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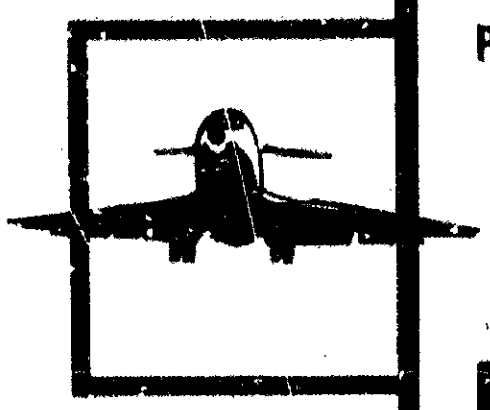

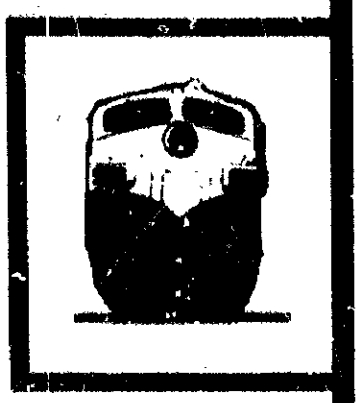

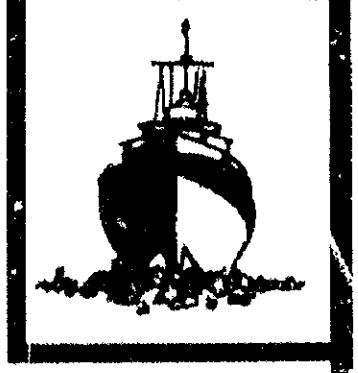

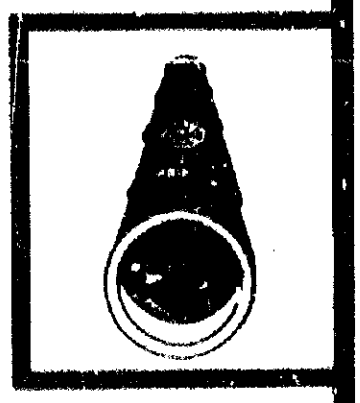

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

COLLISION OF MISSOURI-KANSAS-TEXAS
RAILROAD COMPANY TRAIN NO. 103
WITH STANDING FREIGHT CARS
NEAR TEMPLE, TEXAS
MARCH 17, 1983

NTSB/RAR-83/08

UNITED STATES GOVERNMENT

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15. Supplementary Notes

16. Abstract

About 4:10 p.m., on March 17, 1983, after receiving a clear signal indicating a clear main track route, Missouri-Kansas-Texas Railroad Company train No. 103, entered a misaligned track switch leading from the main track to an interchange track and collided with standing freight cars on the interchange track. A signal maintainer was working on the switch circuit controller, and had disconnected the shunt wires while working at that location. The engineer of train No. 103 received serious injuries, and the fireman and brakeman received minor injuries. Damage was estimated to be about $2,443,295.

The National Transportation Safety Board determines the probable cause of this accident was the display of a false proceed aspect at the entrance to a signal block in which a track switch had been left misaligned by a signal maintainer, who was working at that location. Contributing to the accident were the use of a track shunt circuit protection system not designed on the closed-circuit principle and a lack of procedural instruction to and supervision of the relatively inexperienced signal maintainer.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: August 23, 1983

COLLISION OF MISSOURI-KANSAS-TEXAS RAILROAD COMPANY TRAIN NO. 103 WITH STANDING FREIGHT CARS NEAR TEMPLE, TEXAS March 17, 1983

SYNOPSIS

About 4:10 p.m., on March 17, 1983, after receiving a clear signal indicating a clear main track route, Missouri-Kansas-Texas Railroad Company train No. 103 entered a misaligned track switch leading from the main track to an interchange track and collided with standing freight cars on the interchange track. A signal maintainer was working on the switch circuit controller and had disconnected the shunt wires while working at that location. The engineer of train No. 103 received serious injuries, and the fireman and brakeman received minor injuries. Damage was estimated to be about $2,443,295.

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INVESTIGATION

Events Preceding the Accident

About 9:30 a.m., c.s.t. 1/ on March 17, 1983, a Missouri-Kansas-Texas Railroad Company (MKT) signal maintainer arrived at a main track switch which leads from the MKT to an interchange track to the Belton Railroad Company (BRR) outside the city limits of Temple, Texas. (See figure 1.) The signal maintainer had been instructed to relocate the switch circuit controller, 2/ which was located on the adjacent tie to the headblock tie. 3/ Relocation of the switch circuit controller involved removal and replacement of the shunt wires 4/ leading from the switch circuit controller to the rails of the main track.

1/ All times hereinafter are central standard time.
2/ According to the Association of American Railroads Signal Manual a switch circuit controller is: A device for opening and closing electric circuits operated by a rod connected to a switch, derail, or movable-point frog. See discussion in Signal Information.
3/ Headblock ties are those switch ties located at the point of a switch, of sufficient length to provide anchorage for the switch stand mechanism.
4/ According to the Association of American Railroad's Signal Manual a shunt is a by-path in an electrical circuit.

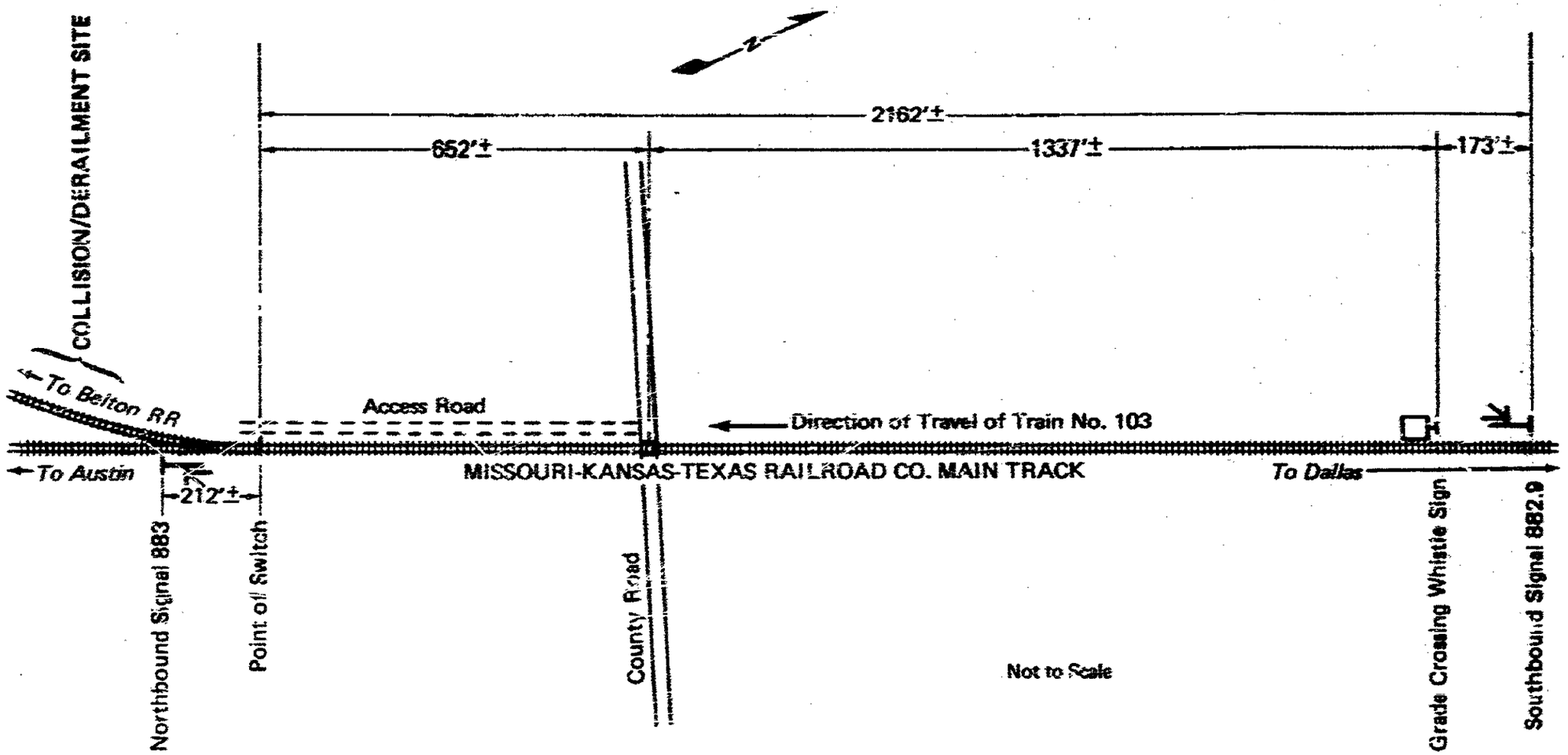


Figure 1.--Accident site.

