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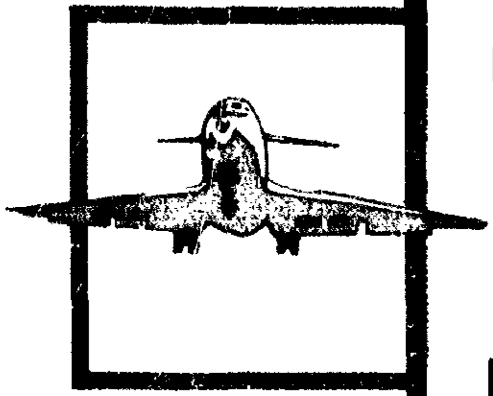

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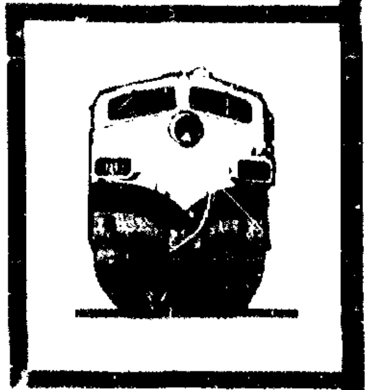

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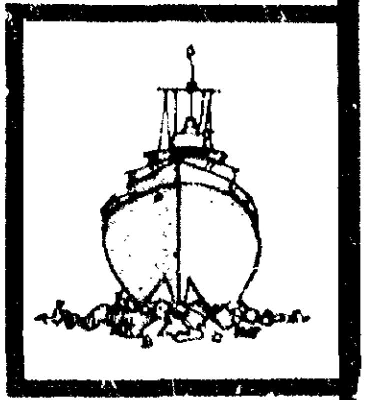
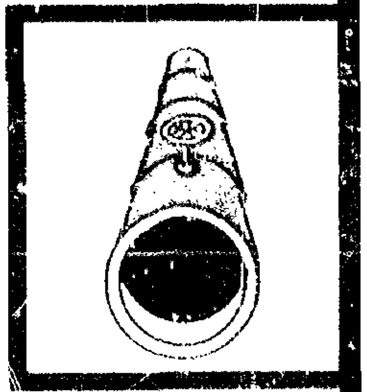
RAILROAD ACCIDENT REPORT



DERAILMENT OF ST. LOUIS SOUTHWESTERN RAILWAY COMPANY (COTTON BELT) FREIGHT TRAIN EXTRA 4835 NORTH AND RELEASE OF HAZARDOUS MATERIALS NEAR PINE BLUFF, ARKANSAS JUNE 9, 1985



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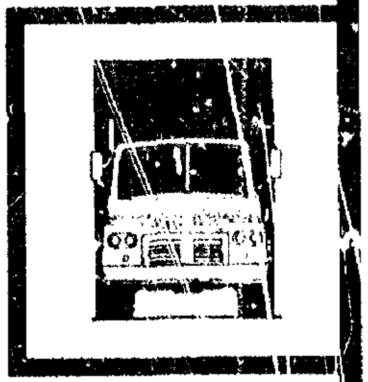

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16. Abstract About 1:33 p.m., c.d.t. on June 9, 1985, St. Louis Southwestern Railway Company (Cotton Belt) freight train Extra 4835 North derailed while passing over a ballast-deck pile trestle located about 3.3 miles southwest of Pine Bluff, Arkansas. Eighteen of the 42 derailed cars were loaded tank cars, and 14 of these cars contained regulated hazardous or toxic chemical commodities; 4 others contained non-regulated flammable petroleum and liquid plastics products. Fire broke out in the wreckage, and smoke and toxic gasses were released into the atmosphere. Two tank cars which were subjected to intense thermal exposure exploded but did not rocket. More than 2,800 persons were evacuated from within a 1-mile radius of the derailment site. Property damage was reported to be more than $4 million.

The National Transportation Safety Board determines that the probable causes of this accident were (1) the failure of the St. Louis Southwestern Railway Company to destress and adequately anchor the track to retard longitudinal movement at Bridge 272.14 as required by its rules, after disturbing the track in hot weather; and (2) the excessive speed and consequential heavy braking of Extra 4835 North on a downgrade approaching the accident location, which compounded the longitudinal stresses imposed on the track structure by heat. Contributing to the accident was the St. Louis Southwestern Railway's failure to adequately enforce the speed restrictions imposed on trains operating over its Pine Bluff sub-division.

17. Key Words derailment; hazardous materials; fire; speed; destress and anchor track; top and bottom shelf couplers

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Abstract (continued)

Lessening the severity of the accident were (1) an extraordinarily timely and effective response by the Cotton Belt and local fire and police forces attributable to training and planning previously conducted under the auspices of the railroad and local emergency organizations, and (2) the presence of top and bottom shelf couplers, jacketed insulation and head shielding which absorbed the effects of impact on tank cars carrying hazardous materials.

CONTENTS

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WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: October 7, 1986

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SYNOPSIS

About 1:33 p.m., c.d.t. 1/ on June 9, 1985, St. Louis Southwestern Railway Company (Cotton Belt) freight train Extra 4835 North derailed while passing over a ballast-deck pile trestle located about 3.3 miles southwest of Pine Bluff, Arkansas. Eighteen of the 42 derailed cars were loaded tank cars, and 14 of these cars contained regulated hazardous or toxic chemical commodities; 4 others contained non-regulated flammable petroleum and liquid plastics products. Fire broke out in the wreckage, and smoke and toxic gasses were released into the atmosphere. Two tank cars which were subjected to intense thermal exposure exploded but did not rocket. More than 2,800 persons were evacuated from within a 1-mile radius of the derailment site. Property damage was reported to be more than $4 million.

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Lessening the severity of the accident were (1) an extraordinarily timely and effective response by the Cotton Belt and local fire and police forces attributable to training and planning previously conducted under the auspices of the railroad and local emergency organizations, and (2) the presence of top-and-bottom shelf couplers, jacketed insulation and head shielding which absorbed the effects of impact on tank cars carrying hazardous materials.

INVESTIGATION

The Accident

At 11:45 a.m. on June 9, 1985, northbound St. Louis Southwestern Railway Company (Cotton Belt) freight train Extra 4835 North consisting of 6 locomotive units, 93 cars, and a caboose departed Eagle Mills, Arkansas, for Pine Bluff, Arkansas, a distance of about

1/ All times herein are central daylight time.

55 miles. The engineer, fireman, and head brakeman were in the lead locomotive unit; the fireman, who was fully qualified as an engineer, continuously operated the train after it left Eagle Mills. An extra brakeman was riding in the fourth locomotive unit, and the conductor and rear brakeman were in the caboose. This crew had operated the train from its point of origin at Shreveport, Louisiana.

About 20 miles out of Eagle Mills, Extra 4835 North stopped for about 12 minutes in the passing track at Fordyce, Arkansas, to permit two southbound freight trains to pass. When Extra 4835 North left Fordyce it was running about 1 hour 20 minutes behind a preceding northbound freight train. A third southbound freight train was passed about 20 minutes after Extra 4835 North left Fordyce.

At a point about 5 miles south of Pine Bluff and 1.9 miles south of Bridge 272.14, Extra 4835 North began descending a 1.7-mile grade with an average falling gradient of 0.74 percent northbound. At the time the train was moving at 54 mph and the throttle was in the eighth (full throttle) position with the brakes released. After the locomotive started down the grade, the fireman initiated a minimum 6-pounds reduction of train brakepipe pressure to apply the train brakes to prevent acceleration and slack action within the train. He followed this by making progressive one-position throttle reductions for the same purpose. When the locomotive nearly reached the bottom of the grade, the fireman increased the brakepipe pressure reduction to 10 to 13 pounds. By this time he had already reduced locomotive power to the fourth (half-throttle) position. As a result the train was traveling 49 mph when the locomotive reached the bottom of the grade.

According to the fireman, he observed a lateral "kink" in the main track at a point 30 to 40 feet north of the south end of Bridge 272.14 when the train's head end was 75 to 100 yards south of the kink. He estimated that both rails were 10 to 12 inches out of normal alignment to the left (west), and that the kink was 2 to 2 1/2 feet long. The fireman made a full-service application of the train brakes when he saw the kink, and he used the radio to alert the conductor that the train would be passing over the irregularity in the track.

As the locomotive units of Extra 4835 North passed over the kink, they rocked laterally but did not derail. The first 25 cars in the train also passed safely over the kink. However, when the locomotive was about 1/4-mile north of Bridge 272.14 and moving at about 41 mph, the train brakes went into emergency and cars began derailing at the bridge. The 26th through the 56th cars from the train's head end derailed at and immediately south of the bridge. As a result of the derailment, the west rail was turned over north of Bridge 272.14, and this caused the derailment of the 15th through the 25th head cars which had passed safely over the kink in the track. (See figure 1.) These 11 cars included 8 loaded tank cars, all but 2 of which were placarded and contained hazardous chemical commodities. None of these tank cars was punctured or ruptured, and although a tank car lost some of its cargo of hydrogen peroxide solution through a dome leak, there was no outbreak of fire with any of these cars. (See figure 2.)

However, fire broke out immediately in the wreckage of the 31 cars at the south of the bridge. Two tank cars containing butyl acrylate, a combustible liquid, were ruptured and their contents ignited. Burning liquid engulfed many derailed cars including an insulated tank car loaded with liquid synthetic plastic and an insulated tank car that contained ethylene oxide, a flammable liquid. Two derailed tank cars containing vinyl chloride, a flammable gas, and two tank cars containing hydrogen fluoride anhydrous, a dangerous corrosive chemical, were located on the perimeter of the fire area. However, the vinyl chloride cars and the hydrogen fluoride car nearest the fire were jacket insulated and were not ruptured or punctured in the derailment.

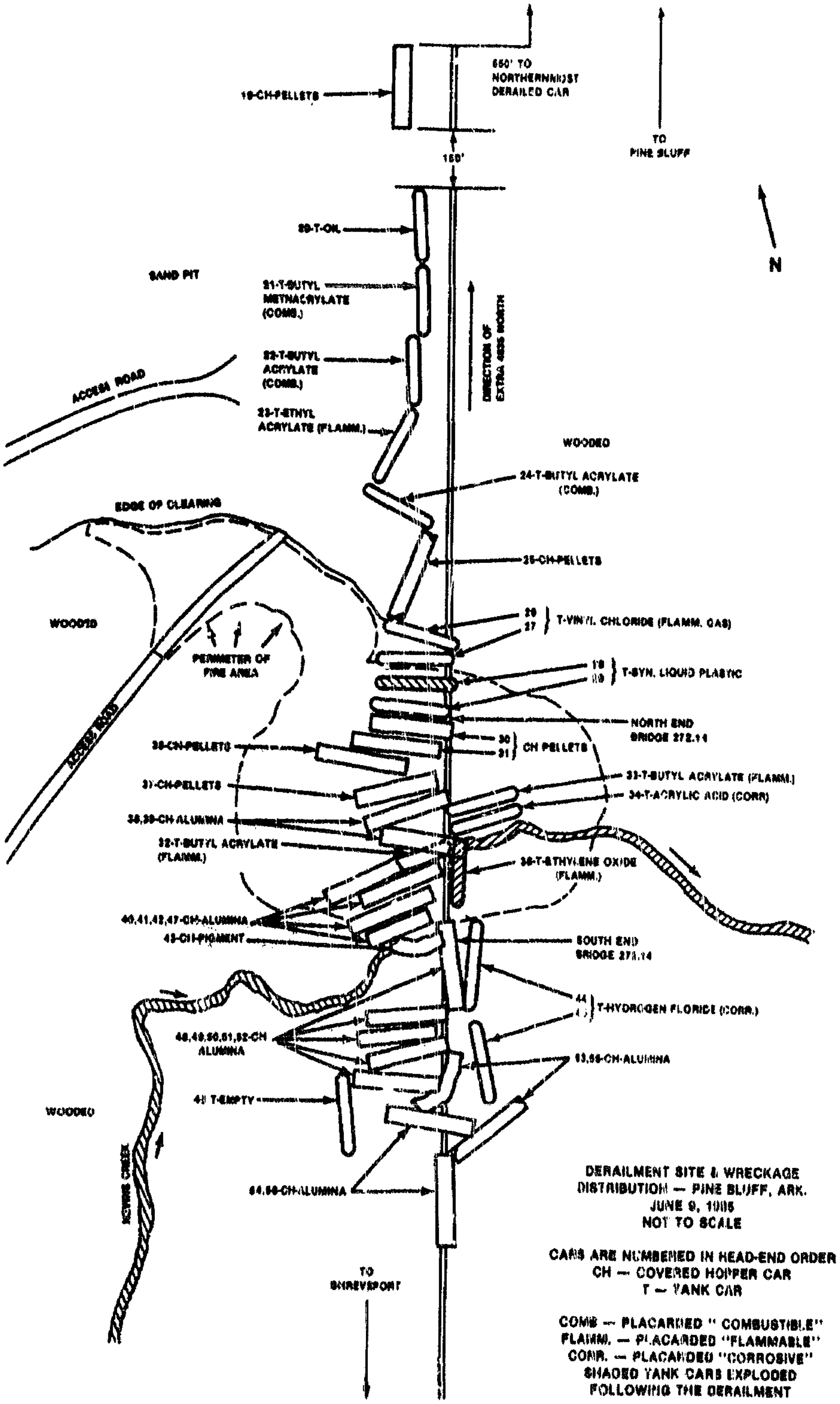

Figure 1.--Plan view of accident site and wreckage distribution.

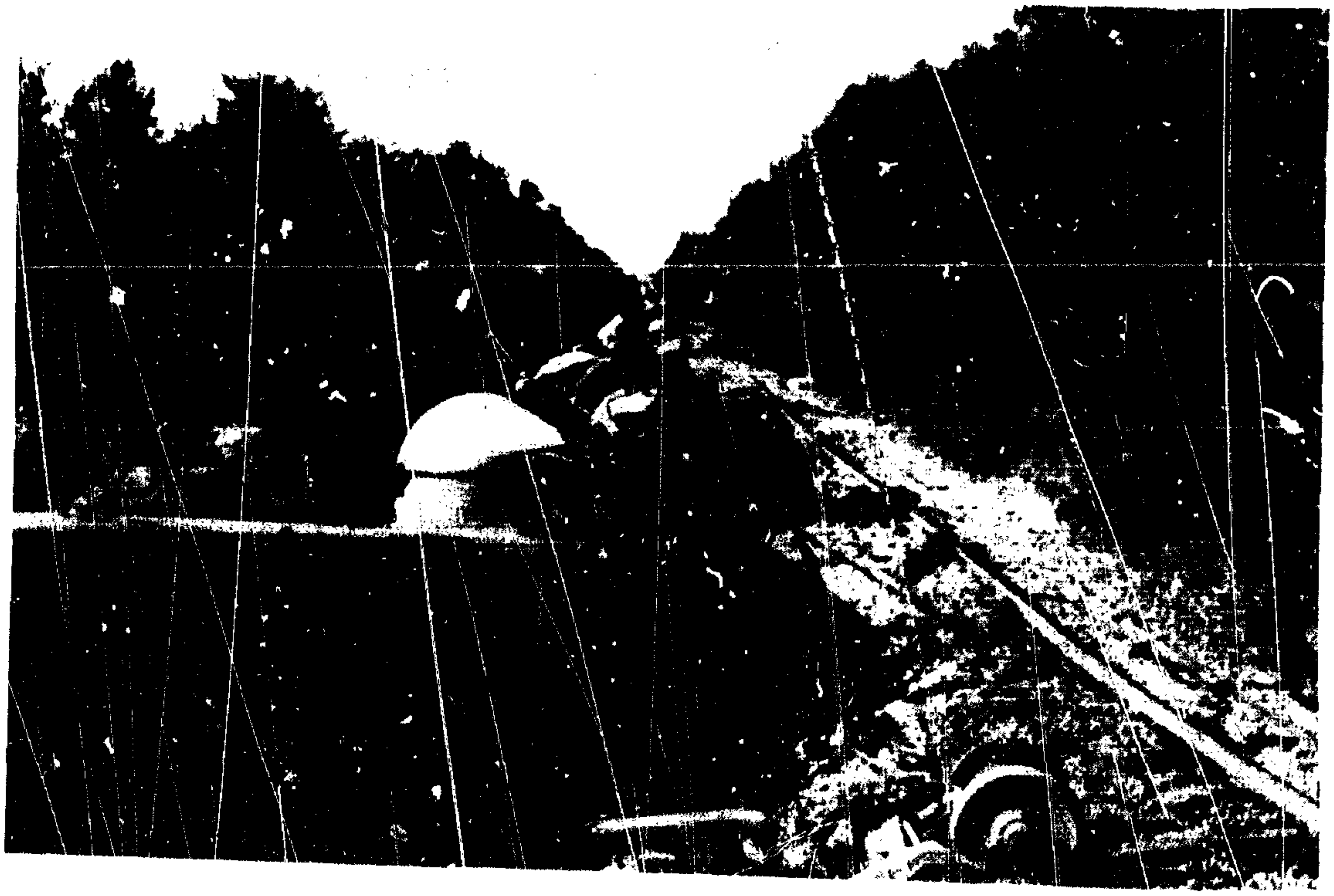

Figure 2.--View facing north showing derailed tank cars that remained in line with the track north of the general derailment area at Bridge 272.14. All of these cars had top-and-bottom shelf couplers, and none of them was ruptured or breached.

