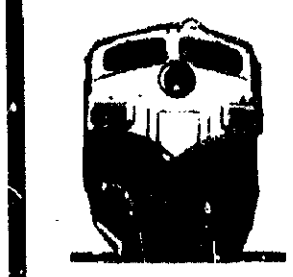
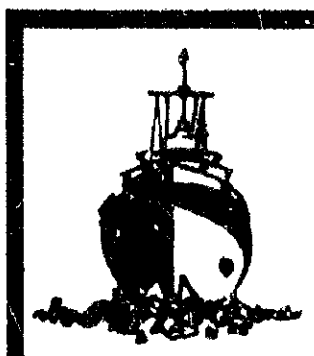
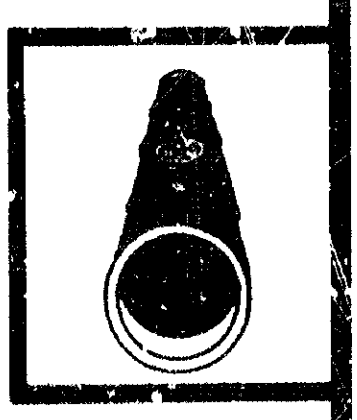
PB82-120197







NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

DERAILMENT OF SOUTHERN PACIFIC TRANSPORTATION COMPANY FREIGHT TRAIN EXTRA 9164 WEST SURF, CALIFORNIA MAY 22, 1981

NTSB-RAR-81-8

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

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16. Abstract

At 4 a.m., P.d.t., on May 22, 1981, 39 cars of Southern Pacific Transportation Company's (SP) westbound Extra 9164 derailed at Surf, California, while moving successively through a 2° curve, a short length of tangent track, and a 1° curve on a 1-percent descending grade. The derailing cars struck and derailed 20 cars of eastbound SP Extra 8874, which was standing on a side track south of the main track, and the locomotive, 3 cars, and the caboose of SP Lompoc Local Extra 1507, which was standing on a side track north of the main track. One employee was injured seriously, and 13 other employees and 3 transients were treated and released at either the local community hospital or a local Air Force hospital for inhalation of plaster dust and of gas formed from residual hydrogen fluoride in an empty tank car. Damage was estimated at $1,552,522.

The National Transportation Safety Board determines that the probable cause of this accident was the derailment of the trailing truck of the 53d car from the locomotive, an empty boxcar, at the entrance spiral to a 1° right curve because of hunting and wheel climb due to track/train dynamics. The derailed car continued on the track structure for about 1,100 feet until it struck a track frog in a crossover. The trailing truck then became detached from the car body and the following 38 cars derailed, striking cars standing on adjacent tracks. Contributing to the cause of the accident was the overspeed movement of the train.

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NATIONAL TRANSPORTATION SAFETY BOARD
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RAILROAD ACCIDENT REPORT

Adopted: September 15, 1981

DERAILMENT OF SOUTHERN PACIFIC TRANSPORTATION COMPANY FREIGHT TRAIN EXTRA 9164 WEST AT SURF, CALIFORNIA, ON MAY 22, 1981

SYNOPSIS

At 4 a.m., p.d.t., on May 22, 1981, 39 cars of Southern Pacific Transportation Company's (SP) westbound Extra 9164 derailed at Surf, California, while moving successively through a 2° curve, a short length of tangent track, and a 1° curve on a 1-percent descending grade. The derailing cars struck and derailed 20 cars of eastbound SP Extra 8874, which was standing on a side track south of the main track, and the locomotive, 3 cars, and the caboose of SP Lompoc Local Extra 1507, which was standing on a side track north of the main track. One employee was injured seriously, and 13 other employees and 3 transients were treated and released at hospitals for inhalation of plaster dust and of gas formed from residual hydrogen fluoride in an empty tank car. Damage was estimated at $1,552,522.

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INVESTIGATION

The Accident

At 9:30 p.m., P.d.t., on May 21, 1981, Southern Pacific Transportation Company (SP) train No. 01WCOAY21, Extra 9164 West, 1/ with 3 locomotive units, 11 loaded cars, and 120 empty cars (including the caboose), left West Colton, California, en route to Oakland, California, after a satisfactory airbrake test. The engineer, fireman, and head brakeman were on the locomotive and the conductor and flagman were on the caboose. The engineer operated the train for 107.8 miles to Santa Barbara, California. The train stopped at Santa Susana, California, without incident, and a locomotive unit, which was to be moved dead-in-tow, was placed in the train following the third working unit.

1/ SP trains operate north and south geographically between Los Angeles and Oakland, California, but timetable direction is east and west, respectively. Therefore, for purposes of this report, the land side (east) of the tracks will be referred to as north and the ocean side (west) as south.

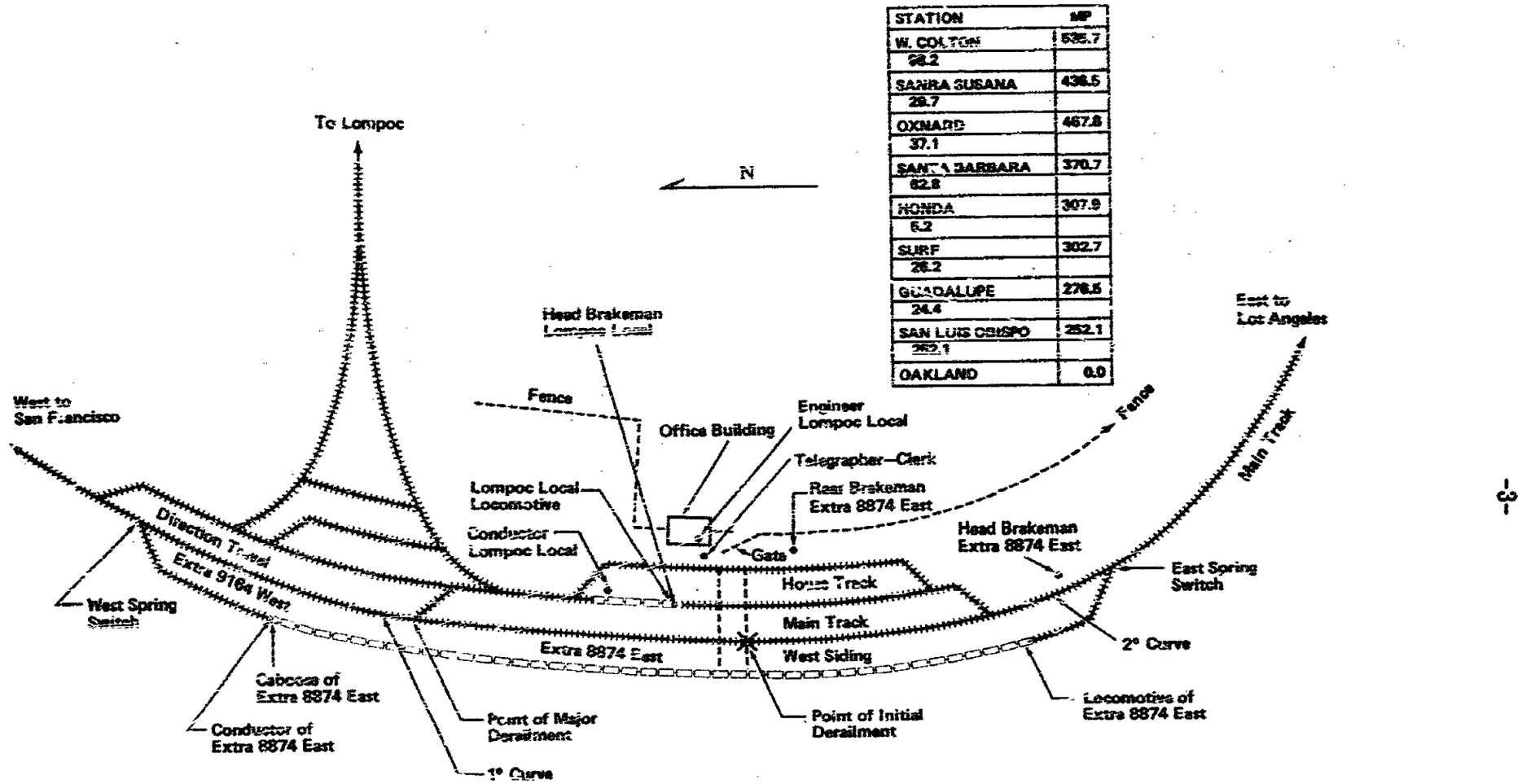
At Oxnard, California, the engineer slowed the train to 30 mph as required by a slow order. When the 30-mph speed was reached, a running brake release was made. The fireman stated that he felt a slight forward surge of the train after which the brakes were applied in an undesired emergency application. When the stopped train was inspected, a broken knuckle in a coupler assembly was found about 30 cars from the caboose and replaced, and the train continued westward. The head brakeman joined the conductor and flagman on the caboose after the knuckle was replaced.

