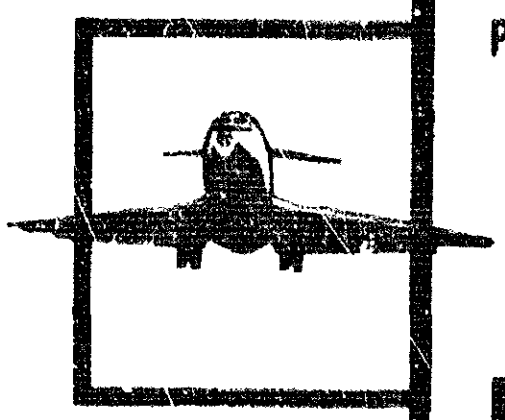

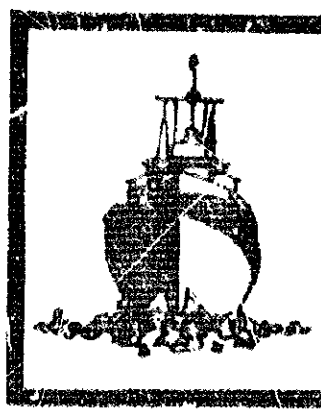

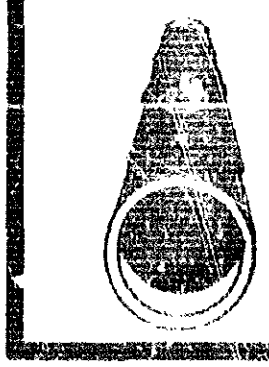

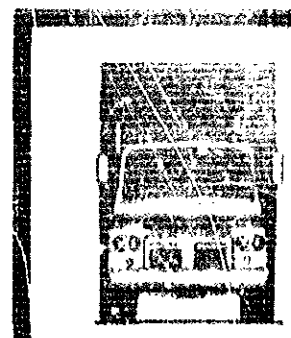

PB89-916303

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

DERAILMENT OF
NATIONAL RAILROAD PASSENGER CORPORATION
TRAIN 7
ON BURLINGTON NORTHERN RAILROAD
NEAR SACO, MONTANA
AUGUST 5, 1988

NTSB/RAR-89/03

UNITED STATES GOVERNMENT

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15. Supplementary Notes

16. Abstract

About 3:15 p.m. mountain daylight time on August 5, 1988, westbound National Railroad Passenger Corporation (Amtrak) train 7, The Empire Builder, derailed near Saco, Montana, while operating on the Burlington Northern (BN) Railroad. Five passengers and 1 Amtrak service crewmember received serious injuries; 87 passengers and 13 Amtrak service crewmembers received minor injuries. The estimated damage was $2,778,000.

The major safety issues in this accident include: BN's inspection and maintenance practices of continuous welded rail (CWR), the adequacy of BN's practices for placing slow orders on CWR, and the crashworthiness of railroad passenger car equipment.

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EXECUTIVE SUMMARY

About 3:15 p.m. mountain daylight time on August 5, 1988, westbound National Railroad Passenger Corporation (Amtrak) train 7, The Empire Builder, derailed near Saco, Montana, while operating on the Burlington Northern (BN) Railroad. Five passengers and 1 Amtrak service crewmember received serious injuries; 87 passengers and 13 Amtrak service crewmembers received minor injuries. The estimated damage was $2,778,000.

The major safety issues in this accident include:

- BN's inspection and maintenance practices of continuous welded rail (CWR),
- the adequacy of BN's practices for placing slow orders on CWR, and
- the crashworthiness of railroad passenger car equipment.

The National Transportation Safety Board determines that the probable cause of the accident was Burlington Northern's inadequate track inspection and maintenance procedures, which resulted in a thermally induced lateral shift of the track structure in front of Amtrak train 7, and Burlington Northern's failure to impose a slow order on the disturbed section of track.

Recommendations on these safety issues were addressed to BN, Amtrak, and to each host railroad Amtrak operates over. Safety Recommendation R-88-31 was reiterated to the Federal Railroad Administration.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT
DERAILMENT OF
NATIONAL RAILROAD PASSENGER CORPORATION
TRAIN 7
ON BURLINGTON NORTHERN RAILROAD
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INVESTIGATION

Events Preceding the Accident

About 10:30 a.m. on August 3, 1988, a Federal Railroad Administration (FRA) track safety inspector and a Burlington Northern (BN) roadmaster in a high-rail vehicle[1] inspected the track in the vicinity of milepost (MP) 317, near Saco, Montana as part of the FRA's routine surveillance program. Neither the BN roadmaster nor the FRA inspector took any exception to conditions of the track in that area.

About 12:30 p.m., a BN track inspector and an assistant high-railed over the area. (See figure 1.) The track inspector testified that while traveling on the passing track in the vicinity of mp 317 he observed in the north rail of the main track a low spot "about an inch ... a little over or something" for about a rail length (39 feet). He could not accurately recall whether he had gotten out of the vehicle to inspect the low spot on foot or if he had only slowed down and checked the spot while moving. However, he said that he did not use a level board to measure the deviation in cross elevation, did not dig out the ballast from the ends of the crossties, did not check for a gap between the base of the rail and the tie plate, did not record the defect on his daily report of inspection, nor place a slow order covering the area of the low spot. The track inspector and BN maintenance-of-way supervisory personnel testified that the inspection was accomplished according to accepted BN practices.

About 2 p.m., the track inspector notified the BN maintenance-of-way section foreman responsible for track maintenance in the area about the low spot. The section foreman and the track inspector agreed that the section foreman would attend to the low spot on August 5 after the section crew completed their current work assignment. The track inspector testified that he did not believe a slow order was necessary to protect the area of the low spot in the interim until the section foreman could attend to it.

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[1] A high-rail vehicle is a highway vehicle equipped with auxiliary steel wheels and apparatus that is designed to operate over railroad trackage.

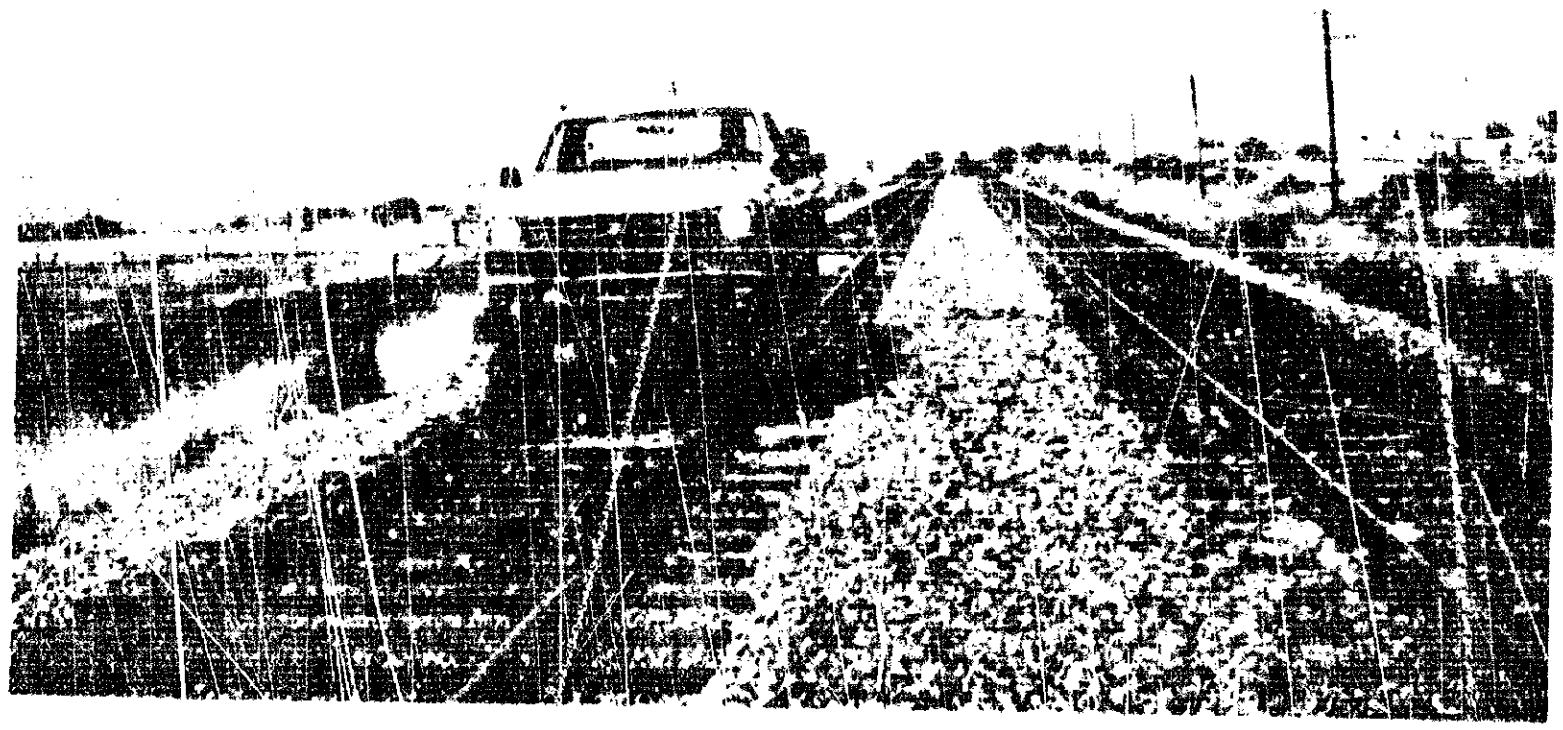

Figure 1.--Track inspector in high-rail vehicle near mp 317

On August 5, track and time limit permit 1416 was issued to the section foreman authorizing him to occupy the main track between the east and the west switches at Saco from 11:30 a.m. to 12:45 p.m. The section foreman stated that he did not check the low spot between the time he was notified on August 3 and the time he and a two-member crew arrived to do the work on August 5. At that time, the section foreman estimated that 40 feet of the north rail of the main track was 1 inch low and that the track surface needed correcting. He inspected the area for tight rail,[2] "a rail that's looking for a place to go; it's got slack in the tie plates," but he did not see any indications that such a condition existed.

According to the section foreman, the section crew placed two track jacks under the north rail and raised the rail level with the south rail in a single lift. The section foreman visually checked the rail for proper alignment and cross level as it was being raised. He stated the rail did not appear to kink as it was being raised. The section foreman operated a track-mounted tamping machine, and the two-member section crew shovelled ballast around the area being tamped. The ballast reportedly was taken from the area

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[2]Tight rail is a condition that results when an increase in ambient temperature causes longitudinal expansion in steel rail. A 1,440-foot unrestrained rail section will expand 9/16 inch with a 5° F increase in temperature and 7 inches with a 60° F temperature increase.

between the main track and the passing track. The section foreman testified that when the tamping was completed the tie cribs were full, the shoulder ballast was 12 inches, and the rail anchors were checked to determine that they were still tight against the crossties. "We tightened I think probably half a dozen of the anchors that were in that area." Neither the section foreman nor either member of the section crew used a level board to verify cross level accuracy either before or after the track was raised. The section foreman estimated that the ambient air temperature was about 80° during the time the track work was being performed. He testified he did not have a rail thermometer and that he was not aware of any requirement to use a rail thermometer.

The BN roadmaster responsible for that area arrived as the work was being completed. The roadmaster spoke with the section foreman, "took a quick visual inspection of the area," "sighted the track" (observed alignment and cross elevation), and checked for evidence of tight rail. He testified that he did not see any indications of tight rail conditions and took no exception to the work performed by the section crew. The roadmaster estimated that he was at the work site about 15 minutes; he then drove the section foreman about 1 mile to a road crossing where the section foreman had parked his pickup truck. The roadmaster departed the area at that time and the section foreman returned to the work site where the section crew was finishing the work. The roadmaster and section foreman stated that they did not discuss whether a slow order should be placed on the area of the track work.

Permit 1416 for the track work was cleared at 12:26 p.m., when the train dispatcher was informed that the track work in the area was completed and that the main track could be used at maximum authorized speed. The CTC train graph in the train dispatcher's office indicated that BN freight train GD3WT-5 met two other freight trains at Saco between 10:56 a.m. and 11:30 a.m. on August 5. Both the passing track and the main track would have been occupied during that time.

The Accident

On August 5, National Railroad Passenger Corporation train 7 (The Empire Builder) departed Chicago, Illinois, en route to Seattle, Washington. The train consisted of a 2-unit locomotive and 12 Superliner passenger cars. The cars were arranged in the following order: two mail cars, one baggage car, one combination dormitory/coach car, one sleeper car, two coach cars, one diner car, one lounge car, one combination baggage/coach car, one coach car, and one sleeper car. A terminal air brake test was performed before the train departed Chicago.

Train 7 arrived in Minot, North Dakota, where the engine and train crews were changed for the 536-mile segment of the trip between Minot and Shelby, Montana. On-board service personnel (OBS) remain with the train for the duration of the trip, while train and engine (T&E) crews assume duty at various points en route. The replacement train crew consisted of a conductor and two assistant conductors. The replacement engine crew consisted of an engineer, a fireman, and an extra engineer who was working

the trip to familiarize himself with the territory in anticipation of substituting for the regularly assigned engineer who planned to be off duty the following 2 days.

The regularly assigned engineer reviewed the air brake certificate and the locomotive inspection card; he took no exception to the locomotive's condition. About 10 a.m., the train departed Minot with 368 persons on board the train: 278 coach passengers, including 8 dead-heading railroad employees; 68 sleeper car passengers, 16 on-board service attendants, and 6 operating crewmembers.

The engineer checked the accuracy of the speed indicator by measuring elapsed time over a known distance. The engineer reported the speed indicator to be accurate to within 1 mph. Running air brake tests and train observations were made independently by each of the three engine crewmembers at separate times. Each engine crewmember was qualified to operate passenger trains on this district and reported the train handled normally in both power and braking modes.

At various points during the trip, it is customary for an engineer and fireman to take turns operating the locomotive. The regularly assigned locomotive engineer testified that "It's a 536-mile run, and we try to limit ourselves to not more than 2 hours at a time behind the throttle." The engine crewmembers decided that only two crewmembers needed to be in the operating compartment at any one time. At station stops where the engine crew alternated control of the locomotive, the third engine crewmember went to either the dormitory car or the passenger-occupied portions of the train. There is no direct access between the locomotive and the train.

About 1 mile west of Saco, the regularly assigned engineer and the extra engineer were in the locomotive control compartment. (They took control of the train at Glasgow, Montana.) The regularly assigned engineer was operating the locomotive, and the extra engineer was seated on the left side of the control compartment. The regularly assigned engineer reported that at that time he saw a "sun kink"[3] (see figure 2) in the track ahead of the train; the train was traveling at 79 mph. He testified that "It was between me and where I normally look when I'm running. I had already scanned that piece of track before I got to it, and I was looking farther out. I couldn't believe what I [saw] when I [saw] it, because I knew it wasn't there seconds ago. But I didn't actually see the sun kink move. It was just there." He stated that he immediately shouted a warning and simultaneously initiated a full service brake application. The regularly assigned engineer stated that he left the power applied on the locomotive in an effort to keep the train stretched and to avoid placing additional stress on the track. The extra engineer testified that after looking at the wayside

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[3] Lateral displacement of the track structure normally associated with high ambient temperature.

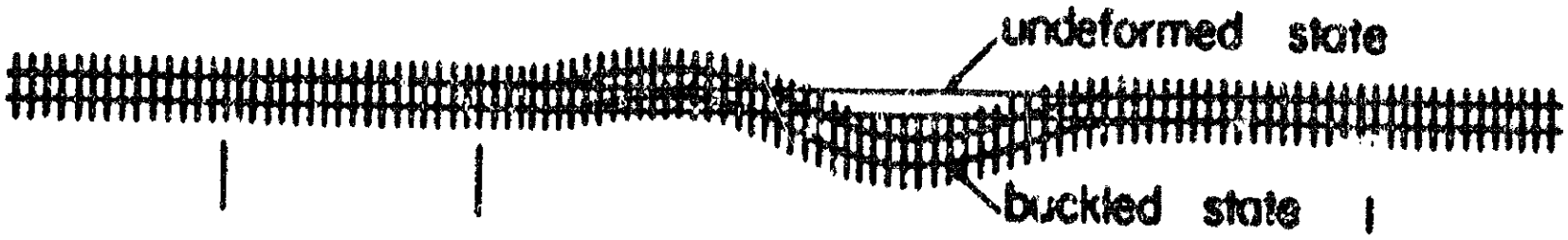


Figure 2.--Sketch of sun kink

signal as train 7 was passing through Saco ". . . for the next couple of seconds I really don't know where I focused my eyes. Then [the engineer] let out an exclamation, and I looked at him to see what he was looking at, and then I [saw] he was looking straight down the track, so I looked down the track, and then that's when I [saw] the sun kink."

About 4 to 5 seconds later, the locomotive entered the area of the sun kinked track and began to rock violently from side to side. Both engine crewmembers were thrown about the control compartment; however, the locomotive did not derail. The dormitory/coach, a sleeper, two coaches, and the diner overturned onto their sides; the lounge car came to rest listing at about a 45^{0} angle. The baggage/coach car, a sleeper car, a coach car, the second baggage car, and the trailing end of the first baggage car derailed upright. The derailed equipment came to a rest approximately parallel to the track structure. (See figure 3.)

The train and engine crew, OBS personnel, and the passengers generally reported hearing the sound of the train's air brakes applying and then felt three distinctive jerks during the train deceleration.

Injuries To Persons

	Passengers	Engine/Train Crews	OBS Crews	Total
Fatal	0	0	0	0
Serious	5	0	1	6
Minor	87	0	13	100
None	254	6	2	262
Total	346	6	16	368

Damage

Eleven cars derailed in the accident. (See appendix B.) About 468 feet of main track was destroyed, and 450 feet of main track was damaged. The damage began at the point of derailment (mp 316.94) and continued westward.

Amtrak and BN estimated the damage as follows:

Equipment	$2,706,000
Track	22,000
Wreckage removal	50,000
Total	$2,778,000

Personnel Information

The OBS personnel and the train and engine crews (T&E) were employed by Amtrak. On April 29, 1987, train and engine crews operating Amtrak trains became Amtrak employees. Before that date, train and engine crews had been supplied by the host railroad, in this instance, BN. All were qualified for their respective positions. Before assuming duty at Minot the T&E crewmembers had each been off duty for 11 hours 28 minutes. (See appendix C.)

OBS personnel work a 6-day cycle: three days outbound on train 7 followed by a 3-day return on train 8. Off-duty time after a completed round trip varies between 4 and 7 days depending upon job category. Total time worked during a round trip ranges from 64 hours 20 minutes for service attendants and food specialists to 79 hours for train attendants. The longest scheduled continuous work period is 21 hours 30 minutes for a train attendant. Sixteen hours thirty minutes is typical of the longest scheduled work period for the remainder of the crew.

