITH RULE G

I, _____

CONDUCTOR, ENGINEER, YARD FOREMAN, RUN NO.

CERTIFY THAT I AM NOT IN VIOLATION OF RULE G OF THE RULES AND RE- , LATIONS OF THE SOUTHERN PACIFIC TRANSPORTATION COMPANY, AND THAT BASED ON MY PERSONAL CHECK OF THEIR APPEARANCES AND ACTIONS_____

_____

_____DO NOT APPEAR TO BE IN VIOLATION OF RULEG.

(INCLUDE IN THE SPACE ABOVE THE NAMES OF CREW MEMBER WHO WERE CHECKED, ENGINEER, FIREMAN. HELPER, BRAKEMAN, SWITCHMAN, TBM)

_____

TIME DATE SIGNATURE

_____

LOCATION OF ON/OFF DUTY POINT.

RIGINAL COPY TO TRAIN ORDER OPERATOR, YARDMASTER , CARBON COPY TO BE RETURNED DURING TOUR OF DUTY.

*U S GOVERNMENT PRINTING OFFICE:1988-201-610:81010