The fireman, who was also qualified through training and examination as an engineer, began operating the train at Santa Barbara. The train reached the summit of a 0.8-percent grade about 2 miles west of Honda, California, and 3.2 miles east of Surf, California. As the train passed over the crest of the grade, the fireman progressively reduced the throttle setting. The fireman estimated that the train was traveling about 55 mph with the throttle in position run 2 as it passed through Surf. Because of the undesired emergency brake application at Oxnard, the engineer and fireman decided that the airbrakes would be used only if necessary, and the airbrakes had not been used after leaving Oxnard. Therefore, as the train descended a 1-percent grade through Surf, neither the dynamic brakes nor the airbrakes were used. About 4 a.m., when approximately one-half of the train had moved past the SP train order office building at Surf, cars began to derail and the train's brakes applied in emergency. The initial derailment occurred about 50 feet east of the train order office, but the major derailment occurred near a crossover about 1,100 feet west of the office. (See figure 1).

Thirty-nine cars derailed from Extra 9164 West. The derailing cars struck and derailed 20 cars from SP Extra 8874 East, which was standing in a side track south of the main track, and 3 cars, a caboose, and the locomotive of SP Lompoc local Extra 1507, which was standing on a side track north of the main track. (See figure 2.) The 53d car, an empty boxcar, was the first car found to be derailed following the accident. The rear truck (A end) had become detached from the east end of the car during the derailment. The east end of the boxcar had moved southward and had been dragged about 600 feet west of the crossover that connected the main line and the house track. The No. 4 brake beam was missing from the truck. A brake beam found adjacent to the house track mainline crossover where the major derailment occurred was identified by SP mechanical personnel as the No. 4 brake beam of the rear truck of the 53d car.

The R-3 wheel on the rear truck of the 53d car had a deep gash in the flange indicating that it had struck a sharp, rigid object. The front truck of the 54th car was derailed but the trailing truck of that car was not derailed. Wheel flange marks were found on the center sill of the 54th car, which may have derailed at the same time that the 53d car derailed. The remaining derailed cars were jackknifed or stacked between the house track and the siding south of the main track, east of the crossover.

Three crewmembers of Extra 8874 East had watched Extra 9164 West as it passed. The head brakeman, who was standing on the north side of the main track about 2,300 feet east of the railroad office at Surf, said that he inspected the entire train as it rolled past him and that he neither saw nor heard anything unusual. He said that after approximately 100 cars of the train passed him, the train's brakes applied in emergency and that the caboose came to a stop about 5 car lengths west of him. About that time, he heard airbrakes apply again on a train, and he saw that the red mars light (an oscillating red headlight) on the locomotive of Extra 8874 East was illuminated, indicating that an emergency brake application had occurred on the train. Also at that time, he observed that Extra 8874 East lurched back about 30 feet. The rear brakeman of Extra 8874 East, who was standing on the north side of the main track about 200 feet east of the office, also did not observe anything unusual as the train passed, until he saw sparks coming from



STATION	MP
W. COLTON	535.7
98.2	
SANTA SUSANA	436.5
28.7	
OXNARD	467.8
37.1	
SANTA BARBARA	370.7
62.8	
HONDA	307.9
5.2	
SURF	302.7
26.2	
GUADALUPE	276.5
24.4	
SAN LUIS OBISPO	252.1
252.1	
OAKLAND	0.0

Derailment Southern Pacific Transportation Company Train
01WCOAY21 at Surf, California on May 22, 1981
No Scale

Figure 1.--Plan view of accident site.

Figure 2.—Accident site.

the car wheels of about 20 cars as a result of applied brakes and then saw cars derailing. As the head cars of Extra 9164 West started past the caboose of Extra 8874 East, the conductor in the caboose heard the brakes of Extra 9164 West apply in emergency. He said that the train separated and about 30 cars (his estimate) continued past the caboose for about 3,000 feet to the point where the locomotive stopped.

Three crewmembers of the Lompoc local also watched Extra 9164 West as it passed. The conductor was on the north side of his train near its locomotive. He saw nothing unusual until, after an estimated 30 cars passed him and he was about 175 feet west of the office, he saw "sparks, dust and rocks shooting" from Extra 9164 West. At that time, he also saw the freight cars start to lean. The engineer of the Lompoc local was watching from the train order office window as Extra 9164 West passed. He began to hear a metal-to-metal grinding sound, and he ran about 10 feet to the front door to examine the train more closely. At that time he saw sparks coming from under the moving train. He turned back into the office, ran out the rear door, and moved eastward about 25 feet to the edge of the office building, from where he saw cars derailing and moving toward the office building. The head brakeman of the Lompoc local, who was in the locomotive cab, heard noises caused by the derailment and left the cab of the locomotive to escape from the derailing cars.