The maintenance-of-way crew, the section foreman, the track inspector, and the roadmaster were employed by the BN. The section foreman testified that he and the section crew normally worked 7:30 a.m. to 4 p.m., Monday through Friday. However, the schedule had been changed several weeks before the accident to 6 a.m. to 2:30 p.m., Monday through Friday, to take advantage of cooler morning temperatures and to avoid the higher afternoon temperatures. (See appendix C.)

Train Information

Amtrak train 7 operates daily from Chicago to Seattle. The train operates as train 7 on the outbound trip between Chicago and Seattle and as train 8 on the inbound trip.

Locomotive Units.--The locomotive units were built by the Electro-Motive Division (EMD) of the General Motors Corporation. Both locomotive units were model F40PH, 3,000-horsepower, diesel-electric passenger units. A 6-month inspection was performed on lead locomotive unit AMT 409 on July 28, 1988; an annual inspection was performed on trailing locomotive unit

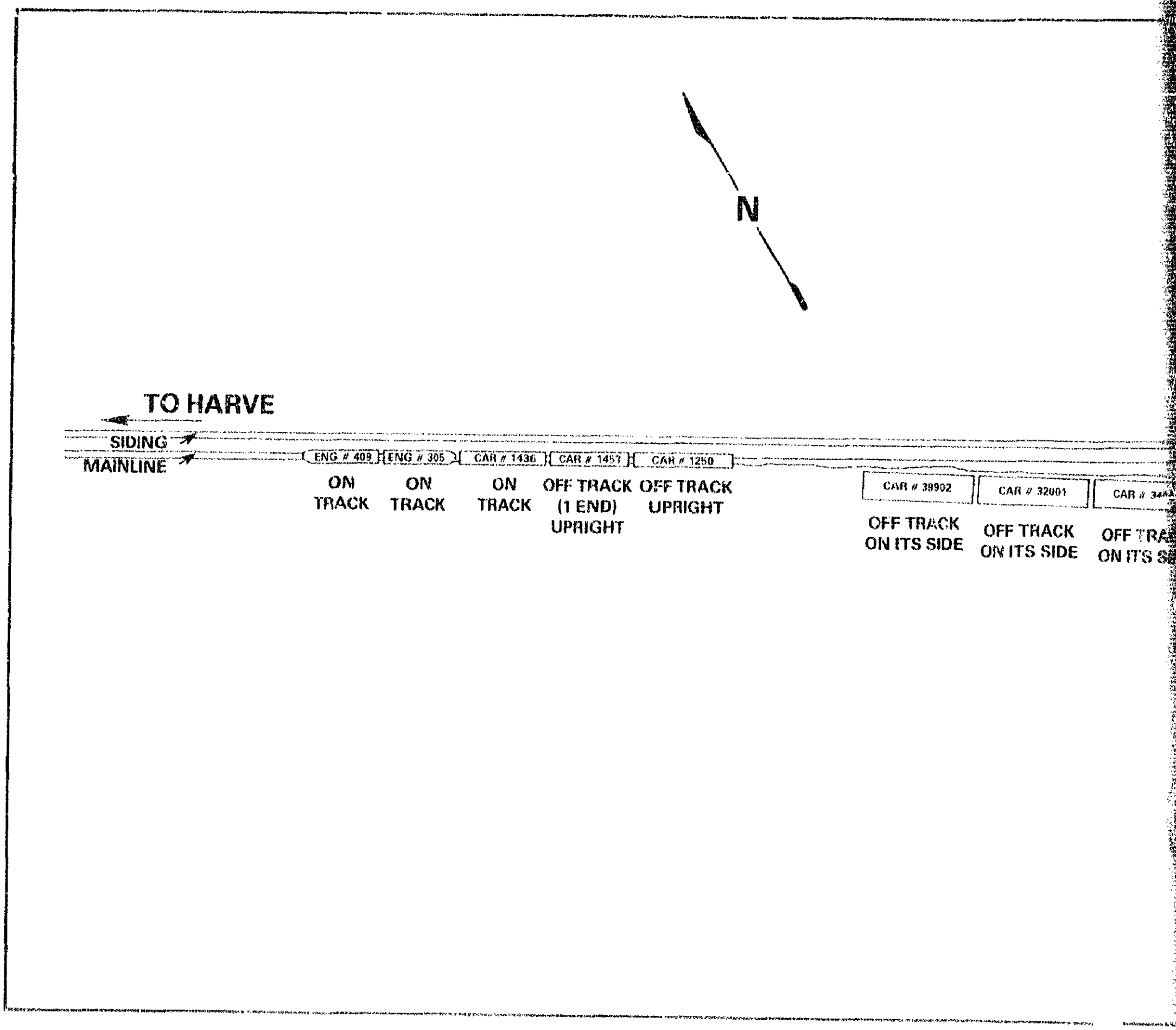
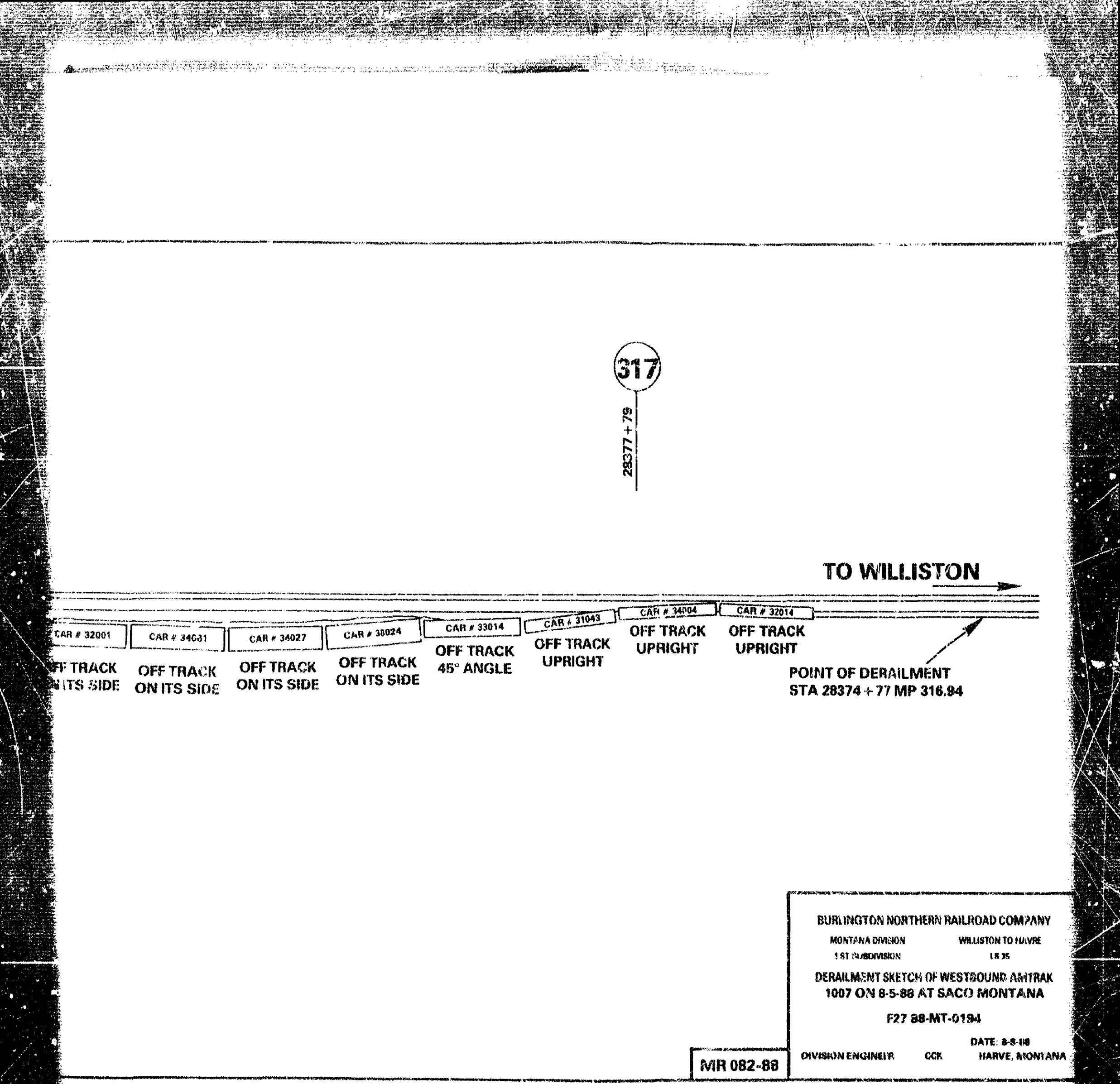


Figure 3. – – Plan view



Plan view of accident site.

AMT 305 on June 13, 1988. Each locomotive was equipped with an Aerotron 4-channel radio; schedule 26L air brake equipment; Pulse Electronics, Inc., Train Sentry II Alerter; speed indicators; twin sealed-beam headlights; and overspeed limit control with a warning whistle. The lead locomotive unit was equipped with a Pulse Electronics, Inc., multi-event recorder system that measured and recorded onto magnetic tape elapsed time, distance, speed, traction motor current, throttle position, automatic brake application, independent locomotive brake application, throttle position, and dynamic brake application. Trailing locomotive unit AMT 305 was equipped with an Aeroquip two-event recorder which measured elapsed time and speed and transcribed the information onto a paper tape.

The Aeroquip two-event recorder and the speed indicator from AMT 305 were calibrated and tested by BN mechanical personnel in Seattle. The drive for both the recorder and speed indicator on AMT 305 had been set for a 37-inch-diameter wheel (116.18-inch circumference) although the actual wheel size at the time of the accident was 38 inches(119.32-inch circumference). This resulted in about a 3-percent error.

The multi-event recorder cassette was removed from AMT 409 at 5:10 p.m. on August 5 by a BN operating officer while the locomotive was still at the accident site. (See appendix D.) BN personnel used a Pulse Electronics, Inc., desk-top playback system to prepare a paper printout from the information contained in the cassette. (See figure 4.) The printout indicated a continuous 18-psi automatic air brake application with further reductions to 22 psi. The cassette was taken to the Safety Board's laboratory to determine why the brake pipe reduction did not appear to correspond with the other data recorded at the same time on the cassette. Before beginning any detailed laboratory analysis of the cassette, the Safety Board prepared a paper printout using a Pulse Electronics, Inc., playback system similar to that used by the BN. The brake pipe reduction did not appear in the Safety Board's printout. (See figure 5.)

BN's assistant superintendent/locomotive shops testified that he had calibrated the playback system before preparing the paper printout on the night of the accident and that he had observed the brake pipe anomaly at the time he prepared the original printout. He stated, "I've seen this happen before. Occasionally, I've had it happen where we've had a bad air manifold on a locomotive." He did not recalibrate the playback system before releasing the paper printout. The assistant superintendent/locomotive shops testified that he had been formally trained on separate occasions by two major manufacturers of event recording devices in the preparation and interpretation of the paper printouts.

Amtrak's assistant chief mechanical officer testified that all 210 locomotives in Amtrak's fleet are equipped with some type of recording device. The recording devices are inspected every 92 days concurrently with the locomotive periodic inspection required in 49 Code of Federal Regulations (CFR) 229.23; however, at present, no Federal regulations require that locomotives be equipped with any type of event recorder. The assistant chief mechanical officer further testified that Amtrak removes the event recorder

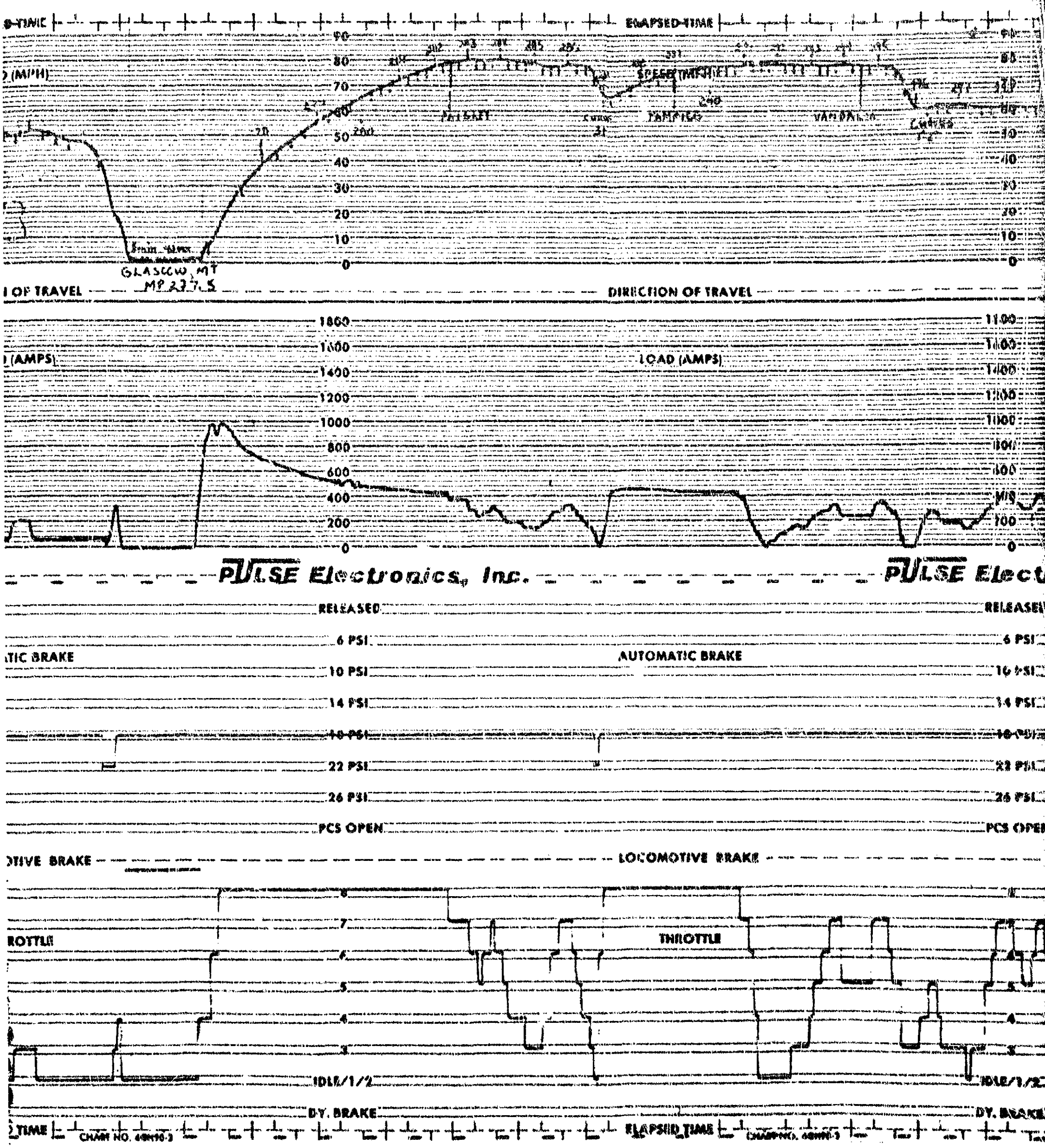
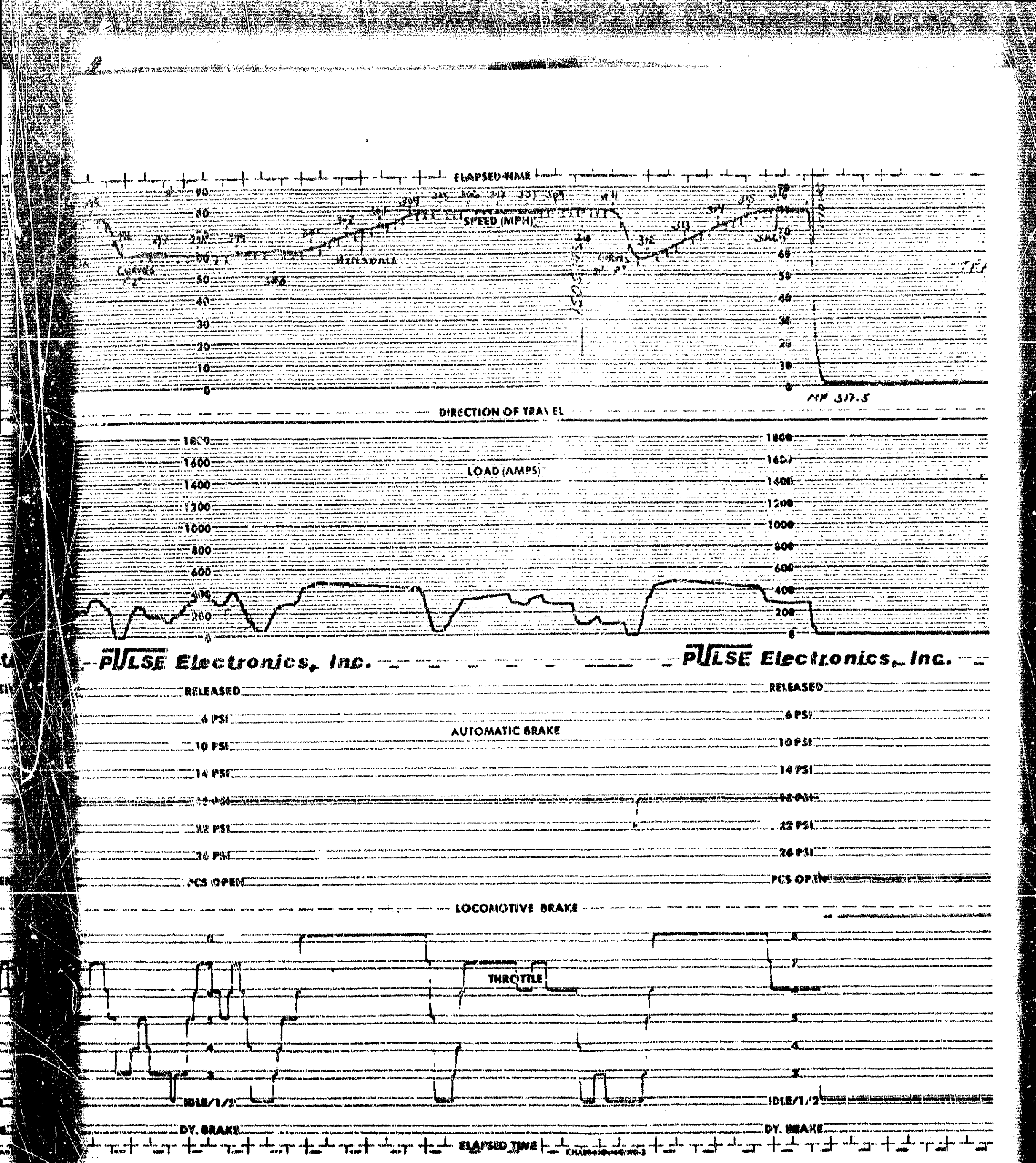


Figure 4. -- BN prepared even



prepared event recorder printout.