Immediately after the derailment, the train's fireman contacted the Cotton Belt dispatcher by radio to report the derailment and fire. At 1:37 p.m., 4 minutes after the accident occurred, the dispatcher reported the fire and its location to the Pine Bluff fire department, and the first fire department units were on-site at 1:39 p.m. Although only a short distance outside Pine Bluff's city limits, the accident site was in a sparsely populated section. The train's fireman was familiar with the location and furnished the dispatcher with detailed instructions on the best way to get to the derailment site. These instructions were relayed to the city fire department units.

As part of his train manifest information, the conductor of Extra 4835 North had details and instructions on the hazardous commodities in the tank cars and the conductor gave these to the fire department's assistant chief shortly after he arrived at the derailment site. The instructions for the tank car containing ethylene oxide recommended the evacuation of all persons within a 5,000-foot radius of the car. The assistant fire chief decided to postpone attacking the fire and immediately began the recommended evacuation after determining that the ethylene oxide car was probably in the fire area. An estimated 2,840 persons were subsequently evacuated from within a 1-mile radius of the derailment area; most of these persons lived in residential neighborhoods in the southwest section of Pine Bluff.

Injuries

There were no injuries to members of the train crew, responding emergency personnel forces, or to the public as a result of this accident.

Damage

Initially, the fire in the wreckage was fueled by liquid butyl acrylate released from two ruptured tank cars, but it rapidly spread to pelletized synthetic plastic (polyethylene and polypropylene) that was spilled from four covered hopper cars, two of which were on top of the apparently still-intact tank car containing ethylene oxide. Intense fire impinging on the ethylene oxide car caused it to explode at about 6:40 a.m. on June 10, about 17 hours after the accident occurred. Although a fireball resulted, the car did not rocket, probably because it was still under the covered hopper cars. A torch fire burned a large hole in one of the derailed tank cars containing liquid synthetic plastic (polymethylene polyphylisocyanate). Ultimately, the contents of the car was consumed by fire which impinged on a second tank car loaded with the same commodity. This car exploded about 4:30 a.m. on June 11, but it did not rocket.

Burning plastic liquid pooled around the two tank cars containing vinyl chloride, but unmanned fire department master stream devices were used to play water on these jacketed fiber glass and rock wool-insulated tank cars to prevent overheating and consequent venting of the contents. Elsewhere, the fire was allowed to burn itself out.

As a result of crushing impacts during the derailment and the post-accident fires, 20 cars were destroyed and scrapped at the accident site; 22 others were damaged, but were salvaged and returned to their owners. The contents of 31 cars were either totally or partially lost, but no serious environmental problem resulted since most of the hazardous chemical product loss was consumed by fire. There was a considerable quantity of bulk calcined alumina (granulated aluminum ore), paint pigment, and unburned plastic pellets that was discharged from derailed covered hopper cars, but these products posed no serious threat to the environment. The effects of fire and explosion were confined to the accident site, and there was no impact on or damage to residential property in the area.

About 1,600 feet of track and Bridge 272.14, a 127-foot ballast-deck pile trestle, were destroyed. Damage was estimated as follows:

Train equipment	$1,415,000
Train lading	1,223,000
Track	200,000
Bridge 272.14	1,500,000
Total	$4,338,000

Train Information

At the time of the accident, Extra 4835 North consisted of 6 operative 4-axle locomotive units, 90 loaded cars, 3 empty cars, and a caboose. The train had a trailing weight of 10,548 tons and the tonnage per car with operative brake was 112.2. The train was 5,671 feet long, and the total rated horsepower of the locomotive was 15,500. The lead locomotive unit was a General Motors model GP38-2, and the trailing units included another of this type as well as one General Motors model GP35 unit and 3 General

Electric model B-30-7 units. The lead unit had a speed indicator, type 26L brake equipment, and a radio. It did not have operative dynamic braking capability or an operative speed recorder. However, the fifth unit had a functioning Pulse Electronics 8-track event recorder which was designed to record elapsed time, speed, throttle position, load amperage, direction of travel, use of the automatic air brake, locomotive brake, and dynamic braking.

Extra 4835 North originated at Shreveport, Louisiana, and originally consisted of 4 locomotive units and 60 cars; as such, the train's average weight per car with operative brake was 107 tons. Two locomotive units, including the one with the Pulse event recorder, and 34 cars were added to the train at Eagle Mills, Arkansas. One of the cars picked up, an empty gondola, was restricted by time table instruction to a maximum speed of 45 mph. From the start of its trip at Shreveport, Extra 4835 North was designated as a "K" train - one that contained hazardous materials cars. This and the tons per operative brake calculation were set out in the train data the engineer and conductor had been provided at Shreveport.

Tank Car Performance

At the time of the accident, Extra 4835 North contained 26 loaded tank cars which were placarded as follows:

Placard	Tank Cars Total	Tank Cars Derailed
Dangerous - Flammable Gas	2	2
Dangerous - Flammable Liquid	13	2
Dangerous - Combustible Liquid	2	2
Dangerous - Corrosive Liquid	3	3
Dangerous - Oxidizer	1	1
Combustible Liquid	5	4

Also derailed were four tank cars loaded with non-regulated combustible liquids. All 18 loaded tank cars that derailed were equipped with top-and-bottom shelf couplers, and 13 tank cars had thermal insulation. Both derailed flammable gas cars (vinyl chloride) had jacketed fiber glass and rock wool-insulation that afforded effective thermal protection. One of these cars received a coupler strike in the side (see figure 3) from a covered hopper car with a conventional Type E coupler; the other vinyl chloride car had significant impact damage, mostly from strikes by wheelsets. These impacts were absorbed by the jackets and insulation material, and the shells and heads of the cars were not breached (see figure 4). Both the ethylene oxide car and a nonplacarded tank car loaded with liquid plastic were also insulated, but after exposure to intense heat, both cars exploded 17 hours and 39 hours, respectively, after the accident.

As far as could be determined, none of the derailed tank cars sustained coupler-inflicted head punctures, and there was no failure of a tank car bottom outlet that resulted in leakage of product.

Track Information

Beginning at milepost 273.91 and ending at a point 875 feet south of Bridge 272.14, the single Cotton Belt main track descends a continuous northbound grade 8,600 feet long. In this distance the drop in elevation is 66.8 feet and the average gradient is about 0.74

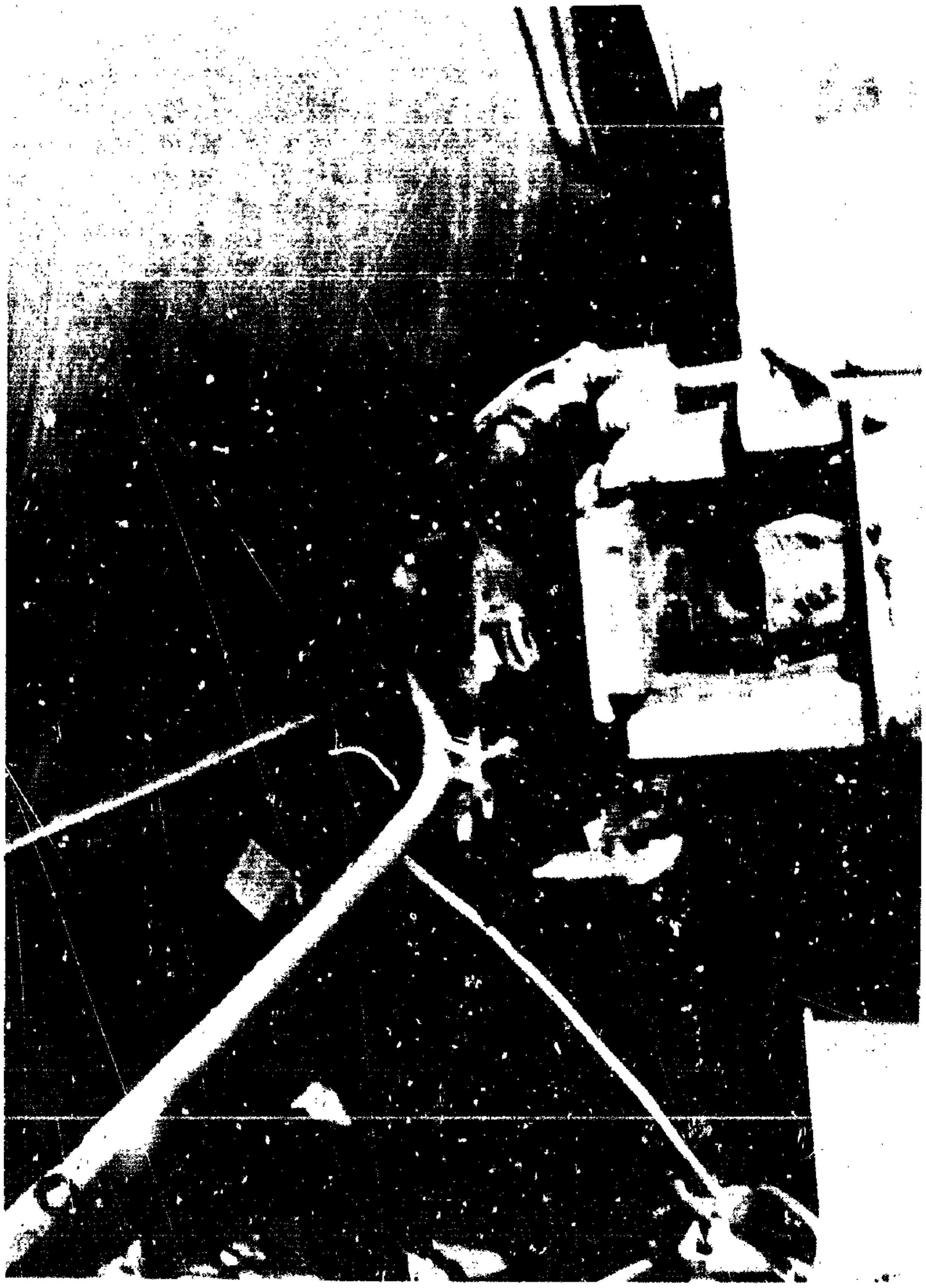

Figure 3.--Conventional Type E coupler of a covered hopper car imbedded in the side of a vinyl chloride tank car. The strike was absorbed by the outer jacket and insulation, and there was no damage to the tank shell.

Figure 4.--Heads of the two jacket-insulated tank cars loaded with vinyl chloride showing damage from impacts that was absorbed by the outer jacket and insulation material.

percent. The most severe drop in elevation occurs over a distance of about 4,200 feet where the gradient varies from 0.989 percent to 1.10 percent, nominally a 1-foot descent in each 100 linear feet of track. The track is level from the bottom of the grade northward to Bridge 272.14 and 2,500 feet beyond. This level section is straight except for a 503-foot right-hand 1°6' curve northbound that is exited at a point 780 feet south of Bridge 272.14.

The accident occurred in a 0.8-mile section of track between mileposts 271.5 and 272.3 that was constructed of 112-pound continuous welded rail (CWR) laid in 1967. This rail had been rolled in 1949 and used thereafter as jointed rail in standard 39-foot lengths. Before being installed at the accident site, the rail had been end-cropped and plant welded to continuous to quarter-mile lengths. It was programmed for replacement with 136-pound CWR in August 1985, and the new rail was already on the right-of-way for this purpose. There were sections of 136-pound CWR on both sides of the 112-pound section; the section to the south was laid in 1981, and that to the north in 1974.

The 112-pound CWR section was laid on 6 3/4- by 11-inch double-shouldered tie plates atop 7- by 9-inch by 9-foot treated crossties laid in good quality crushed stone ballast. Tie cribs were fully compacted and the shoulder ballast sections extended about

12 inches beyond the crosstie ends with a 1.5:1 slope. The track was maintained to meet Federal Railroad Administration (FRA) Class 5 standards. 2/

In the undamaged section of tangent track south of the derailment area, there appeared to be no set spiking pattern, although most tieplates had two rail-holding spikes. Some tieplates had one or two plate-holding spikes, but many had none. Two tieplates were missing in the 400 feet of track immediately south of the derailment area. In this section ties were spaced on 19-inch centers, and there were 47 rail anchors to retard northward rail movement per 100 ties; 25 were applied to the west rail and 22 were applied to the east rail. (See figure 5.) About 40 percent of these anchors were not bearing against ties. (See figure 6.) Fresh rub marks made by spike heads on the base of the rail indicated the rails had moved 3 to 4 inches northward. (See figure 7.)

Cotton Belt standards at the time the 112-pound CWR was installed called for box anchoring 3/ every third tie, thus providing 33 anchors per 100 ties to retard movement in each direction on each rail. The standard in effect at the time of the accident required box anchoring of every second tie. The 136-pound CWR sections on each side of the 112-pound CWR section were anchored according to this latest standard. (See appendix E.)

Cotton Belt maintenance of way rules require that anchors will conform in number and distribution to the prescribed standard; that anchors must be set to bear against ties and, when necessary, anchors must be reset to maintain solid bearing to prevent rail movement. In addition, out-of-face 4/ raising of CWR track can only be done at the same or lower temperature than that prevailing at the time the rail was laid. (See appendix E.) Cotton Belt maintenance of way supervisors were unable to locate any record of the temperature at the time the 112-pound CWR section was laid in 1967. However, they did report that the section was included in a mechanized tie renewal program on September 29, 1983, and that an average of slightly more than one of every three ties was replaced at the time. According to National Weather Service records, temperatures at Pine Bluff on the day the ties were replaced ranged from a low of 54° F to a high of 83° F.

After the tie renewal program, the 112-pound CWR section was machine surfaced in February 1984 and again in February 1985. According to the Cotton Belt's district maintenance of way manager. this section was the location of "chronic" and recurring alignment and surface irregularities that required repeated attention. On May 7, 1985, a maintenance gang cut both rails near milepost 271.8 about 1/3 mile north of Bridge 272.14. A 4 1/2-inch section was removed from the east rail, and a 6 1/2-inch section was cut out of the west rail. Before the cuts were made, the anchors were removed to destress the track for a distance of about 700 feet in both directions from the location of the cut. After the rails were allowed to expand and close the gaps, they were rejoined by field welding and the anchors were then reset to the every-other-tie box anchoring pattern. (See figure 8.) Between May 7 and June 9, 1985, the track was destressed at four other locations within 2 miles of Bridge 272.14.

2/ "Classes of Track," 49 CFR Part 213.9, establishes six track classifications, identified as Classes 1 through 6, and prescribes physical standards, minimum maintenance requirements, and maximum permissible operating speeds for each classification. The maximum permissible speeds for Class 5 track were 80 mph for freight trains and 90 mph for passenger trains. Over the objections of the Safety Board, FRA in 1982 eliminated all requirements for restraint of longitudinal rail movement from these track standards.
3/ Box anchoring is the practice of setting rail anchors to bear against both sides of a tie to retard rail movement in both directions.
4/ Out-of-face trackwork is work that proceeds completely and continuously over a given piece of track as distinguished from work at disconnected points only.

Figure 5.--The main track at Bridge 272.29 facing north toward the derailment area. Note the irregular distribution of rail anchors that was typical of the 112-pound CWR section approaching the accident location from the south.

Figure 6.--East rail of the 112-pound CWR section south of the derailment site showing the lack of a rail-holding spike on the gauge side of the tieplate. Only one anchor is bearing against the tie and there is a rub mark on the base of the rail where it moved to the left (north) under this anchor. Positions of the anchors in relation to the tie may have been reversed before the accident.

Figure 7.--Fresh rub mark on the base of the east rail 330 feet south of the derailment site caused by the rail moving to the left (north) under the spike head.