When Extra 9164 West actuated the approach annunciator to Surf, the telegrapher-clerk in the train order office went outside to inspect the train as it passed. He said that after about one-third of the train passed him, he saw an unusually heavy sparking of the wheels. He estimated that about six cars passed with the sparks and a "flame" coming from under the cars. He said that the sparks generally were coming from the area of the car wheels, but that the "flame" seemed to be coming from under the opposite side of the cars. He said that rocks or pieces of metal were becoming airborne from 40 to 50 feet east of the office and striking the office building and breaking windows. He ran into the office and while looking back he heard metal-to-metal grinding noises. He continued through the office end out the back entrance.

None of the persons who observed the passing train saw anything unusual until particles became airborne or they saw sparks coming from beneath the train. No one saw the first car or cars derail.

During the derailment, an "empty" DOT 112A 400W tank car, which had last contained hydrogen fluoride, struck the locomotive of the Lompoc local, and a gash about 36 inches long was cut in the side of the tank. Because of the gash, gas from an unknown residual amount of hydrogen fluoride in the tank car, under approximately 16 psi (at 70° F), escaped and formed a gas cloud. None of the crewmembers or three transients, reported to have been riding on Extra 9164 West, was seriously injured by the escaping gas.

Injuries to Persons

Injuries	Extra 9164 West	Extra 1507	Extra 8874 East	Others	Total
Fatal	0	0	0	0	0
Nonfatal	4	4	4	5	17
None	1	0	1	0	2
Total	5	4	5	5	19

Damage

Sixty-three freight cars, a caboose, and a single locomotive unit were derailed in the accident. Twenty-five cars from Extra 9164 West, five cars from Extra 8874 East, and four cars from the Lompoc local were destroyed. The locomotive of the Lompoc local was derailed and slightly damaged. About 3,000 feet of track was destroyed. Damage costs were estimated to be:

Equipment	$1,144,800
Track	114,000
Lading	256,722
Wreck clearing	37,000
	$1,552,522

Crewmember Information

The engineer and fireman of Extra 9164 West had attended the SP engineer training school at El Cerritos, California. All of the train crewmembers and the telegrapher-clerk were current on SP operating rules and were qualified for their respective positions in accordance with SP requirements. (See appendix B.)

Train Information

The locomotive of Extra 9164 West consisted of units SSW 9164, SP 9213, and UP 3734. Units 9164 and 9213 were model SD-45-2 manufactured by the Electro Motive Division (EMD) of the General Motors Corporation. Unit 3734 was an EMD model SD-40-2 and unit 8990, the dead-in-tow-unit, was an EMD model SD-45. The locomotive weighed 1,626,000 pounds including the dead-in-tow unit. The locomotive units were equipped with operable radios, a 26-L airbrake system, and a speed indicator, but did not have a speed recorder, alertness device, or deadman control device. The caboose also was equipped with an operable radio.

The 131-car train was 7,484 feet long excluding the three-unit locomotive and had a trailing tonnage of 5,485 tons. The train was arranged so that the head 57 cars were empty cars with an approximate total weight of 2,000 tons. The next 34 cars, including the derailed cars, weighed about 1,891 tons, with 4 cars having an average weight of about 130 tons each. The trailing 40 cars weighed 1,481 tons. Eight tank cars--seven empty and one containing oil--were among the cars that derailed. Also derailed were six cars over 73 feet long and one car 35 feet long or less. The 71st car from the locomotive was restricted to 45 mph because at speeds greater than 45 mph, a car of that type was subject to hunting. 2/

The DOT 112A 400W tank car that leaked the hydrogen fluoride was the 78th car in the train. The car and its contents were being shipped by Allied Chemical Corporation.

Method of Operation

Trains are operated through the accident site by timetable, train orders, and the signal indications of an automatic block signal system. The maximum allowable speed for

2/ Hunting is an oscillatory lateral movement of the trucks that develops at certain speeds and which can induce wheel climb. Data is available to show that empty boxcars and certain types of other cars will hunt within a particular speed range. Worn side frames, worn wheel contours, and worn rail conditions contribute to hunting.

freight trains is 55 mph. There are six dragging or derailing equipment detectors and four hot box detectors between Oxnard and Surf. The last of these, a hot box detector and a dragging equipment detector, are located 9.8 miles east of Surf. None of the detectors was actuated between Oxnard and Surf by Extra 9164 West. The train order office at Surf was equipped with an operable radio.

Southern Pacific operating rules require crews of standing trains and telegrapher-clerks to observe passing trains for defects that might be dangerous. According to SP operating rule No. 829, when possible these individuals are supposed to stand on the ground at a safe location for this rollby inspection. (See appendix C.) When defects are observed, traincrews are alerted by radio and/or signals.

A computer terminal is provided in each open train order office. The telegrapher-clerk will forward a train consist to the next office ahead when the train passes his office. The consist printout displays a symbol for identifying cars containing hazardous materials. A train containing hazardous materials has the letter "K" included in its designation symbol. For example, Extra 9164 West would have been identified as 01WCOA K 21 if it had contained loaded cars of hazardous materials. The symbol indicates the train is the first unit from West Colton to Oakland, and that it contained hazardous materials. The "21" indicates that the train originated at West Colton on May 21, 1981. In the actual designation of Extra 9164 West as 01WCOA Y 21, the Y indicated mixed freight.

Upon inquiry, the computer will identify "K" trains. A printout of the consist will provide a commodity classification code for the commodity, such as "FG" for flammable gas, and a Standard Transportation Commodity Code (STCC), a seven-digit number beginning with 49. When the STCC number is used, the computer will print out pertinent information about the commodity, such as what it is and how it is to be handled. On the morning of May 21, 1981, the computer system was shut down for routine maintenance and a printout was not immediately available for the guidance of emergency forces that responded to this accident.

Before they depart the terminal, the traincrews and enginecrews are provided with a written consist list which gives the order of cars in the train, their initials and numbers, their lading, and their destination. The list also shows the locomotive numbers, the train tonnage, and the train length. Loaded hazardous materials cars are identified on the consist.

Uniform Freight Classification Tariff Rule 35, Section 7, permits not more than 3 percent by weight or up to 1/3 of the quantity shown on billing documents for the last revenue-paying shipment of a tank car's contents to be left in the car when it is unloaded. This procedure maintains pressurization so that contaminants will not enter the car. The tariff is used to describe the classification of freight on which transportation charges will be based. The shipper determines whether the car is offered to the carrier as an "empty" or a "load." Freight charges usually are not imposed for "empty" cars moving under Rule 35, Section 7.

Title 49 CFR 174.25(c) requires that unless a waybill accompanies an "empty" tank car identifying the last contents of the car, the information must be shown on the consist or wheel report. In addition, 49 CFR 172 requires that an "empty" tank car placard be applied to "empty" tank cars that last contained hazardous materials unless all previous contents have been cleaned out of the car. Current "communication" regulations in 49 CFR 172 for "empty" tank cars provide for the top 1/3 of DOT tank car placards to be covered by a black triangle with the word "empty." Regulations require the class name to appear in the midsection of the placard. When the top 1/3 of the placard is covered with

the "empty" triangle, it obscures the class pictograph on the "empty" placard. Title 49 CFR 173 requires that cars transporting hydrogen fluoride be marked with the commodity name in 4-inch-high letters on the sides of the car. The 112A 400W tank car was marked and placarded as required by regulations. The car came to rest against the locomotive of the Lompoc local with the end placard and markings visible from south of the yard office.