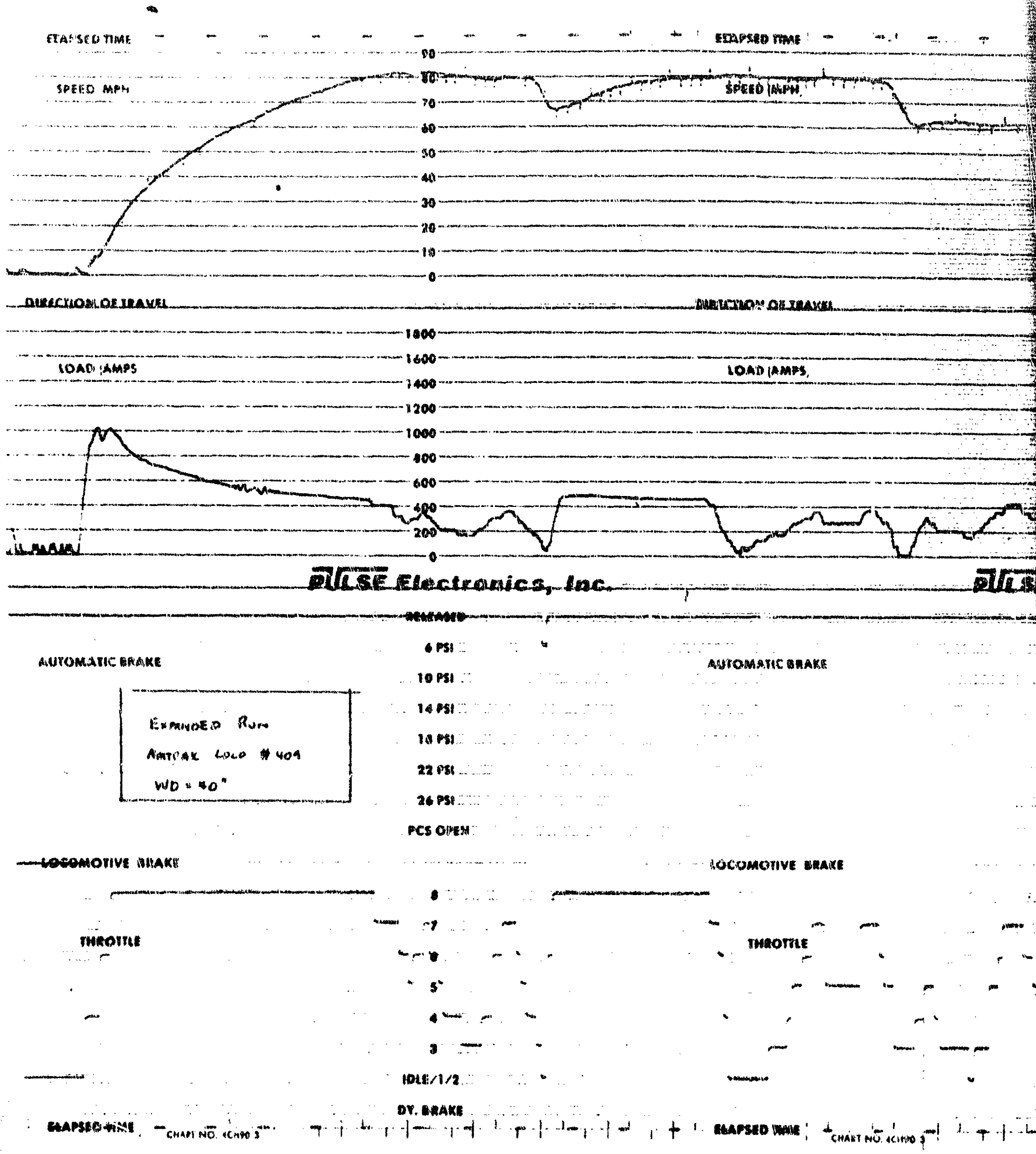
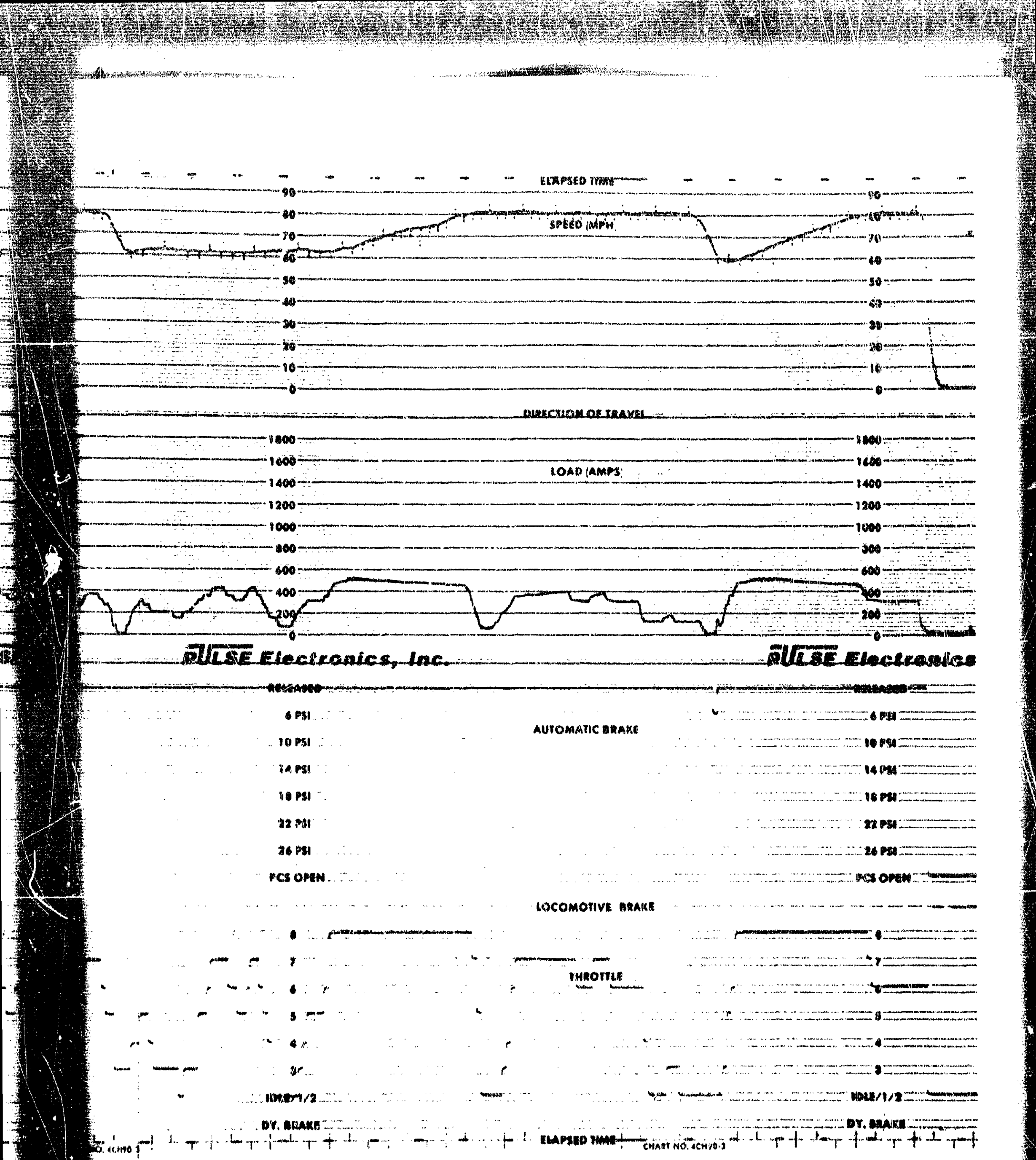


Figure 5. - - Safety Board event



oard event recorder printout.

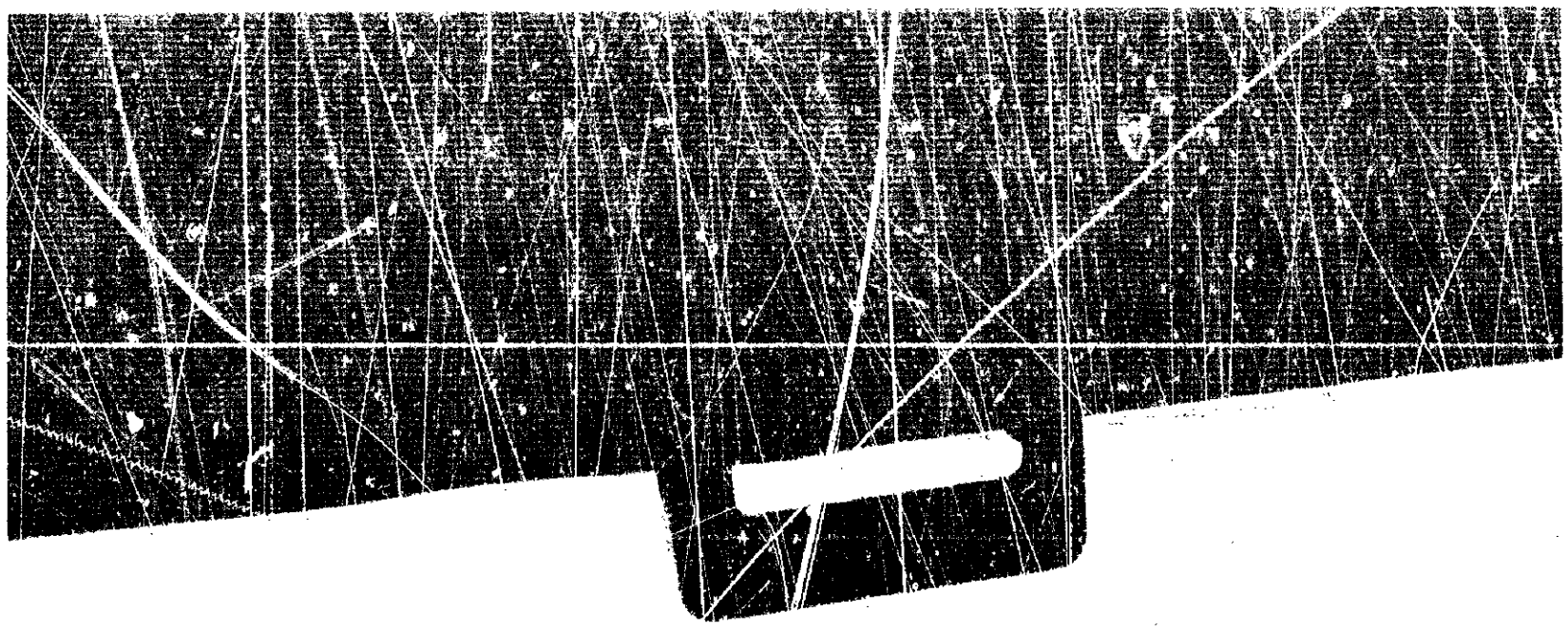


Figure 6.--Emergency window removal decal and handle

from each locomotive once every 2 years and returns the multi-event recorders to the manufacturer where they are rebuilt before being installed on another locomotive. All locomotives equipped with two-event recorders are being equipped with multi-event recorders during this 2-year cycle.

Passenger Cars.--Each Superliner passenger car was equipped with battery-powered emergency lighting. The emergency lighting is designed to activate automatically when the power supply is interrupted. The rear sleeping car attendant testified that ". . . it's very common for trains [to] leave Chicago with emergency lighting not working, and you write it up, and you get that car next week and the emergency lighting is still not working."

The chief of OBS personnel testified that he had left on trips with car deficiencies that previously had been written up but were not repaired. He further testified that when train 7 departed Chicago on the day of the accident none of the toilets were working in one of the sleeper cars, which required passengers to use the toilet in other cars. According to the chief of OBS personnel, he had stopped train 7 twice en route while he attempted to repair the toilets. Both attempts were unsuccessful.

Some windows on the passenger cars were designed and designated as emergency exits. According to Amtrak, a decal-type placard with instructions in English and a graphic depicting emergency window removal should have been affixed to all emergency window glazing assemblies. (See figure 6.) The window glazing assemblies consist of a layer of glazing material which meets

the minimum standards of 49 CFR Part 223 and a layer of glass. The two layers are held together inside an aluminum frame. A metal handle (pull tab) is supposed to be attached to the nonglass layer of glazing. Rubber molding held the window glazing assembly in place in the window opening. A red plastic handle imprinted with "EMERGENCY EXIT PULL HANDLE-REMOVE RUBBER" should be attached to the rubber molding as a means of gripping the molding for removal. The written instructions to remove the window directs the evacuee to:

1. Locate red plastic handle on window and pull handle towards you.

2. Use red handle to strip away rubber molding.

3. Locate metal handle on window and pull towards you to remove window pane.

The graphic illustrates the metal handle located behind the red plastic handle. The postaccident inspection of the train equipment revealed that the placards were missing on some windows, that the metal handles were not located behind the red plastic handles on some windows (see figure 7), that the red plastic handles were missing on some windows, and that the metal handles were missing on some windows (see figure 8).

While reviewing postaccident photographs of emergency window conditions on train 7, the Amtrak assistant chief mechanical officer testified:

> . . . it's a misapplication of the window, number one. The rubber was misapplied on the window. And if you were to pull on the handle, the red handle on this car, it would remove the rubber strip, and then you could pull on the handle and remove this window. The window would come out; it in no way hampers the operation of the window. It is not applied properly, and this is something that should be picked up in the normal inspection on a train.

According to the assistant chief mechanical officer, it is contrary to Amtrak policy for a passenger car to be put in service with an existing defect of a safety nature or a defect that will adversely affect passenger comfort. He stated that improperly installed emergency windows, inoperative emergency lighting, or inoperative toilets should have caused the cars to have been withheld from service. The assistant chief mechanical officer further stated that an already existing quality control group (which reports directly to Amtrak's chief mechanical officer) was expanded after this accident. Quality control inspections are now performed at each location where Amtrak cars are mechanically inspected and prepared for service.

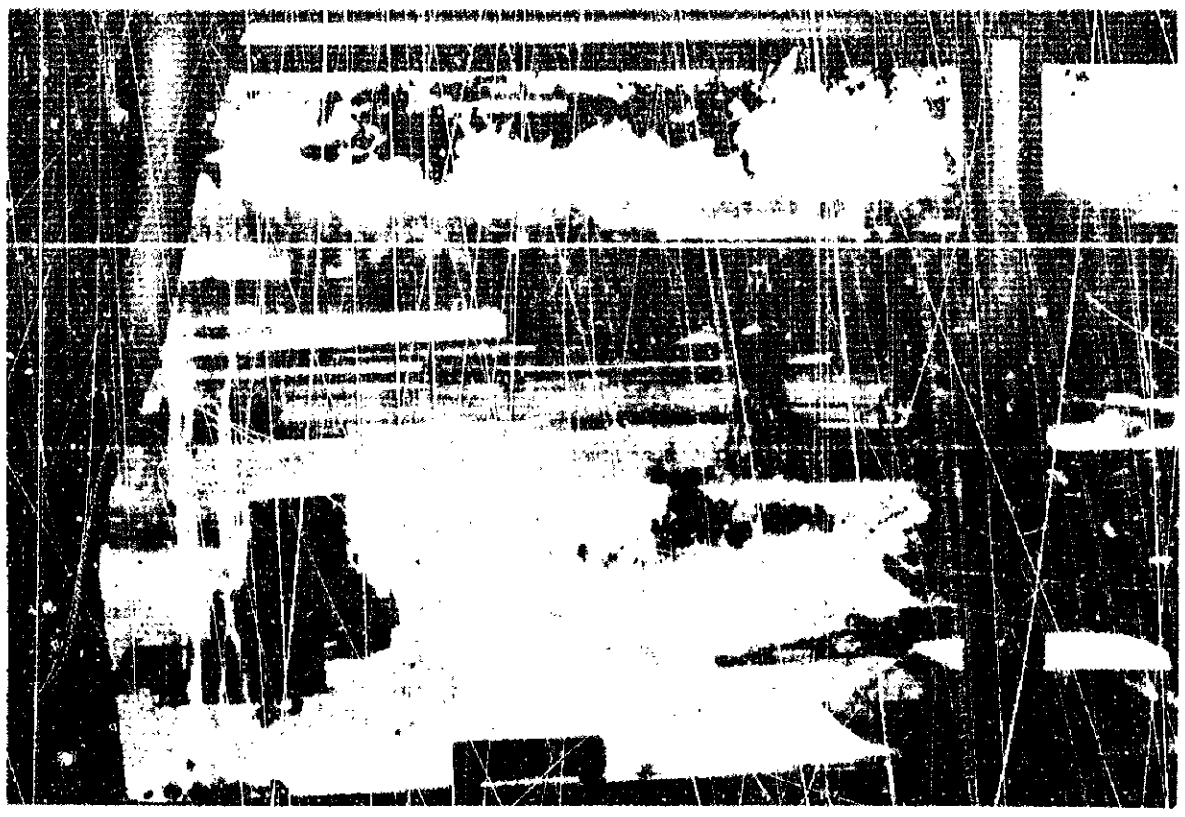


Figure 7.--Misapplied emergency window, with missing placard

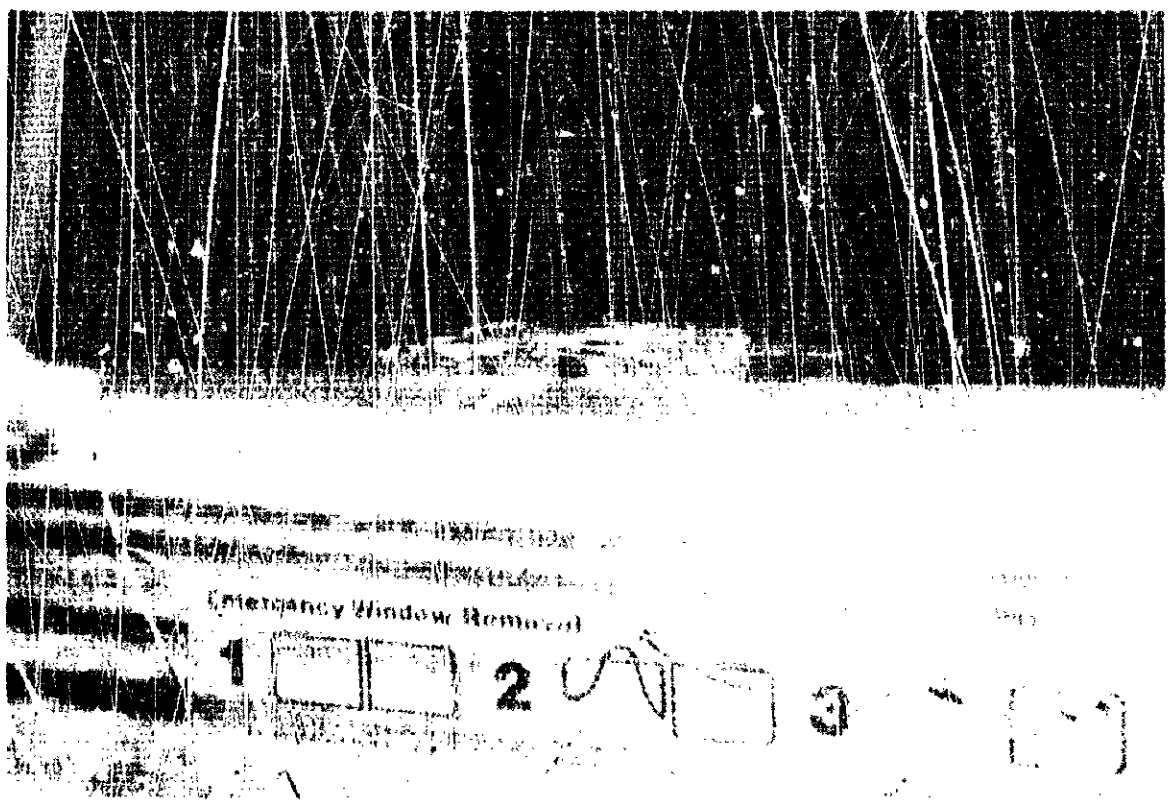


Figure 8.--Emergency window without metal handle

Track Information

General.--Train 7 derailed on BN's Montana Division, First Subdivision, in the area of mp 316.94. The track structure in the accident area consists of a single main track and a single passing track. (See figure 9.)