Shortly after beginning the work, the signal maintainer stopped working and departed the job site to buy a file to sharpen a chain saw that he would be using later at the job site. About 11:30 a.m., after taking a short lunch break, the signal maintainer returned to the job site. At the time, a local service freight train was proceeding southwardly through the location. After the freight train passed, the signal maintainer removed the switch circuit controller housing from the 11-foot long crosstie ahead of the headblock tie. He then cut off the end of the tie (to which the housing had been secured) evenly with the ends of the crossties to facilitate access to the underside of the adjacent headblock tie and to insert the housing retaining bolts from the underside of the headblock tie. After relocating the housing to the headblock tie, he reconnected the connecting rod from the switch point to the opposite side of the switch circuit controller. The noninsulated shunt wires were then replaced with new insulated shunt wires but were not connected to the rails. (See figure 2.)

About 3:30 p.m., after a mechanized track maintenance gang proceeding northwardly on the main track passed by the job site, the signal maintainer reversed the main track switch to hook up his track drill and then drilled two new holes in the web of the rail to receive the shunt wire connectors. The signal maintainer stated, "I remember seeing train (No.) 103, and I stepped back and I looked around to make sure that I had no tools or materials that I was using next to the mainline, and after doing that I kind of stepped back down off the switch. . . ." At the time, the replacement shunt wires had not been connected, the switch had not been aligned back to its normal position, and performance tests had not been conducted on the installation.

The Accident

About 1:30 p.m., train No. 103 departed Waco, Texas, after receiving an initial terminal air brake test, and proceeded to Temple, Texas. No defective conditions were noted in the air brake system or equipment. The train consisted of 69 loaded cars and a caboose, and had a trailing tonnage of 8,750 tons. The lead 12 cars of the train carried soybeans, and the remaining cars carried wheat. All of the cars were high-cubic capacity covered hopper cars.

After arriving in Temple, train No. 103 waited about 20 minutes for the mechanized track maintenance gang to clear the main track. About 4:01 p.m., the train departed Temple under the operation of the fireman, a qualified engineer, and proceeded in a southerly direction en route to Smithville, Texas. The engineer was sitting on the left (east) side of the locomotive unit; the fireman was sitting on the right (west) side of the locomotive unit; and two brakemen were riding in the second locomotive unit. The engineer and fireman stated that they received green (clear) aspects at signal Nos. 8809, 8817, and 8829, all of which were located ahead of the main track switch to the interchange track, and that they called out the signal indications to each other as required by the MKT operating rules. Signal No. 8829 was located about 2,162 feet north of the main track switch for the interchange to the Belton Railroad and was the last southbound signal before that switch. Shortly before passing signal No. 8829, the fireman made a minimum application of the automatic air brake because of the descending grade. Shortly after passing the signal, the fireman began sounding the locomotive warning whistle and bell for an at-grade county road crossing. At the time, the train was moving about 35 miles per hour.

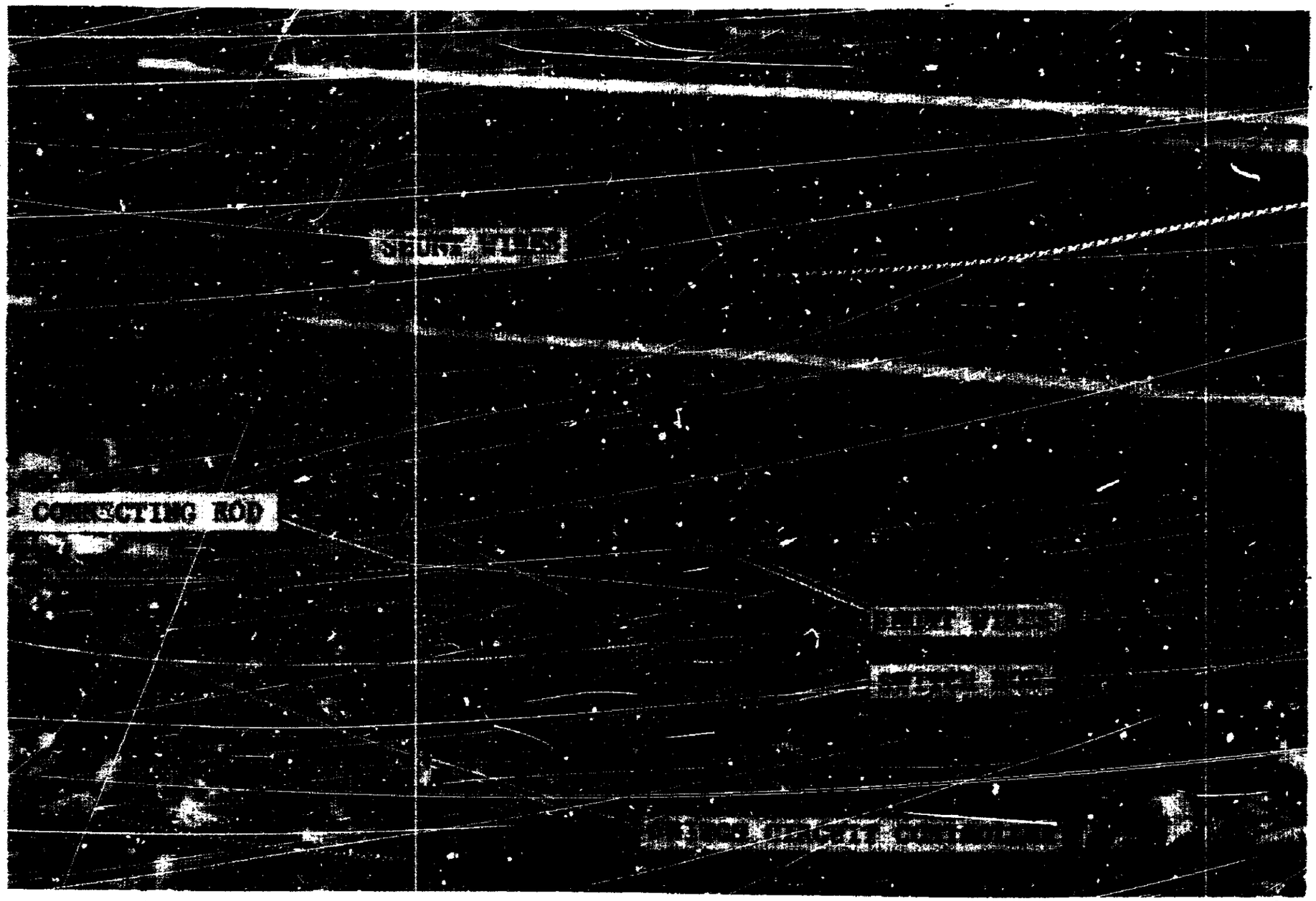


Figure 2.—Switch circuit controller after relocation.

The fireman stated that, as the locomotive approached the road crossing, he saw someone at the switch: "He seemed to be bent over (the switch), from that point I recall him getting up and walking away from it." About the time the locomotive passed over the road crossing, the fireman and the engineer saw that the position indicator on the switch was set for a diverging move, the switch points were open, and freight cars were standing on the interchange track. The engineer moved to the doorway, which was located directly in front of him, and the fireman placed the automatic brake valve in the emergency position and started to follow the engineer out of the cab. However, because the engineer hesitated in the doorway before jumping from the locomotive unit, blocking the fireman's exit, the fireman lay on the cab floor and braced himself for the collision.

About 4:10 p.m., train No. 103 entered the switch leading to the interchange track and collided with the standing freight cars. The four locomotive units derailed to the east of the interchange track, but clear of the MKT main track. The fourth unit jackknifed, bypassed, and subsequently overrode and crushed the operating compartment end of the third unit. The fuel tank on the fourth unit was torn open, and the spilled diesel-fuel-oil was ignited; the ensuing fire destroyed the third and fourth locomotive units. The ten cars behind the locomotive derailed and jackknifed; the eleventh car did not derail, but sustained damage.

The most northerly of the standing freight cars was destroyed and the car behind it was damaged; the remaining five cars rolled south on the interchange track. The hand brakes had been set on the two most northerly of the seven cars, and also on the most southerly car. (See figure 3.) The engineer sustained serious injuries, and the fireman, and a brakeman who was on the second locomotive unit, sustained minor injuries; the other brakeman was not injured. The conductor, who was riding in the caboose, also was not injured.