However, in some instances, "empty" tank cars that last contained hazardous or corrosive materials are identified on a consist as "dangerous." The conductor of Extra 8874 East said that the consist of Extra 9164 West did not provide adequate information about hazardous materials cars and empty tank cars to enable their being quickly identified. About June 1, 1981, the SP initiated a new format at certain terminals that includes more information on hazardous materials cars, whether loaded or empty. The SP said that the new format will be expanded as soon as possible to cover the entire system.

The International Association of Fire Chiefs (IAFC) has petitioned the Materials Transportation Bureau (MTB) of the U.S. Department of Transportation (DOT) for the removal of all references to "empty" placards in 49 CFR Parts 172 and 174 because the IAFC believes the placards are misleading. The DOT has issued an Advance Notice of Proposed Rulemaking (Docket HM-180) regarding such placards.

The crews also are provided with a train profile printout which shows the individual car weights in sequential order, and for each five cars the weight and length is given as a cumulative value. Information also is given to identify long, short, high/wide, and slow-speed cars. The restricted speed car, the 71st car on Extra 9164 West, was identified on the train profile printout by an asterisk, but the asterisk was smudged and indistinct, and the crews overlooked the restricted speed car.

Track Information

The railroad at Surf consists of a single-track main line with a 6,220-foot passing track on the south side, and a small switching yard ranging from two to three tracks on the north side. The track on the north side adjacent to the main line, identified as the house track, is about 4,546 feet long. The house track enters the main line at the west end of Surf, 171 feet west of the switch to the pass track. It enters the main line on the east end about 1,200 feet east of the office building in the 2° curve. A crossover, which contained a track frog, extends between the house track and the main line about 1,100 feet west of the office building. (See figure 1.) A narrow, private, black-topped grade crossing was about 50 feet east of the Surf office building. The office building is located about milepost 302.7. The zero milepost is at San Francisco, California, and mileposts increase by timetable direction sequentially from west to east.

The track through Surf is built of a mixture of 113-, 132-, and 136-pound, continuous-welded rail laid on timber crossties on a crushed-stone ballast. No exceptions were taken to the track or roadway by Safety Board investigators.

As Surf is approached from the east, the track extends through a 270-foot transition curve, a 634-foot, 2° curve to the right, and a 270-foot exit transition curve. Then the track is tangent for about 710 feet and then extends through a 200-foot transition curve, a 1,134-foot, 1° curve to the right, and a 200-foot exit transition curve. The grade is 1-percent descending westward.

Meteorological Information

The weather at Surf about 4 a.m. on May 22, 1981, was clear with a light breeze blowing from the ocean and good visibility. The temperature was about 60° F.

Medical and Pathological Information

The brakeman on the caboose of the Lompoc local received a skull fracture, broken ribs, cuts, bruises, and abrasions. The conductor of the Lompoc local received back injuries and inhalation injuries from the gas and dust. The brakeman on the caboose of Extra 9164 West broke a bone in his right foot. The engineer of the Lompoc local received bruises, and the head brakeman suffered from gas and dust inhalation. Other employees were given a general examination and released from hospitals.

Survival Aspects

The locomotive of the Lompoc local was struck by a derailing tank car, but the cab was not crushed. The head brakeman was not injured when the impact occurred. The caboose of the Lompoc local was overridden by derailing cars and crushed, but the rear brakeman was able to get out of the caboose without help even though he was injured.

The gas cloud caused by the hydrogen fluoride released from the punctured tank car, combined with the dust from a bagged plaster compound that spilled from some wrecked cars, irritated eyes and caused breathing difficulty. The hydrogen fluoride that spilled onto the ground was neutralized by the plaster compound, which was mostly lime. The gas and dust cloud only covered a small area immediately around the train order office, and it dissipated in several hours.

Several train crewmembers, in their efforts to flee the area, ran into a chainlink fence that surrounded the office and extended east and west along the land side of the tracks. The head brakeman of the Lompoc local scaled the fence with difficulty by climbing over a locked gate just east of the office building. Other train crewmembers finally found an opening in the fence near the office through which they escaped the area.

After the derailment, an unidentified motorist gave four of the SP employees involved in the accident a ride to the 13th Street gate of nearby Vandenberg Air Force Base, from where they were then taken to the base hospital for examination. Rescue vehicles from Vandenberg AFB transported other crewmembers and transients to either the base hospital or the hospital in Lompoc.

The disaster response team from Vandenberg AFB was alerted when the train crewmembers arrived at the base gate and reported the accident at about 4:15 a.m., and the team was dispatched to Surf where they arrived at about 4:30 a.m. The team immediately established a command post and assumed control of the situation. The team ordered an evacuation of all railroad personnel and established a roadblock to prevent other persons from entering the area. The team was instrumental in identifying the cause of the gas cloud and the contents of tank cars involved in the derailment by working through the conductor of Extra 8874 East with the SP operating department. The team remained in charge until the SP hazardous materials team arrived about 8:30 a.m. from San Francisco. The SP hazardous materials team neutralized the hydrogen fluoride by mixing a 15:1 ratio of lime and water and forcing it into the tank car opening. Breathing apparatus were not available for the SP traincrews or the telegrapher-clerk. The disaster response team was equipped with breathing apparatus.

Tests and Research

The 53d car was built in 1959 and reconditioned during 1975. The last periodic inspection to satisfy Federal Railroad Administration (FRA) regulations was made in May 1979.

On June 3, 1981, the truck from the "A" end of the 53d car was inspected and tested at the SP mechanical facility at Roseville, California. The truck was a National C-1 Roller Bearing with hangerless-type brake beams. (See figure 3.) The matching truck sides were cast in June 1962 and the truck bolster in June 1959. The roller bearing adapters were gauged and were within acceptable tolerances. The roller bearing cups showed damage at R-3, L-3, and L-4 which occurred in the derailment.

Clearances between bolster gibs 3/ was measured to be:

Location	Top (inches)	Bottom (inches)
L-4	9 9/16	9 7/8
L-3	9 1/2	9 7/8
R-4	9 5/8	10 3/16
R-3	9 5/8	9 7/8

The clearance of a new bolster is a nominal 9 5/8 inches.