The passing track is parallel and adjacent to the north of the main track. It is 10,169 feet long and extends from about mp 316.3 to about mp 318.2. The main track is tangent from about mp 313.6 to about mp 319. Both the main and passing tracks cross an open deck bridge over Beaver Creek about mp 316.7. The general track structure is raised about 6 feet above ground level in the area of mp 317. At the time of the accident, surface water was standing at ground level on the south side of the track structure in the area of the accident site. (See figure 10.) The surrounding area is predominately agricultural with various types of irrigation.

Track gradient is basically level in the accident area. For westbound trains, the track is level (0.00 percent) at mp 315.5 through mp 315.87 where an ascending 0.14 percent grade continues to mp 316.63, where the track again becomes level through mp 317.04.

The main track was constructed of 132-pound RE section[4] continuous-welded rail. The CWR was laid in the zone concept[5] at 85° F. The rails were laid on 7 3/4- by 14-inch double-shouldered tie plates with a 1:40 cant. A canted tie plate is tapered in thickness from the outer to the inner edge of the rail seat. The cant inclines the rail toward the center of the track to obtain a central loading and more uniform wear on the head and assists in maintaining correct track gage.[6] The rails were secured to 7-inch by 9-inch by 8-foot 6-inch treated timber crossties with two rail-holding and two plate-holding cut spikes per tie plate; there were 23 crossties for each 39 feet of track (20 inch centers). The rail was box-anchored on every other tie in the area of mp 316.94. The ballast section consisted of crushed granite. In the undisturbed area of track immediately east and west of the accident site, the tie cribs were full and the shoulder ballast extended 14 inches or more beyond the ends of the crossties.

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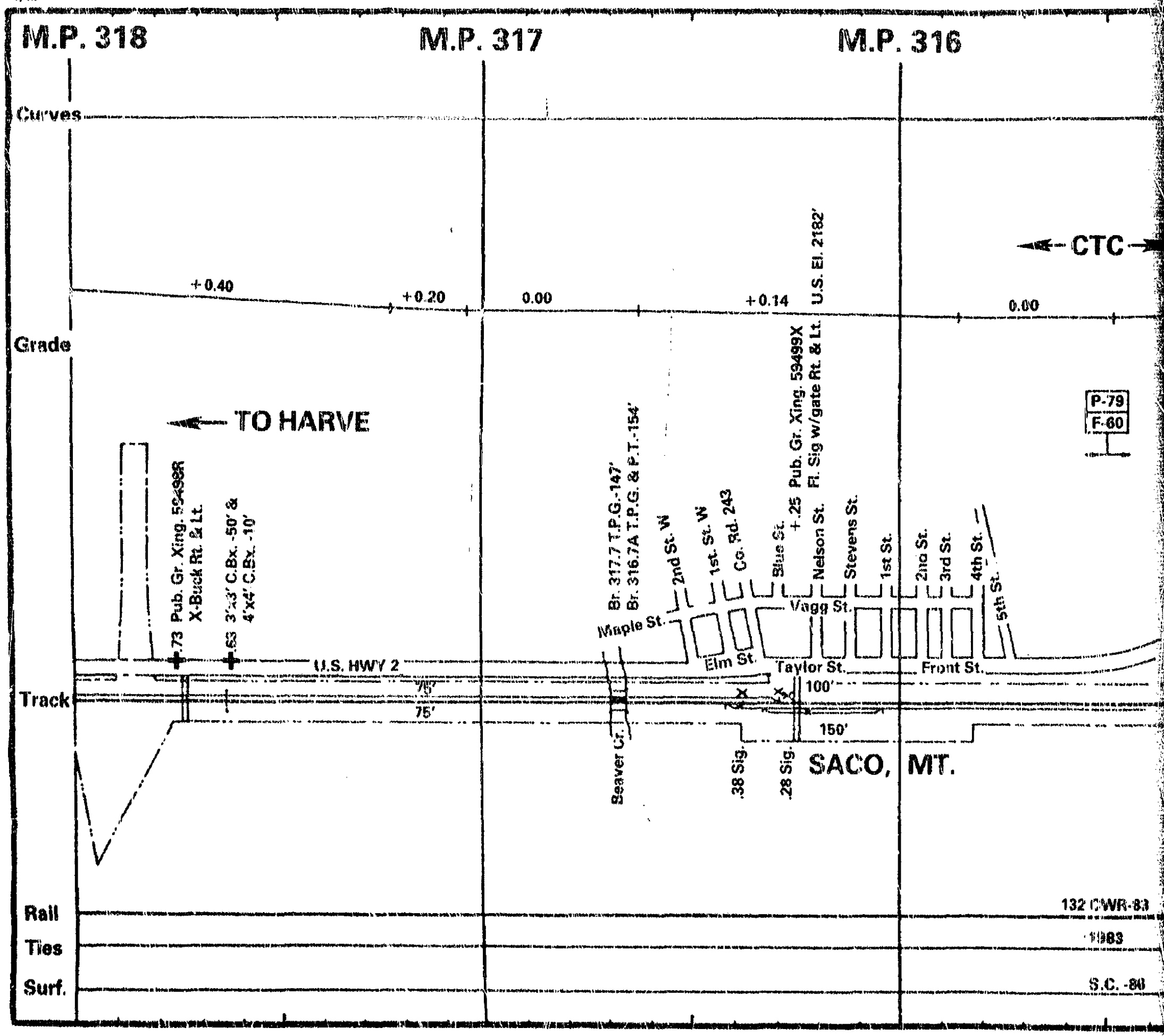
[4]A 132-pound RE section refers to rail which nominally weighs 132 pounds per linear yard and is a standard rail section recommended for use by the American Railway Engineering Association.

[5]In the zone concept, CWR is laid at a designated temperature for a geographic area. If the rail does not reach that designated temperature from natural heating, the rail must be artificially heated or the rail stretched using a hydraulic expander.

[6]Archdeacon, M. C., Editor in Chief, "The Track Cyclopedia," Ninth Edition, Simmons-Boardman Publishing Corporation, Omaha, Nebraska, pp.S12-4.



FIGUR

Figure 9. - - BN conso

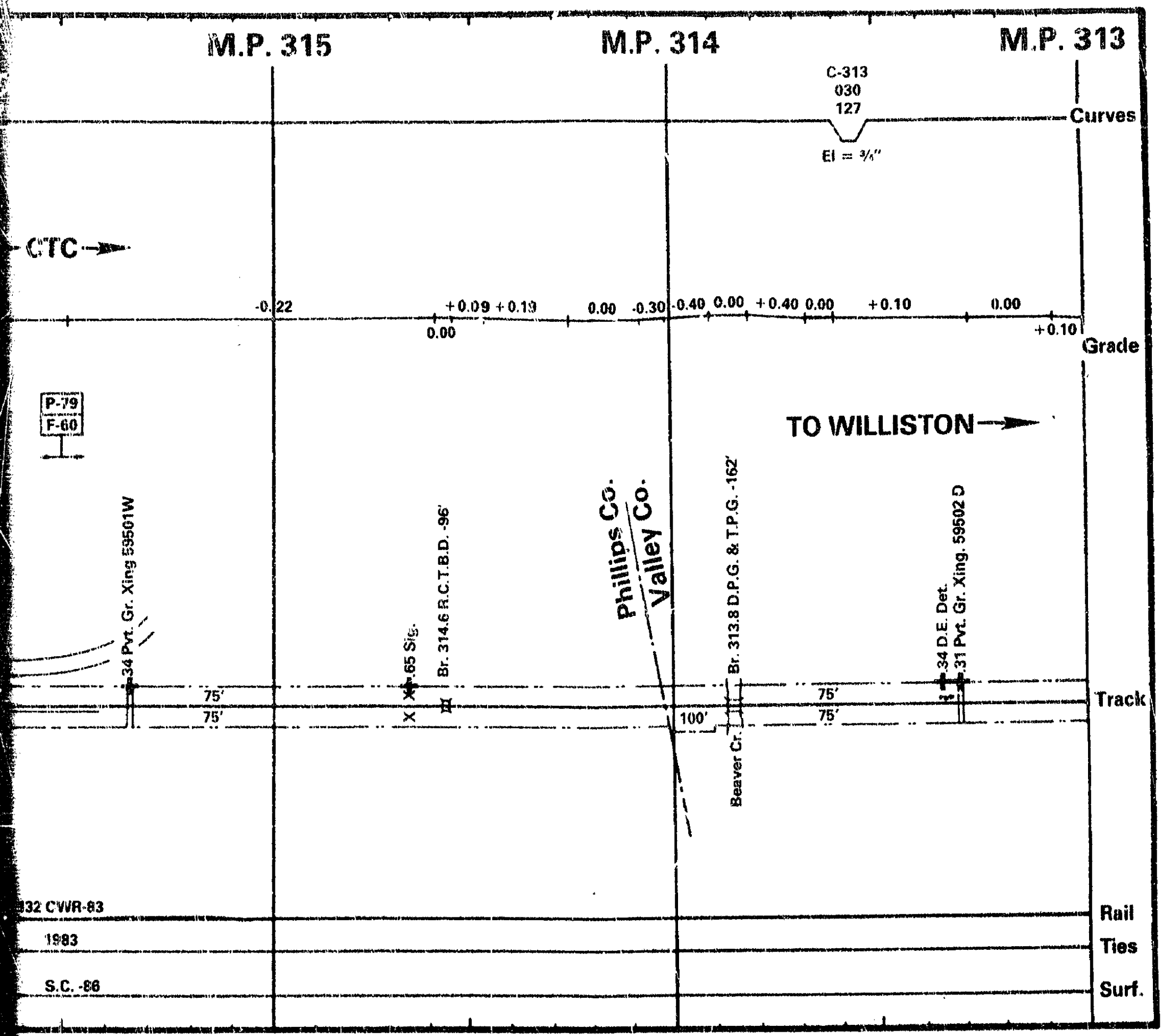


FIGURE 9

Consolidated track chart.

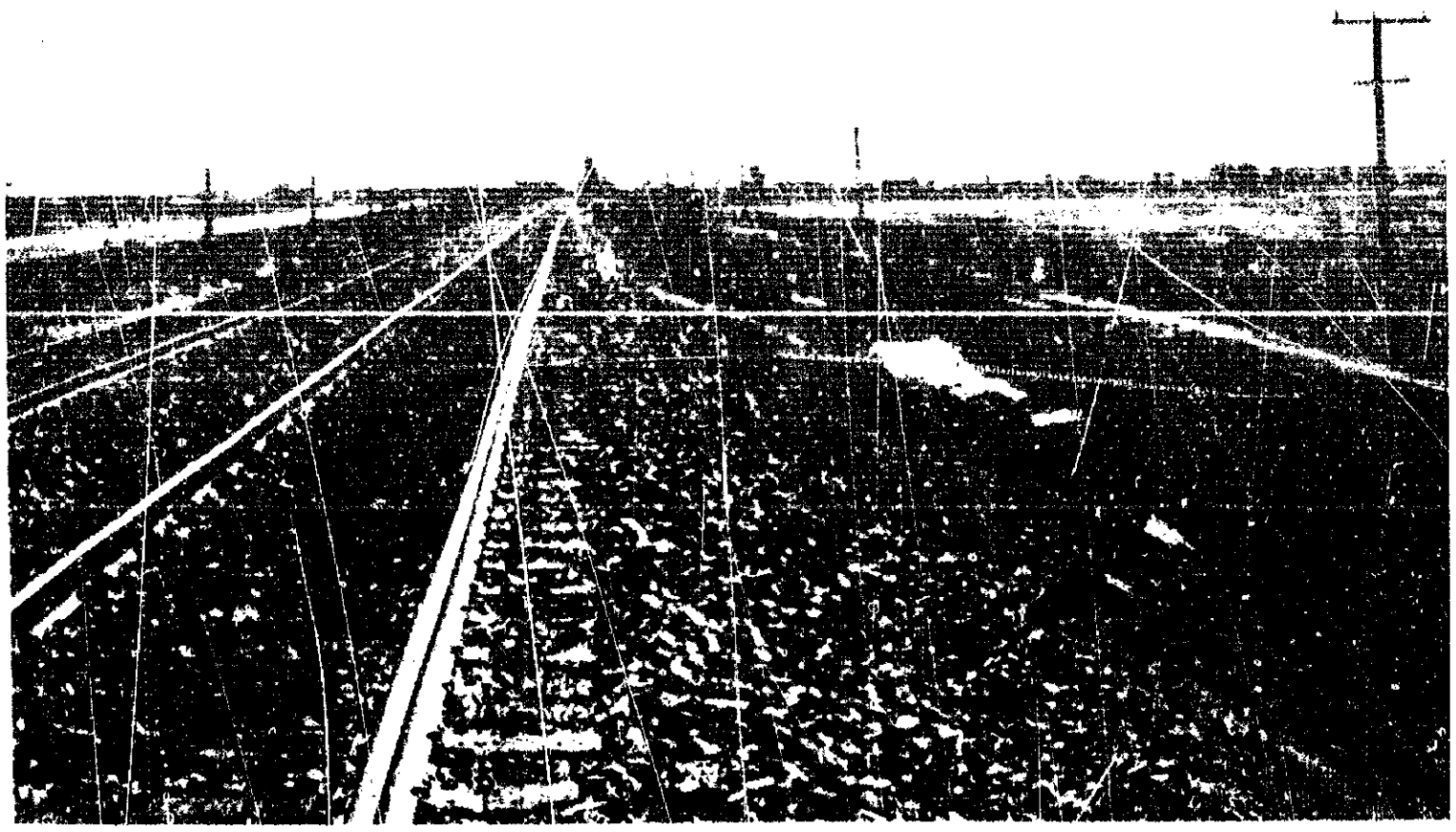


Figure 10.--Eastward view of accident site after track restoration

According to the second edition of "Railroad Engineering":[7]

> Advantages of CWR include a longer rail life due to the elimination of joint wear and batter, savings in general track maintenance costs, easier, quieter riding, reduced wear and tear on equipment, a reduction in the frequency (and therefore the cost) of rail relay, and better track circuit conductivity, with the need for bonding eliminated.
>
> Disadvantages include the difficulty of renewing broken, defective, and curve-worn rails and of handling long rail in trains. Precautions must be taken to avoid sun kinks when the rail is in compression while performing track maintenance, and a heavier, wider ballast section and shoulder are required. Pull-aparts may occur when the rail is in tension during cold weather. These difficulties can be overcome by adherence to proper techniques and practices. The full continuity of CWR may increase resonance from hunting or lateral nosing of equipment, which would otherwise be interrupted by the irregularity of jointed track.

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[7]Hays, William W., Railroad Engineering, 2d Edition, John Wiley and Sons, New York, New York, 1982, p. 544.

Track Maintenance.--BN authorizes passenger trains to operate at 79 mph on the main track on the Montana Division. To authorize at that speed, BN must maintain the track to meet or exceed the track safety standards in 49 CFR Part 213 for class 4 track. Class 4 track must be inspected twice weekly with at least 1 calendar day interval between inspections for any deviation from FRA standards.

Title 49 CFR 213.13 states:

> Measuring track not under load. When unloaded track is measured to determine compliance with requirement of this part, the amount of rail movement, if any, that occurs while the track is loaded must be added to the measurement of the unloaded track.

Title 49 CFR 213.63 states, in part:

> Track Surface. Deviation from zero cross level at any point on tangent . . . may not be more than: 1 1/4 inch for Class 4 track.

BN's Maintenance Training Program for Track Foremen and Track Inspectors states, in part:

> Rail Temperatures - The rail thermometers will be placed on the shaded side at a point where the base meets the web, and left in place not less than 10 minutes to record the temperature of the metal accurately. Rail thermometers shall be placed about one rail length from either end of each string for the readings. Air temperature must never be used because rail temperature varies greatly from air temperature.
>
> Continuous Welded Rail - No spot surfacing may be performed when the rail temperature is more than 10 degrees above the recorded laying temperature.

Track Buckling.--BN maintenance records indicated that during 1987, a pile driver was used to drive 39-foot sections of used rail on 2-foot centers into the ground in the vicinity of mp 317 to stabilize the area. The section foreman testified that he recalled performing spot maintenance in the vicinity of mp 317 on one occasion in June 1988. He stated that "It was the same condition" that existed on August 5 and that in the previous incident, an approximate 40-foot section of the north rail had sagged about 1 inch. The same repair methods used on August 5 were used in the previous incident. The section foreman estimated the ambient temperature to have been about the same in both cases since ". . . it got hot the first of May of this year in that area." The section foreman stated that based on his 25 years of experience with the track structure in this area, the location of the accident was a known sink hole.