Figure 8.--The main track viewed facing south toward the derailment site at milepost 271.8 showing the field weld marking the location where the west rail was cut on May 7, 1985. Every second tie has been box anchored. New 136-pound rail to replace the existing 112-pound CWR is laying on the tie ends ready to be installed.

The day after the cut was made near milepost 271.8, the district manager had the maintenance gang replace some ties in the track on Bridge 272.14 because he noticed the ties were rounded on the bottom and might be the cause of the misalignment problems at that location.

On May 31, 1985, the district manager instructed the foreman of a surfacing gang to work on the track on Bridge 272.14. According to the foreman, the track was in proper alignment but there was a low spot about 15 feet long in the track. On inspection the foreman found no evidence that the low spot was caused by ballast stone leaking through the bridge floor. The surfacing gang worked on the track early on the morning of June 4, 1985, when the temperature ranged from 82° to 85° F. A tamper was used to raise the west rail about 2 1/2 inches and the east rail about 1 inch at the low spot. According to the foreman, he tamped the lifted section three times to make certain the ballast was solid under the track. A ballast regulator was then used to dress the ballast. The work was completed by 9 a.m. when the foreman placed a 25 mph slow order on that section. No rail anchors were added or reset after the work was completed.

On June 5, 1985, the district manager inspected the track at Bridge 272.14 and found it properly aligned and level. The next day he had the slow order raised to 40 mph. At 9:30 a.m. on June 7 the track inspector assigned to the territory passed over the location on a motorcar while making his regular semi-weekly inspection. He reported that the alignment, surface, and ballast appeared to be "perfect, okay for maximum speed." On the strength of this report the slow order was removed that morning.

In the 112-pound CWR section between mileposts 271.5 and 272.3 there were four pile trestles of the ballast deck type with a timber deck or floor supporting a ballast section on which the track is laid. The ballast section is held in place by retaining timbers on each side, and the opening between these timbers is 14 feet wide. All four trestles were in a continuous tangent. From south to north, the first of these trestles was Bridge 272.29 and it was 98 feet long. The second trestle, Bridge 272.14, was located 670 feet north of Bridge 272.29. It was 127 feet long, had a maximum height of 16 feet, and had been completely renewed on June 25, 1954. Bridge 271.88, the third trestle from the south, was 197 feet long and was located 1,093 feet north of Bridge 272.14. This trestle marked the northernmost limit of the derailment area; neither it nor Bridge 272.29 was damaged in the derailment.

Meteorological Information

At the time of the accident, the weather was clear, calm, and dry with visibility of 10 miles. The report of surface weather observations at the National Weather Service station at Pine Bluff gives the following readings for June 9, 1985:

Hour (c.d.t.)	Temperature (in degrees Fahrenheit)	Dew Point
0540	71*	68
0649	72	68
0750	76	67
0850	81	65
0950	85	69
1050	89	71
1150	90	69
1250	92	70
1350	93	70
1550	95*	69
1749	95	70
1950	89	72
2150	84	74

*Low and high readings for the day.

Low and high temperature readings for preceding and succeeding days were recorded at Pine Bluff as follows:

Date	Low	High
June 1	76°-0556	98°-1452
June 2	74°-0540	93°-1654
June 3	74°-0548	92°-1550
June 4	75°-0551	95°-1651
June 5	74°-0540	92°-1349
June 6	76°-1750	88°-1650
June 7	70°-0540	89°-1250
June 8	69°-0548	90°-1651
June 10	75°-0550	93°-1350

Method of Operation

The accident occurred on the Pine Bluff sub-division of the Cotton Belt's Pine Bluff Division. The division offices are at Pine Bluff; the superintendent, assistant superintendent, dispatchers, road foreman of engines, and other supervisors are headquartered there. The Pine Bluff sub-division extends 154 miles from Pine Bluff to Texarkana, Arkansas. Train operations over the sub-division are under the immediate supervision of a trainmaster who is headquartered at Camden, Arkansas, which is roughly midway between Pine Bluff and Texarkana.

Trains are operated over the Pine Bluff sub-division by automatic way-side signals of a Centralized Traffic Control system (CTC); timetable and bulletin order instructions; air brake, train handling, and operating rules; and radio-transmitted instructions from the dispatchers. In addition to the model board of the CTC machine, dispatchers use a recording graph to track the movement of trains by time and location. This graph indicated that southbound freight trains passed over the accident location at 10:07, 10:45, and 11:43 on the morning of June 9. Subsequently, a 6,523-ton northbound freight train passed the accident location at about 12:30 p.m. As with Extra 4835 North, this train was restricted to a maximum speed of 45 mph. Neither the crew of this train nor the crews of the three southbound trains reported any unusual conditions at Bridge 272.14.

The maximum authorized speed for all trains on the Pine Bluff sub-division was 70 mph according to the timetable in effect at the time of the accident. However, there was no location between Eagle Mills and Pine Bluff where that speed was permitted. Between mileposts 272.3 and 286.4 the maximum allowable speed was 65 mph, elsewhere it was 60 mph or less. Between mileposts 286.4 and 287.4, the timetable restricted speed to 40 mph. North of the accident location, between mileposts 271.3 and 269.1, the maximum allowable speed was 50 mph, and beyond milepost 269.1, approaching the Pine Bluff yards, the speed was restricted to 20 mph. There was a temporary slow order of 25 mph in effect between mileposts 285.2 and 285.0 south of the accident location. 5/

The timetable stipulated a 55 mph restriction for trains handling hazardous commodities and/or empty cars; those trains handling certain empty gondola or flat cars were restricted to 45 mph. There was also a timetable restriction limiting the maximum weight of trains to 11,000 tons except for unit trains. (See appendix C.) Rule 33 of Cotton Belt's Air Brake Rules and Regulations stipulated a 55-mph maximum speed for trains weighing more than 80 tons per car with operative brake. (See appendix D.)

During 1983, the most recent year for which data was available, an aggregate of 28.2 million gross tons of freight train traffic was moved over the single main track at the accident location. This was about equally divided between northbound and southbound movement. An average of 15 trains were operated daily over the accident location in 1985.

According to the trainmaster headquartered at Camden, he routinely made surprise efficiency checks of trains enroute, and he had a radar gun for making speed checks. The trainmaster was required to make a specific number of efficiency checks and to render a monthly accounting of his checks to the division superintendent. However, he was given the freedom to decide what types of checks he made. According to the trainmaster, he was only required to ride two local freight trains monthly. He did not often ride the through freight trains. However, he stated that the road foremen of engines rode with the through freight crews on a regular basis.

The trainmaster nominally worked a daylight tour of duty and had every other weekend off. He did not have an assistant or a counterpart at night, and there was no one to assume his duties when he was off. According to the trainmaster, he was on vacation on the day of the accident.

Crewmember Information

The crew of Extra 4835 North consisted of a conductor, engineer, fireman, and three brakemen. All were qualified under Cotton Belt rules without restrictions. At the time of the accident, the crew had been on continuous duty for 9 hours, 18 minutes. All the train crewmembers had been off duty for more than 24 hours prior to reporting for duty on the day of the accident. (See appendix B.)

The engineer's service record indicated that he had been cited, but not disciplined, three times between 1980 and 1983 for efficiency test failures. Additionally, on June 22, 1984, the trainmaster at Camden, Arkansas, had radar-checked a 45-mph train being operated by the engineer at a speed of 58 mph. The engineer was suspended for 30 days for this violation, although the Cotton Belt later reduced this discipline to demerits

5/ Compliance with timetable speed restrictions and temporary slow orders requires that the entire train be drawn through the affected section at or below the stipulated speed. Since Extra 4835 North was more than a mile long, it would have to maintain that speed for about 1.3 miles here to be in compliance.

without loss of pay on a leniency basis. The engineer was discharged following the derailment of Extra 4835 North, but was restored to his job with full rights and seniority after 90 days. The fireman was also discharged, but he was restored to duty after 36 days.

The conductor and three brakemen were given short suspensions without pay after the derailment of Extra 4835 North. The rear brakeman, who had been previously suspended for 30 days as a result of the same June 22, 1984, speed violation cited in the case of the engineer, was suspended for 10 days following the June 9, 1985 derailment. (See appendix B.)

About 4 hours after the accident, urine samples were obtained from all the train crewmembers at a Pine Bluff clinic under the supervision of a doctor. Toxicological reports furnished by the laboratory indicated negative test results for ethanol, cannabinoids, cocaine, barbiturates, amphetamines, and other drugs for all the samples.

Response to the Emergency

The Cotton Belt dispatcher reported the accident and its approximate location to the Pine Bluff Fire Department which dispatched three engine companies and a ladder company 4 minutes after the accident occurred. More or less simultaneously, three Jefferson County volunteer fire departments also responded, and a fourth Pine Bluff engine company was dispatched about 5 minutes after the accident. In all, 32 Pine Bluff firemen and numerous county volunteer firemen reached the scene. A mutual aid agreement between Jefferson County and Pine Bluff was in effect, and there were no jurisdictional conflicts.

While enroute to the derailment with the first responding fire units, the Pine Bluff assistant fire chief had the fire department dispatcher contact the Cotton Belt dispatcher for information on the hazardous commodities in the train and the recommended procedures to deal with them. The Cotton Belt dispatcher retrieved this information from a computer, and the data was relayed to the assistant fire chief as he and his first units reached the derailment site.

Shortly after arriving at the site, the assistant fire chief encountered the train's conductor who gave him the train manifest data which confirmed the information the assistant fire chief received over the radio. The firemen also had access to the 1984 edition of the U.S. Department of Transportation (DOT) emergency response guidebook and the Association of American Railroads (AAR) publication, Emergency Handling of Hazardous Materials in Surface Transportation, which was on board the first fire department vehicle to reach the derailment area.

After receiving the train manifest data from the conductor, the assistant fire chief decided that the fire was too dangerous to attack, and he ordered his responding units to points at least 3,000 feet away from the fire area. Some units were dispatched over the various roads leading into the area to set up roadblocks and to instruct nearby residents to evacuate their homes. Pine Bluff Police Department and Jefferson County Sheriff's Department units cordoned off the area and denied access to all persons not involved in the response effort. The derailment area was sealed off so quickly that the Cotton Belt superintendent was stopped twice at roadblocks while enroute to the derailment less than 30 minutes after it happened.

Coordination of the response effort was assumed by the director of the Jefferson County Office of Emergency Services who set up a command post about a mile from the derailment site. At 3 p.m. he ordered the evacuation of all persons within a 1-mile radius of the derailment site. The Governor of Arkansas declared an emergency and placed the Arkansas National Guard on a standby basis. Arkansas State Police assisted the city and county police in carrying out the evacuation order which was completed about an hour after the order was issued. An estimated 2,840 persons left their homes and businesses. Some went to the homes of friends and relatives outside the evacuated area; others were accommodated at the Salvation Army shelter in Pine Bluff which had ample feeding facilities.

Throughout the emergency, the local forces were assisted by railroad and chemical company hazardous materials experts who regularly surveyed the situation from the air. After the second and last tank car explosion early on the morning of June 11, the fire diminished and it was decided that firemen should re-enter the area and set up unmanned hoses to cool the vinyl chloride tank cars. This was accomplished by applying water to the cars at the rate of 400 gallons per minute for 5 hours and subsequently at 250 gallons per minute for 35 hours. After the fire was suppressed and the various hazardous commodities were transferred or otherwise removed safely from the area, the emergency was terminated at 2:12 p.m. on June 15.

On May 22-23, 1984, the Bureau of Explosives of the Association of American Railroads (AAR) and the Jefferson County Office of Emergency Services jointly conducted four 4-hour hazardous materials handling training courses for Pine Bluff area emergency personnel at Pine Bluff. Cosponsors of the program included the Arkansas State Office of Emergency Services, the Arkansas Fire Academy, the Arkansas Law Enforcement Training Academy, and Pine Bluff and Jefferson County fire and police departments. Topics in the course included tank car characteristics and hazardous materials identification and handling in derailments. Every agency that responded to the June 9, 1985, derailment, including the Cotton Belt, had personnel at the accident site who had attended this course.

According to the coordinator of the response effort, the training resulted in every agency understanding its responsibilities in the effort, as well as the responsibilities incumbent on the other agencies. He stated that he recognized the effect of the training in the ways personnel conducted their activities. Additionally, the coordinator stated that the training contributed significantly to the smoothness and the lack of confusion in the response to the emergency.

Tests and Research

The Barco speed indicator of the lead locomotive unit of Extra 4835 North was calibrated for accuracy and found to indicate actual speeds at settings of 1 mph through 40 mph. At actual speed of 80 mph the indicator gave a reading of 78 mph. On this basis, it was estimated that at 60 mph the indicator would give a reading of 59 mph. Proper allowance for wheel diameter was made in this testing.

The Pulse event recorder was tested following the accident to verify the readout information it yielded. Except for the automatic air brake recording function, which was not found to be reliable, all systems functioned properly. Subsequently, a physical verification of the accuracy of the speed recording function was performed by radar monitoring a running test of the locomotive unit at speeds of 45 to 60 mph. This confirmed that the speed recording function was accurate in that speed range.

Examination of the event recorder readout indicated that Extra 4835 North was operated in excess of its maximum authorized speed of 45 mph at the following locations between Eagle Mills and the accident location:

Milepost Locations	Mileage	Maximum Speed Attained
315.3 to 311.5	3.8	55
306.0 to 301.1	4.9	59
299.8 to 293.7	6.1	59
282.0 to 272.0	10.0	54
Total distance	24.8 miles	

In addition, the printout indicated that Extra 4835 North was operated at speeds of 30 to 35 mph through the temporary 25 mph slow order between mileposts 285.2 and 285.0 and was accelerated from 44 to 47 mph in the 40 mph timetable speed restriction between mileposts 287.4 and 286.4.

Calculations of the theoretical kinetic energy of Extra 4835 North as it began descending the grade at mileposts 273.91, established that the energy which would have to be dissipated to stop the train from 54 mph would be 44 percent greater than the energy to be dissipated from 45 mph. At the bottom of the grade, the kinetic energy at 50 mph would have been 56 percent greater than the kinetic energy at a speed of 40 mph.

ANALYSIS

Operation of the Train

From the time it left Shreveport, Extra 4835 North contained cars loaded with hazardous commodities; as such, it was classified as a "K" train and was restricted to a maximum speed of 55 mph. The weight of the train always exceeded 80 tons per car with operative brake and, as a result, its speed was further restricted by the timetable to a maximum of 45 mph. These speed restrictions were plainly set forth in the train manifest data furnished to the conductor and engineer at Shreveport. All the crewmembers acknowledged that they were aware they were restricted to 45 mph before they departed for Pine Bluff.

After leaving Eagle Mills, the tonnage of Extra 4835 North was only slightly less than the maximum 11,000 tons permitted for trains of mixed freight, and since 31 of the 34 cars the train picked up were loaded cars, the average weight per car with operative brake had increased from 107 to 112 tons. This was 40 percent greater than the 80-ton threshold for the 45 mph speed restriction. Nevertheless, an event recorder on one of the locomotive units indicated that the train was operated at speeds in excess of those permitted by the timetable and a slow order for 27 of the 55 miles between Eagle Mills and the accident location at Bridge 272.14. On two occasions the train's speed reached an indicated 59 mph--14 mph faster than that permitted.

One hour 48 minutes elapsed between the time that Extra 4835 North began moving at Eagle Mills and the time it derailed at Bridge 272.14. During this time, the train traveled 55.26 miles. However, the event recorder indicated that Extra 4835 North stopped at Fordyce for 12 minutes. Hence, the actual time the train was in motion was 1 hour 36 minutes, and its average speed while moving was 34.6 mph. The delay at Fordyce and the train's rate of progress was corroborated by the train graph in the dispatcher's office. There can be little doubt that the event recorder's speed readout gives an accurate indication of how the train was handled. Moreover, considering the relatively long times required to twice accelerate a heavy train from a standing start and to stop it once, the Safety Board believes that so high an average speed performance could only be achieved by consistently violating the speed restrictions.

Yet another fair demonstration of the handling of Extra 4835 North enroute to the accident site is the fact that it gained 17 minutes on the preceding train in the 35 miles between Fordyce and Bridge 272.14 despite the fact that it had 40 percent more tonnage in tow than that of the train ahead. This train was also restricted to 45 mph, and the Safety Board believes that the difference in the performance of the two trains can be attributed to the manner in which their respective crews observed the restrictions. It may also have a bearing on the fact that the first train got safely across Bridge 272.14, whereas Extra 4835 North did not.