The truck side frame dimension that interfaced with the bolster gibs was measured and found to be:

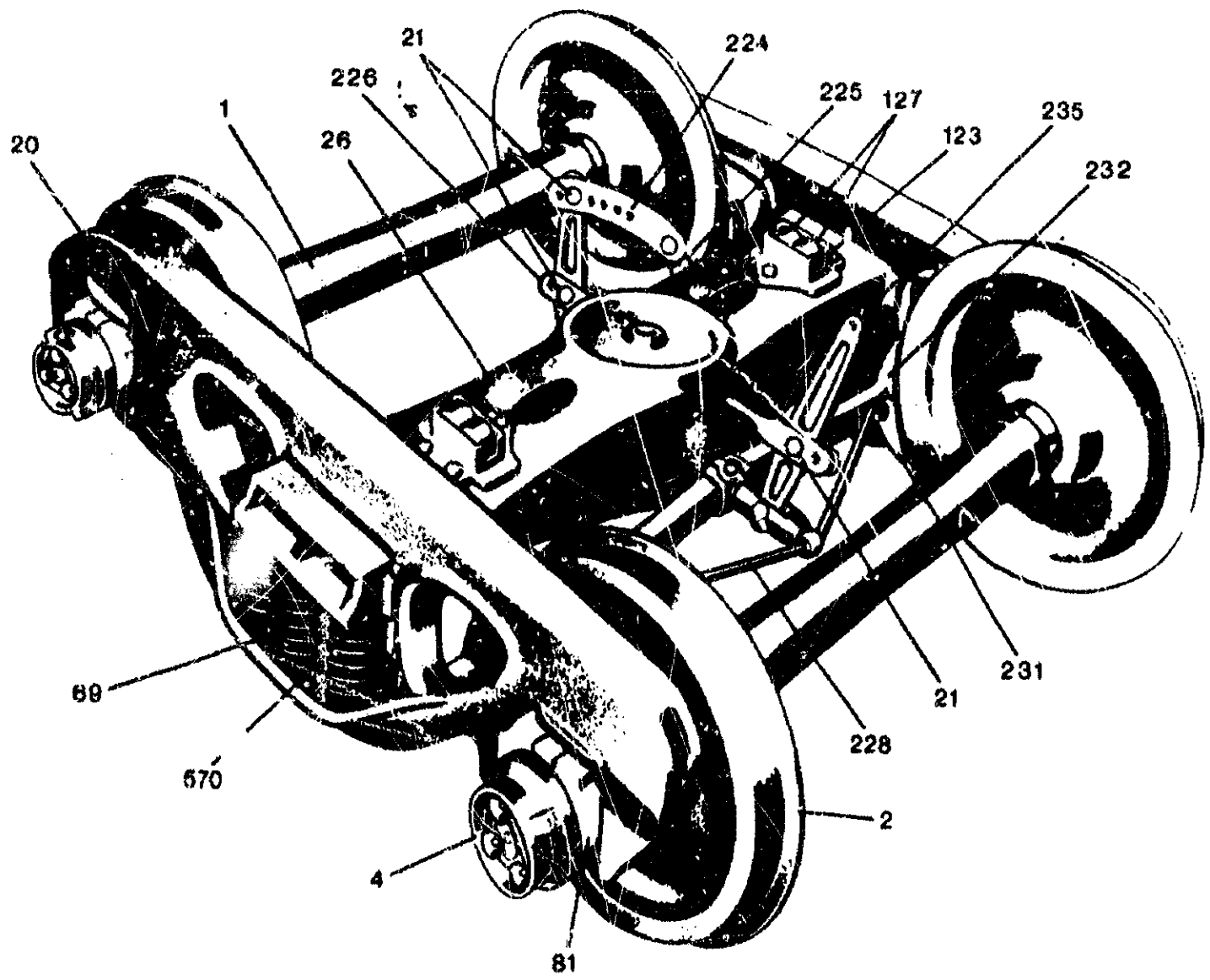
Location	Top (inches)	Bottom (inches)
L-4	8 1/2	9
L-3	8 1/8	8 11/16
R-4	8 3/8	8 5/8
R-3	8 1/8	8 3/16

A new side frame at this measurement point measures a nominal 9 inches. A mark on the side frame at the point this measurement was made showed evidence of a heavy strike that was received during the derailment. A maximum total clearance of 1 3/4 inch occurred between the bolster and side frame of this truck at the bottom R-4 location. Nominal clearance between the bolster and side frame is 7/8 inch.

For the test, a replacement brake beam was placed in the truck in the No. 4 position. The car springs were removed and blocks inserted in the side frames to lower the bolster to its normal, empty-car position. An air jack was placed between the side frames and pressure was applied. (See figure 4.) The brake beam did not drop out. As the pressure increased on the side frames, the roller bearing adapter caught on the edge of the roller bearing at the end of the axle. This barrier kept the side frames from moving farther apart. As the force was increased, the bottoms of the side frames began to spread, and it was concluded that the frames would "pop" out and the brake beam would drop out. The consensus of those present representing the Safety Board, the FRA, the SP, and the State of California Public Utilities Commission was that a spread of this magnitude would have occurred only if the truck were derailed. Force was applied to the truck while it was under the jack pressure to "parallelogram" the truck assembly, but the brake beam still did not drop out.

The "R" end of the brake beam that was believed to have come out of the "A" truck of the 53d car had been cut off with an oxygen-acetylene torch after the derailment. The

3/ Small projections at each end of the truck bolster that provide vertical guidance for the bolster and lateral restraints to the side frames when assembled as a truck.



STABILIZED TRUCK, ROLLER BEARINGS, BODY MOUNTED AIR BRAKE EQUIPMENT

PART NO.	DESCHIPTION	PART NO.	DESCRIPTION
1	CAR AXLE	127	SIDE BEARING ROLLER
2	CAR WHEEL	224	BRAKE DEAD LEVER GUIDE
4	TRUCK JOURNAL ROLLER BEARING	225	BRAKE LEVER BRACKET
20	TRUCK SIDE FRAME	226	BRAKE BOTTOM CONNECTION
21	BRAKE PIN	228	BRAKE BEAM COMPLETE
26	TRUCK BOLSTER	231	BRAKE SHOE
69	TRUCK SPRING	232	BRAKE SHOE KEY
81	ROLLER BEARING WEDGE	235	BRAKE LEVER
123	TRUCK SIDE BEARING CAGE	570	TRUCK FRICTION WEDGE

Figure 3.—Freight truck similar to the truck from the "A" end of the 53d car.

Figure 4.--Air jack in place shown forcing side frames apart on the "A" end truck of the 53d car.

"L" end had the lower half of the brake head missing. The tension member had been pulled loose at the point at which it was welded to the compression member. (See figure 5.) The weld did not break as the tension member was pulled loose. The tension member had a slight bend toward the rear of the car near the strut member. The unit end extension was rotated nearly 180° and the metal was severely distorted from heat. It was apparent that it had been affected by a great amount of heat generated from an undetermined cause. There were no wheel flange marks on the brake beam and only light scuffmarks.