BN conducts an annual symposium on the thermal control of CWR. Each member of the section crew involved in the track maintenance on August 5 had

attended one or more of these symposia. BN "Prevention of Track Buckling," was distributed at each symposium. The pamphlet states, in part:

> This booklet is intended to assist you in the prevention of track buckles or "sun kinks" in your day-to-day track maintenance activities.
>
> This booklet will discuss the prevention, detection, and repair of track buckles as they apply to: (1) Track Inspection, (2) Spot Maintenance, (3) Out of Face Maintenance (4) Rail Relay procedures.
>
> Track Inspection There are normally several things that occur in the track structure that warn of a tight rail condition and/or a potential track buckling problem. If track inspection is made in a conscientious and careful manner, the early signs of a potential problem can be detected and steps taken to eliminate the conditions which might cause a track buckle. [11 early signs of a potential problem are listed, the fourth of which is] Sink hole or soft spot.
>
> Additional attention should also be given to track which has been recently disturbed by normal spot maintenance . . .
>
> During periods when the air temperature is expected to exceed 90 degrees F., track inspection should be conducted during the heat of the day, normally between noon and 8 p.m.
>
> Spot Maintenance During periods of extreme changes from cool to warm weather (normally in the spring and fall), and during periods of hot weather, special care must be taken in the performance of most day-to-day maintenance activity or spot maintenance.
>
> Any track maintenance work which disturbs the ballast holding power with the ties must be done carefully during periods of hot weather.
>
> **ALL WORK WILL BE PERFORMED IN ACCORDANCE WITH MAINTENANCE OF WAY CIRCULAR NUMBER 1.** (emphasis added by BN)

Various portions of Maintenance of Way Circular No. 1 require the procedures outlined in the track buckling pamphlet.

The section foreman, roadmaster, and general roadmaster each testified that they did not consider the track maintenance performed near mp 317 on August 5, 1988, to have "disturbed the ballast."[8]

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[8] BN does not have a standard definition of "disturbed track" or what is necessary to "disturb the ballast."

Method of Operation

Train Movements.--Train movements on the Montana Division are governed by operating rules, timetable authority, general orders, special instructions, train orders, and indications from the wayside signals of a centralized traffic control (CTC) system.

Amtrak train movements are governed by the requirements of the host railroad. BN adopted the General Code of Operating Rules on April 27, 1986, and Seattle Region Timetable No. 9 became effective October 25, 1987. The maximum authorized speed for passenger trains was 79 mph at the accident location. Trains not authorized by timetable schedule, such as train 7, are classified as "extra trains."

BN Rules of the Maintenance-of-Way, Form 15125, authorizes maintenance-of-way forces to reduce the maximum authorized speed of trains over a section of track by one of the following methods:

> Track bulletin is issued through the train dispatcher to train and engine crews. The track bulletin contains information on conditions affecting the safe movement of trains or engines. Train and engine crews must receive a track warrant or clearance at their initial station unless otherwise instructed by the train dispatcher. All track bulletins which affect train movement must be listed on the track warrant or clearance. The conductor and engineer must retain copies of all track bulletins received by them, and each crewmember must read and understand the requirement of the track bulletins applicable to their train.
>
> Form X train order (slow or cautionary orders) is issued through the train dispatcher to train or engine crews. The orders contain information limiting maximum authorized train speed for a specified period of time, and/or for a designated location. Crewmember's receipt and exchange of information requirements are the same for a form "X" train order as for track bulletin. Trains must approach the designated limits expecting to find men or on-track equipment fouling main track without flag protection.
>
> Flag protection, a display of a flag on a track indicating a condition may exist which could affect safe train movement at maximum authorized speed. Flags of prescribed color must be used by day, and reflectorized flags of prescribed color and type by night. Flags may be cloth, metal or other suitable material. Flags must be placed to the right of the track when practicable, as viewed from an approaching train.

No track protection or speed restrictions were in effect for the area of mp 317 after the maintenance-of-way section crew completed the track work on August 5. The roadmaster stated that it would be the responsibility of the section foreman to place appropriate slow orders after completing spot maintenance. The roadmaster further stated that he had confidence in the

judgment of the section foreman who raised the track in the area of mp 317 on August 5.

BN Rules of the Maintenance of Way, Form 15125, prescribe, in part:

TRACK FOREMEN

560. RESPONSIBILITIES: They are in charge of and responsible for the safe condition of tracks, roadway and right-of-way as directed, and for the economical use of labor, material and equipment used in the performance of their duties.

561. TRACK INSPECTION: Track foremen must patrol track, unless otherwise instructed, as frequently as is necessary to insure safety of track and structures. They shall inspect their territories, either personally or by assignment of a qualified member of their crew. When track inspectors are assigned, their inspection shall replace the regularly scheduled inspection of track foremen.

* * * * *

563. INSPECTION PRIMARY CONCERNS: The inspection should be primarily concerned with track structure and all conditions which may affect the safe operation of trains at authorized speed. Track structure should be inspected to detect items such as . . . deviations in alignment, surface or cross level on tangent track . . .

* * * * *

566. APPROPRIATE CORRECTIVE ACTIONS: [Track foremen] shall, upon finding any condition requiring immediate attention:

1. Provide protection as required,
2. Notify the proper authorities and request assistance as needed and
3. Take corrective action as required.

* * * * *

TRACK INSPECTORS

573. RESPONSIBILITIES: They shall inspect their territories as directed . . .

574. INSPECTION REPORT: A daily report on the prescribed form must be submitted to the roadmaster. They shall also keep track foremen informed of conditions on their sections. They shall correct defects which they discover in the course of inspection to the extent possible, keeping the roadmaster and track foremen informed.

Heat Orders.--The assistant superintendent/transportation for the Montana Division testified that:

> In 1987, we issued a general order, which did specify that when the Fahrenheit temperature was above 90° that Amtrak or passenger trains would reduce speed to 69 miles per hour, freight trains to 50 miles an hour. This was put out on our first and second sub, which is from Williston to Con Kelly. [This includes the accident location.] This year, 1988, in the spring, when we normally would be putting this general order out, we were told by our regional general manager that the BN policy was that we could do it if we felt we needed it, but it was up to our maintenance-of-way department and engineering department as to how they thought our track conditions were, whether they thought it was necessary or not, and that if we did not put it out, . . . then the policy was that the maintenance-of-way department would leave [placing the slow order] the responsibility of the roadmasters on their respective territories, to watch the conditions and the weather, the temperature, and if necessary, they would put it out by track bulletin, which goes out to the crew daily.

According to the assistant superintendent/transportation, the decision was made at the division level to leave the responsibility with the local roadmaster in 1988 and not issue a general order ". . . because we had a lot of work done in the last three years on our track and it was in good condition . . ." After the accident, BN reinstituted on a system-wide basis the policy of slowing trains when the ambient air temperature reaches 90° F.

Title 49 CFR 217.9 states:

> Program of operational tests and inspections; recordkeeping.
> (a) Each railroad to which this part applies shall periodically conduct operational test and inspections to determine the extent of compliance with its code of operating rules, timetables, and timetables special instructions in accordance with a program filed with the Federal Railroad Administrator.
>
> (d) Each railroad shall keep a record of the date and place of each operational test and inspection performed in accordance with its program. Each record must provide a brief description of the operational test or inspection, including the characteristics of the operation tested or inspected, and the results thereof.

BN's assistant superintendent/transportation testified that BN operating officers routinely performed efficiency tests on Amtrak crews. The results of those tests were recorded locally and then forwarded to BN headquarters. Amtrak also routinely conducts efficiency tests on its operating crews. BN efficiency test failures that could possibly require employee discipline would be handled as a joint matter with Amtrak; however, the assistant superintendent/transportation was not aware of any program to inform Amtrak of the results of BN efficiency testing that did not result in

formal disciplinary proceedings. Further investigation by the Safety Board determined that BN's experience in this regard was typical of Amtrak host railroads. The host railroads queried reported that efficiency tests performed on Amtrak operations were easily separated from other efficiency tests. Each host railroad stated that it would have no objection to releasing the results of that testing to Amtrak; however, no host railroad was aware of Amtrak ever having requested the information.

Meteorological Information

Surface climatological observations were taken daily by a resident of Saco for the National Weather Service (NWS). Maximum and minimum temperatures recorded from June 1, 1988, through August 5, 1988, ranged from a maximum of 104° F on June 25 and June 26 to a minimum of 40° F on June 1. The average daily temperature range for June was 32.5° F with the greatest differential being 53° on June 25; the average daily temperature range for July was 36.3° F with the greatest differential being 46° F on July 22; the average daily temperature range for the first 5 days of August was 33.2° F with the greatest differential being 42° F on August 5. There was a 45° differential from the minimum recorded on August 4 to the maximum recorded on August 5.

The NWS makes hourly observations at Glasgow. Saco is 38 miles northwest of Glasgow. The elevation is 2,293 feet at Glasgow and 2,182 feet at Saco. There are no significant terrain features between Saco and Glasgow. (See figure 11.) The following information was recorded at Glasgow on August 5, 1988:

Time (MDT)	Temperature (° F)	Sky Cover (Tenths in knots)	Wind
0050	66	0	SE 9
0148	65	0	SE 10
0251	65	0	SE 9
0349	61	0	SE 9
0447	60	0	SE 8
0550	58	0	E 5
0648	63	0	SE 8
0747	70	0	SSE 4
0852	74	0	W 8
0949	79	0	WNW 8
1048	83	0	W 7
1151	89	0	NW 7
1248	92	0	WNW 10
1348	94	0	WNW 10
1450*	95	0	NW 13
1550	95	0	NW 10
1649	96	0	W 5

*The accident occurred at 1515 hours

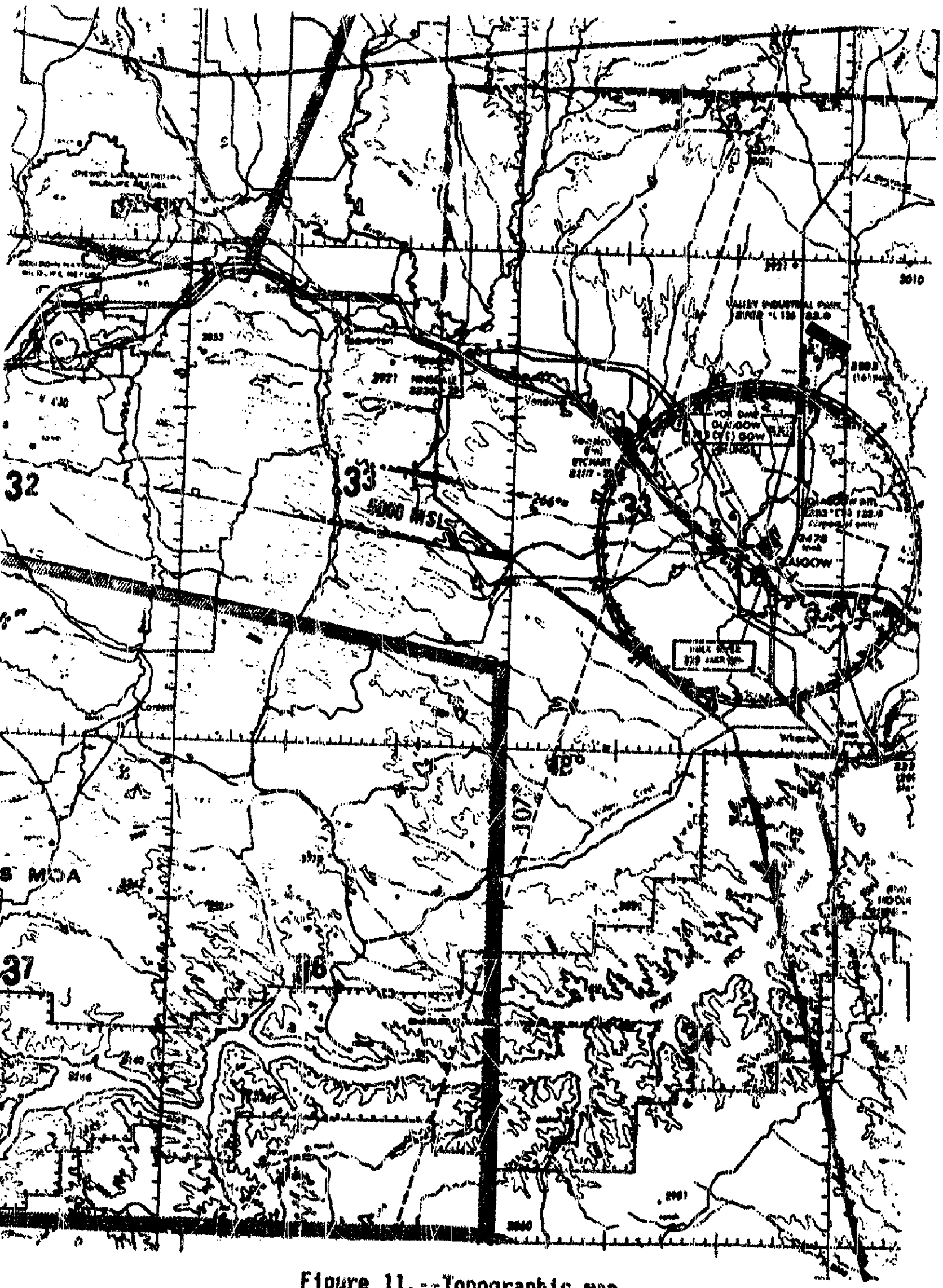

Figure 11.--Topographic map

Medical Information

Of the 368 passengers and railroad employees aboard train 7 at the time of the accident, 106 persons were injured; 13 OBS personnel and 87 passengers reported minor injuries, 1 OBS crewmember and 5 passengers received serious injuries. Eleven persons were admitted to hospitals with minor to serious injuries. The primary cause of injury was secondary impact with interior furnishings or other occupants. One passenger reported being struck by a coffee pot and burned by hot coffee. (See appendix E.)

All of the injured and many uninjured passengers stated that they received assistance from OBS personnel. Several uninjured passengers complained of not receiving assistance from OBS personnel.

Emergency Response

Saco, Montana, is a rural community of approximately 250 people with no permanent medical facility. The nearest hospitals are located at Malta, Montana (25 miles west) and Glasgow (38 miles east). Law enforcement is provided by the Phillips County Sheriff's Department (PCS) and the Montana Highway Patrol. Saco has a volunteer fire department which has reciprocal mutual aid agreements with other local communities.

A motorist who was traveling on a highway that lays parallel to the track saw the train derail. He stopped in Saco at approximately 3:15 p.m. and notified a local resident who in turn notified the chief of the Saco Volunteer Fire Department. Word of the accident spread quickly through Saco and nearly the entire community responded to the accident site to aid in the evacuation and provide ladders, blankets, food, and water to the survivors. Saco's superintendent of schools immediately opened the high school, which was used as an evacuation center/triage area, and arranged school buses for transportation.

The Valley County Dispatch Center in Glasgow received a telephone call from a Saco Volunteer Fire Department emergency medical technician (EMT) at 3:17 p.m. The EMT reported the accident and requested that ambulances from Hinsdale, Montana, and Glasgow be dispatched to the scene.

The Phillips County Dispatch Center (PCDC) was initially notified of the accident at 3:20 p.m. by the PCS who had received notification from a Montana Power Company dispatcher. A Montana Power Company work crew had notified their dispatcher that they had seen the accident while driving along Highway 2. At 3:21 p.m., the PCDC received a second report of the accident from the Amtrak depot agent in Malta. At 3:24 p.m, the PCDC notified the Montana Highway Patrol and the State of Montana Disaster and Emergency Services office. At 3:33 p.m., the Montana State Fire Marshal contacted the PCDC to offer any needed assistance. At 3:39 p.m., a member of the Bureau of Land Management contacted the PCDC and offered to assist with three trained EMTs. The emergency medical response included four ambulances that arrived between 3:21 p.m. and 3:43 p.m. (See appendix F.)

Three passengers were transferred from Glasgow by air ambulance for further treatment. Two of those passengers were transferred to Billings, Montana; the other was transferred to Minot, North Dakota.

The Valley County Long Run Volunteer Fire Company (LRVFC) responded to the accident with two trucks and five firefighters. Firefighters assisted medical personnel at the scene in removing three passengers on backboards out of the overturned cars. The only equipment used was the ladder from one truck. All of the LRVFC firefighters had received Firefighter I designation after completing fire training conducted by the State of Montana. They could not recall having received any training sponsored by Amtrak or the BN.

Also, the Malta Volunteer Fire Company (MVFC) responded to the accident with nine personnel and three pieces of equipment. The MVFC fire chief stated that the two counties (Valley and Phillips) operate on different radio frequencies so communications at the scene were given with direct voice commands. The fire chief could not recall any previous incidents where both counties were simultaneously involved in the same emergency. The chief stated that his fire company had received a notebook from Amtrak containing emergency procedures pertaining to passenger cars; however, they had not received any training from the railroad.

Passengers who reported being trapped inside the overturned cars were extricated by rescue personnel who dropped ladders down through emergency exit windows. The windows had been removed by passengers inside the cars and railroad and rescue personnel outside the cars. Passengers inside the overturned cars reported that they found it difficult to reach the emergency exit windows. In once instance, emergency response personnel experienced difficulty in extricating a handicapped woman from the sleeping compartment designed for handicapped passengers. Also, neither the family room sleeping compartment nor the handicapped sleeping compartment had been equipped with an emergency window.

The conductor testified that while he did not have any difficulty using the available emergency equipment, "One thing that would really have helped would have been a ladder, because when you're over on your side like that, people can't get out. When they come out of that top side, they can't get down on the ground."

Amtrak's assistant chief mechanical officer was not aware of any Amtrak cars that were equipped with any type of ladder. He testified that "ladders in a case such as this may have been helpful; I'm not positive..." However, he expressed concerns about securing a ladder in an overturned car, storage of a ladder when not in use, and whether it might not be better in some individual cases for passengers to remain with the car rather than attempt to negotiate a ladder.

Toxicological Information

Title 49 CFR Part 219, Subpart C, Post-Accident Toxicological Testing, states:

219.203 Responsibilities of railroads and employees.
(b) Timely sample collection. (1) The railroad shall make every reasonable effort to assure that samples are provided as soon as possible after the accident or incident.

BN supervised collection of samples for toxicological testing from the Amtrak T&E crewmembers. T&E crewmembers stated that they were aware that samples would be required from them as soon as they saw the extent of damage from the accident.

BN's assistant superintendent/transportation arrived at the accident site at 5:15 p.m. He stated that by 5:20 p.m., he had informed the T&E crewmembers that they would be required to submit samples for postaccident toxicological testing. He further stated that he made a conscious evaluation of the T&E crewmembers during various postaccident discussions with them and did not observe an indication of the presence of drugs or alcohol; the assistant/superintendent transportation had been formally trained in the detection of drugs and alcohol. (Negative test results were ultimately reported for all of the tested crewmembers.) While en route to the accident scene, the assistant superintendent/transportation had arranged to meet BN operating officers at the accident site to transport the T&E crewmembers to a medical facility where samples could be collected. One operating officer was aboard a BN freight train when he received the radio message to report to the accident scene so he arranged for another operating officer to pick him up.