Condition of the Track

According to the Cotton Belt's district manager of track maintenance, the section of 112-pound CWR between mileposts 271.5 and 272.3 was a chronic source of surface and alignment problems and was shortly due to be replaced with heavier and newer welded rail which was already on the scene. When this replacement was made, the current Cotton Belt standard of box anchoring every other tie to prevent longitudinal rail movement would, no doubt, be employed. This probably would have solved the recurrent track irregularities in this section. However, in the meantime only temporary and inadequate stop-gap measures were employed.

Following the cutting and rewelding of the 112-pound CWR section near milepost 271.8 on May 7, 1985, the maintenance gang box anchored every second tie to a point about 700 feet south of where the rail cuts had been made. The rail anchors were reset so that they were bearing properly against the ties. Hence, this part of the 112-pound CWR section was restrained against movement as provided for by the Cotton Belt's current anchoring standards. However, the approximately 1,940 feet of 112-pound CWR remaining to the south through Bridge 272.14 to the 136-pound CWR section beginning at milepost 272.3 was not destressed at the time the rail cut was made. The number of anchors in this section was considerably less than what was called for under the old Cotton Belt standard of box anchoring every third tie. Moreover, as many as 40 percent of the anchors that were still in place were not bearing against ties as required. Hence, the rail in the 1,940-foot section was only somewhat restrained against movement and not nearly so much so as were the sections of rail abutting to it on both ends.

Relatively high midday temperatures were commonplace in the accident area in the late spring and early summer with the mercury typically rising rapidly after sunrise. The weather pattern during the 8 days preceding the accident was relatively static with temperatures rising from early morning lows in the low to mid-70's to highs in the 88° to 98° range by early afternoon. On the day of the accident, the temperature rose 21° to 22° between 5:40 a.m. and the time of the accident. It was a clear day, and the temperature of the rail normally would have been 35 to 50 degrees higher than the ambient temperature.

The longitudinal expansion or contraction of unrestrained steel rail is expressed in the following formula: $L=0.0000065\triangle t$. On the basis of this formula, 1 mile of unrestrained rail would move 41 inches as a result of a temperature change of 100° F. 6/ With an increase in ambient temperature of 21 to 22 degrees and rail

6/ William W. Hay, Railroad Engineering, Second Edition, 1982. $\triangle L$ equals the change in rail length, and $\triangle t$ reflects the change in rail temperature. The number 0.0000065 is the coefficient of expansion.

temperature 35° to 50° in excess of ambient temperature, longitudinal movement in a 1,940-foot section of unrestrained rail would be between 8-1/2 and 11 inches. With greater restraint against movement provided by more effective anchoring in the abutting rails sections, the rail in the 1,940-foot section would move or run from each end toward the middle. Any misalignment caused by the rail expansion and running would tend to occur within the 1,940-foot section, most likely at a point where the track had been recently disturbed and was not so firmly imbedded in the ballast.

The location on Bridge 272.14 where ties had been replaced on May 8 and where the track had been raised and tamped on June 4 was approximately 850 feet north of the south end of the 112-pound CWR section at milepost 272.3 and about 1,090 feet south of the southernmost point where anchors were reset following the rail cutting on May 7. The Safety Board believes that this location was highly vulnerable to misalignment caused by excessive stresses imposed by rail expansion and/or train movement, and that it was imperative that the rails be properly restrained by anchoring at the time the track was disturbed. Between June 4 and the scheduled replacement of the 112-pound CWR, the normal climate for this part of Arkansas would be hot and sunny days with significant temperature variations between early morning lows and midday highs. The district maintenance of way manager understood the stresses that would result from the temperature variations and the consequent necessity to properly restrain the rail against movement. However, he failed to order the track anchored in accordance with the Cotton Belt's current standard after having the track disturbed by raising it at Bridge 272.14.

Train-Generated Forces on the Track

When the 6,523-ton freight train preceding Extra 4835 North descended the 1.7-mile grade and reached Bridge 272.14 at about 12:30 p.m., it imposed severe stresses on the track and probably resulted in some movement of the rails that were already under considerable stress from a temperature rise. However, if any misalignment of the track resulted, it apparently was not great enough to be noticed by the train crewmembers.

The excessive speed of Extra 4835 North while on the descending grade approaching the accident site would have necessitated an increase in the amount of braking force needed to dissipate the kinetic energy in order to slow the train to prescribed operating speed within a given distance. Also, increased braking was needed to overcome the train's tendency to accelerate on the descending grade due to gravity. The braking force applied to the train would exert longitudinal forces to the rails which would tend to push the rails ahead of the train.

As Extra 4835 North reached the bottom of the grade and entered the 112-pound CWR section, the rail was moving or running ahead of it. This was indicated by the marks made on the base of the rail as it moved northward under the spike heads. Although it was a clear day and the train was moving on straight track, the fireman did not see the lateral kink in the track until he was only 75 to 100 yards away from it. This was probably because the track did not go out of alignment until the train reached that point. The Safety Board believes that so great an irregularity in the track would have been easily seen from a much greater distance had it occurred earlier. Unable to absorb the added stress caused by the rails running ahead of the train, the track buckled out where it had been disturbed and the ballast was least able to hold it in line.

The Safety Board's investigation of the derailment of Amtrak passenger train No. 169 at Philadelphia, Pennsylvania, on June 8, 1984 also revealed the tendency of poorly restrained rail to run ahead of a moving train and to buckle out where it had been recently disturbed. In this instance, a relatively short section of unrestrained rail was abutted on both ends by adequately restrained rail, and a train had recently passed over the track without the train crew observing any geometric irregularity in the track.

Because of the typically undulating profile of the Pine Bluff sub-division, long trains are frequently in an uphill-downhill situation and train brake applications with variations of throttle position are used to prevent slack action in such situations. Because of the need to avoid slack action and the use of power or "stretch" braking to do so, northbound trains approaching Bridge 272.14 would commonly generate great stresses on the track. The potential for track misalignment problems was great here. This made it all the more imperative that the track be properly restrained to prevent rail movement and that train crews operate their trains in compliance with their authorized speeds.

Crewmember Performance and Rules Enforcement

The investigators did not find any evidence that the crewmembers of Extra 4835 North were fatigued, impaired, or inattentive while they were enroute from Shreveport to the accident site. The fireman's skillful handling of throttle and train brakes to control slack action as the train descended the grade toward Bridge 272.14 indicated he was experienced and well-qualified in the handling of heavy trains. The Safety Board believes, however, that he was well aware that he had been continuously violating the train's maximum authorized speed. This should have been obvious, as well, to the other five crewmembers particularly the engineer who was directly responsible for the safe operation of the train and for supervising the fireman's actions. Since the engineer was on the lead locomotive unit, he was in a position to monitor the speed indicator. The Safety Board believes that an experienced engineer would know that his train was running 1/3 faster than was permitted even if he did not have access to a functioning speed indicator. Moreover, the engineer's past performance supports the conclusion that he probably approved of the manner in which the fireman operated the train.

Although the engineer served a 30-day suspension in 1984 after the Camden trainmaster radar-checked his 45-mph train at a speed of 58 mph, the discipline apparently failed to motivate him to be more responsive to speed restrictions. Such indifference to speed restrictions on the part of some engineers and the trainmen who work with them may be relatively commonplace and has repeatedly resulted in serious train accidents with attendant peril to the public. In the recent past, the Safety Board has investigated a number of train accidents involving the release of hazardous commodities in which speed restrictions and other operating rules were violated. Moreover, the engineers involved in these accidents apparently were not convinced that the restrictions were necessary and, in any event, they were not motivated to obey the rulebooks and timetables. Management provided only part-time rules enforcement efforts by an inadequate supervisory staff, an inconsistent policy of rules enforcement and discipline, and a tendency toward leniency which mitigated the effect of discipline. These factors were also apparent in the Safety Board's investigation of this accident. The principal rules enforcer on the Pine Bluff sub division worked days, was off every other weekend, and had no assistant or counterpart to perform his duties when he was off. Train crews certainly understood this situation. Indeed, the trainmaster was on vacation when the accident occurred. Moreover, the trainmaster was principally concerned with riding the local freight trains in order to expedite their movement.

The dispatcher's train graph showed that Extra 4835 North was moving significantly faster than the 45-mph train preceding it; the emphasis on expediting train movement, which is not uncommon in the competitive environment in which most railroads operate, may have lent itself on the Pine Bluff Division to a tendency to be permissive and lenient with engineers who can "get over the road" in short time, even it means they violate rules and restrictions in the process. The dispatcher's train graph showed that Extra 4835 North was moving significantly faster than the 45-mph train that was preceding it, and an experienced dispatcher could be expected to anticipate the normal progress of any train moving across the territory he supervised. Under the circumstances, the dispatcher should have known that Extra 4835 North was running at excessive speed. Nevertheless, the dispatcher did not contact the crew to inquire what speed they were making.

Even when an efficiency check and this accident revealed that speed restrictions were significantly violated, management's disciplinary policy was seemingly inconsistent and overly-lenient. The engineer was discharged after the accident, but he was quickly re-instated although he had been suspended for an almost identical violation less than a year before. Not long after the engineer was reinstated, the discipline for his earlier offense was nullified altogether. In the case of the rear brakeman, he was suspended for 10 days although, he too, had been suspended 30 days for the identical violation less than a year previous. The Safety Board is convinced that employees who are prone to violate rules will not be deterred from doing so unless they can expect to be cited for violations and will receive appropriate progressively severe and meaningful disciplinary action as a result.

This was the second major train derailment resulting in the release of hazardous commodities on the Pine Bluff sub-division in recent years. On March 29, 1978 a Cotton Belt "K" train enroute from Shreveport to Pine Bluff turned over a rail in a curve at Lewisville, Arkansas and derailed the 4 locomotive units and 43 cars. The head of a non-insulated tank car carrying vinyl chloride was punctured, the chemical ignited, and buildings within 1,500 feet of the car were destroyed or damaged. About 1,700 persons were evacuated and property damaged exceeded $2 million. The Safety Board's investigation determined that the train was moving about 35 mph through a 10 mph restriction, and the Safety Board held that the probable cause of the accident was the train crew's failure to comply with the speed restriction. 7/

On May 31, 1982, 30 cars of a Seaboard Coast Line Railroad freight train derailed at Colonial Heights, Virginia. 8/ Three derailed tank cars containing hazardous commodities ignited and the ensuing fire destroyed them and 10 other cars. Twelve fireman and a State emergency official collapsed due to heat exhaustion while fighting the fire. A nearby school was evacuated and the area was cordoned off to prevent public access during the emergency. The damage exceeded $1.2 million.

The Safety Board's investigation of the Colonial Heights derailment determined that the train was moving 64 mph when it derailed, although the maximum authorized speed was 50 mph. Moreover, the engineer had been repeatedly held responsible for past accidents resulting from his violation of rules and instructions. On two occasions he had been discharged and later reinstated on a leniency basis; otherwise, disciplinary action consisted of demerits on the engineer's record without suspension or loss of earnings.

As a result of a 43-car derailment of an Illinois Central Gulf Railroad freight train at Livingston, Louisiana on September 28, 1982, 9/ 20 of 34 derailed tank cars containing hazardous commodities were punctured or breached. Fires broke out which ultimately

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7/ Railroad Accident Report -- "St. Louis Southwestern Railway Freight Train Derailment and Rupture of Vinyl Chloride Tank Car, Lewisville, Arkansas, March 29, 1978" (NTSB/RAR-78/8).

8/ Railroad Accident Report--"Derailment of Seaboard Coast Line Railroad Train No. 120 at Colonial Heights, Virginia, May 31, 1982" (NTSB/RAR-83/04).

9/ Railroad Accident Report--"Derailment of Illinois Central Gulf Railroad Freight Train Extra 9629 East (GS-2-28) and Release of Hazardous Materials at Livingston, Louisiana, September 28, 1982" (NTSB/RAR-83/05).

resulted in thermally-induced explosions of two tank cars that had not been breached in the derailment. About 3,000 persons living within 5 miles of the derailment site were evacuated for up to 2 weeks. A main highway was blocked and all business activity in the city was interrupted during that period. Many residential and commercial buildings were destroyed or severely damaged. More than 200,000 gallons of toxic chemicals were absorbed into the ground requiring massive excavation and long-distance haulage to dump sites. The damage exceeded $50 million.

At the time the Livingston derailment occurred, the train was moving at about 45 mph where the speed was restricted to 35 mph and was operated by an unauthorized and unqualified person. The engineer was on the locomotive but was impaired by alcohol. The investigation also revealed that, prior to turning over control of the train, the engineer had operated it at excessive speeds, and also that he had continuously violated speed restrictions during his previous trip. In his 10 years of service, the engineer had been repeatedly cited for rules violations and for failure to observe speed restrictions. He had been discharged twice and reinstated on a leniency basis, and had been suspended on six other occasions. As a result of its investigation, the Safety Board was convinced that the disciplinary action was insufficient to induce the engineer to obey the rules and restrictions.

Considering the financial and human impact of these accidents, the Safety Board finds it dismaying that railroads heavily involved in the transportation of hazardous commodities would not adopt the most stringent measures necessary to insure that their trains are operated in accordance with speed retrictions. This is particularly so in the case of the Cotton Belt, which is one of the principal haulers of tank cars loaded with hazardous commodities, and which had earlier experienced a serious accident involving them and train overspeed. In the intervening years, serious accidents of a similar nature elsewhere should have emphasized to Cotton Belt management the critical importance of train crew compliance with speed restrictions. The Cotton Belt must impart to its train service employees and line supervisors the understanding that violations will not be tolerated. Moreover, this understanding must be underwritten by a most comprehensive enforcement program. Proper regard for the public safety requires nothing less.

Tank Car Performance

Although this accident resulted in the ignition of chemical products in tank cars and, ultimately intense heat that caused the explosion of two tank cars, the releases of vinyl chloride that occurred at the Lewisville and Livingston accidents were avoided because the tank cars containing this commodity were of an improved design. The vinyl chloride cars at Pine Bluff sustained considerable damage, but unlike the vinyl chloride car at Lewisville, they did not receive coupler strikes in the heads because they were equipped with top-and-bottom shelf couplers. Even had coupler separation occurred, jacketed insulation and head shielding would have reduced the likelihood of a head puncture.

The Safety Board pointed out in its report of the Livingston accident that tank cars with jacketed insulation fared much better than those with coated insulation, or no insulation at all, during the derailment sequence and when subjected to intense heat. This experience was confirmed in the Pine Bluff derailment where the vinyl chloride cars and a jacket-insulated hydrogen fluoride car sustained severe mechanical abuse in the derailment. Nevertheless, the effect of impacts on these cars was absorbed by the outer jacket and the insulation material.

At Livingston, coated insulation on some vinyl chloride cars was partially scraped off in the derailment, and this, together with the less effective thermal protection eventually resulted in the overheating, venting, and burning off of the product. Ultimately, it was necessary to use explosives to destroy these cars and all of the product. At Pine Bluff, the vinyl chloride cars were exposed to burning plastic for more than 30 hours before firemen could begin cooling the cars. During this time, the insulation prevented overheating and venting, and it was not necessary to jeopardize the safety of firemen by sending them in to deal with the cars while nearby fires were still intense and the possibility of explosion still existed. Moreover, the cars and their contents were saved. The Safety Board believes there remains little room for doubt that jacketed insulation along with top-and-bottom shelf couplers have proven to be thoroughly cost and safety effective.

The Efficacy of Shelf Couplers

In the Livingston accident, many tank cars equipped with conventional Type E couplers diverted widely from the track. As a result, they became extremely vulnerable to strikes by other cars. Virtually every one of these cars was breached and lost its chemical lading. The Safety Board noted in its report that this probably would have been avoided had the cars been equipped with shelf couplers. Inasmuch as all the tank cars derailed in the Pine Bluff accident were thus equipped, there was minimal lateral divergence of these cars and most remained in line with and close to the track. As a result, most of the tank cars sustained no rupturing strikes from sills and wheelsets of other cars. Those tank cars which were destroyed were crushed by following "jumbo" covered hoppers equipped with standard Type E couplers.

Although the Livingston and Pine Bluff derailments involved about the same number of derailed cars and occurred at about the same speed, the Pine Bluff accident was by far the less catastrophic. The Safety Board believes that the top-and-bottom or double shelf couplers on the Pine Bluff tank cars were largely responsible for this, and that if all freight cars were equipped with some type of shelf couplers the potential for catastrophic derailments would be greatly reduced.