Injuries to Persons

Injuries	Traincrew	Others	Total
Fatal	0	0	0
Nonfatal	3	0	3
None	2	1	3
Total	5	1	6

Damage

The last two units of the four-unit locomotive sustained extensive damage in the collision and ensuing fire, and were considered destroyed. (See figure 4.) The operating compartment of the third unit was crushed, and the fuel tank on the fourth unit was torn open about one-half of the circumference of the tank. The pilot and front platform of the leading unit were damaged and the underframe, electrical, and air brake equipment of the first two units were damaged. (See figure 5.)

The 10 lead cars of train No. 103 were derailed. The five lead cars which jackknifed behind the locomotive were destroyed. The following five cars sustained extensive damage. The eleventh car of the train received moderate damage at its leading end, but it did not derail. Of the seven empty standing freight cars, the most northerly, a box car, was destroyed in the collision, the adjoining open-top hopper car was derailed and received extensive damage, and the remaining five cars separated and rolled southward on the interchange track.

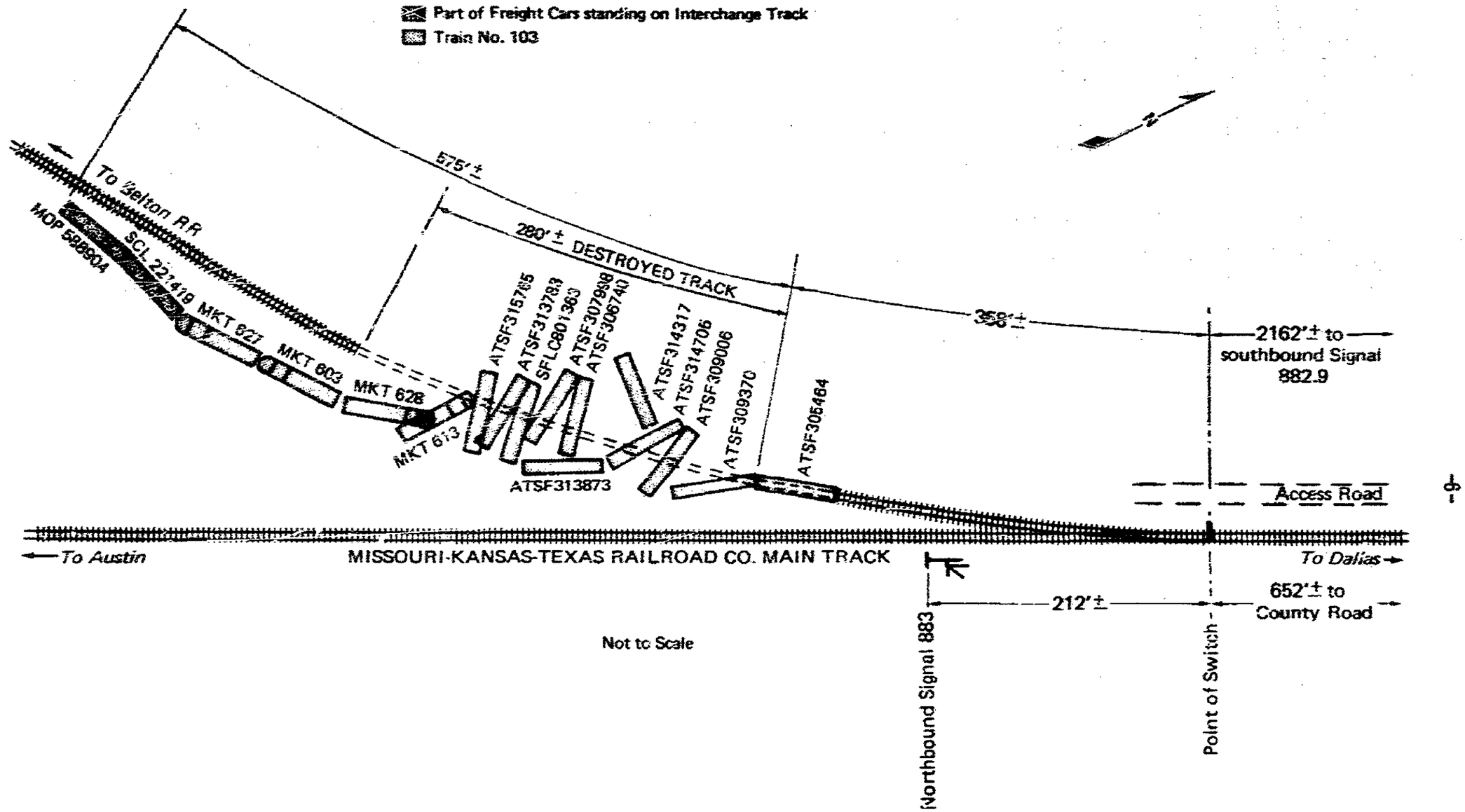


Figure 3.—Plan view of the accident site.

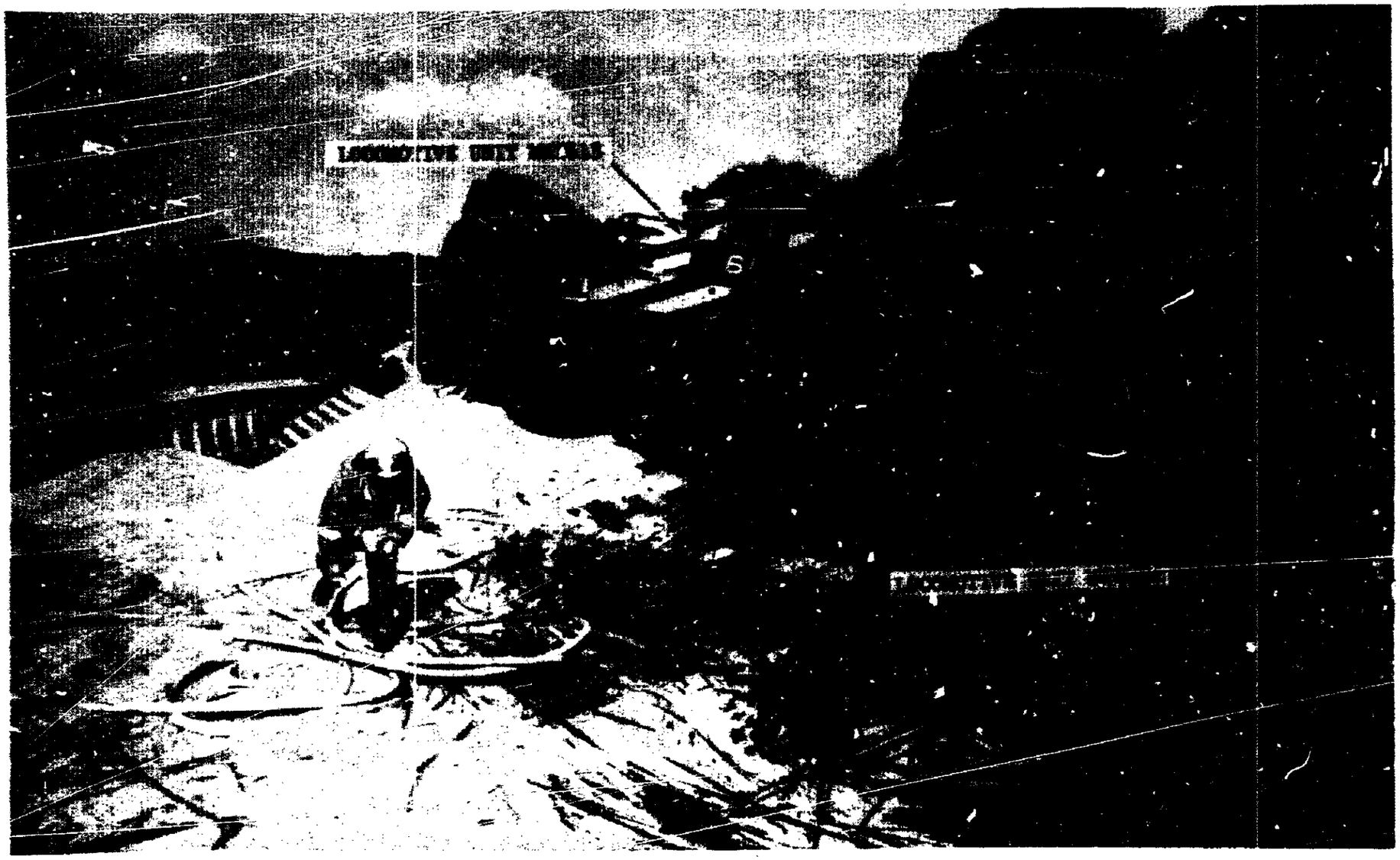


Figure 4.—Last two locomotive units of train No. 103.

Figure 5.—First two locomotive units of train No. 103.