When the two officers arrived at the accident scene in one vehicle, they found that the vehicle did not have sufficient capacity to transport the entire T&E crew so another officer's vehicle was designated to transport crewmembers. The assistant superintendent/transportation decided to send the T&E crew to Havre, Montana (approximately 115 miles west of the accident site) to have the toxicological samples collected. He believed that the medical resources available in the Saco area would be strained to accommodate the people injured in the accident. He stated that his experience had indicated that the collection of samples for toxicological testing received a lower priority than the treatment of injuries.

Before the operating officers departed for Havre, the conductor began to complain of pain from injuries received in the accident so the operating officers decided to have him examined by the paramedics at the accident site. The examination took "about an hour," and about 8 p.m., the operating officers and five T&E crewmembers departed Saco.

On arriving at Havre, the operating officers delivered the event recording magnetic tapes to the BN yard office so that they could be printed out. The T&E crew estimated that they arrived in Havre about 11 p.m. and that they were at the yard office about 10 minutes before continuing on to the hospital. When they arrived at the hospital two unrelated medical emergencies were in progress which further delayed the collection of the samples until 11:40 p.m.

One assistant conductor had become separated from the other crewmembers and was not transported to Havre. The assistant conductor

stated that about 5:15 p.m. on-scene medical personnel advised him to proceed to the hospital in Glasgow to receive x-rays for possible injuries sustained during the accident. The assistant conductor informed the conductor that he was being transported by ambulance to the hospital. After being examined by a physician and having x-rays taken the assistant conductor was released from the hospital and was taken to the Glasgow Civic Center. About 12:30 a.m. on August 6, an Amtrak trainmaster contacted the assistant conductor by telephone at the civic center and instructed him to return to the hospital to provide specimens for toxicological testing. The assistant conductor stated that he returned to the hospital between 12:45 a.m. and 1 a.m. and was informed by hospital staff that an official FRA "tox-box"[9] was required before they would take toxicological samples. The assistant conductor waited at the hospital until a BN trainmaster arrived with the tox-box; the samples were collected at 2:30 a.m.

The conductor testified that after the passengers were evacuated and before he was taken to the school for examination, "We were just sitting there on the track waiting for something to happen, and then one of the BN officials come up and he wanted the name of every passenger on the train, their originating station, and their destination. So I was able to find the pouch with the tickets and stuff, and [the extra engineer] and [the uninjured assistant conductor] and myself, we set on the track there and filled this all out for this official." Neither he nor the uninjured T&E crewmembers were sequestered before they departed for Havre. The conductor also gave interviews to the media while he waited. The conductor further testified that he was taken to the school about 7 p.m.

Both Amtrak and BN withhold employees from service after an incident that requires toxicological testing until the results of the testing are received and evaluated. To obtain expedited test results, the urine sample is divided by the collecting medical facility and sent to a private laboratory. Blood and urine samples from all six T&E crewmembers were sent to the Center for Human Toxicology (CHT), Salt Lake City, Utah; urine samples from the five T&E crewmembers transported to Havre were tested by the American Institute of Drug Detection, Rosemont, Illinois; and a urine sample from the injured assistant conductor was tested at Deaconess Hospital, Glasgow, Montana. The specimens were tested for the standard range of alcohol and both licit and illicit drugs. Negative results were obtained from all tests for all six T&E crewmembers.

BN's chief medical officer (CMO) stated that on occasion negative toxicological test results have been received from a local laboratory and positive test results would later be received from the CHT. The CMO further stated that the difference in the test results came from the varying sensitivity limits at which toxicological tests are conducted with CHT tests generally being more sensitive. In cases where an employee was returned to work based on negative results from a local laboratory and was later

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[9] A kit containing the necessary supplies and instructions for forwarding toxicological specimens of blood and urine in accordance with 49 CFR Part 219.

determined by the CHT to have had a drug present at the time the sample was drawn, BN policy is to immediately remove the employee from service for medical reasons and place the employee in a medically supervised rehabilitation program.

The maintenance-of-way employees were not required by Federal regulations to give samples for toxicological testing. The assistant superintendent/transportation testified that he had been involved in a previous incident where an employee had been fatally injured and toxicological samples were collected from both a train crew and maintenance-of-way section crew ". . . and the FRA refused to run the samples [from the section crew] and said they [FRA] did not want non-Hours of Service employees tested at that time." The assistant superintendent/transportation further testified that the section crew involved in the Saco accident could have been tested under BN policy ". . . if we have reasonable cause. But it wasn't done in this case."

Tests and Research

Sight Distance Tests.--Sight distance tests were conducted at the accident location beginning at 3:30 p.m. on August 18, 1988. At the time the testing began, the temperature was 93° F; by the time the testing was completed at 5:40 p.m., the temperature had risen to 95° F. Scattered clouds were at 16,000 feet with a thin broken layer at 25,000 feet; there were no surface atmospheric restrictions to visibility. The winds were from the northwest at 20 knots.

A full-scale wooden model simulating a sun kink was put in place at mp 316.94. The model was built according to dimensions described by the locomotive engineer of train 7. The surface of the running rail was masked to prevent glare, and the surface of the model was covered with gray tape to reflect approximately the same amount of light as the running rail.

An Amtrak F40PH passenger locomotive (AMT 258), headed westward, was used in the testing. AMT 258 was the same type of locomotive as the accident locomotive. Representatives from the Safety Board, Amtrak, BN, the Brotherhood of Locomotive Engineers, and the United Transportation Union were present in the locomotive control compartment. The locomotive was positioned east of Saco and then operated toward the point of derailment. Individuals in the control compartment called out when they could distinguish the simulated track disturbance. Markers were dropped when the first and last individuals called out. The individuals in the control compartment did see the placement of the model after the first test was completed. Two separate tests were conducted. In the first test, the simulated track disturbance was initially sighted at 2,379 feet and the last individual called out at 2,243 feet. In the second test the initial sighting was at 3,179 feet and the last individual called out at 2,643 feet.

Stopping Distance.--Amtrak calculated a projected stopping distance of 2,478 feet for train 7 from 79 mph using a full-service brake application and an immediate throttle reduction to idle. This would have resulted in a blended brake application.

Postaccident Air Brake Inspection.--BN operating officers conducted air brake tests on the two locomotives and first three cars before they were moved from the accident scene; the remaining cars were damaged to the extent that no meaningful air brake tests could be conducted. The assistant superintendent/transportation witnessed the tests and stated the brake pipe was charged to 110 psi, a 6 psi reduction was made, a "normal" air exhaust was heard in the locomotive control compartment, and the brakes were applied on the locomotives and cars. A further reduction was made to 12 psi; again, a normal air exhaust was heard and the brakes remained applied. No exception was taken to the foundation brake rigging. A further reduction was made to full service; again, a normal air exhaust was heard and the brakes remained applied. No exception was taken to the foundation brake rigging. When an emergency brake application was initiated from the control stand, the pneumatic control switch (PCS) opened and the brake pipe pressure went to zero. The PCS was reset and, as the brake pipe recharged, the brakes released. The independent brake valve functioned to apply and release the brakes on the locomotive units in response to movement of the brake handle. Depressing or "bailing off" the independent brake valve handle properly released the brakes on both locomotive units.

ANALYSIS

The Accident

Amtrak train 7 complied with the predeparture requirements of 49 CFR Part 232 for power brakes and 49 CFR Part 230 for locomotive inspections. En route tests performed by the engine crewmembers determined that the speed indicator was functioning within acceptable limits. After carefully evaluating the information contained on the event recorder printout, the Safety Board believes the regularly assigned engineer, who was operating train 7 from Glasgow to the accident site, handled the train in a competent and professional manner. Each speed restriction was fully complied with, primarily through throttle modulation with only minor supplementary brake applications. The deceleration and acceleration rates indicate that the engineer definitely preplanned the trip to provide a comfortable ride to the passengers and to eliminate excessive in-train forces.

Both the regularly assigned engineer and the extra engineer reported observing a sun kink in the track structure forward of their train after passing through Saco. Many passengers, OBS personnel, and T&E crewmembers reported hearing and feeling the train brakes apply shortly before the train derailed. The Safety Board believes these reports confirm the regularly assigned engineer's statements about what he saw and what action he took. The Board concludes that the track structure was laterally shifted (buckled) in front of Amtrak train 7.

The sight distance tests coupled with the stopping distance information supplied by Amtrak indicate adequate distance should have been available for the locomotive engineer to have significantly slowed or even stopped train 7 before it passed over the buckled track; however, the Safety Board could not determine at what precise instant the track buckled. Studies

on track buckling[10] and empirical data have not been able to establish exactly when a track will buckle. The studies support the thesis that dynamic loading of the track structure by a train is often the catalyst for track buckling if the track structure is susceptible at the time. Vehicle loads generate both lateral and vertical wheel forces, partially lifting the rail and/or ties vertically out of the ballast which results in loss of ballast resistance. The Board believes that the track buckle could have been exacerbated by the approach of train 7 at 79 mph. Therefore, the Board believes that there was no action the engine crew could have taken to avoid or decrease the severity of the accident once the track buckle was observed.

Track Maintenance Procedures

The use of CWR provides a structurally stronger track, decreases the maintenance cost of tracks and rolling stock, decreases the power consumption of a moving train, and provides a more comfortable ride.[11] Attendant to the advantages of CWR is the inherent responsibility of managing its thermal expansion and contraction since CWR is more susceptible to sun kinks. The Safety Board is aware that BN has an active program in this area. Each BN maintenance-of-way employee involved in the track maintenance near mp 317 shortly before the accident was qualified by BN on the Rules of the Maintenance of Way, which deal in a general manner with some of the requirements for maintaining CWR. Additionally, each of the BN employees had attended one or more annual symposia on the prevention of track buckling. The symposium addresses specific details of CWR track inspection and spot maintenance procedures during hot weather and periods of weather extremes.

The Safety Board believes that the track maintenance work near mp 317 on August 5 was performed during a period of hot weather and prolonged weather extremes. The ambient temperature was 89° F when the section gang started the work in the area of mp 317 and 92° F when they completed the work. Daily ambient temperatures consistently varied 40° F or more. The Board further believes that the BN was aware that extreme weather conditions

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[10]Kerr, A. D., "Thermal Buckling of Straight Tracks; Fundamentals, Analyses, and Preventive Measures," American Railway Engineering Association, Bulletin 669, Vol. 80, pp. 16-47, 1978; Kish, A., U.S. DOT, Transportation Systems Center, "Recent Results in Track Buckling Research," American Railway Engineering Association, Bulletin 716, Vol. 89, pp. 281-300, 1988; Dogneton, P., "The Experimental Determination of the Axial and Lateral Track-ballast Resistance," Railroad Track Mechanics and Technology, Proceedings of a Symposium, Pergamon Press, 1978; and Kerr, A. D., "Lateral Buckling of Railroad Tracks Due to Constrained Thermal Expansions--A Critical Survey," Railroad Track Mechanics and Technology, Proceedings of a Symposium, Pergamon Press, 1978. Research sponsored by the FRA under contract DOT-FR-0017.

[11]Donley, M.G., "Thermal Buckling of Curved Railroad Tracks," Association of American Railroads Research and Test Department, Report R-514, 1982.

existed since the normal working hours of the section crew had been rearranged to take advantage of the cooler morning hours, and track inspections of CWR were being extended to 8 p.m. or until the ambient temperature dropped below 95° F.

At the time of the accident, BN's requirements were less restrictive for spot maintenance than for out-of-face maintenance. Responsibility was placed with the on-site supervisor, usually a section foreman, to determine if a slow order was necessary after spot maintenance. However, a slow order was mandatory after out-of-face maintenance.

The Safety Board believes that the section foreman thought that the area was a sink hole or soft spot, knew that the ambient temperature was rising but was not aware of the exact temperature, and did not want to leave the low spot unrepaired through the weekend. The section foreman had previously supervised spot maintenance at the same location under similar conditions and using the same procedures without placing a slow order and without any adverse occurrence. The section foreman also had knowledge that an extensive subsurface stabilization program had taken place at this location. The Safety Board believes that the foregoing circumstances may have influenced the section foreman's decision not to place a slow order after the track work was completed. The purpose of a slow order is to allow the ballast to consolidate after disturbance in order to provide greater lateral resistance. Extant research and empirical data both indicate that a slow-moving train (10-25 mph) has a greater positive effect in ballast consolidation than a fast-moving train. The Board is pleased to note that the BN has recently expanded its mandatory slow order policy to include spot maintenance performed when the ambient temperature is above 85° F.

To determine if a section of unloaded track complies with 49 CFR 213.13 the amount of deflection, if any, must be added to any deviation in cross level. This simulates the load a train will later apply. The measurement of deflection should include any gap between the rail and the top of the crosstie, as well as any void between the bottom of the crosstie and the ballast bed. Since the track inspector did not check the low spot he observed on August 3 for additional deflection, the Safety Board believes that his inspection of the track at the accident site was cursory. The track inspector's failure to check for movement on the unloaded rail becomes especially significant since his initial estimate of the low spot was in excess of 1 inch; at 1 1/4 inch, both BN and FRA standards would have required a slow order. The section foreman had not seen the low spot and had relied on the track inspector's evaluation; consequently, the spot maintenance was scheduled for the convenience of the section crew. Had the track inspector been more diligent in his inspection and evaluation and more assertive when he informed the section foreman, maintenance probably would have been scheduled earlier and may have been more comprehensive.

BN's track maintenance program prohibits spot maintenance on CWR when the rail temperature is more than 10° above the recorded rail laying temperature. Rail temperatures are often 10° F to 30° F above ambient temperature and may be even higher under conditions of prolonged direct sunlight and vehicular loading. To determine the rail temperature and,

subsequently, to determine if spot maintenance can be performed, the rail temperature must be taken with a rail thermometer. Since neither the section foreman nor the roadmaster used, or even possessed, a rail thermometer they had no means of knowing whether or not they were complying with BN's requirements.

Only visual observations for signs of rail expansion were made by the roadmaster and section foreman. BN's track maintenance program makes no allowance for visual observations replacing rail temperature readings in spot maintenance. BN's CWR rail relaying program as outlined in "Prevention of Track Buckling" specifies:

> 1. Never use ambient or air temperature, only actual rail temperature. (emphasis and underscoring BN's)

BN's policy to use rail temperature instead of using ambient temperature is consistent with both research in this area and standards within the railroad industry. The Safety Board believes that railroad employees who are required to perform their duties based upon rail temperature should possess a rail thermometer.

Several foregoing circumstances in concert produced the situation wherein the BN's track structure was unable to support the passage of Amtrak passenger train 7. The deviation in track surface that was discovered by the track inspector on August 3 was not adequately defined because the track inspector did not take any measurements of that deviation. Had the track inspector done so, it is likely the required corrective maintenance work would have been recognized as warranting closer scrutiny and immediate attention. The track maintenance that was eventually performed on August 5 was done during a period of hot weather, with wide variations in daily temperature extremes. BN maintenance-of-way officials were aware of these weather conditions as they existed. BN's maintenance rules currently preclude performing spot maintenance when ambient temperature exceeds 90° F. A slow order restricting the speed of passing trains until the disturbed ballast section became consolidated may well have prevented this accident. However, the imposition of a slow order on August 5 rested with the judgment of the section foreman, and although the section foreman's supervisor visited the work site, the imposition of a slow order was not discussed. Neither of these personnel was issued, or in possession of, a rail thermometer. Rail temperatures cannot be determined solely on the basis of ambient temperatures and, dependent on many factors, can normally be substantially higher than ambient temperatures. Direct exposure to sunlight in an open environment, such as the rail in this case was, normally will result in a rail temperature substantially higher than ambient temperature. When track restraint is disturbed, as was the case in this instance, rail expansion tends to displace the track structure. The Safety Board believes that had a slow order been placed on the track after the maintenance work was performed, the accident probably would have been prevented.

Injuries

The primary cause of all injuries were secondary impacts with interior furnishings, surfaces, or with other occupants. One passenger reported being struck by a coffee pot and burned by hot coffee.

In its investigation of a collision and derailment in Russell, Iowa,[12] the Safety Board found that unsecured coffeemakers were dislodged during the accident. As a result of its investigation of that accident, the Board recommended that Amtrak:

R-88-48

Develop and install effective retention devices for coffeemakers in all passenger cars to prevent them from becoming dislodged in an accident.

In its response to Safety Recommendation R-88-48, dated October 29, 1988, Amtrak stated that an effective retention device for on-board coffeemakers has been designed and ordered, "and that when material for the retention devices is received these devices will be installed on all cars." On December 29, 1988, Amtrak further responded that the retention device would be installed on all passenger cars by September 30, 1989.

The coffeemaker retention device on train 7 consisted of an open metal ring attached to the countertop (see figure 12), and the coffeemaker was placed unsecured inside the metal ring. In this accident, the coffeemaker came out of the retention device and hot coffee injured the passenger, demonstrating that the retention device is ineffective. The Safety Board believes the lack of effective restraints and restraints devices not being in place (see figure 13) continues to allow food service items to be ejected, becoming potential sources of injury. The Board is holding Safety Recommendation R-88-48 in an "Open--Unacceptable Action" status until further response is received from Amtrak.

The Safety Board noted that in this accident, as in other accidents, seatback cushions became dislodged when struck from the rear, exposing the sheet metal support. Following its investigation of a train derailment in New York City on July 23, 1984,[13] the Safety Board recommended that Amtrak:

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[12]Railroad Accident Report--"Collision and Derailment of Amtrak Train 6 on the Burlington Northern Railroad, Russell, Iowa, October 12, 1987" (NTSB/RAR-88-04).

[13]Railroad Accident Report--"Head-on Collision of National Passenger Corporation (Amtrak) Passenger Trains Nos. 151 and 168, Astoria, Queens, New York, New York, July 23, 1984" (NTSB/RAR-85/09).