The SP performed several computer simulations on the performance of Extra 9164 West through the accident area. Safety Board investigators participated in these simulations. The results of the simulations substantiated the enginecrew's account of their operation of the train. However, the speed at which the train was traveling when the emergency brake application occurred was determined by the computer simulation to have been about 60 mph in contrast to the 55 mph estimated by the enginecrew. The simulation, which was believed to duplicate more nearly the conditions prevalent and the manner in which the train was being operated, did not indicate the development of excessive compressive or tensile forces on either the 51st, 52d, or 53d cars of the train in the area of the Surf train order office. As shown by the computer, the maximum compressive forces that developed in the train while it was being operated without brakes and in throttle position run 2 were between -10,000 to -20,000 pounds of force. After the emergency brake application became effective, high compressive forces of around -100,000 pounds were developed in the train near the heavy loads, but not in the part of the train containing the 53d car. The heavy loads were in the vicinity of the east switch of the house track when the high compressive forces were developed.

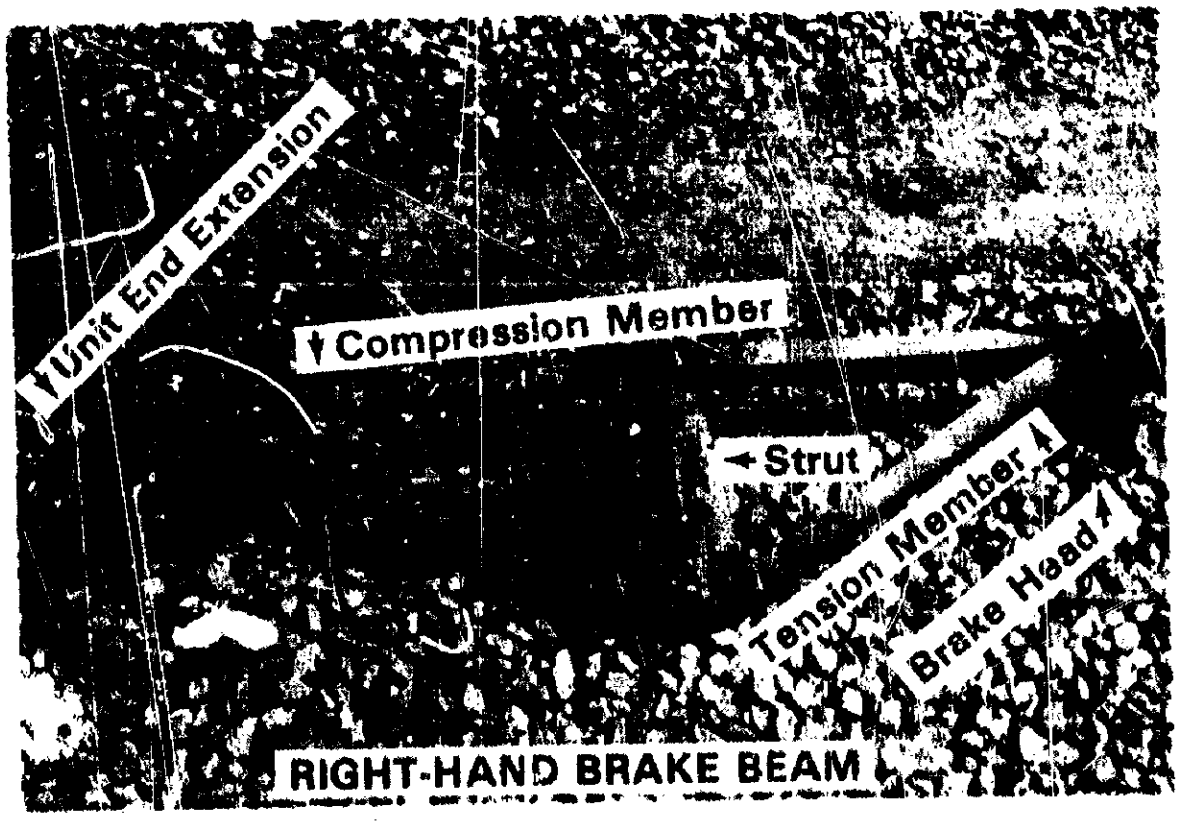


Figure 5.—Damaged brake beam identified as being the No. 4 brake beam from the 53d car (top) and an undamaged brake beam (bottom).

Compressive forces below -100,000 pounds are generally insufficient to cause a "liftout" of a car. The lateral to vertical forces (L/V ratio) were also insignificant in the simulation run. An L/V ratio approaching 1 is the theoretical value for a "liftout." The L/V ratio in the simulation run that most nearly matched the train handling reported by the engineer was less than 0.05 for the 51st, 52d, and 53d cars.

Several other simulations were made, but the method of operating the train was varied. One simulation assumed making a 6-pound brakepipe reduction with the throttle in position run 2. The results indicated some compressive forces as high as -300,000 pounds in that part of the train containing the heavy cars. Another simulation assumed that the throttle was left in position run 8 as the train crested the grade west of Honda. When the train's speed reached 60 mph, a 6-pound brakepipe reduction was made and maintained until the speed of the train was reduced to 50 mph, and then it was released. The train regained a speed of 60 mph as the train passed through Surf. The emergency brake application was made at the same place as previously done, but again, no high compressive forces were indicated near the 53d car.

The computer simulation was not programmed to consider wear on side frames. The program is also unable to simulate the effect of car hunting, or the actual condition of the track. The roadway design curvature, when taken into account, has little overall effect on the indicated speed of the train. Since the computer printout is made at 1-second intervals, it does not reproduce the behavior of the train continually. Therefore, the L/V ratio is given as a static, instantaneous value.

ANALYSIS

The Derailment

Crewmembers of the standing trains and the telegrapher-clerk were making the rollby inspection required by the operating rules as Extra 9164 West passed through Surf. The head brakeman of Extra 8874 East did not observe anything unusual about the train as it passed through the 2° right curve more than 2,300 feet east of the office building, which indicates that there was no dragging or derailed equipment at that point. The rear brakeman of Extra 8874 East did not see any evidence of dragging equipment or of any cars being derailed from where he was inspecting the train, about 200 feet east of the office building. This again indicates a no-fault status of the train at that point. The first indication of a problem with Extra 9164 West was when the rear brakeman of Extra 8874 East saw heavy sparking resulting from a brake application. The telegrapher-clerk's first indication that something was wrong was the loose ballast gravel flying past him at the office, and the engineer of the Lompoc local first noticed that something was wrong when he heard a metal-to-metal grinding noise coming from Extra 9164 West as it passed the office. This indicates that the first problem with the train occurred just east of the office. The conductor of the Lompoc local was about 175 feet west of the office when he became aware of "sparks, dust, and rocks shooting" from the direction of the moving train. Up to that time there had been no derailment. From the time the engineer of the Lompoc local, who was in the office, heard the grinding noise, he had sufficient time to run from the window to the front door from where he saw sparks coming from under the train. He had time to run to the back of the building before he saw cars derailing, which indicates that at least 10 to 12 seconds elapsed from the time the problem began until the actual derailment of cars. In the 10 to 12 seconds, a car that derailed at the grade crossing 50 feet east of the office, traveling about 60 mph, would have moved 1,100 feet to the crossover west of the office before the following cars would derail.