About 280 feet of the interchange track was destroyed.

Damage was estimated as follow:

Equipment	$2,294,064
Track	24,231
Lading	50,000
Wreck Clearing	75,000
Total	$2,443,295

Personnel Information

The engineer, fireman, conductor, and both brakemen of train No. 103 were qualified for their respective positions in accordance with MKT requirements. The signal maintainer was initially employed by the MKT about 3 years before the accident as a signalman helper. After 3 months of service as a signalman helper, he was promoted to assistant signalman. After 10 months of service as an assistant signalman, he was promoted to signal maintainer. He was qualified for his position as signal maintainer in accordance with MKT requirements. His normal tour of duty was 8 a.m. to 5 p.m., and his duty reporting point was at Taylor, Texas, about 38 miles south of Temple, Texas. (See appendix B.)

The MKT's Engineer of Communications and Signals (C&S) stated that MKT was concerned about the qualifications and training of its signal maintainers: "whenever we put an inexperienced young man out like that we endeavor to have a supervisor with him just as much as possible. And we try to give them as much instruction and help as we possibly can, to make sure that they don't do anything that's detrimental to the safety of the railroad. . . ." The senior signal supervisor said that the signal maintainer at the accident site "had more experience than some other people we have working, and as a matter of fact he was one of the leading, . . . third highest in seniority [in his district]. I had faith in him as far as his maintaining ability."

The signal maintainer had received on-the-job training interspersed with four formal classroom technical training sessions of 2 weeks each, which had been conducted in the Southern Pacific Transportation Company signal training school in Houston, Texas, under contract with the MKT. The signal maintainer completed the fourth formal classroom technical training session on May 14, 1982.

Train Information

The locomotive of train No. 103 consisted of four diesel-electric locomotive units: MKT 627, MKT 603, MKT 628, and MKT 613. They were model SD-40-2, 3,000 horsepower 6-axle units, manufactured by the Electromotive Division of General Motors Corporation. The locomotive weighed about 1,472,000 pounds. Each unit was equipped with a type 26-L airbrake system, dynamic brakes, speed indicators, speed recorders (see appendix C), and operable radios. None of the units were equipped with alertness or deadman control devices; no such devices were required. The caboose was also equipped with an operable radio.

Track Information

The main track through the accident area, designated as "Smith" in the MKT timetable and located just south of Temple, is constructed of 112-lb RE section 5/ jointed rail. The 39-foot rails are laid in double-shouldered tieplates atop 9-inch by 7-inch by 8-foot 6-inch treated crossties. The rails are fastened with two rail-holding line spikes per tie plate, and longitudinal rail movement is restrained by rail anchors. A crushed rock ballast section extends more than 12 inches beyond the crosstie ends, and the tie cribs are full and compacted. A crosstie renewal program was completed in 1980, and the track was last surfaced on March 10, 1983.

The main track alignment at the accident site is tangent and descends southwardly at an approximate 0.7 percent grade. The track, which is on a southwardly descending grade of varying percentages for about 3 miles approaching the accident site, met or exceeded the minimum standards of the Federal Railroad Administration's (FRA) track safety standards for class 4 track. 6/

The manually operated main track switch, which leads to the interchange track and to the Belton Railroad Company, is constructed of 115-lb RE rail and is part of a No. 11 turnout. 7/ A red, nonreflectorized 15-inch square switch position indicator is attached near the top of the switch stand mast (see figure 6) about 5 feet above the top of the crossties. The switch position indicator displays a red (stop and proceed) aspect to a train on the main track when the switch is aligned for a diverging movement. The interchange track to the south of the turnout is constructed of 85-lb rail, and its gradient descends below that of the main track. The interchange track alignment proceeds southwardly through a right-hand 2° curve about 1,800 feet in length. The interchange track met or exceeded the minimum standards of the FRA's track safety standards for class 1 track. 6/

Signal Information

Automatic signal No. 8829, a color light signal, governs southbound movements on the MKT main track through the signal block in which the interchange track is located. (See figure 7.) Signal No. 8817 is located in approach to signal No. 8829, and signal No. 8809 is located in approach to signal No. 8817. According to the MKT's senior signal supervisor, if the signal block governed by signal No. 8829 is occupied, or if the main track switch is not fully closed in its normal position for a main track movement, signal Nos. 8829 and 8817 should display red (stop and proceed) aspects, and signal No. 8809 should display a yellow (approach) aspect, which requires the engineer to reduce train speed and be prepared to stop for the next signal.

5/ 112-lb RE section refers to rail which weighs 112 pounds per linear yard. At the time of its manufacture in 1946, it was a standard rail section recommended for use by the American Railway Engineering Association.

6/ According to 49 CFR 213.9, "Classes of Track: operating speed limits," class I track prescribes a maximum allowable operating speed of 15 miles per hour for passenger trains and 10 miles per hour for freight trains. Class 4 track prescribes a maximum allowable operating speed of 80 miles per hours for passenger trains, and 60 miles per hours for freight trains.

7/ According to the American Railway Engineering Association's Manual for Railway Engineering a turnout number is: the number corresponding to the frog number of the frog used in the turnout.

Figure 6.--Switch position indicator at switch to interchange track, with switch set in normal position.

The alignment of the main track switch for a diverging movement to the interchange track should result in a shunt of the signal circuit between the two rails of the track. The track shunt removes voltage from the track relay which, in turn, affects the signal circuit and causes the signal to display the red (stop and proceed) aspect. The shunt is imposed by the closure of electrical contacts within the switch circuit controller. A connecting rod between the near switch point and the switch circuit controller mechanically activates the closure of the electrical contacts. (See figure 8.) The shunt circuit path proceeds from four shunt wires, which are connected to the rails of the track, through the electrical contacts within the switch circuit controller. Tapered rail

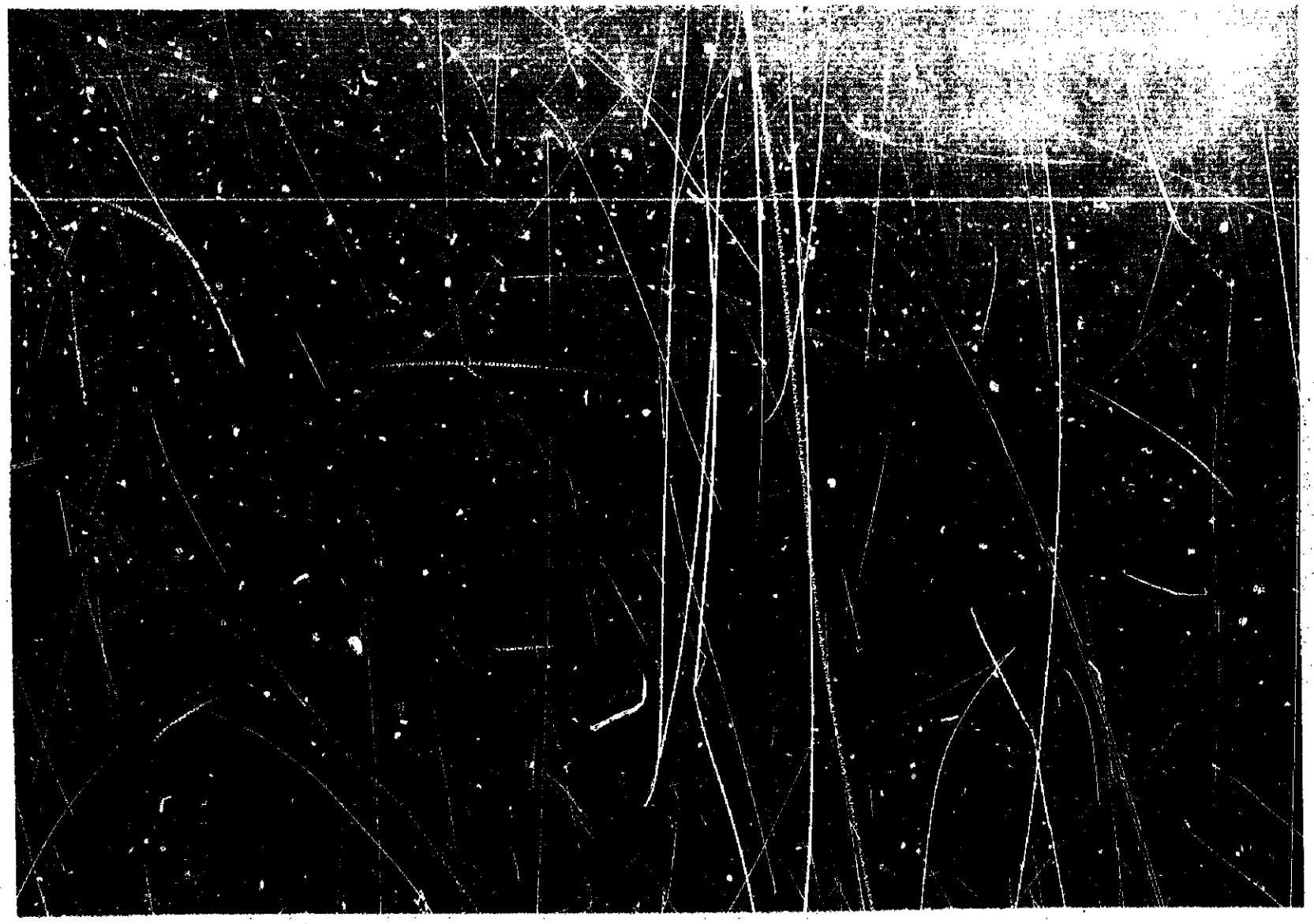


Figure 7.--Signal No. 8829 displaying a green (clear) aspect.

connectors are located at the rail end of each of the four stranded, insulated shunt wires which are driven into holes drilled in the rail web and secured by a pressure fit. Two rail connectors are driven into each rail to provide redundancy to the track shunt circuit switch protection system so that it will continue to function properly in the event one shunt wire becomes broken or disconnected.