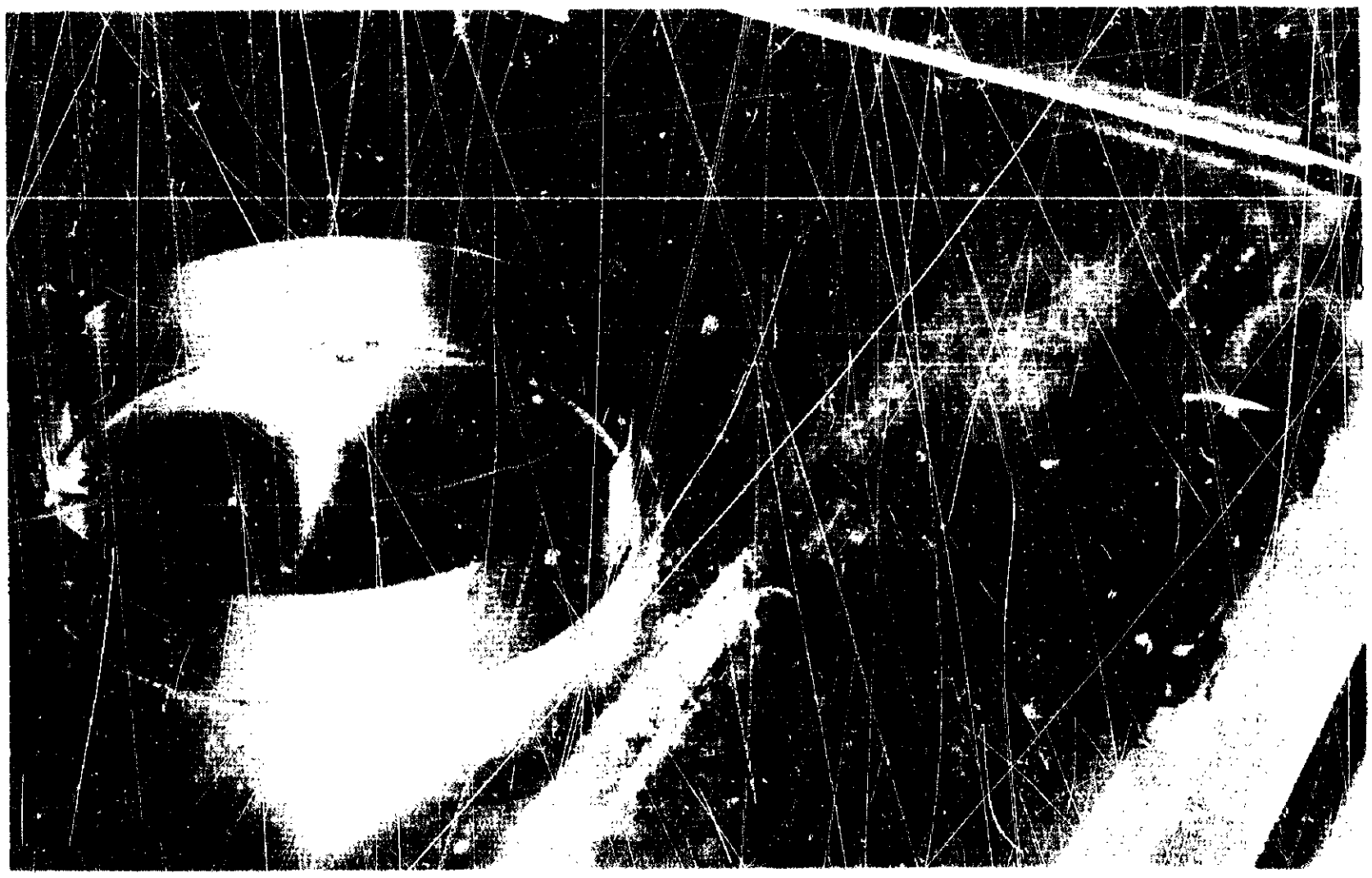

Figure 12.--Metal ring to restrain coffee pot

R-85-81

Modify the coach seats used in Amfleet equipment so that seatback cushions cannot become dislodged when struck and expose surfaces which can cause injuries in accidents.

On November 4, 1985, Amtrak responded that it had initiated a program to satisfy the recommendation and as of that date had completed 125 cars. Although the Safety Board's then ongoing investigation of the Essex Junction, Vermont,[14] revealed a similar problem with the seatbacks of Heritage-class coaches, the program outlined by Amtrak for its Amfleet equipment indicated that the intent of Safety Recommendation R-85-81 was being met, and the recommendation was placed in a "Closed--Acceptable Action" status.

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[14]Railroad Accident Report--"Derailment of Amtrak Passenger Train No. 60, the Montrealer, on the Central Vermont Railway near Essex Junction, Vermont, July 7, 1984" (NTSB/RAR-85-14).

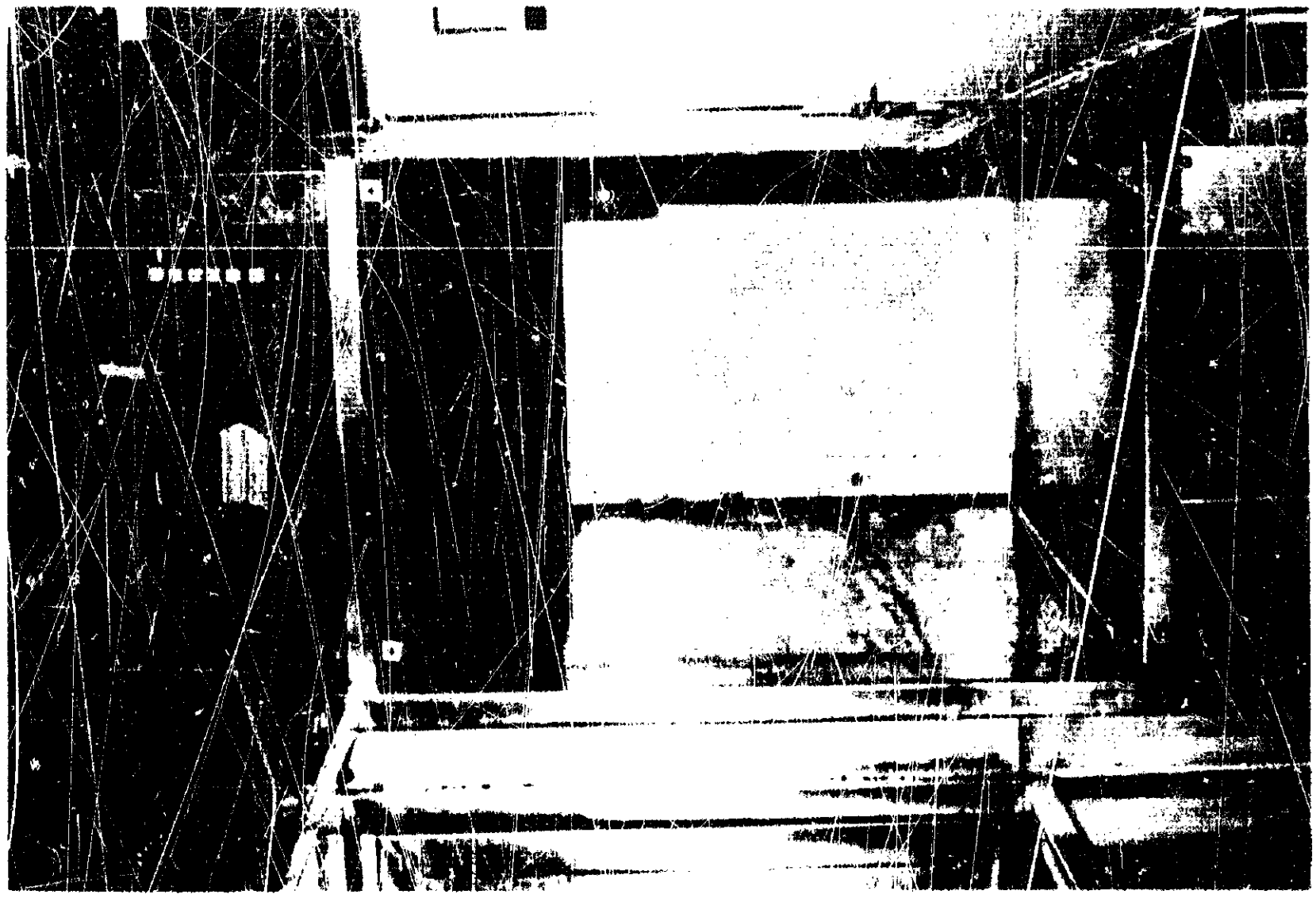

Figure 13.--Properly restrained oven on left remained in place during the accident. Restraints were not in place (although the restraint brackets were) and the oven on the right fell out during the accident.

To ensure that Amtrak would follow up on the problem with the Heritage-class coaches, the Safety Board, as a result of its completed investigation of the Essex Junction accident, recommended on January 15, 1986, that Amtrak:

R-85-127

Redesign and modify the coach and seatback cushions in the Heritage-class coaches to prevent their becoming dislodged when they are impacted from behind.

Amtrak responded on September 22, 1987, that it had developed a modification to the seatback cushion, which was being made during overhaul or when cushions are renewed. Eleven cars had been completed as of the date of the response. Due to normal maintenance cycles, Amtrak expected full changeover to take 6 years. On April 19, 1988, Amtrak informed the Safety Board that it had reviewed its installation schedule and had shortened it to

4 years. Based on this projected timeframe, Safety Recommendation R-85-127 is being held in an "Open--Acceptable Action" status.

The Safety Board further pointed out in its report of the Russell, Iowa, accident that it was pleased with Amtrak's progress with the modifications to the original type seatback cushions in the Amfleet cars covered in Safety Recommendation R-85-81. However, these same type of seats had been installed not only in the Heritage-class cars covered in Safety Recommendation R-85-127 but also in Superliner coaches. The Board subsequently recommended that Amtrak:

R-88-46

Redesign and modify the coach and seatback cushions in the Superliner-class coaches to prevent their becoming dislodged when they are impacted from behind.

Amtrak replied on October 15, 1988, that all Superliner coaches were being modified the same as Amfleet coaches. The Safety Board is holding Safety Recommendation R-88-46 in an "Open--Acceptable Action" status.

Personnel Information

All the train and engine crewmembers were qualified for their respective positions and each had been off duty a sufficient amount of time to satisfy the requirements of the Hours of Service Act.

The Safety Board is aware that OBS personnel are not covered under the provisions of the Hours of Service Act or the requirements of 49 CFR Part 228. Further, the Board is concerned that OBS personnel are routinely scheduled work cycles that are in excess of 16 hours. There were 346 passengers and only 16 OBS personnel on board train 7 at the time of the accident. Ninety-one passengers sustained minor to moderate injuries and 14 OBS personnel sustained minor injuries. All of the injured and many uninjured passengers stated that they received assistance from OBS personnel. However, several uninjured passengers complained of not receiving assistance from OBS personnel.

Before the accident, OBS personnel were conducting routine duties throughout the train; consequently, some time was necessary for all OBS personnel to position themselves at their primary locations after the accident. Following the accident, several OBS personnel remained inside the cars to assist the trapped and more seriously injured passengers and, thus, were not visible to all the uninjured passengers. Although it would have been ideal for each passenger to have received assistance and to have been kept apprised of postaccident events, the Safety Board believes the OBS personnel performed adequately under the circumstances.

Event Recorders

Event recording devices are becoming commonplace in the railroad industry. Provisions in the Rail Safety Improvement Act of 1988 to amend Section 202 of the Federal Railroad Safety Act of 1970 state:

> (m)(1)(A) The Secretary [of the Department of Transportation] shall, within 18 months after the date of the enactment of the Rail Safety Improvement Act of 1988, issue such rules, regulations, standards, and orders as may be necessary to enhance safety by requiring that trains be equipped with event recorders within 1 year after such rules, regulations, orders, and standards are issued.
> (2) For the purposes of this subsection, the term 'event recorders' means devices that--
> (A) record train speed, hot box detection, throttle position, brake application, brake operations, and any other function the Secretary considers necessary to record to assist in monitoring the safety of train operations, such as time and signal indication; and
> (B) are designed to resist tampering.

The FRA held hearings on January 10, 1989, in Washington, D. C., in an effort to determine if any rules or standards are necessary for event recorders, and if so, what the scope of any proposed rules and standards should entail. The Safety Board believes that Congressional mandate is clear on the merits of event recorders and continues to adhere to the interpretation of the Rail Safety Act of 1988 presented by the Board at the FRA's public hearing, in that legislative intent was clearly to require event recorders.

Both locomotive units in the accident were equipped with event recording devices. An incorrect wheel size for the second locomotive unit was entered into the playback system resulting in an inaccurate printout. The playback machine was incorrectly calibrated before the printout was prepared for the lead locomotive unit, resulting in another inaccurate printout. The Safety Board discovered a large variation in the extent of training that railroad officials charged with preparing and evaluating event recorded information had received. The Board views event recorded information as an effective tool for monitoring, evaluating, and improving the safety of train operations. For event recorded information to be useful, it must be accurate, consistently prepared, and credibly interpreted. The Board believes that every locomotive consist should be equipped with at least one operating multi-event recording device and that ideally each locomotive unit should be equipped with an operating multi-event recording device.

Emergency Exits

Amtrak train 7 departed Chicago with misapplied emergency windows, instructional placards missing from some emergency windows, no emergency windows in the sleeping compartment designated for handicapped passengers, and no emergency window on the lower level of the dormitory/coach car.

As a result of its investigation of a fire on board an Amtrak passenger train in Gibson, California, on June 23, 1982,[15] the Safety Board recommended that Amtrak:

R-83-64

Provide an emergency escape window exit in each sleeping compartment as well as in all passenger hallways.

In its response to Safety Recommendation R-83-64, Amtrak advised the Safety Board that it was in the process of installing these windows. Consequently, Safety Recommendation R-83-64 was placed in an "Open--Acceptable Action" status.

However, during its investigation of the Saco accident, the Safety Board learned that in one instance, emergency response personnel experienced difficulty in extricating a handicapped passenger from the sleeping compartment designed for handicapped passengers. Through oversights, Amtrak did not install the interior emergency exit window feature in lower-level end sleeper compartments at the time these types of windows were installed in the other sleeping compartments. Also, instructional placards for removing upper- and lower-level windows were not installed on the cars' exteriors. Further, Amtrak informed Board investigators that the installation of these lower-level emergency windows and upper- and lower-level placards could take as long as 2 years. The Board considers 2 years to be excessive and believes that passengers should not occupy lower-level end sleeper compartments that are not equipped with emergency exit windows or the appropriate placards with instructions for removing the exit windows from inside and outside the compartment. Based on the new information that this work could take up to 2 years, the Board has reclassified Safety Recommendation R-83-64 as Open--Unacceptable Action."

On September 18, 1988, the Safety Board reiterated Safety Recommendation R-83-64 and also recommended that Amtrak:

R-88-71

Install placards that show instructions for removal of sleeper car compartment windows from inside and outside the compartments.

R-88-72

Immediately affix a placard with the universal handicapped facilities symbol on doors and windows of sleeper compartments designated for occupancy by handicapped passengers.

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[15]Railroad Accident Report--"Fire Onboard Amtrak Passenger Train No. 11, Coast Starlight, Gibson, California, June 23, 1982" (NTSB/RAR-83-03).

R-88-73

Prohibit the use of all sleeper compartments that are not equipped with emergency exit windows.

Amtrak pointed out in its November 3, 1988, response that metal placards showing step-by-step instructions for window removal from outside the car are affixed to all four corners of Amfleet and Superliner cars and that a red-lettered sign is in place on Superliner cars instructing rescue agencies to go to the corners of the cars for window removal instructions. The Safety Board is aware of how the Superliner cars are placarded but does not believe that placarding is adequate. Crush damage sustained during an accident or a car's final resting position may make the ends of a car inaccessible. The Board believes Amtrak should apply placards outside each window depicting window removal from the outside and inside each window depicting window removal from the inside. Further information obtained during the Board's investigation of this accident indicates that Amtrak does intend to install placards that show instructions for removal of sleeper car compartment windows from inside and outside the compartment, as outlined in Safety Recommendation R-88-71.

With respect to affixing a placard with the universal handicapped facilities symbol on doors and windows of sleeper compartments as outlined in Safety Recommendation R-88-72, the Safety Board is pleased to note that Amtrak has already begun this project and expects its completion in 1989. Pending a further update and notification that the project has been completed, Safety Recommendation R-88-72 was placed in an "Open--Acceptable Action" status. The Board is also pleased that Amtrak has placed on its cars 130,000 posters showing emergency evacuation systems similar to those used in the airline industry.

The Safety Board is disappointed with Amtrak's continued use of sleeping compartments that are not equipped with emergency exit windows. The Board continues to believe that this presents an undue risk to passenger safety and urges Amtrak to reconsider its position. Pending Amtrak's consideration of the Board's comments, Safety Recommendation R-88-73 is being held in an "Open--Unacceptable Action" status.

The lack of a means to get from inside an overturned car to the ground outside prolonged the evacuation time in this accident. It is fortunate that an extended evacuation time was available. Had fire broken out or other conditions existed, the results could have been catastrophic. People attempting to evacuate an overturned passenger car may encounter significant scaling problems before getting to a position where they can try to reach the ground. The Safety Board agrees with Amtrak that a ladder may solve some problems while introducing others; however, the Board believes Amtrak should devise some mechanism to provide an escape route from an overturned passenger car.

Operational Testing

Although operational testing was not a causal factor in this accident, the Safety Board has long been an advocate of effective operational testing as a means of promoting safe train operations. The information gained is of primary importance for quality assurance in monitoring rules compliance and routine performance for safety enhancement purposes. The Board understands that in order to be objective this type of testing must be surreptitiously performed, which in many instances is time consuming. It appears that information on operational testing of Amtrak employees could be easily obtained from Amtrak's host railroads. The Board believes that Amtrak should implement a program with each of its host railroads to periodically obtain information the host railroad has compiled on Amtrak employees and that this information should be sent to the tested employees' immediate supervisors.

Toxicology

The BN was responsible for ensuring the timely collection of toxicological samples from the Amtrak crew. The Safety Board believes the significant delay in obtaining the toxicological samples was unnecessary and could have been avoided. The unsequestered conductor and uninjured assistant conductor were allowed to be ". . . just sitting there on the track waiting for something to happen," before being engaged in determining passenger destinations. The conductor gave an interview to the media after the train was completely evacuated and before going to give toxicological samples. Later, four crewmembers were held at the accident scene for approximately 1 hour while the conductor received medical attention. The conductor could have been transported along with the other injured crewmember and the delay for the uninjured crewmembers could have been avoided. The operating officers further delayed the collection of the toxicological specimens from the five crewmembers by stopping at the yard office in Havre to deliver the multi-event recorder tapes before taking the crewmembers to the hospital.

The Safety Board addressed concern for the timely collection of toxicological samples on June 21, 1988, in its study on alcohol/drug use.[16] A review of sample collection times from 46 railroad accidents that occurred in 1987 revealed an average collection time of 5 1/2 hours, with a range from 1 1/2 to 14 hours. The study identified some of the reasons for the delays as:

-- general confusion at accident sites;
-- debriefing of the train crew;
-- lack of understanding of the rule's requirement;
-- inadequate management direction;
-- the need to treat injured crewmembers;
-- the train crew's participation in handling the emergency; and
-- long distances to hospitals or other sample collection sites.

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[16] Safety Study--"Alcohol/Drug Use and Its Impact on Railroad Safety" (NTSB/SS-88/04).