Federal regulations 10/ have required couplers that will resist vertical loads of at least 200,000 pounds on all DOT specification 112 and 114 tank cars since 1978, and on certain DOT specification 105 tank cars since 1984. In addition, Types E and F top-and-bottom shelf couplers, which meet the requirements imposed by the regulations, have been voluntarily installed on other types of tank cars by their owners in light of shelf couplers' proven effectiveness in preventing vertical coupler misalignment in derailments and consequent tank head punctures from coupler strikes. Moreover, by preventing or at least delaying the uncoupling and separation of derailed cars, shelf couplers tend to keep these cars generally in line with and close to the track, thus minimizing their ability to strike other cars and reducing their own vulnerability to being struck in the side by following cars. Also, there is the well-documented capability of shelf couplers to prevent derailments caused by a variety of events that can occur in routine railroad operations. These include: 1) jackknifing of cars caused by excessive slack run-in or buff force 11/; 2) override of cars caused by overspeed impacts in hump yard and flat switching

10/ Code of Federal Regulations, 49 CFR 179.105 and 179.106.

11/ Slack action results when part of a train moves faster or slower than an adjacent part. After the available slack has either run in or run out, the parts of the train must rapidly attain uniformity of speed. This can result in potentially severe shock forces. Compressive forward slack action or running in is referred to as buff force; the drawing force of the locomotive and slack going out is called draft force.

operations; 3) failed couplers and draft gear falling to the track and causing the derailment of following cars; 4) excessive vertical oscillation which is known to have caused short unloaded cars to have one or both trucks leave the rails and even to leave the train; and 5) the failure of a wheel or truck sideframe which ultimately results in upcoupling and a general derailment.

The Type E coupler was adopted as standard by the Association of American Railroads (AAR) in 1932 and remains in use on a large proportion of the North American freight car fleet. When two Type E couplers are mated there is no restriction to vertical motion. The Type F coupler approved by AAR in 1970 has an interlocking feature which restricts vertical motion when it is coupled to another F coupler or a shelf coupler. A Type F coupler mated to another F coupler may even support an adjacent car which has one or both of its trucks derailed and/or detached. However, shelf couplers represent a very considerable improvement over the Type F coupler in these capabilities.

The Safety Board has conducted numerous field investigations of derailments that resulted from Types E and F couplers failing and falling to the track. Typically, such a failure occurs near the head of a heavy train that is ascending a grade with the train's locomotive exerting high draft force. As an 118-car Chessie System train was ascending a grade near Buchanan, Virginia in 1979 12/, a Type F coupler at the rear of a piggyback flat car failed and fell to the track. A total of 38 cars were derailed and damage exceeded $1.1 million. Also in 1979, a Seaboard Coast Line Railroad freight train derailed on a heavy grade at Dunnellon, Florida 13/ as a result of a severe draft force-induced failure of a Type E coupler which fell to the track. The derailment occurred on a bridge, which was destroyed, and a carload of automobiles fell across a State highway which was spanned by the bridge.

In both the Buchanan and Dunnellon derailments, as with other derailments investigated by the Safety Board, the coupler mated to the failed coupler was not a shelf coupler; otherwise, these derailments probably would not have occurred.

Also, in 1979, the Safety Board was informed by officials of the Chicago, Rock Island & Pacific Railroad that a train had arrived in their Trenton, Missouri yard with a tank car loaded with liquified petroleum gas (LPG) that was missing the truck from under one end of the car. That end of the car was being supported by the shelf coupler of another LPG tank car. The investigation determined that the car had traveled 96 miles in this condition. A Safety Board investigator examined the cars and reported that the shelf coupler had not disengaged although it was "severely bent from the tremendous weight of the loaded LPG cars." 14/

Early in 1980, the Coupler and Draft Gear Committee of the AAR was asked to make the bottom-shelf E coupler an AAR standard and requirement on all new and rebuilt freight cars other than tank cars required to have top-and-bottom shelf couplers. The rationale given was that a shelf coupler retained the mated coupler in the event it failed and prevented the failed coupler from falling to the track and causing a

12/ See Field Investigation Report, "Chessie System Freight Train Derailment, Buchanan, Virginia, February 28, 1979" (NTSB-DCA-79-F-R030).
13/ See Field Investigation Report, "Seaboard Coast Line Railroad Freight Train Derailment, Dunnellon, Florida, July 8, 1979" (NTSB-ATL-79-F-R048).
14/ Special Investigation Report— "The Accident Performance of Tank Car Safeguards March 8, 1980" (NTSB/HZM-80/1).

derailment. 15/ The shelf coupler was included in the AAR Manual of Standards and Recommended Practices effective July 1, 1980, but it was not then required to be installed on new and rebuilt cars.

Many of the most serious train derailments during the past decade did not involve coupler-inflicted punctures of the heads of tank cars, but catastrophic releases of hazardous materials did occur as a result of damage to the sides of tank cars by cars with conventional Types E and F couplers that were located well behind the tank cars. Without couplers that would resist jackknifing and wide lateral divergence from the track, these cars overtook and struck the tank cars with their end sills, couplers, or wheelsets.

The potential value of shelf couplers in keeping derailed cars in line with the track and preventing side strikes was recognized by the Safety Board in its investigation of a 1978 freight train derailment at Youngstown, Florida. 16/ The primary derailment involved 5 locomotive units and the 8 cars immediately behind them. A secondary derailment involved 36 cars, including 10 tank cars loaded with hazardous materials. Many cars in the secondary derailment jackknifed and an insulated tank car loaded with pressurized liquid chlorine was struck in the side and punctured by the end sill of a piggyback flatcar. The flatcar was equipped with conventional couplers and it was originally located several cars behind the chlorine car it struck. The chlorine gas released as a result of the puncture killed 8 persons and injured 138.

In its report of the accident, the Safety Board found that, "It is even questionable whether the metal jacket and the insulation of the DOT 105 tank car were instrumental in reducing the size of the puncture. The Safety Board believes, however, that top-and-bottom shelf couplers probably would have kept the cars more in line with the track. Had the cars stayed in line, they probably would not have jackknifed, which may have prevented the flat car from puncturing the tank cars."

In another catastrophic 1978 accident, a fracture propagating from a gouged and dented girth weld in the side of a derailed tank car at Waverly, Tennessee 17/ permitted liquified petroleum gas (LPG) to escape, ignite, and burn explosively. As a result, 59 persons were injured, 16 fatally, and much property was destroyed or heavily damaged, including 30 residential and commercial buildings and 26 motor vehicles. The Safety Board's investigation developed that the damaged tank car and another loaded with LPG had remained coupled together and that shelf couplers had prevented the puncturing of their heads. Moreover, the cars had remained in line with and close to the track. However, a following boxcar equipped with conventional couplers diverted widely from the track and slid past the tank cars. In passing, it apparently sideswiped the car that later exploded and inflicted gougelike scrapes and dents in its side. The fracture that allowed the gas to escape occurred in one of the dents.

15/ AAR Mechanical Division, Coupler and Draft Gear Committee Circular D.V.-1960, May 26, 1980, page 12.
16/ Railroad Accident Report--"Derailment of Atlanta & Saint Andrews Bay Railway Company Freight Train, Youngstown, Florida, February 26, 1978" (NTSB/RAR-78/7).
17/ Railroad Accident Report--"Derailment of Louisville & Nashville Railroad Company's Freight Train No. 584 and Subsequent Rupture of Tank Car Containing Liquified Petroleum Gas, Waverly, Tennessee, February 22, 1978" (NTSB/RAR-79/1).

Again, shelf couplers prevented override and coupler-inflicted head punctures during the initial phase of a 1979 hazardous materials derailment at Inwood, Indiana 18/, but following cars that were not restrained by shelf couplers breached and ruptured eight loaded tank cars resulting in the loss of more than 100,000 gallons of chemical product. A toxic chemical vapor cloud formed that affected an area 25 miles long and as much as 12 miles wide. Several communities were affected and a number of residents required hospital treatment for respiratory difficulties after being exposed to the chemical cloud. In addition, absorption of much of the chemical released into the ground resulted in long-term solid and water table contamination.

In 1982, the Coupler and Draft Gear Committee recognized the value of the shelf coupler in preventing uncoupling and lateral divergence of derailed cars, and recommended that it be required on new and rebuilt cars other than those tank cars already required to have shelf couplers. (See appendix G.) Through a special letter ballot, the AAR membership overwhelmingly approved 19/ the adoption of the new and rebuilt car requirement, and the AAR's Manual of Standards and Recommended Practices has required bottom-shelf E couplers on all new and rebuilt freight cars, other than tank cars, since July 1, 1982. A 1981 proposal to permit substitution of bottom-shelf couplers for conventional couplers in field repairs 20/ was not adopted, but is still under consideration by the AAR. At present, there is no cost differential between newly manufactured Type E and bottom-shelf E couplers.

Although the bottom-shelf coupler is not totally effective in preventing vertical coupler misalignment unless it is coupled to another shelf coupler, proliferation of shelf couplers in the freight car fleet will gradually reduce the incidence of uncoupling of cars in derailments over a period of many years. Given the average service life of freight cars, at least 30 years will pass before the freight car fleet will be completely equipped with shelf couplers unless the AAR permits the proposed substitution of this improved design for conventional couplers in field repairs. In light of the proven value of shelf couplers in preventing derailments, as well as mitigating the serious consequences of those derailments that do occur, the Safety Board urges the AAR to immediately require their substitution for conventional couplers in field repair work in addition to requiring their use on new and rebuilt cars.

Response to the Emergency

The extraordinarily timely and effective response by the Cotton Belt and the local fire and police forces to this emergency was a model of highly-coordinated and professional action. Unlike Livingston, Colonial Height, and most of the other major hazardous materials derailments investigated in the past by the Safety Board, there was never any confusion during the emergency. As the first fire department units were reaching the scene only 6 minutes after the accident occurred, the Cotton Belt had already retrieved data on the chemical commodities and the recommended response data for them. This information was quickly confirmed by the manifest data presented by the train's conductor. In addition, the fire units had the latest response guidelines with them

18/ Field Investigation Report--"ConRail Freight Train Derailment at Inwood, Indiana, November 8, 1979" (NTSB-DCA-80-F-R007) and Hazardous Material Accident Spill Maps--"Hazardous Material Release From Railroad Tank Cars Near Inwood, Indiana, November 8, 1979" (NTSB/HZM-MAP-80/2).

19/ AAR gives the vote as 1,106,212 for and 166,217 against the proposal.

20/ AAR Mechanical Division Coupler and Draft Gear Committee Circular D.V.-1981, May 26, 1981, "Rule 16 Proposed Correct Repair Chart," pages 71-73.

when they arrived on the scene. As a result, the well-trained assistant fire chief who was in charge was able to immediately determine that the most prudent course was to evacuate nearby residents and restrict access to the area, rather than to follow the traditional urge to "do something" with the fire.

The evacuation of residents was quickly accomplished with little difficulty. It was carried out on the basis of the known hazards and was neither overdone nor unduly drawn out. Hence, the impact on the affected residents was minimized. Mutual aid agreements and an area disaster plan with a designated emergency coordinator had much to do with the success of the overall response to this emergency.

The response to this emergency and to the 1984 derailment of an Amtrak passenger train at Essex Junction, Vermont 21/ are fine examples of how good advance planning and training can produce a truly professional response to an unprecedented and unanticipated emergency. Although small cities and their surrounding rural areas with relatively limited resources were involved in both instances, a well-organized and broad-based training program had been previously conducted under the auspices of the railroads and local emergency organizations. And in both cases, the State and its agencies moved quickly to give real support to the local organizations.

CONCLUSIONS

Findings

1. Extra 4835 North was classed as a hazardous commodities train and was always restricted to a 45-mph maximum speed because its trailing weight exceeded 80 tons per car with operative brake. The train crewmembers were properly informed of these facts, and they stated that they were always aware of their train's 45-mph limit.

2. Although the fireman was operating the train, the engineer was directly responsible for his compliance with speed restrictions. The engineer did not express disapproval of the manner in which the fireman handled the train.

3. Although the dispatcher's train graph indicated that Extra 4835 North was making significantly faster progress than another 45-mph train preceding it, the dispatcher did not contact the crew of Extra 4835 North concerning the speeds they were making.

4. Despite the fact that a hazardous materials train had derailed as a result of exceeding the speed limit with catastrophic results on this part of the Cotton Belt in 1978, supervisory oversight of through train operations was conducted on a day time basis. Moreover, the greatest emphasis may have been placed on expedited train performance.

5. While Cotton Belt policy may require that trains be operated at the required speeds, management has failed to motivate train crewmembers and line supervisors to comply with this policy on the Pine Bluff sub-division.

21/ 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).

6. The trailing weight of Extra 4835 North was only slightly less than the maximum permitted on the Pine Bluff sub-division. As a result, this train would require maximum braking effort to control speed on downgrades and would exert the maximum potential stresses imposed on the track structure even when operated at the proper speed.

7. A 1,940-foot section of track which included the accident site at Bridge 272.14 was not restrained against rail movement in accord with Cotton Belt standards, whereas the track on both sides of this section was. With substantial increase in ambient temperature, the rail in this section would tend to move from the ends toward the middle. The frequent surface and alignment problems experienced in the section is evidence of improperly restrained rails.

8. The replacement of ties and subsequent raising and tamping of the track at Bridge 272.14 made this location highly vulnerable to misalignment due to rail stresses. Proper anchoring of the track would have alleviated the problem, but anchoring deficiencies were not corrected. This may have been the result of reluctance on the part of maintenance of way supervisors to expend resources on a section of track that was shortly to be reconstructed with new and heavier rail.

9. Because of the increases in ambient temperature during the morning and the fact that it was a clear day, the potential for longitudinal rail movement in the relatively unrestrained 1,940-foot section may have been 8 inches or more before the 6,523-ton northbound train preceding Extra 4835 North passed over the section. Since this train was operated at or near the 45-mph speed limit imposed on it, the ballast at the disturbed section on Bridge 272.14 was able to hold the track in alignment despite the stresses imposed by heat and kinetic energy.

10. When Extra 4835 North started down the grade approaching Bridge 272.14 it was moving at 54 mph and generating 44 percent more kinetic energy than it would have at 45 mph. Heavy braking necessary to overcome that energy imposed longitudinal stresses on the rails. Consequently, the rail was running ahead of the train as it approached Bridge 272.14, and this combined with thermal stresses already imposed caused the track to buckle.

11. Railroads such as the Cotton Belt that are heavy haulers of hazardous commodities need to inform their train crews and line supervisors that violations of speed restrictions and critical operating rules will not be tolerated. Even so, these railroads cannot obtain employees' compliance if only casual and part-time enforcement programs are practiced.

12. This accident did not have the catastrophic results of earlier hazaradous materials derailments because top-and-bottom shelf couplers prevented vertical misalignment of couplers and wide lateral divergence of derailed tank cars, and because the effects of the intense heat were mitigated by the jacketed insulation on critical tank cars.

13. The general use of shelf couplers on all types of rail cars would prevent derailments caused by failed couplers and would probably reduce the adverse effects of all train derailments. This is well understood by the Association of American Railroads which should expedite the changeover to shelf couplers by requiring their substitution for conventional couplers in car repair work.

14. The timely, effective, and intelligent response to the emergency was a result of the immediate access to the commodity and response data provided by the Cotton Belt, and by the training, advance planning, and coordination of the local forces.

Probable Cause

The National Transportation Safety Board determines that the probable causes of this accident were (1) the failure of the St. Louis Southwestern Railway Company to destress and adequately anchor the track to retard longitudinal movement at Bridge 272.14 as required by its rules, after disturbing the track in hot weather; and (2) the excessive speed and consequential heavy braking of Extra 4835 North on a downgrade approaching the accident location, which compounded the longitudinal stresses imposed on the track structure by heat. Contributing to the accident was the St. Louis Southwestern Railway's failure to adequately enforce the speed restrictions imposed on trains operating over its Pine Bluff sub-division.

Lessening the severity of the accident were (1) an extraordinarily timely and effective response by the Cotton Belt and local fire and police forces attributable to training and planning previously conducted under the auspices of the railroad and local emergency organizations, and (2) the presence of top-and-bottom shelf couplers, jacketed insulation and head shielding which absorbed the effects of impact on tank cars carrying hazardous materials.