The relocation of the switch circuit controller at the accident site was part of an MKT systemwide objective to relocate the devices from their original location on the tie ahead of the first headblock tie to the first headblock tie. According to MKT's Engineer of C&S, the relocation procedure was considered "a rather routine operation" by the C&S department management and there were no written step-by-step procedures. He further stated that the only instructions provided to signal maintainers regarding protection of train movements during the relocation of the switch circuit controllers ". . .is to comply with the rules, and we (MKT) assume that if they do not understand how to comply with the rules that they will apply to their supervisors for instructions on what's involved." New MKT C&S department employees are examined on their knowledge of operating and safety rules when they are assigned to a position, but they are not required to take periodic rules reviews. The MKT has no written standard plans and procedures for switch circuit controllers and shunt protection systems.

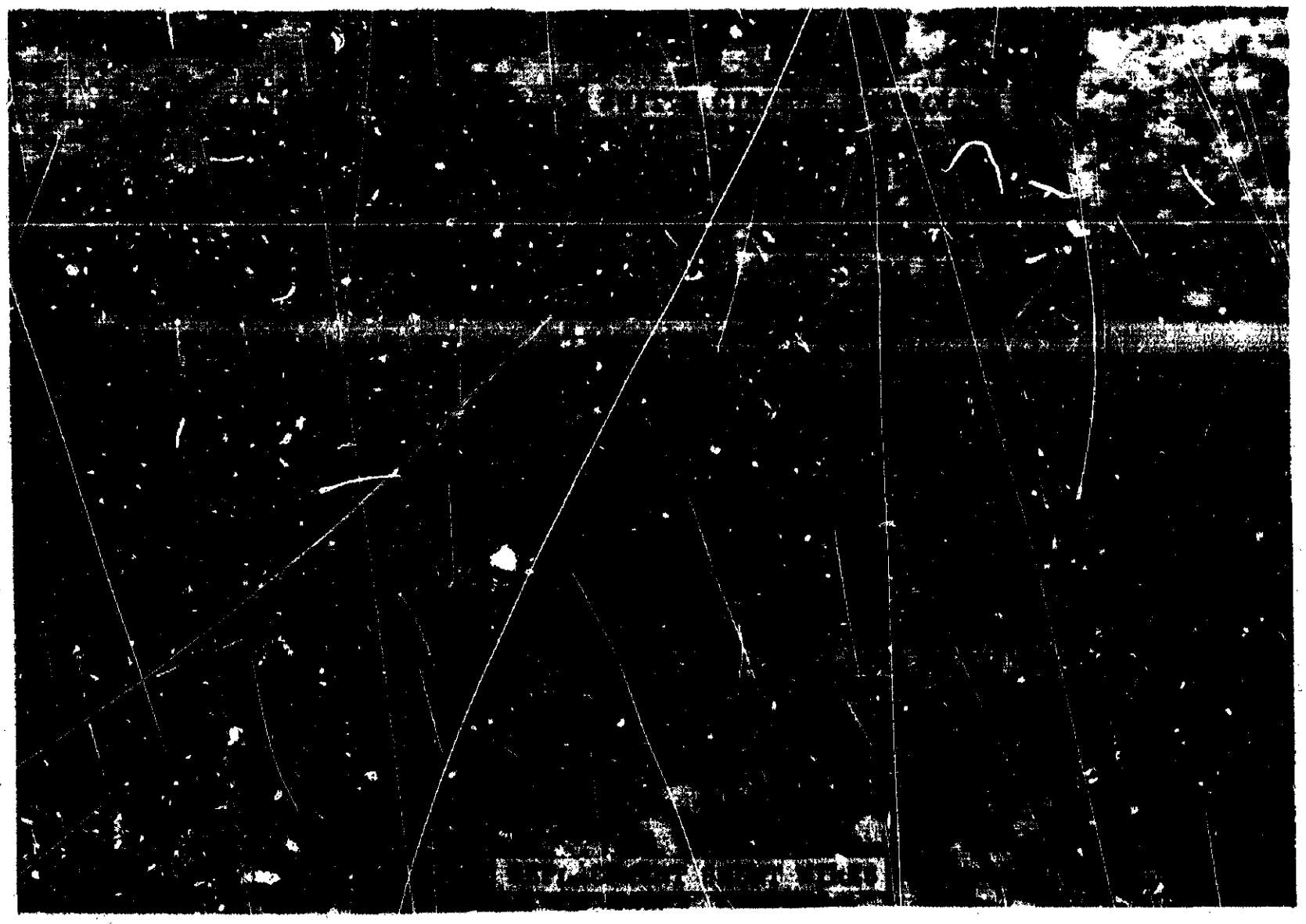


Figure 8.--Circuit controller and connecting rod.
Note noninsulated shunt wires to be replaced.

Employees of the MKT C&S department are required to obtain train location lineups when they are working on main tracks. The lineups, which are issued twice daily, at 8 a.m. and noon, list the originating points and departure times of train movements. The signal maintainer at the accident site stated that he had obtained a copy of the morning lineup, but that he did not obtain a copy of the afternoon lineup. Employees required to obtain lineups are not required to submit them to their supervisors at the end of a tour of duty.

FRA's Rules, Standards, and Instructions (RS&I) for signal systems (49 CFR Part 236) states the following, in part:

> §236.4 Interference with normal functioning of device.
>
> The normal functioning of any device shall not be interfered with in testing or otherwise without first taking measures for insuring safety of train operation which depends on normal functioning of such device.
>
> §236.5 Design of control circuits on closed circuit principles.

All control circuits 8/ the functioning of which affects safety of train operation shall be designed on the closed circuit principle, 9/ except circuits for roadway equipment of intermittent automatic train stop system.

§236.6 Hand-operated switch equipped with switch circuit contoller.

Hand-operated switch equipped with switch circuit controller connected to the point, or with facing-point lock and circuit controller, shall be so maintained that when point is open one-fourth inch or more on facing point switch and three-eights inch or more on trailing-point switch, track or control circuits will be opened or shunted or both, and if equipped with facing-point lock with circuit controller, switch cannot be locked. On such hand-operated switch, switch circuit controllers, facing-point locks, switch-and-lock movements, and their connections shall be securely fastened in place, and contacts maintained with an opening of not less than one-sixteenth inch when open.

The following are excerpts from the Rules For The Maintenance of Way and Structures, Missouri-Kansas-Texas Railroad Company:

102. Signals and Signal Circuits -- When repair, adjustment, change or replacement is made in any part of the signal system that may affect the system, test shall be made immediately to determine that proper operation is assured.

The apparatus shall be so installed and maintained that it will insure the safe operations of trains.

Inspections, tests, logs and reports relative thereto will be made and reported in accordance with current instructions.

102(3) When track or other changes are made which affect the proper operation of signals, action must be taken to insure that signals display their most restrictive aspect until changes have been completed.

If track is found to be unsafe for trains due to broken rail, wide gage, stripped joint, or other cause, the signal maintainer must take immediate action to protect trains and, in signal territory, set signals to display their most restrictive aspect and then notify train dispatcher.

When the condition of switches or track does not permit the proper operation of signal devices, condition must be promptly reported to Train Dispatcher, Section Foreman or Roadmaster for necessary correction.