There are indications that each of these reasons contributed to the delay of collecting toxicological specimens from the train crew involved in the Saco accident. Toxicological testing eventually revealed that no drugs or alcohol were identified in the specimens of any crewmember. As a result of its safety study, the Safety Board recommended on August 9, 1988, that the FRA:

R-88-31

Amend 49 CFR Part 219 to require railroads to collect all appropriate toxicological samples as soon as practicable and not more than 4 hours after the triggering event. Written explanation of the reason(s) for failure to collect samples within 4 hours or not at all must be submitted to the Federal Railroad Administration.

Sample collection delays seriously limit the ability of analysts to detect a parent drug or its psychoactive components for some of the major drugs (cocaine, some amphetmines, and PCP) for which testing is being undertaken. Clearly, the presence of these drugs in railroad personnel at the time of an accident must be confirmed or rejected, and that is possible only if sample collection is undertaken within the first few hours after the event. Sample collection delays, as in this accident, could preclude even alcohol detection. Most States recognize this and have established a 3-hour limit for the collection of breath/blood samples after highway accidents. The Safety Board strongly believes that appropriate toxicological samples must be collected within 4 hours and that the reasons for any delay should be documented.

Although the Independent Safety Board Act of 1974, Section 307(a) 49 United States Code 1906(a) requires that the Secretary of the Department of Transportation respond formally in writing within 90 days after receipt of a recommendation regarding transportation safety, the FRA did not respond to Safety Recommendation R-88-31 until March 10, 1989. In its response, the FRA stated that it was unable to agree with the need for a set time limitation for the collection of toxicological samples. The Safety Board has placed Safety Recommendation R-88-31 in an "Open--Unacceptable Action" status. As a result of the long delay by the BN in collecting samples in this accident, the Board reiterates Safety Recommendation R-88-31 and urges the FRA to amend 49 CFR Part 219 to require sample collections within 4 hours following an accident. The continued acceptance by the FRA of delays of many hours seriously weakens the effectiveness of the alcohol and drug rules and the ability to determine whether the use of alcohol and/or controlled substances by safety sensitive railroad employees is a human performance factor in accidents.

CONCLUSIONS

Findings

1. There was a thermally induced lateral shift of the track structure in front of Amtrak train 7. The lateral shift occurred when the train was closer than the 2,478 feet necessary to stop.

2. The approach at 70 mph of Amtrak train 7 could have exacerbated the lateral shift of the track structure.

3. There was nothing the engine crew could have done while traveling at the maximum authorized speed of 79 mph to have avoided or decreased the severity of the accident after he observed the shifted track.

4. The track maintenance near mp 317 on August 5, 1988, was performed during a period of hot weather and prolonged weather extremes.

5. BN was aware that extreme weather conditions existed in the area.

6. The track inspector's cursory inspection on August 3, 1988, did not adequately identify the deviation in the track surface near mp 317.

7. Neither the section foreman in charge of performing the spot maintenance near mp 317 on August 5, 1988, nor his supervisor possessed a rail thermometer to measure the rail temperature; rail temperature cannot be determined from ambient temperature.

8. The primary cause of injury was secondary impact with interior furnishings or surfaces.

9. The lack of effective restraint devices allowed food service items to be ejected and caused injury during the accident.

10. After the accident, the event recorder printouts from both locomotive units were inaccurately prepared.

11. Difficulty was experienced extricating a passenger from a designated handicapped sleeping compartment that was not equipped with an emergency window.

12. Collection of toxicological samples by the BN was unnecessarily delayed.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was Burlington Northern's inadequate track inspection and maintenance procedures, which resulted in a thermally induced lateral shift of the track structure in front of Amtrak train 7, and Burlington Northern's failure to impose a slow order on the disturbed section of track.

RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board made the following recommendations:

--to the Burlington Northern Railroad:

Establish a definition for disturbed track in the track maintenance program. (Class II, Priority Action) (R-89-31)

Issue rail thermometers to appropriate track maintenance personnel, and reemphasize the necessity of using rail thermometers to determine actual rail temperature for track buckling countermeasures. (Class II, Priority Action) (R-89-32)

Reemphasize to on-line officers involved in the sample collection process the need to collect toxicological samples promptly. (Class II, Priority Action) (R-89-33)

--to the National Railroad Passenger Corporation:

Develop and implement a program with each host railroad Amtrak operates over to obtain the information on operating tests performed by the host railroad on Amtrak employees, and relay that information to the tested employee's immediate supervisor(s). (Class II, Priority Action) (R-89-34)

Develop procedures and equipment for evacuation of passenger cars involved in an accident, and train employees in those procedures and equipment. (Class II, Priority Action) (R-89-35)

--to each Amtrak host railroad:

Cooperate with Amtrak in developing a program to inform Amtrak of the results of operating tests performed by your railroad on Amtrak employees. (Class II, Priority Action) (R-89-36)

In addition, the Safety Board reiterated the following recommendation to the Federal Railroad Administration:

R-88-31

Amend 49 CFR Part 219 to require railroads to collect all appropriate toxicological samples as soon as practicable and not more than 4 hours after the triggering event. Written explanation of the reason(s) for failure to collect samples within 4 hours or not at all must be submitted to the Federal Railroad Administration. (R-88-31)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

James L. Kolstad
Acting Chairman

Jim Burnett
Member

John K. Lauber
Member

Jospeh T. Nall
Member

Lemoine V. Dickinson, Jr.
Member

April 11, 1989

APPENDIXES

APPENDIX A

INVESTIGATION

1. Investigation

The National Transportation Safety Board was notified of the accident about 7 p.m. eastern standard time, August 5, 1988. The Safety Board dispatched four investigators from its Washington D.C., headquarters and one investigator from its Los Angeles, California, field office.

Groups were formed to investigate operational, human performance, track, survival factors, and vehicular aspects of the accident. Parties to the investigation during the on-scene phase of the investigation included the Federal Railroad Administration, the National Railroad Passenger Corporation, the Burlington Northern Railroad, the Brotherhood of Maintenance-of-Way Employees, and the Brotherhood of Locomotive Engineers.

2. Deposition Proceeding

The Safety Board convened a 2-day staff conducted deposition proceeding on November 16, 1988, in Great Falls, Montana, as part of its investigation. Sworn testimony was taken from 15 witnesses. All parties to the investigation participated in the deposition proceeding.

APPENDIX B

DAMAGES

AMT 1453 — Car remained upright. One truck derailed, wheels changed.

AMT 1250 — Car remained upright. Both trucks derailed, wheels changed.

AMT 39902 — Car overturned onto its left side. Minor truck damage, metal skirt bent, roof sheet bent, interior ceiling panels bent, couplers bent, Freon lines bent under car.

AMT 32001 — Car overturned onto its right side. Control wiring damaged, couplers and uncoupling levers bent, side door and opening bent, grilles torn, corner side sheet bent, roof sheet bulged, lower level side sheet buckled, corner post missing, equipment room doors bent and torn.

AMT 34061 — Car overturned onto its left side. Control wiring damaged, medium truck damage, equipment room doors and openings bent and torn, draft sill pocket bent and broken, air brake portion missing.

AMT 34027 — Car overturned onto its left side. Control wiring damaged, medium truck damage, coupler bent, diaphragm bent, angle cock bracket broken.

AMT 38024 — Car overturned onto its right side. Heavy truck damage, air brake manifold bent, diaphragms bent and torn, coupler broken, roof sheet cut and torn, body bolster cut, equipment room doors cut and torn, side sheets bent, roof sheets cut and torn, side doors bent.

AMT 33014 — Car list over, right side lower, Coupler and uncoupling lever cut, end sill bent, lower side sheet bent, diaphragms cut and torn, medium truck damage, control wiring damaged.

AMT 31043 — Car remained upright. Coupler bent, medium truck damage, control wiring damaged.

AMT 34004 — Car remained upright. Diaphragms bent, couplers bent, minor truck damage, control wiring damaged.

AMT 32014 — Car remained upright. Air conditioning grille bent, sill steps bent, minor truck damage, diaphragm bent, uncoupling lever cut, side door bent.

APPENDIX C

CREWMEMBER INFORMATION

Engineer, David L. Sickels

Engineer Sickels was employed by the Northern Pacific Railroad on October 11, 1954, as a locomotive fireman. He was promoted to locomotive engineer on April 17, 1975, and began work for Amtrak on April 29, 1987, as a locomotive engineer. He passed an examination on the operating and air brake rules on February 11, 1987. The engineer received his last physical examination on April 8, 1987. At that time, his uncorrected distant vision was reported to be 20/40 in both eyes, his corrected distant vision was reported to be 20/15 for his right eye and 20/20 for his left eye; his uncorrected near vision was reported to be 20/25 for both eyes. Engineer Sickels stated that he was wearing tinted corrective lenses at the time of the accident.

Extra Engineer, James W. Kountz

Engineer Kountz was employed by the Great Northern Railroad as a locomotive fireman on September 4, 1969. He was promoted to locomotive engineer on October 25, 1972, and began work for Amtrak on April 29, 1987, as a locomotive engineer. He passed an examination on the operating and air brake rules on April 20, 1987. His last physical examination was on April 6, 1987. At that time, his uncorrected distant and near vision were reported to be 20/20; however, his BN Employee Personal Record on four occasions between August 29, 1973, and December 16, 1982, references his eyesight. Some of the remarks include, "should wear glasses when operating locomotive," and "glasses to be worn constantly and carry an extra pair." Engineer Kountz underwent radial keratotomy surgery on April 1, 1985.

Conductor, Ray H. Pearson

Conductor Pearson was employed as a railroad laborer on October 2, 1951. He held positions as carman helper, switchman, brakeman, and was promoted to conductor on May 20, 1982. He passed an examination on the operating and air brake rules on September 23, 1987. He passed his last physical examination on April 13, 1987, without restrictions. He began working for Amtrak as a conductor on April 11, 1987.

Track Inspector, Cecil Ozark

Track inspector Ozark was employed as a railroad laborer on June 7, 1954. He was initially promoted to track inspector on April 24, 1972. He had held positions of assistant foreman, foreman, gang foreman, section laborer, and section foreman from December 17, 1973, until February 9, 1988. On February 9, 1988, he began inspecting track on the accident district. On Februay 18, 1988, he passed a BN examination on operating and maintenance-of-way rules with a score of 95 out of a possible 100.

Section Foreman, Burton Beto

Section foreman Beto was employed as a railroad laborer on April 13, 1960. He was initially promoted to foreman on April 2, 1972. He had held positions of machine operator, track inspector, traveling equipment maintainer from February 1, 1974, until June 12, 1979. On June 12, 1979, he became section foreman on the accident district. On February 19, 1988, he passed a BN examination on operating and maintenance-of-way rules with a score of 89 out of a possible 100.

Roadmaster, Gary Nybergt

Roadmaster Nyberg was employed by the Northern Pacific Railroad on September 6, 1967, as a laborer. He held positions of machine operator, assistant gang foreman, gang foreman, track inspector, and section foreman. He was promoted to roadmaster in 1974. On March 22, 1988, he was certified a qualified rules examiner when he passed a BN examination on operating and maintenance-of-way rules with a score of 98.6 percent.

APPENDIX D

EVENT RECORDER CHAIN OF CUSTODY

CHAIN OF EVENTS REGARDING REMOVAL AND PRINTING OF SPEED TAPES REMOVED FROM THE LOCOMOTIVE POWER ON AMTRAK TRAIN 1-1007-04 INVOLVED IN DERAILMENT AT SACO, MONTANA ON 8-5-88.

MULTI-EVENT RECORDER WAS REMOVED FROM AMTK 409 AT 1710 HOURS, 8-5-88, AT MP 314, BY TRAINMASTER L.J. SHEFFELBINE. BARCO PAPER SPEED TAPE WAS REMOVED BY TRAINMASTER SHEFFELBINE FROM AMTK 305 AT 1705 HOURS, 8-5-88, AT MP 314.

THE MULTI-EVENT RECORDER AND THE BARCO PAPER TAPES WERE BOTH BROUGHT INTO HAVRE, MONTANA BY TRAINMASTER W.R. WALTERS AT 2235 HOURS AND DELIVERED TO ASST SUPT ADMN, G.D. ALLEN.

ASST SUPT ADMN G.D. ALLEN ALONG WITH SUPV OF LOCOMOTIVES C.E. ANDERSON RAN THE TAPES IN AN EXPANDED AND REAL TIME MODE RETAINING THE PRINTS AT THE SUPERINTENDENT'S OFFICE.

THE MULTI-EVENT RECORDER TAPE AND THE BARCO PAPER SPEED TAPES WERE THE GIVEN TO TRAINMASTER D.G. BOESPFLUG AT HAVRE AND HE DEPARTED FOR SACO, MONTANA DELIVERING THE TAPES TO SUPERINTENDENT P.C. KEIM.

SUPERINTENDENT P.C. KEIM THEN TURNED THE MULTI-EVENT RECORDER AND BARCO PAPER SPEED TAPES OVER TO AMTRAK OFFICIALS LOCATED AT SACO, MONTANA.

G.D. allen
G.D. ALLEN
ASST SUPT ADMN

APPENDIX E

QUESTIONNAIRE RESPONSE

The Safety Board sent questionnaires to 200 passengers in an attempt to gather a representative sampling of their activities and observations before and after the accident. Responses were received from 116 passengers.

Dormitory/Coach Car 39902

Three passengers from this car responded to the questionnaire. Two of these passengers received moderate injuries, including hip and rib fractures. The third passenger received a minor head injury. All three reported that they received their injuries when they were thrown about in the car as it came to rest on its side.

Two of these passengers were removed by stretcher. The third egressed unassisted through the crew quarters. None of these passengers recalled seeing any crewmembers. There were no instructions given on how to evacuate the car.

Sleeper Car 32001

Twelve passengers from this car responded to the questionnaire. Nine of those passengers received injuries ranging from bruises and back pain to fractured ribs and concussions. Three reported no injuries. The passengers reported that they received their injuries when they were thrown about in the car as it derailed and overturned.

Nine passengers egressed unassisted through emergency exit windows. One egressed by ladder, one egressed unassisted through the vestibule door, and one was removed from a stretcher.

Coach Car 34061

Seven passengers from this car responded to the questionnaire. Five of those passengers received injuries ranging from a broken leg, and fractured scapula, to lacerations, bruises, and strains. Two passengers reported no injuries.

Four passengers reported egressing through an emergency exit window. Three passengers climbed a ladder that had been provided to them. Three passengers crawled along the staircase and exited out the vestibule door. Six passengers reported receiving assistance from the crew.

Coach Car 34027

Six passengers from this car responded to the questionnaire. Five of those passengers received bruises. One passenger reported no injuries.

Five passengers stated that they egressed through emergency exit windows after a ladder was lowered to them. One passenger exited through an opening between two cars.

Other Coach Passengers

Fourteen other passengers responded to the questionnaire but failed to state which coach car they were located in at the time of the accident. Ten of those passengers received injuries, the most severe being a fractured neck (C1-2 fractured).

Nine passengers egressed through emergency exit windows by ladders that were lowered to them. Three passengers were taken out on stretchers. Two passengers exited through a opening between two cars.

Diner Car 38024

Three passengers from this car responded to the questionnaire. All three passengers were standing at the time of the accident near the back of the car; all three received neck and back injuries.

All three passengers exited the car through an emergency exit window with no assistance from OBS personnel.

Lounge Car 33014

Nineteen passengers from this car responded to the questionnaire. Fifteen passengers reported injuries ranging from a fractured back to lacerations and burns from hot coffee. Several other passengers reported objects flying about and striking passengers.

Fifteen passengers stated they received no assistance in evacuating the train from OBS personnel. Four passengers reported receiving assistance from the snack bar attendant. All the passengers egressed from the lounge car doors with the assistance of volunteers who helped them down with ladders.

Coach/Baggage Car 31043

Eighteen passengers from this car responded to the questionnaire. Ten passengers reported minor injuries. Eight passengers reported no injuries.

Seventeen passengers exited through the end doors. One passenger exited through an emergency exit window. Sixteen passengers stated that they did not receive any assistance from OBS personnel. Two passengers stated that they asked two OBS personnel outside the car for assistance but that the OBS personnel refused to assist them and instead proceeded to remove baggage from the baggage compartment.

Sleeper Car 34004

Twenty-six passengers from this car responded to the questionnaire. Nine passengers reported bruises and back strain. Seventeen passengers reported no injuries.

Twenty-three passengers stated that they did not receive any assistance from OBS personnel and most stated that no assistance was needed. One passenger saw two Amtrak OBS personnel standing outside the car and requested them to help. According to the passenger, the OBS personnel replied,"we're hurt" and did not give any assistance. One uninjured passenger was trapped inside a toilet, fellow passengers assisted in opening the door.

Sleeper Car 32014

Eight passengers from this car responded to the questionnaire. Four passengers reported minor injuries.

Four passengers reported receiving assistance from OBS personnel. Four passengers reported receiving no assistance but further stated that no assistance was needed.

APPENDIX F

EMERGENCY MEDICAL RESPONSE

M-1, Glasgow ambulance: en route to Saco at 1521; on scene at 1603; 1713 en route to Glasgow Hospital; arrived at hospital 1753; 1820 depart hospital to return to Saco; 1940 depart saco to return to Glasgow Hospital; 2023 arrive at Glasgow Hospital.

M-2, Glasgow ambulance: en route to Saco at 1526; on scene at 1603; 1710 en route to Glasgow Hospital; 1724 having mechanical problems (vapor lock) and disabled; 1725 Ft. Peck Indian Reservation ambulance en route to assist M-2; 1728 vapor lock problem solved, M-2 en route to Glasgow hospital; 1747 arrive at Glasgow Hospital; 1753 standing by at hospital; 2116 en route to Glasgow airport; 2121 arrive at airport; 2204 arrive Glasgow Hosptal; 2231 en route to Glasgow civic center for injured passenger; 2232 arrive at civic center; 2303 arrive at Glasgow Hospital.

M-4, Hinsdale ambulance: 1543 arrive at Saco; 1614 en route to Glasgow Hospital with four patients; 1657 arrive at Glasgow Hospital; 1713 en route to Saco High School; 1752 arrive at Saco High School; 1817 en route to Glasgow Hosptal; 1858 arrive at Glasgow Hospital; 2207 return to Hinsdale.

M-6, Ft. Peck ambulance: 1532 alerted to standby for Glasgow ambulance; 1538 en route to Glasgow; 1556 arrive at Glassgow Hospital; 1710 en route to Saco High School; 1725 assisting M-2 with mechanical problems; 1750 arrive Saco High School; 1810 en route to Glasgow Hospital; 1858 arrive at Glasgow Hospital; 2024 en route to Glasgow Airport; 2056 return to Glasgow Hospital; 2157 return to Ft. Peck.

* U.S. GOVERNMENT PRINTING OFFICE:1989-262-320:00002