RECOMMENDATIONS

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

--to the St. Louis Southwestern Railway Company:

> Uniformly maintain its main tracks in accordance with its current standard for the number and distribution of rail anchors to inhibit rail movement. (Class II, Priority Action) (R-86-41)
>
> Provide intensive full-time supervisory oversight to its mainline train operations with particular emphasis placed on the enforcement of speed restrictions and operating rules, by routinely monitoring crews, speed tapes, event recorders, and train graphs. (Class II, Priority Action) (R-86-42)

--to the Association of American Railroads:

> Require that when it is necessary to replace couplers on all freight cars other than tank cars now required to be equipped with shelf couplers during the course of field repair work, the replacement couplers be of the bottom-shelf type. (Class II, Priority Action) (R-86-43)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

September 16, 1986

APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

Investigation

The National Transportation Safety Board was notified of this accident at 4:42 p.m. on June 9, 1985, and immediately dispatched investigators from the Fort Worth Field Office and Washington, D.C. The investigator-in-charge and other members of the investigative team were subsequently dispatched to the scene from Washington. Individual investigative groups were established for operations, track, hazardous materials, and emergency response.

Hearing

The Safety Board conducted a deposition proceeding as part of its investigation of this accident on August 12, 1985, at Pine Bluff, Arkansas. Parties to this proceeding included the St. Louis Southwestern Railway Company; County of Jefferson, Arkansas; United Transportation Union; Brotherhood of Locomotive Engineers; and the Federal Railroad Administration. Eleven witnesses testified.

APPENDIX B

TRAIN CREWMEMBER INFORMATION

Conductor Johnny Charles Reed

Conductor Johnny Charles Reed, 53, was employed as an apprentice carman by the Cotton Belt in 1952. He was made a brakeman on October 24, 1955, and promoted to conductor on October 18, 1963. On October 3, 1969, he was promoted to acting assistant trainmaster-agent, and on November 1, 1970, he was promoted to assistant trainmaster. Mr. Reed resigned from this position on April 12, 1971, and exercised his seniority as a conductor. He last passed an examination on Cotton Belt operating rules on March 25, 1985. Mr. Reed received demerits against his service record without suspension for rules infractions in 1977 and 1983. His record also indicated that he had failed efficiency checks on four occasions since 1980. One of these, on April 29, 1983, was a citation by the Camden trainmaster for operation at excessive speed. No discipline was assessed for any of the efficiency check failures. Following the Pine Bluff accident, Mr. Reed was charged for operation at excessive speed and was suspended for 15 days.

Engineer Kenneth David Reed

Engineer Kenneth David Reed, 41, was employed as a locomotive fireman by the Cotton Belt on November 10, 1965, and he was promoted to locomotive engineer on September 4, 1968. Mr. Reed was not related to conductor Johnny Charles Reed. He was last examined on the operating rules on April 27, 1985. Mr. Reed was assessed demerits against his service record as a result of a yard collision in 1977, and he was suspended for 30 days after he was cited by the Camden trainmaster for his operation of a 45-mph train at 58 mph on June 22, 1984. This discipline was reduced to demerits against his record by the Cotton Belt in November 1985, and he was paid the earnings he lost during the suspension. Mr. Reed's service record indicates that between 1980 and 1983 he was cited for three other efficiency test failures without disciplinary action. Following the Pine Bluff derailment, Mr. Reed was charged with operation at excessive speed and he was subsequently discharged. However, he was restored to duty with all rights and seniority unimpaired after 90 days.

Fireman Donald J. Miller

Fireman Donald J. Miller, 43, was employed as a locomotive fireman by the Cotton Belt on June 22, 1968, and he was promoted to locomotive engineer on June 14, 1972. He had last passed examination on the rules in March 1985. Mr. Miller's service record indicated he had been suspended for 60 days following his involvement in the collision of his engine and standing cars in December 1980. The record also indicated that during 1982 and 1983 he was cited for three efficiency check failures without disciplinary action. Mr. Miller was discharged by the Cotton Belt on June 22, 1985, for operating Extra 4835 North at excessive speed prior to the train's derailment, and he was reinstated without loss of rights or seniority on a leniency basis on July 28, 1985.

Swing Brakeman Austin Hill

Brakeman Austin Hill, 37, was employed by the Cotton Belt as a brakeman on November 4, 1969, and he was promoted to conductor on May 16, 1975. He last passed examination on the operating rules in April 1985. Mr. Hill's service record indicated he was assessed demerits for rules infractions on three occasions during 1976 through 1978 and he was dismissed following the September 28, 1979 collision of a yard locomotive with standing cars. According to Mr. Hill, he was not directly involved in the accident and was reinstated with rights and seniority unimpaired. His record also indicates citation for nine efficiency check failures between 1979 and 1982 none of which involved disciplinary action. Following the derailment on June 9, 1985, Mr. Hill was charged with operation at excessive speed and was suspended for 10 days.

Head Brakeman Robert Clyde Hornsby

Brakeman Robert Clyde Hornsby, 37, was employed by the Cotton Belt as a brakeman on March 24, 1970, and he was promoted to conductor on May 16, 1975. He last passed examination on the operating rules on April 26, 1985. Mr. Hornsby's service record indicated demerits were charged against his record for a rules infraction in 1976 and cited three efficiency check failures without disciplinary action during 1979. Following the derailment of Extra 4835 North, Mr. Hornsby was charged with operation at excessive speed and he was suspended for 10 days.

Rear Brakeman Ray McMillan

Brakeman Ray McMillan, 60, was employed by the Cotton Belt as a freighthouse trucker and checker on September 8, 1949, and he was made a brakeman on April 13, 1951. He was not a promoted conductor. Mr. McMillan last passed examination on the operating rules in April 1985. His service record indicated he had been assessed demerits for a 1975 rules infraction and that he was suspended for 30 days for the operation of a 45 mph train at 58 mph on June 22, 1984. This was the same violation for which engineer Kenneth D. Reed had been disciplined. Following the derailment of Extra 4835 North, Mr. McMillan was charged with excessive speed operation and suspended for 10 days.

APPENDIX C

EXCERPTS FROM PINE BLUFF DIVISION TIMETABLE NO. 6 EFFECTIVE APRIL 28, 1985

St. Louis Southwestern Railway Company

COTTON BELT ROUTE

PINE BLUFF DIVISION TIMETABLE 6

EFFECTIVE SUNDAY, APRIL 28, 1985 AT 12:01 A.M. CENTRAL STANDARD TIME

W. J. LACY, Vice President-Transportation

L. C. SIMPSON, General Manager

K. A. MOORE, Assistant General Manager

E. L. HORD, Superintendent-Operations Planning and Control

R. R. McCLANAHAN, Superintendent

C. BRADLEY, Assistant Superintendent

PINE BLUFF SUBDIVISION

SOUTHWARD Mile Post		STATIONS		NORTHWARD Station Number
264.2	YL TO	PINE BLUFF YD	BKWY	82100
266.7		PINE BLUFF SHOPS	MKW	82010
266.8		M P CROSSING	AX	
269.3	*11003	SOUTH PINE BLUFF		81585
280.4	*7371	RONE		81552
286.8	*8983	RISON		81541
287.1	*6763	BALINE		81533
307.2		F & P CROSSING	AX	
307.4	*7823	FORDYCE		81530
313.0	*8582	THORNTON		81485
321.2	*8350	BEARDEN		81454
324.9		GRAVEL PIT	T	81451
327.4	*8364	EAGLE MILLS	T	81447
336.7		NC JCT		
337.6		CAMDEN	BKW	81400
338.7		SC JCT		
338.9		M P CROSSING	AX	
340.4	*4716	HERBERT		81382
346.9	*7326	BUENA VISTA		81371
357.9	*10159	STEPHENS		81362
366.1	*11197	McNEIL	T	81340
373.3		WALDO		81334
376.8	*8084	LUMBER		81330
385.2	*8039	STAMPS		81310
386.2		L & A CROSSING	AX	
389.7	*11820	LEWISVILLE	KW	81300
390.3		SHREVEPORT JCT	T	
403.4	*8877	McKINNEY		81117
416.3	YL	GERTRUDE		81104
418.7	TO	TEXARKANA YD	BKW	81080
		(154.5)		

CTC: M P Crossing (266.8) to Gertrude; Camden (NC Jct to SC Jct) and Texarkana Yd bracketed separately.

MAXIMUM AUTHORIZED SPEED FOR TRAINS

BETWEEN	ALL TRAINS
PINE BLUFF AND TEXARKANA	70

Exceptions:

263.7 and 269.1	30
269.1 and 271.3	50
271.3 and 286.4	65
286.4 and 287.4	40
287.4 and 294.6	60
294.6 and 294.9	50
294.9 and 306.9	60
306.9 and 307.3	40
307.3 and 311.5	45
311.5 and 312.2	55
312.2 and 316.8	60
316.8 and 317.6	50
317.6 and 334.5	60
334.5 and 336.4	55
336.4 and 336.6	45
336.6 and 338.7 (East Track)	20

Exceptions:

336.6 and 338.9 (West Track)	35
338.9 and 339.1	25
339.1 and 339.9	35
339.9 and 344.4	45
344.4 and 348.9	40
348.9 and 360.5	60
360.5 and 366.5	60
366.5 and 369.7	50
369.6 and 387.3	50
387.3 and 406.2	60
406.2 and 406.9	55
406.9 and 407.8	40
407.8 and 416.4	50
416.4 and 417.8	35
417.8 and 419.2	30

3. OTHER SPEED RESTRICTIONS	MPH
Trains handling hazardous material listed in Rule 616(A)	55
Engines operated from other than lead locomotive in direction of movement	20
Trains handling loaded bulkhead flats weighing less than 64 tons	45
Trains handling loaded bulkhead flat cars weighing 64 tons or more	65
Trains handling empty bulkhead flat cars	45
Trains handling empty, specially equipped gondola cars (TOPS car kind code "GP")	45
Trains handling empty anode flat cars; (TOPS car kind code "FA")	45
Trains handling loads with idler car(s)	45
Trains handling pipe loaded on 89 ft. flat cars	55
Trains handling empty PC 598500-598999, CR 598500-598999	45
Loaded Continuous Welded Rail (CWR) Trains	45*
Trains handling empties, except cabooses	35
Trains handling over 120 cars	35

*Loaded CWR trains must be handled separately from other trains.

RULE 616(A) "K" TRAINS:

Trains handling cars placarded "EXPLOSIVES A", "POISON GAS", "RADIOACTIVE", or tank cars containing a product classified as FLAMMABLE GAS or the individual commodities ANHYDROUS AMMONIA, CHLORINE, HYDROGEN CHLORIDE, HYDROGEN FLOURIDE or SULFUR DIOXIDE will be identified on train lists by "K" as the last letter in train identification. These trains are referred to as "K" trains.

EXCEPTION: The above will not apply to cars carrying vans or containers placarded "EXPLOSIVES A", "POISON GAS", or "RADIOACTIVE".

At crew change locations, a "K" train must be given a rolling inspection by outbound crew unless the entire train has received a predeparture inspection by crew or by Mechanical Department employe.

APPENDIX D

EXCERPTS FROM COTTON BELT AIR BRAKE AND TRAIN HANDLING RULES

ST. LOUIS SOUTHWESTERN RAILWAY COMPANY

AIR BRAKE RULES AND REGULATIONS

GOVERNING

TRAIN HANDLING, TESTING AND OPERATION OF AIR AND DYNAMIC BRAKES AND AIR SIGNAL APPARATUS

EFFECTIVE JANUARY 25, 1981

RULE 33. Tonnage Per Operative Brake.

The maximum tonnage per operative brake that may be handled on descending grades of 1.8 percent or over will be prescribed by the Superintendent.

Freight trains handling cars with single capacity brakes (*), with tonnage exceeding 100 tons per operative brake, must not exceed 45 MPH, except maximum speed must not exceed: (1) 25 MPH; or (2) 20 MPH in grade territories as designated by Superintendent by milepost locations under appropriate subdivision.

Freight trains containing operative radio controlled remote locomotives handling cars with single capacity brakes, with tonnage exceeding 80 tons per operative brake, with a maximum of 85 tons per operative brake, must not exceed 30 MPH; except maximum speed must not exceed 25 MPH on descending grades of 1.4 percent or over.

APPENDIX E

EXCERPTS FROM COTTON BELT MAINTENANCE OF WAY RULES

M 936. Before skeletonizing track, sufficient space must be provided between rail ends to permit free expansion of rail, thus avoiding buckling and throwing track out of line due to tight rail.

M 937. In continuous welded rail territory track skeletonizing will be programmed only during periods when temperature is at or below the temperatures prevailing when rail was laid, unless rail has been re-stressed, but never above 80 degrees F. (ambient). Anticreepers will conform in number and distribution to approved pattern while work is being conducted, and final adjustments made prior to reballasting.

Sufficient ballast must be dumped in tie cribs to adequately secure track before trains are permitted to pass over.

Skeleton track must be kept to a minimum and carefully watched. Protection must be provided as required by Rules M 200 to M 208 inclusive.

117

M 920. Where welded rail is laid it must be secured with prescribed number of rail anchors and track fully ballasted. Out-of-face raises must not be made except at same, or lower temperature which prevailed at time welded rail was laid.

RAIL ANCHORS

M 1030. Where rail anchors are used, a sufficient number shall be applied to hold each rail in its proper position. The minimum shall be four to each rail. Where rail continues to creep, it must first be ascertained that anchors are properly applied through the entire length of track where rail is creeping before applying additional anchors. The extent of their use will be determined by the roadmaster.

On continuous welded rail, the number and distribution of rail anchors must conform to approved standard. (See Drawing C.S. 1913, Plate 19.)

129

M 1031. In applying rail anchors, they should be set properly against the tie. Care must be taken to avoid overdriving, as this may fracture or spread the metal, resulting in loss of holding power.

M 1032 Rail anchors must be inspected frequently and, when necessary, reset to maintain solid bearing against the tie.

M 1033. Where necessary, rail anchors shall be applied so as to prevent movement of rail in either direction.

M 1034. A sufficient number of rail anchors to prevent creeping shall be applied in tracks approaching rail road crossings, interlocked switches and drawbridges.

M 1035. Rail anchors must not be applied on open deck bridges or trestles except as specifically authorized.

M 1036. No change should be made in approved anchor pattern without first getting permission from chief engineer's office.