8/ According to the Association of American Railroads Signal Manual, a control circuit is: an electrical circuit between a source of electric energy and a device which it operates. (Footnote supplied)

9/ According to the Association of American Railroads Signal Manual, the closed circuit principle is: the principle of circuit design where a normally energized electric circuit which on being interrupted or deenergized, will cause the controlled function to assume its most restrictive condition. (Footnote supplied)

Signal maintainers and track forces will cooperate in joint track and signal work to see that signal apparatus is maintained in proper condition.

102(6) Signal circuit shall not be opened or shunted or other action taken which may cause failure of operation of signal or other apparatus at a time when such action may affect safety of train operation. The safe movement of trains must be protected at all times.

103. Federal Laws and Regulations — Employees whose duties require must familiarize themselves with and observe federal laws and regulations relating to hours of service, track safety standards, rules standards and instructions for railroad signal systems, safety appliances and other federal laws pertaining to their duties, and make proper reports thereunder.

122. Signal Maintainers — Signal maintainers will report to and comply with instructions from the signal supervisor. Unless otherwise provided, they are responsible for the repair and maintenance of the signal apparatus and systems.

122(1) They must see that all work is done in accordance with current standards, plans and instructions, and in compliance with federal regulations. They will keep records as instructed and render reports as required.

After the accident, Safety Board investigators questioned the senior signal supervisor about whether he would have provided protection for train movements by using a temporary shunt or by dropping a signal relay if he had been performing the relocation. He stated, "Probably not." The signal maintainer stated that he had performed about 10 similar relocations of switch circuit controllers before March 17, 1983, and that he had not arranged to provide protection for train movements dependent on the signal system on those occasions.

Safety Board investigators questioned the MKT's Engineer of C&S after the accident as to whether the signal maintainer had received a copy of, and had been instructed in the RS&I. He stated that he ". . .checked our files, and we found out, or we did not find an acknowledgement of (the signal maintainer), of receipt of an RS&I."

The MKT's Engineer of C&S informed the Safety Board that as a result of the March 17, 1983, accident the MKT has begun a program of replacing the track shunt circuit protection systems of the type involved in the accident with series break-type circuits on those routes over which passenger trains operate.

Method of Operation

Trains are operated on the main track through Temple, Texas, by timetable, train orders, special instructions, and signal indications of the continously-lighted wayside signals of the Automatic Block Signal (ABS) system. The maximum allowable speed at the location is 70 mph for passenger trains and 60 mph for freight trains. Special instructions within the MKT timetable stipulate "Trains handling 30 or more loads of grain. . .must not exceed 35 MPH." Train No. 103 was restricted to a maximum speed of 35 miles per hour. Six passenger trains and 71 freight trains were operated through Temple, Texas, in the 7-day period preceding the accident.

The signal maintainer told Safety Board investigators: "Well, prior to the accident I do remember looking south, down the track, and seeing a yellow or maybe a red signal, it wasn't really clear to me, and I realized that there had been machine (mechanized track maintenance) gangs there at the north end of Little River, 10/ or at Little River Pass (passing siding), and I knew that before I left Smith, or before I headed back to Taylor, I would have to take care of the signal trouble [farther south from his position]." He further stated that he did not realize that the switch was aligned for the interchange track when he stepped back as train No. 103 approached. The MKT's Engineer of C&S also told Safety Board investigators, that signal maintainers and signal supervisors had been counseled on maintaining tracks in such a manner that trains would not be delayed by work being performed by signal maintainers.

The MKT's Division Superintendent informed Safety Board investigators that the number of train delays due to signal failures, such as restrictive aspects caused by broken shunt wires and rail bonds, 11/ had decreased within the last 6 to 12 months before the accident.

Meteorological Information

At the time of the accident, the visibility was good, the temperature was about 45° F., the relative humidity was about 84 percent, and the winds were from the northwest at about 20 knots. There was no precipitation.

Medical and Pathological Information

When the engineer of train No. 103 jumped from the lead locomotive unit, he suffered a dislocated right shoulder, lacerations to both arms, knees, and the face, and contusions. He was admitted to an area hospital for treatment.

The fireman and one brakeman, both of whom suffered contusions, were treated by a physician, and then were released.

Tests and Research

A postaccident examination of the switch circuit controller at the switch to the interchange track revealed that the controller had not been damaged as a result of the accident. After the replacement shunt wires were attached, and the necessary adjustments were completed, signal No. 3829 functioned properly. Officials of MKT's C&S department stated that signal No. 3829 displayed a green (clear) aspect with the main track switch aligned for the interchange track when the shunt wires were not connected. The MKT forwarded a False Proceed Signal Report to the FRA on March 18, 1933. (See appendix D.)

A postaccident inspection of the lead locomotive unit revealed that the throttle was in the power-off position, the automatic brake valve was in the emergency position, the independent brake valve was in the full application position, the headlight switch was on and the selector was in the bright position, and the emergency valve on the left side of the locomotive unit was in the unapplied position. The airbrake equipment was tested at Waco, Texas, on March 22, 1933, by supplying air to the main reservoir, under a standby locomotive unit. The equipment functioned as it was designed.

10/ Little River is a station on the MKT located about 4 1/2 miles south of the accident site.

11/ According to the Association of American Railroads Signal Manual, a rail bond is: a metallic connection attached to adjacent rails to insure electrical conductivity.

Other Information

Immediately after the accident, a member of a farm crew working nearby notified the Temple Fire Department of the accident. He then drove his pickup truck to the scene, placed the injured engineer in the pickup truck, and transported the engineer to an ambulance service facility where the engineer received emergency treatment. The engineer continued on to the hospital in an ambulance.

Firefighters arrived shortly after being notified and worked more than an hour to extinguish the fire at the accident scene. About 8 p.m. the following day, firefighters returned to the scene after the fire rekindled in the wreckage. They took about 30 minutes to bring the fire under control.

ANALYSIS

The Accident

The fireman and engineer were operating train No. 103 in accordance with applicable rules and regulations. Although the fireman and engineer saw the misaligned switch when the lead locomotive unit was at or near the at-grade county road crossing and the fireman immediately initiated an emergency brake application, there was insufficient distance to stop or slow the train sufficiently to lessen the effect of the accident. Automatic signal No. 8829 was displaying a green (clear) aspect despite the misaligned main track switch since the shunt wires, which would have caused the signal to display a red (stop and proceed) aspect, had not been connected to the rails. Therefore the Safety Board concludes that the signal was displaying a false proceed 12/ aspect.

Signal System Safety

The shunt circuit involved in this accident was not designed on the closed-circuit principle and, therefore, did not have the inherent fail-safe feature of causing the most restrictive signal aspect (red---stop and proceed) when a part of the protection system was not able to function. If a series break-type circuit had been installed at the main track switch, the signal maintainer's disconnection of the shunt wires would have interrupted the signal control circuit and caused the signal to display a red (stop and proceed) aspect. The firemen and engineer would have been able to see the red aspects at the previous signals (No. 8829 and 8817) and could have brought train No. 103 to a safe stop, thus, preventing the accident. The Safety Board notes that the MKT has initiated a program of replacing its track shunt circuit protection systems with series break-type circuits on that portion of the MKT on which passenger trains are operated and commends the MKT for its program. However, we urge the MKT to extend the program to its entire system.

The Safety Board investigated the collision of a passenger train with a freight train at Spencer, North Carolina, on October 8, 1977, 13/ and the collision of freight trains at Crewe, Virginia, on November 28, 1981, 14/ both of which occurred as a result of false

---

12/ According to the Association of American Railroad's Signal Manual a false proceed is: a failure of a system, device, or appliance to indicate or, function as intended which results in less restriction than is required.

13/ Railroad Accident Report--"Side Collision of Southern Railway Company Trains Nos. 1 and 152, Spencer, North Carolina, October 8, 1977" (NTSB-RAR-78-3).

14/ Railroad Accident Report--"Side Collision and Derailment of Norfolk & Western Railway Company Trains Nos. 8S878, Yard Shifter, &67HNP, Crewe, Virginia, November 28, 1981" (NTSB-RAR-82-3).

proceed aspects. In both accidents, the circuit controllers and shunt circuits involved were a part of the same type of signal system used at Temple, Texas. As a result of its investigation of the Spencer accident, the Safety Board recommended that the FRA:

> Require that the track shunt circuit imposed by contact closure in a circuit controller be phased out as soon as practicable and a series break-type circuit, which will satisfy the requirements of the FRA's Rules, Standards, and Instructions, be used in place thereof. (R-78-23)

The FRA responded that a shunt circuit is not an electrical circuit and therefore is not subject to the provisions of 49 CFR 236.5.