The evidence indicated that the 53d car was the first to derail, which is consistent with the noises heard and the flying debris seen by the telegrapher-clerk and the

crewmembers of the Lompoc local after much of the train had passed. The noise and "flames" probably were caused by the car's derailed wheels or truck side frames rubbing against the rails. It is possible that the front truck of the 54th car may have derailed along with the rear truck of the 53d car, and the wheels rubbing its center sill may have contributed to the sparks and "flames" reported. The severe cut found in the R-3 wheel flange upon inspection probably occurred when the wheel struck the wing of the track frog in the crossover leading from the house track to the main line 1,100 feet west of the office. Upon impact with the track frog, the 53d car could have bounced and separated from its truck, causing the following cars to derail and pile up. When the train separated, the train line was vented when the air hoses were pulled apart, and the airbrakes applied in emergency. The fact that the trailing truck of the car following the 53d car was not derailed tends to eliminate a rail turnover between the office and the crossover until after the general pile-up. It also supports the probability that cars following the 53d car did not derail until they piled up behind the derailed cars at the crossover. No wheel marks were found on the rail head in the area of the grade crossing. However, an empty car, especially if it were hunting, might jump or roll lightly over the ball of the rail without leaving a mark.

Statements made by the witnesses indicate that the pile-up of cars progressed from the crossover to the rear of the train instead of forward of the point of the major derailment, as cars normally do. This indicates that the excursion of the cars from the main track began near the crossover and was followed by an emergency brake application. The presence of the cars in the two tracks on either side of the main line caused the pile-up to progress toward the rear of the train from the point of the initial derailment, in a derailing pattern similar to one that would occur at a location where the roadbed runs through a cut area.

The manufacturer of the truck side frames had virtually no reports of a brake beam dropping out except where the brake beam was severely bent. The No. 4 brake beam of the 53d car was found separated from the "A" truck after the derailment. It is unlikely that a brake beam will drop out of a truck side frame unless the truck is derailed. Although the measured wear on the truck components of the 53d car suggested that excessive lateral movement allowed by the wear would permit the brake beam to fall, tests conducted at Roseville showed that this was highly improbable with a roller bearing wheel assembly. Furthermore, the tests showed that the increased clearances of the gibs caused by wear did not seem to materially affect the loss of the brake beam. Therefore, the Safety Board concludes that the brake beam dropped out after the 53d car initially derailed at the grade crossing.

The brake beam had been overheated from an undetermined cause. There was evidence that the bottom rod connecting the Nos. 3 and 4 brake beams on the "A" truck had been rubbing against an opening in the car bolster. However, because the bottom rod extended through the bolster, the downward travel of the brake beam would have been limited. If the brake beam had been dragging for some length of time, an alarm should have been given by one of the dragging equipment detectors, but none, including the one 9.8 miles east of Surf, was actuated. Also, it is possible that the hot box detector at the same location or one passed earlier might have been activated if the brake beam had been abnormally hot at that point. The emergency stop made by Extra 9164 West at Oxnard could have caused damage to the brake beam, but there is no evidence to support this possibility. The compression member, which could have had an old fracture or could have been fractured at Oxnard, was not deformed from its normal alignment except for the twisted brake head and unit end extension. The deformation of the brake beam could not have occurred while the brake beam was cold because there was no evidence of brittle breakage or cracking. Therefore, it seems unlikely that the brake beam was bent between Los Angeles and Oxnard and seems likely that it was overheated and bent at a point west

of Oxnard. Additionally, there was no trouble observed or reported on Extra 9164 West before it arrived at Oxnard. Because of the lack of evidence that the brake beam was down, and as a result of the tests conducted at Roseville, the Safety Board concludes that the brake beam did not cause the derailment.

Car hunting also could have caused the derailment. The wear of the truck side frames and the car bolster of the 53d car could have been caused by hunting over a period of time, and the wear could have been conducive to hunting at the time of the accident at a speed of about 60 mph. If the 45-mph speed restriction required for the 71st car had been observed by the trainerow, the critical speed, 50 mph to 60 mph, at which the 53d car would have begun to hunt or to hunt in a violent manner, would not have been reached. The lack of either compressive or tensile forces on the car may have contributed to the car's climbout, since essentially it was running free. The overspeed movement of the train from the maximum authorized speed, as determined by the computer simulation, contributed to the cause of the derailment.

The computer simulations indicated that the make-up of Extra 9164 West did not cause excessive compressive forces as the train descended the grade from Honda to Surf in the operational mode described by the engineer. However, when different operating techniques were programmed into the computer, excessive values of compressive forces could be developed in the drawbars of the cars with heavy loads. If the engineer had used the airbrakes between Oxnard and Surf, a derailment probably would have occurred. Also, the L/V ratio was high in that same heavily-loaded part of the train, which indicates the probability of a car liftout or rail climb.

Since the computer program did not include the mechanical condition of the equipment, actual track conditions, or of certain operating characteristics, the results of the simulated run do not eliminate the possibility that track/train dynamics affected the movement of the train. Also, the computer printout of L/V ratio values were instantaneous static results and the behavior of the train as a continuing output was not available. Therefore, the Safety Board concludes that the interaction of the train with the track influenced the behavior of Extra 9164 West.

The derailment of Union Pacific Railroad Company (UP) Extra 2800 East at Hastings, Nebraska, on August 2, 1976 4/ was precipitated by the UP's improperly placing a block of heavy cars at the rear of a 116-car freight train. The compressive forces that developed in the 42d, 43d, and 44th cars in the train caused them to jackknife in an area in which track work was being performed. The Safety Board believes that the SP and the railroad industry in general should review the results of studies in track/train dynamics and apply these principles more diligently in the make-up of long trains.

Hazardous Materials

The fumes from the residual hydrogen fluoride in the punctured tank car and the plaster dust cloud made it virtually impossible for persons involved to breathe. The telegrapher-clerk and crewmembers were unknowingly subjected to a danger when they encountered the gas and dust cloud. The head brakeman of the Lompoc local and the conductor of Extra 8874 East were on their trains when the tank was punctured. If breathing apparatus had been available, these men would not have suffered as much from the effects of the gas fumes and plaster dust; moreover, in some circumstances, their ability to render needed assistance on-scene would have been enhanced. The Safety Board recognizes that even if breathing apparatus had been available on the trains, most of the

4/ Railroad Accident Report--"Union Pacific Railroad Freight Train Derailment, Hastings, Nebraska, August 2, 1976" (NTSB-RAR-77-1).

men were not close enough to the cabooses or locomotives to be able to pick up the apparatus. Despite this, the Safety Board believes that railroads should consider placing breathing apparatus in the locomotive cabs and cabooses of trains carrying hazardous materials for use by crewmembers in case of a hazardous materials spill.

The Disaster Response Team from Vandenberg AFB responded within 30 minutes and conducted a well-organized effort to control and evacuate the area. The team dispatched victims to a hospital for treatment and established a checkpoint for controlling access to the area. In addition, the team, with the help of the conductor of Extra 8874 East, attempted to identify the commodities involved in the accident to determine the extent of the hazard confronting them and the toxicity of the gas and dust cloud. The team responded and performed in a highly creditable manner, and their controlled oversight of the activities may have saved lives and prevented serious injuries.