APPENDIX F

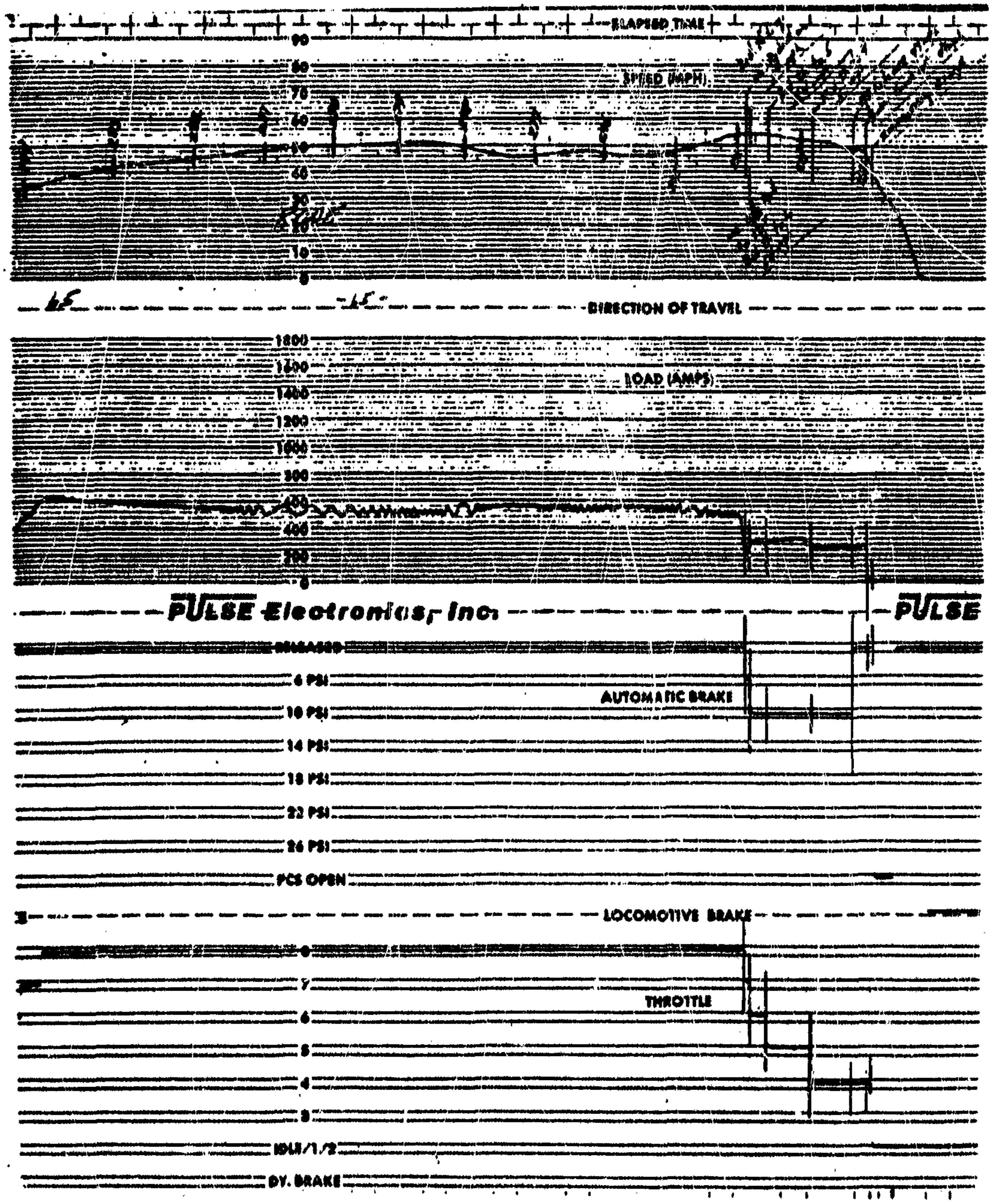
PRINTOUT OF PULSE EVENT RECORDER

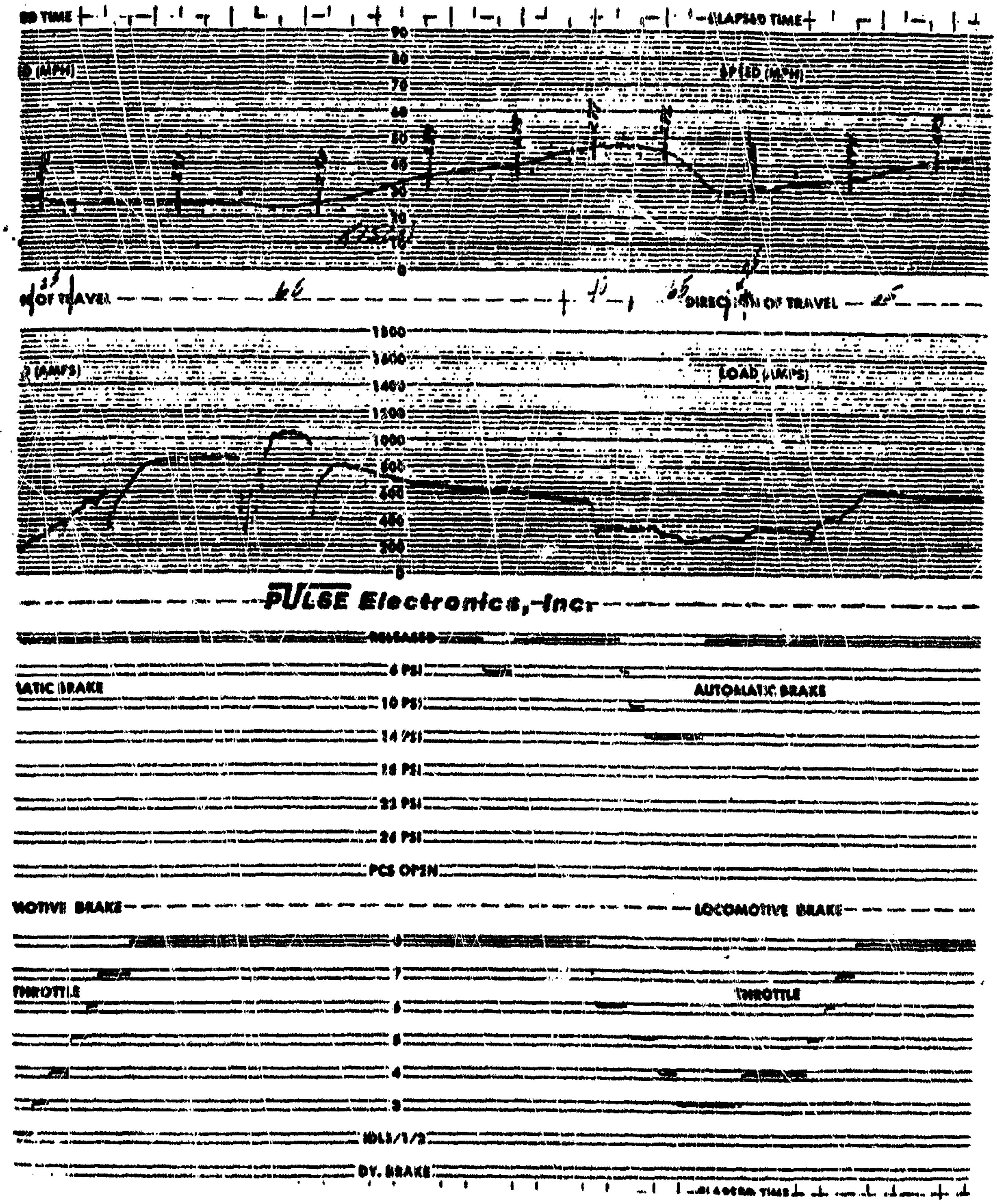
DATA PACK (TM) Use Pencil Only DP400

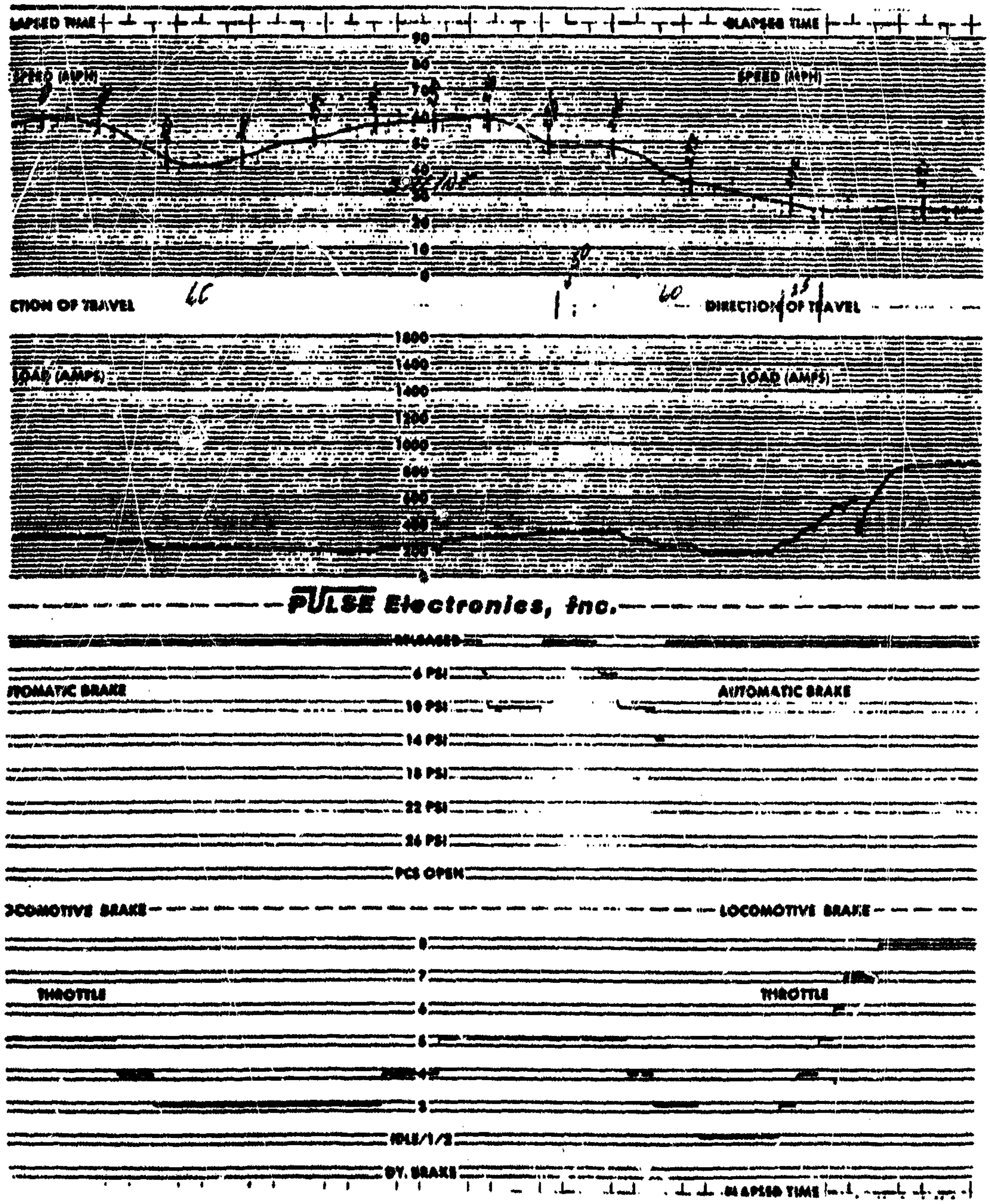
PULSE Electronics, Inc.

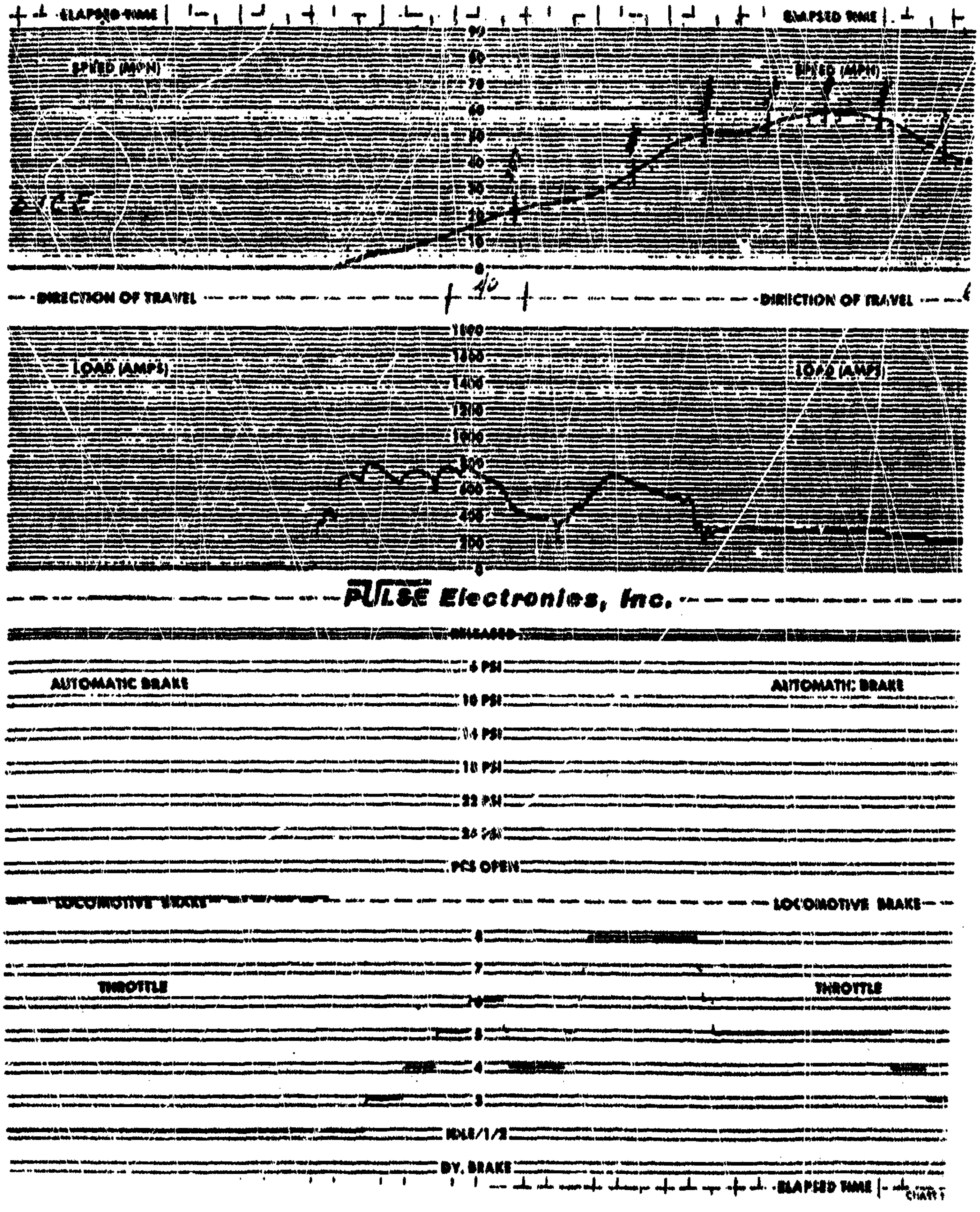
LOCOMOTIVE NUMBER	7866
WHEEL SIZE (DATE)	3/6
RECORDER NO.	

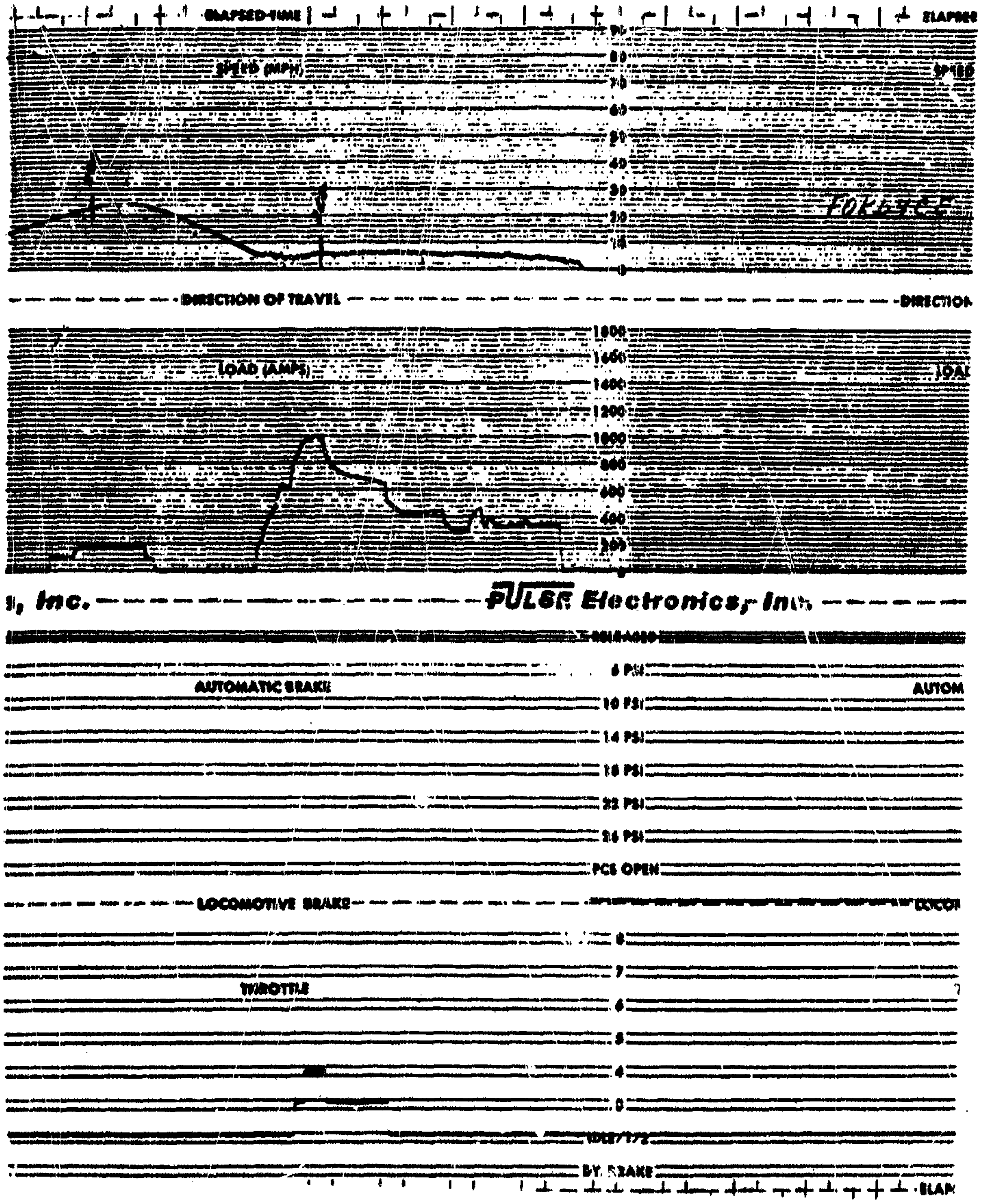
INSTALLATION	DATE 4-21-85	LOCATION SNT	INITS [illegible]
REMOVAL	DATE 6-9-85	LOCATION PBA	INITS RT.
TRAIN NO. SRCRK	TIME 1700	REMARKS DERAILMENT	