In its report of the Crewe accident, the Safety Board noted the FRA's response to safety recommendation R-78-23 and said: "The Safety Board believes that this interpretation is not realistic since the shunt circuit functions as an integral component of the electrical control circuit, and is, by definition, a by-path in an electrical circuit. The application of a shunt circuit not designed on the closed-circuit principle to a control circuit which, by regulatory requirement, is designed on the closed-circuit principle nullifies the fail-safe concept of the signal system, and affects the safety of train operations. The Safety Board believes the benefit of safety requires the FRA to revise the appropriate regulation, or interpretation thereof, to eliminate this inconsistency."

Safety recommendation R-78-23 was placed in a "Closed--Superseded" status, as a result of the investigation of the Crewe accident, in which the Safety Board recommended that the FRA:

> Revise the appropriate regulation, within the Rules, Standards, and Instructions for signal systems, or the interpretation thereof, to require track shunt circuit switch protection to be of the series break-type circuit and require the replacement of track shunt circuit protection systems with a series break-type circuit on a priority basis. (R-82-48)

Recognizing that the implementation of safety recommendation R-82-48 would be a large undertaking, the Safety Board suggested in its report of the Crewe accident that "the replacement of switch shunting circuits with series break-type circuits could be accomplished by assignment of priority. Passenger train routes and routes over which substantial amounts of hazardous materials are shipped should receive such conversions first. The remaining switch shunting circuits could be replaced with series break-type circuits on a lifespan replacement cycle." Safety recommendation R-82-48 has been placed in an "Open--Awaiting Response" status.

The Safety Board has reviewed the FRA's Notice of Proposed Rule Making (NPRM) 49 CFR Parts 233, 235, and 236 (Docket No. RSSI-78-5, Notice No. 8 dated March 21, 1983). Within the NPRM, the FRA proposes a new Section 236.60, which reads:

> 236.60 Shunting of track circuits.
>
> Switch shunting circuit shall not be hereafter installed, except where track or control circuit is opened by the circuit controller.

Proposed Section 236.60 would prohibit future installations of the type of shunt circuit protection system involved in the Spencer, Crewe, and Temple accidents, and it would partially satisfy the intent of safety recommendations R-78-23 and R-82-48. However,

proposed Section 236.60 does not address the eventual elimination of shunt circuit protection systems, which the FRA recognizes in the preamble to the NPRM as not being fail-safe. Existing shunt circuit protection systems could be perpetuated unless some limitation is imposed upon those systems. The Safety Board believes that the FRA should expand proposed Section 236.60 by specifying a date by which the existing shunt protection systems would be eliminated or by imposing a requirement that the existing systems be eliminated when extensive repairs, such as replacing or rebuilding the circuit controller, are necessary.

Shunt circuit protection systems can be rendered ineffective by means other than those described in these accidents. Routine track maintenance operations, such as crosstie tamping performed by mechanized track maintenance gangs, often results in broken rail bonds and shunt wires. When the shunt wires of a track shunt circuit protection system of this type are broken, a false proceed aspect may result.

Communications and Signals Department Procedures

The MKT did not establish any standard plans or procedures regarding the track shunt circuit protection systems, and it did not establish any procedures regarding the relocation of the switch circuit controllers. This failure of the MKT to establish such plans and/or procedures forced the signal maintainers to devise and implement their own means of performing the maintenance and relocation functions. Although this absence of procedural guidance may not have hampered an experienced signal maintainer, the Safety Board believes that this lack of procedural guidance by the MKT may have been a factor detrimental to the performance of the relatively inexperienced signal maintainer involved in this accident.

The MKT's Engineer of C&S acknowledged the inexperience of the signal maintainer and indicated that inexperienced employees receive an extra level of procedural instruction and supervision. However, the level of procedural instruction and supervision that had been afforded the signal maintainer by the MKT had not impressed upon him the rationale or the specifics of MKT's rules, or the applicable requirements of the RS&I. Further, the lack of a periodic review by MKT of its operating and safety rules and the RS&I effectively negated the opportunity of impressing upon the signal maintainer the importance of safety requirements when performing work on tracks while trains are being operated. The Safety Board believes that such periodic reviews of rules are beneficial to safety and should be instituted by the MKT's C&S department. The signal maintainer also had not been taught the importance of obtaining and using train lineups to avoid endangering trains or himself while performing work on tracks while trains are being operated. Since the signal maintainers were not required to submit the train lineups that were obtained each day, the MKT's C&S department supervision was probably not fully aware of the extent to which the signal maintainers were or were not using train lineups. A requirement to submit lineups to their supervisors at each day's end would better assure that signal maintainers working on or about the tracks would obtain the required train lineups and keep themselves apprised of train movements in their work locations and would thereby benefit safety.

The statement by the senior signal supervisor that he would not have protected train movements had he been performing the same work is evidence of an unacceptable attitude on the part of management toward safety risks. This statement, however, suggests that management may be emphasizing the avoidance of train delays to the point of compromising safety. The actions of the signal maintainer on the day of the accident, and

on the 10 other occasions when he did not protect train movements, may reflect the attitude toward safety risks manifested by his supervisor. The Safety Board believes that it is unrealistic for management to expect the safety performance of employees to exceed the examples set forth by the supervisors of those employees.

Although several MKT rules and Federal regulations are in effect regarding protection of train movements while performing work on signal equipment, the signal maintainer did not take the necessary precautions that would have prevented the accident. Although the MKT may have provided the signal maintainer with an acceptable level of training in the technical aspects of his position, the signal maintainer's performance on the day of the accident indicates a lack of understanding of the safety risks involved when working on tracks while trains are being operated. This is understandable when viewed in the context of the senior signal supervisor's attitude that he would not have protected train movements in similar circumstances. The Safety Board believes that this emphasizes the need for detailed procedural instructions for signal maintainers. A signal maintainer normally spends his tour of duty working alone and largely unobserved. He relies on his individual judgment and receives only occasional supervision. The Safety Board concludes that an inexperienced signal maintainer entrusted with providing for safe train movements should be provided with documented procedural instruction and close supervision in order to perform his assigned duties safely.

Survivability

By jumping from the lead locomotive unit, which was moving about 35 mph, and impacting with the roadbed, the engineer sustained the most serious injuries. The fireman, who was unable to exit the unit, lay on the cab floor and braced for the collision which occurred in a 2° right hand curve on a track that was constructed with a light rail section. No serious override of the lead locomotive unit operating compartment occurred probably because the collision forces between the locomotive and the empty cars were able to attenuate tangentially from the curved track, resulting in only minor injuries to the fireman. The second locomotive unit operating compartment did not incur damage and one of the two brakemen riding in that unit incurred only minor injuries.

CONCLUSIONS

Findings

1. The Communications & Signals department of the Missouri-Kansas-Texas Railroad Company did not have any existing standard plans and/or procedures on track shunt circuit protection systems for the guidance of its signal maintainers.

2. The Communications & Signals department of the Missouri-Kansas-Texas Railroad Company did not provide its signal maintainers with procedures for relocating switch circuit controllers.

3. Inadequate supervision and the lack of established plans and/or procedures for relocating switch circuit controllers may have been a factor detrimental to the performance of the relatively inexperienced signal maintainer.

4. The type of track shunt circuit protection system involved in the accident was not designed on the closed-circuit principle; it did not have an inherent fail-safe feature which would have caused a restrictive aspect when the shunt wires were removed.

5. The signal maintainer, who was working at the track switch to the interchange track, left the switch misaligned as train No. 103 approached.

6. Automatic signal No. 8829 was displaying a green (false proceed) aspect when train No. 103 approached the signal because the shunt wires at the misaligned main track switch were not connected.

7. Present provisions in the Federal Railroad Administration's Rules, Standards, and Instructions for signal systems regarding shunt circuit protection systems, as well as proposed changes to those regulations, do not provide for the elimination of a system which nullifies the fail-safe concept of railroad signal systems.

8. The fireman and engineer of train No. 103 were operating their train in accordance with applicable rules and regulations.

9. Although the fireman immediately initiated an emergency application of the automatic air brakes, sufficient braking distance was not available to stop or slow train No. 103 sufficiently to lessen the effects of the accident before the collision with the standing freight cars.

10. No defective conditions, which could have contributed to the accident, were found in the air brake system or equipment of train No. 103.

11. The signal maintainer had obtained the required morning train lineup, but he had neglected to obtain the required afternoon train lineup.

12. The incidence of train delays over Missouri-Kansas-Texas railroad tracks caused by signal failures resulting in restrictive signal aspects had been declining probably because of management emphasis on avoiding delays to trains.

Probable Cause

The National Transportation Safety Board determines the probable cause of this accident was the display of a false proceed aspect at the entrance to a signal block in which a track switch had been left misaligned by a signal maintainer, who was working at that location. Contributing to the accident were the use of a track shunt circuit protection system not designed on the closed-circuit principle and a lack of procedural instruction to and supervision of the relatively inexperienced signal maintainer.