The SP computer system on which the SP relies heavily for identifying hazardous materials in SP over-the-road trains was out of service on the morning of May 22, 1981. In the absence of a working system, the method was limited by the availability of the computer system and is vulnerable. The SP should furnish its crewmembers located in the locomotive and the caboose of each train carrying cars containing hazardous materials or "empty" cars that last contained hazardous materials with data to be used to locate the hazardous materials cars in the train and, as a minimum, to identify the commodity or the tank car's last contents. The Safety Board believes that if accurate data had been available on Extra 9164 West, the hydrogen fluoride that was escaping from the tank car might have been neutralized sooner. The SP's new format for consists should provide an effective system for timely, on-scene information.

The Safety Board discussed the problem posed by "empty" tank cars in its report of a 1970 accident at Soundview, Connecticut. 5/ . . Surf, the contents of an "empty" hazardcus materials tank car injured 17 persons. The exact quantity of hazardous materials (hydrogen fluoride) in the car could not be determined from documents furnished to the railroad. Despite the stenciling of the product name on the car and the "empty" placards, the carrier and others had no way of assessing the danger posed by the "empty" car in the accident without knowledge of the amount of product left in the car.

Current "communication" regulations in 49 CFR 172 for "empty" tank cars provide for the top 1/3 of DOT tank car placards to be covered by a black triangle with the word "empty." Regulations require the class name to appear in the midsection of the placard. When the top 1/3 of the placard is covered with the "empty" triangle, it obscures the class pictograph on the placard. Regulations due to become effective on November 1, 1981, require the inclusion of the United Nations commodity identification numbers on placards. It is assumed that the commodity numbers will remain on "empty" placards, but the regulations allow the option of a permanent orange panel with the United Nations commodity identification number. Thus, the possibility of both the loss of the pictographic identifier and the class identifier exists. Because the Uniform Freight Classification Tariff Rule 35, Section 7 permits an "empty" tank car to contain as much as 1/3 of the quantity shown on billing documents for the last revenue-paying shipment, tank cars containing up to 1/3 carload of hazardous materials may be moving in transportation without adequate identification of the contents on the car or on the accompanying railroad documentation.

5/ Railroad Accident Report---"Penn Central Transportation Company Freight Train Derailment and Passenger Train Collision with Hazardous Material Car, Soundview, Connecticut, October 8, 1970" (NTSB-RAR-72-1).

In view of these circumstances, the Safety Board believes that the petition of the IAFC to amend the safety regulations to provide more adequate safety information is timely and has merit.

CONCLUSIONS

Findings

1. Extra 9164 West was being operated overspeed for a restricted-speed car and at authorized speed for a freight train passing through Surf, as indicated by the computer simulation.

2. Extra 9164 West was being given a rollby inspection by qualified employees as required by the SP operating rules.

3. The initial derailment involving wheel climb by the 53d car occurred immediately east of the railroad office at a grade crossing and the major derailment began at the crossover 1,100 feet west of the office when the derailed wheels of the 53d car struck the track frog in the crossover.

4. The No. 4 brake beam from the "A" end truck of the 53d car was not a causal factor in the derailment because it dropped out after the car derailed.

5. If the speed restriction for the restricted speed car had been observed, the speed at which empty boxcars are known to hunt would not have been reached.

6. Although the train make-up placed heavily loaded cars toward the rear of the train behind lightweight empty cars, there is no evidence to indicate this was a contributing factor in the derailment.

7. The Disaster Response Team from Vandenberg AFB probably prevented further injuries by its prompt, well-organized response.

8. The carrier and personnel responding to the emergency did not have needed information from the shipper for timely determination of the dangers posed by the hazardous material carried in the breached "empty" tank car.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the derailment of the trailing truck of the 53d car from the locomotive, an empty boxcar, at the entrance spiral to a 1° right curve because of hunting and wheel climb due to track/train dynamics. The derailed car continued on the track structure for about 1,100 feet until it struck a track frog in a crossover. The trailing truck then became detached from the car body and the following 38 cars derailed, striking cars standing on adjacent tracks. Contributing to the accident was the overspeed movement of the train.

RECOMMENDATIONS

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

Amend 49 CFR 171.8 to define in specific quantities the maximum quantity of a hazardous material that may be moved in a tank car placarded under 49 CFR 172.525 and offered for transportation by a shipper as an "empty" tank car under DOT regulations. (Class II, Priority Action) (R-81-97)

Amend 49 CFR 174.25(c) to require that shippers show on shipping papers the approximate weight of a hazardous material contained in a tank car offered by the shipper to a carrier as an "empty" tank car for movement under Rule 35 of the Uniform Freight Classification Tariff. (Class II, Priority Action) (R-81-98)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ G. H. PATRICK BURSLEY
Member

FRANCIS H. McADAMS and PATRICIA A. GOLDMAN, Members, did not participate.

September 15, 1981

APPENDIXES

APPENDIX A

INVESTIGATION

The Safety Board was notified of this accident on the morning of May 22, 1981. The Safety Board dispatched a field investigator from its Los Angeles field office who arrived at Surf about 10 p.m. His late arrival was the result of his being at another accident scene conducting an investigation. An Investigator-in-Charge was dispatched to Surf from the Washington, D.C., headquarters about 5 p.m. on May 22. He arrived on the scene about 2 p.m., May 23. A second Washington Headquarters investigator joined the investigative team at Sacramento, California, on May 29, 1981.

APPENDIX B

CREWMEMBER INFORMATION

Extra 9164 West called for duty at 5:30 p.m., on May 21, 1981, at Los Angeles, California.

Robert D. Swain, Engineer

Robert D. Swain, 34, was employed by the Southern Pacific Transportation Company on June 1, 1970, as a student fireman. He was promoted to engineer on December 12, 1972. He was up-to-date on operating rules examinations. Mr. Swain had been off duty 14 hours when he called for duty on May 21.

Charles E. Johnson, Fireman

Charles E. Johnson, 31, was employed by the Southern Pacific Transportation Company on June 14, 1972, as a student brakeman. He transferred into engine service on May 15, 1973, as a fireman, and he was promoted to engineer on September 22, 1974. He was up-to-date on operating rules examinations. He had been off duty 14 hours when he was called for duty on May 21.

APPENDIX C

EXCERPTS FROM SOUTHERN PACIFIC TRANSPORTATION COMPANY OPERATING RULES

No. 829 - When a train stops to be met or passed by another train, trainman on headend of train must make a rolling inspection of passing train from the ground on the side opposite his train. Trainman at the rear of standing train must make rolling inspection from the ground on the side adjacent to their train. . . .

No. 913 - When trains are passing, operator must be on platform prepared to make a rolling inspection, except when excused by train dispatcher or when a train order is held for delivery to that train restricting it at the station.

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