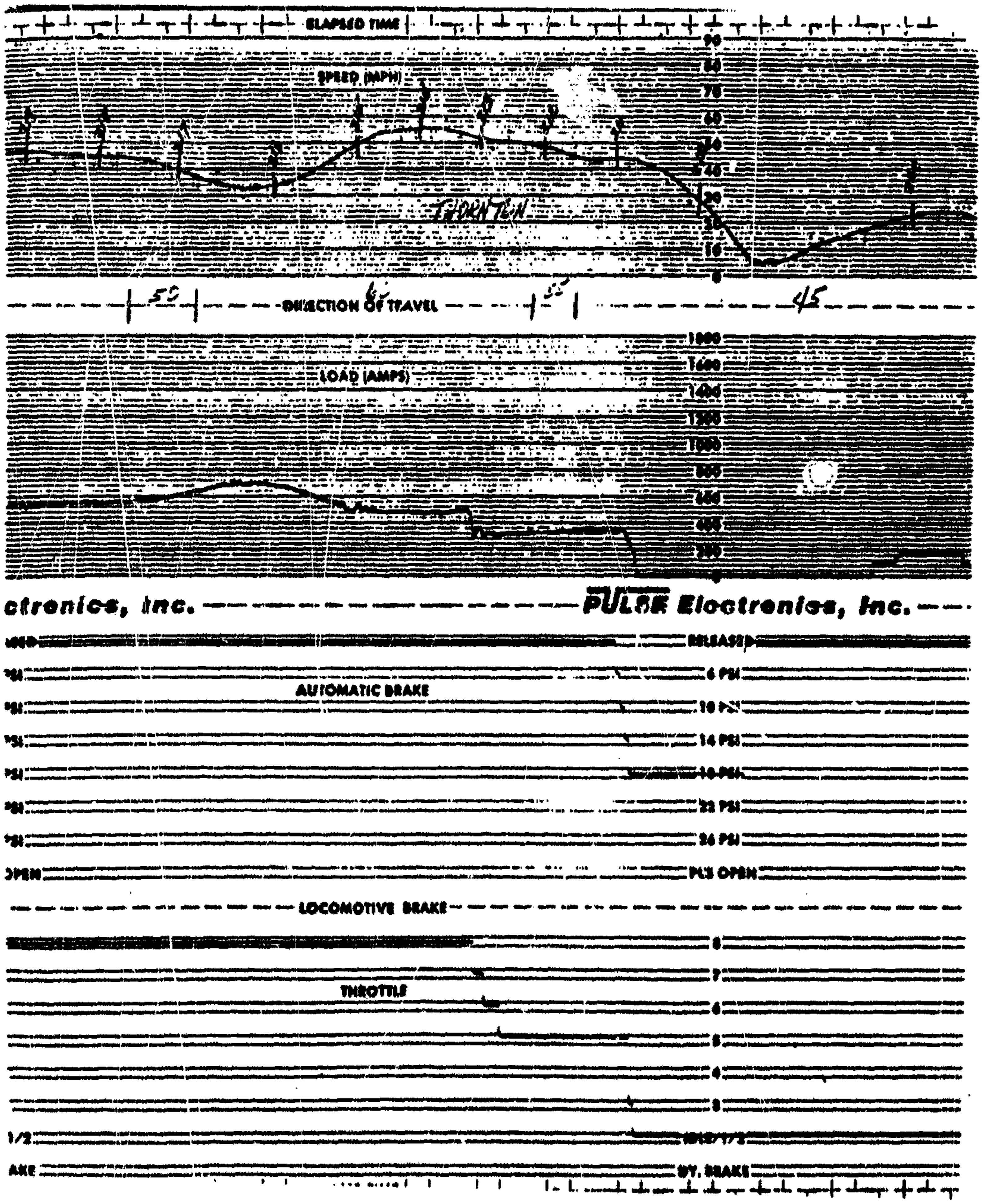

ELAPSED TIME
SPEED (MPH)
90
80
70
60
50
40
30
20
10
0
DIRECTION OF TRAVEL
LOAD (AMPS)
1800
1600
1400
1200
1000
800
600
400
200
0
PULSE Electronics, Inc.
PULSE
RELEASED
6 PSI
10 PSI
14 PSI
18 PSI
22 PSI
26 PSI
PCS OPEN
AUTOMATIC BRAKE
LOCOMOTIVE BRAKE
THROTTLE
8
7
6
5
4
3
IDLE/1/2
DY. BRAKE

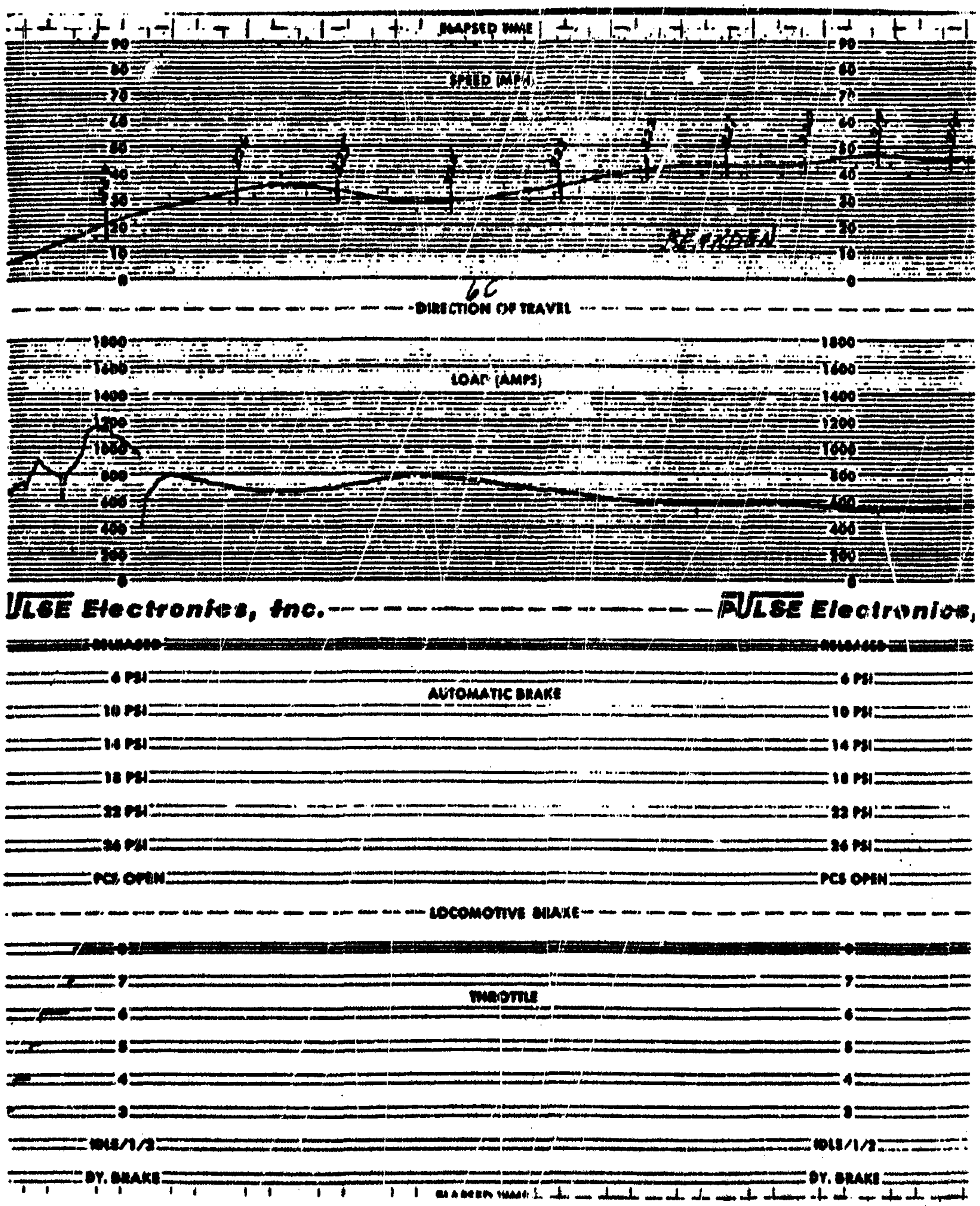

SPEED (MPH)
DIRECTION OF TRAVEL
LOAD (AMPS)
PULSE Electronics, Inc.
RELEASED
AUTOMATIC BRAKE
PCS OPEN
LOCOMOTIVE BRAKE
THROTTLE
IDLE/1/2
DY. BRAKE
ELAPSED TIME


ELAPSED TIME
SPEED (MPH)
DIRECTION OF TRAVEL
LOAD (AMPS)
PULSE Electronics, Inc.
RELEASED
6 PSI
10 PSI
14 PSI
18 PSI
22 PSI
26 PSI
PCS OPEN
AUTOMATIC BRAKE
LOCOMOTIVE BRAKE
THROTTLE
IDLE/1/2
DY. BRAKE


ELAPSED TIME
SPEED (MPH)
DIRECTION OF TRAVEL
LOAD (AMPS)
PULSE Electronics, Inc.
RELEASED
AUTOMATIC BRAKE
PCS OPEN
LOCOMOTIVE BRAKE
THROTTLE
IDLE/1/2
DY. BRAKE


ELAPSED TIME
SPEED (MPH)
DIRECTION OF TRAVEL
LOAD (AMPS)
PULSE Electronics, Inc.
AUTOMATIC BRAKE
6 PSI
10 PSI
14 PSI
18 PSI
22 PSI
26 PSI
PCS OPEN
LOCOMOTIVE BRAKE
THROTTLE
DY. BRAKE


ELAPSED TIME
SPEED (MPH)
THORNTON
DIRECTION OF TRAVEL
55
45
LOAD (AMPS)
ctronics, Inc.
PULSE Electronics, Inc.
RELEASE
AUTOMATIC BRAKE
6 PSI
14 PSI
26 PSI
PLS OPEN
LOCOMOTIVE BRAKE
THROTTLE
DY. BRAKE


ELAPSED TIME
SPEED (MPH)
90
80
70
60
50
40
30
20
10
0
DIRECTION OF TRAVEL
1800
1600
LOAD (AMPS)
1400
1200
1000
800
600
400
200
0
PULSE Electronics, Inc.
RELEASED
6 PSI
AUTOMATIC BRAKE
10 PSI
14 PSI
18 PSI
22 PSI
26 PSI
PCS OPEN
LOCOMOTIVE BRAKE
THROTTLE
8
7
6
5
4
3
IDLE/1/2
DY. BRAKE

APPENDIX G

ASSOCIATION OF AMERICAN RAILROADS
LETTER BALLOT CIRCULAR NO. DV 2033

CIRCULAR NO. D. V. 2033

ASSOCIATION OF AMERICAN RAILROADS
OPERATIONS AND MAINTENANCE DEPARTMENT
MECHANICAL DIVISION

A. W. Johnston
Vice President

Officers of the Division:
F. E. Cunningham, Chairman
D. M. Tutko, Vice-Chairman
F.A. Danahy, Executive Director
R. C. Reber, Secretary

LETTER BALLOT CIRCULAR

OFFICE OF SECRETARY
1920 L STREET, N.W.
WASHINGTON, D.C. 20036

July 8, 1983

TO THE VOTING MEMBERS:

At the Business Meeting of the Division held in Chicago, Illinois on June 29, 1983, the recommendations from the committees of the Division were ordered submitted to letter ballot vote of the members, as indicated by the proposals in this circular.

Wherever possible, attempts have been made to fully explain the recommendations, but in order to save time and expense, these have not been reprinted verbatim in this circular but are written with reference to Committee Annual Report D.V. Circulars by item as well as exhibit number.

The Ballot is attached in duplicate. If it is impossible to return the formal ballot in order to reach this office prior to noon on August 8, 1983, will you please telegraph your vote so that it may be recorded, with the ballot being submitted later as confirmation of your vote (Telex No. 892352 AAR CSD WSH A).

In the event of a negative vote on any proposal, the General Committee requests that you submit, with your ballot, a letter giving a reason for the negative vote. Your information could be of value to the Committee, should a further study of the subject be necessary.

if desired. For additional information, please refer to Circular D. V. 2026, Item 16 and Exhibit 2. The vote of this company is:

In Favor - or - Against

....

Proposal 22 The bottom shelf E coupler was approved by Special Letter Ballot as an AAR Standard, effective July 1, 1980. AAR bottom shelf couplers are included in Section B of the Manual of Standards and Recommended Practices, as well as Field and Office Manual Rules 16-17. Present Field Manual Rule 16, correct repair table, requires that non-shelf couplers be replaced with non-shelf couplers.

This proposal provides for the replacement of non-shelf type E couplers with corresponding bottom shelf E couplers without penalty. This revision is recommended on the basis that it will enable railroads to maintain single inventory if they wish, and that the bottom shelf coupler offers advantages such as reducing the possibility of derailment in the event of a failed mating coupler. It should be noted that Field Manual Rule 16 will continue to prohibit replacement of a bottom shelf coupler with a non-shelf coupler. It is proposed this revision become effective with the first change published to the rules subsequent to approval. For additional details, please refer to Circular D. V. 2026, Item 41 and Exhibit 12. The vote of this company is:

In Favor - or - Against

....

Proposal 23 The bottom shelf E coupler was approved by Special Letter Ballot as an AAR Standard, effective July 1, 1980. AAR Standard bottom shelf E couplers are included in Section B of the Manual of Standards and Recommended Practices and in Field and Office Manual Rules 16-17. In 1982 it was adopted to require that all new or rebuilt cars requiring lower shelf couplers, as shown in Field Manual Rule 16, and Office Manual Rule 88B, except those tank cars requiring double shelf couplers, must be equipped with bottom shelf couplers. This requirement became effective July 1, 1982, and was supported by the consensus that the bottom shelf coupler will improve the interchange car fleet, reduce the possibility of derailment due to retention of mated failed coupler, and assist in keeping cars upright and in line in the event of a derailment. Inclusion of the longer shank SBE68 and SBE69 bottom shelf couplers was withheld from Office Manual Rule 88B at that time due to concern regarding possible shelf interference problems.

As a result of the Committee's hump yard investigation of possible shelf interference problems with long shank SBE68 and SBE69 bottom shelf couplers, this proposal recommends that Office Manual, Rule 88B, be revised to include long shank SBE68 and SBE69 bottom shelf couplers, effective January 1, 1984. The Coupler and Draft Gear Committee has concluded that vertical interference problems experienced with long shank bottom shelf couplers have been minimal.

In concert with the above recommendation, this proposal recommends that Field Manual Rule 17, correct repair table, be revised to provide for the replacement of non-shelf couplers with corresponding bottom shelf couplers, without penalty. It is proposed this revision become effective with the first change published to the rules subsequent to approval. For additional details, please refer to Circular D. V. 2026, Item 42 and Exhibits 13 and 14. The vote of this company is:

In Favor - or - Against

....

Proposal 24 This proposal provides the requirement that owners of cars equipped with E/F couplers with pin bearing blocks cast in Grade C steel prior to March 1970 remove these couplers for inspection when cars are on owners repair track. Due to the high failure rate, under current Interchange Rules, all Grade C and type F couplers having pin bearing block are prohibited in interchange if cast prior to March 1970. Type E/F couplers of this design were not included in this prohibition at this time, however, the Committee has been made aware of reports of failures of couplers of this type during the past year. For additional details, please refer to Circular D. V. 2026, Item 48. The vote of this company is:

In Favor - or - Against

....

Proposal 25 This proposal recommends revision of the draft key Standard S-121 to provide hardness testing and more detailed instructions regarding marking of draft keys. For additional details, please refer to Circular D. V. 2026, Item 58 and Exhibit 17. The vote of this company is:

In Favor - or - Against

....

*U.S. GOVERNMENT PRINTING OFFICE: 1986- 181-101:40058