RECOMMENDATIONS

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

--to the Missouri-Kansas-Texas Railroad Company:

Replace, as soon as practicable on a priority basis, track shunt circuit switch protection not equipped with series break-type circuits with series break-type circuits. (Class II, Priority Action) (R-83-96)

Establish a system of standard plans and procedures to be followed by employees of the Communications and Signals Department so that work performed on signal equipment will not result in an improper functioning of the signal system. (Class II, Priority Action) (R-83-97)

Review and revise, where necessary, supervisory procedures regarding the proper functioning of signal equipment in the Communications and Signals Department to better comply with Missouri-Kansas-Texas Railroad Company rules and Federal regulations. (Class II, Priority Action) (R-83-98)

Establish a scheduled periodic review of the Missouri-Kansas-Texas Railroad Company rules and Federal regulations regarding signal systems for all employees of the Communications and Signals Department. (Class II, Priority Action) (R-83-99)

Establish a procedure so that employees required to obtain current train lineups in the course of their duties maintain such train lineups for the entire time necessary for the safe performance of their duties. (Class II, Priority Action) (R-83-100)

Further, as a result of its investigation of this accident, the National Transportation Safety Board reiterated safety recommendation R-82-48, which was previously made to the Federal Railroad Administration as a result of the Crewe, Virginia, accident on November 28, 1981:

Revise the appropriate regulation, within the Rules, Standards, and Instructions for signal systems, or the interpretation thereof, to require track shunt circuit switch protection to be of the series break-type circuit and require the replacement of track shunt circuit protection systems with a series break-type circuit on a priority basis. (Class II, Priority Action) (R-82-48)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G.H. PATRICK BURSLEY
Member

/s/ DONALD D. ENGEN
Member

August 23, 1983

APPENDIXES

APPENDIX A

INVESTIGATION

The National Transportation Safety Board was notified of the accident at 9:15 p.m., on March 17, 1983. The Safety Board immediately dispatched an investigator from its Fort Worth, Texas, field office to the accident site. Investigators from the Safety Board's Denver, Colorado, field office and the Washington, D.C., headquarters were also dispatched to the accident site.

Groups were formed to investigate the mechanical, operational, signals, and track aspects of the accident. The groups were comprised of personnel from the Missouri-Kansas-Texas Railroad Company, and the Federal Railroad Administration, and were headed by Safety Board personnel. Sworn statements of six principals involved in the accident were taken by Safety Board investigators.

APPENDIX B

PERSONNEL INFORMATION

Signal Maintainer

Mark A. Duffee, 23, was first employed by the MKT railroad as a signalman helper on April 1, 1980. He was promoted to assistant signalman on July 2, 1980, and to signal maintainer on May 4, 1981. He attended four formal classroom technical training sessions of two weeks duration each. The classes were in December, 1980; June, 1981; December 1981; and May 1982. He was last examined on operating rules upon initial employment by the MKT. He passed a company medical examination also upon employment.

Conductor

Edwin C. Helgren, 31, was first employed by the MKT as a brakeman on June 6, 1974. He was promoted to conductor on July 8, 1977. He last attended a class of instruction on operating rules on February 25, 1981. He passed a company medical examination on July 17, 1980.

Engineer

Clyde E. Schubert, 41, was first employed by the MKT as a student fireman on August 30, 1960. He was promoted to engineer on April 18, 1968. He last attended a class of instruction on operating rules on June 15, 1982. He passed a company medical examination on June 29, 1982.

Fireman

Stephen F. DeFranco, 28, was first employed by the MKT as a fireman on November 22, 1981. He was promoted to engineer on April 3, 1982. He was last examined on operating rules on March 3, 1982. He passed a company medical examination on October 14, 1981. Before being employed by the MKT, he was employed by the Consolidated Rail Corporation as an engineer.

Brakeman

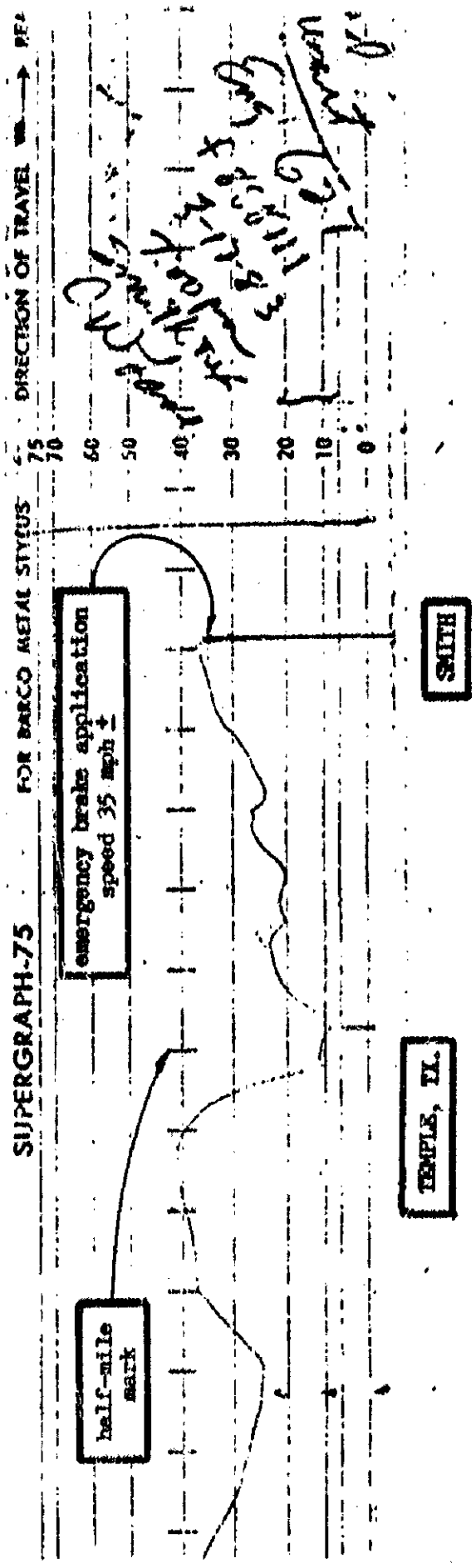
Edward J. Machala, 26, was first employed by the MKT railroad as a brakeman on March 28, 1977. He last attended a class of instruction on operating rules on February 4, 1983. He passed a company medical examination on March 30, 1982.

Brakeman

Rex F. Tiner, 30, was first employed by the MKT railroad as a mechanic in the maintenance of way department on May 30, 1972. He transferred into train service as a brakeman on October 5, 1973. He last attended a class of instruction on operating rules on March 30, 1982. He passed a compeny medical examination on June 7, 1982.

APPENDIX C

SPEED RECORDING TAPE FROM LEAD LOCOMOTIVE UNIT (NO. 627)



APPENDIX D

DOT, FRA FALSE PROCEED SIGNAL REPORT

FEDERAL RAILROAD ADMINISTRATION

FALSE PROCEED SIGNAL REPORT

Department of Transportation, Federal Railroad Administration, Office of Safety, Washington, D.C. 20590

Federal Railroad Administration
11A23 Federal Building
819 Taylor Street
Ft. Worth, Texas 76102

REPORT FOR MONTH OF: March 1983

DATE: March 18, 1983

REPORTING CARRIER: Missouri-Kansas-Texas Railroad Company

REPORTING OFFICER (signature/title)

Vice President - Operation

TYPE OF SYSTEM	DATE	LOCOMOTIVE NUMBER	DEVICE THAT FAILED	LOCATION (city and state)
BLOCK SYSTEMS: [ ] AB [X] APB [ ]	3-17-83	Train 403	Signals 8817 & 8809, 8829	MP 883.0 Smith, Tx.
INTERLOCKING: [ ] AUTOMATIC [ ] REMOTE [ ] MANUAL				
AUTOMATIC SYSTEMS: [ ] ATS [ ] ATC [ ] ACS				
OTHER (specify)				

NATURE AND CAUSE OF FAILURE, CORRECTIVE ACTION TAKEN: On March 17, 1983 Train 403 traveling south of Temple, Texas on the Texas Subdivision passed Signals 8809, 8817 & 8829 which were displaying proceed aspect. Train proceeded south & left main line & entered onto the Belton Railroad at the Smith Switch which was open & lined for the Belton Railroad.

Investigation determined that the Signal Maintainer was working at the Smith Switch changing a switch circuit controller to the head block tie. The maintainer had the switch open & the shunt wires removed while engaged in drilling holes in rail for new shunt wire connections, without taking the precautions prescribed by M of W Rule 102 (3). He had forgotten about the train and did not see nor hear the train until it was almost upon him.