

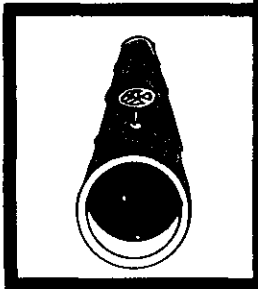
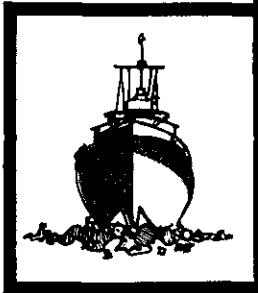
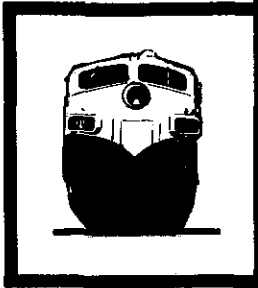
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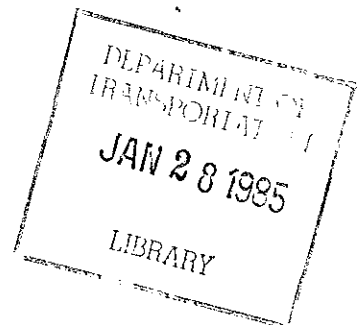
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RAILROAD ACCIDENT REPORT

SIDE COLLISION AND DERAILMENT OF
NORFOLK & WESTERN RAILWAY
COMPANY TRAINS NOS. 6BS78,
YARD SHIFTER, & 67HNP,
CREWE, VIRGINIA
NOVEMBER 28, 1981

NTSB-RAR-82-3



UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB-RAR-82-3.		2. Government Accession No PB82-916303		3. Recipient's Catalog No.	
4. Title and Subtitle Railroad Accident Report, Side Collision and Derailment of Norfolk & Western Railway Company Trains Nos. 6BS78, Yard Shifter, and 67HNP, Crewe, Virginia, November 28, 1981				5. Report Date May 18, 1982	
7. Author(s)				8. Performing Organization Report No.	
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594				10. Work Unit No. 3438A	
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594				11. Contract or Grant No.	
				13. Type of Report and Period Covered Railroad Accident, Report November 28, 1981	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract About 8:20 a.m. on Saturday, November 28, 1981, Norfolk & Western Railway Company freight train No. 6BS78 after receiving a proceed signal indicating a clear main track route, entered a misaligned crossover leading from the eastbound main track onto yard track No. 1 at Crewe, Virginia, sideswiped coal-laden hopper cars being handled by the yard shifter, and then caromed into freight cars of freight train No. 67HNP, which was on the adjacent westbound main track. Two locomotive units and seven cars of train No. 6BS78, nine cars of train No. 67HNP, seven cars on yard track No. 1, and four cars standing on yard track No. 3 were derailed or damaged. The conductor of train No. 67HNP and the front brakeman of train No. 6BS78 received minor injuries as a result of the accident. Damage was estimated to be about \$690,305. The National Transportation Safety Board determines that the probable cause of this accident was the display of a false proceed aspect at the entrance to the signal block in which a conflicting route had been lined and the fact that the crew of train No. 6BS78 could not see the misaligned switch in time to stop their train short of a collision. Contributing to the accident were (1) inadequate supervision to insure compliance with operating rules regarding the alignment of switches, (2) the lack of coordinating procedures in the Maintenance of Way and Signal and Communication Departments which would insure the presence of a signal maintainer when maintenance of way work which might affect signals was undertaken, and (3) careless performance of scheduled inspections of signalized switches.					
17. Key Words Collision, false proceed signal switch shunt circuit, shunt wires, operating rules, switches, fail-safe				18. Distribution Statement This document is available to the public through the National Technical Information Service Springfield, Virginia 22161	
19. Security Classification (of this report) UNCLASSIFIED		20. Security Classification (of this page) UNCLASSIFIED		21. No. of Pages 31	
				22. Price	

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**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

RAILROAD ACCIDENT REPORT

Adopted: May 18, 1982

**SIDE COLLISION AND DERAILMENT
OF NORFOLK & WESTERN RAILWAY COMPANY
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SYNOPSIS

About 8:20 a.m. on Saturday, November 28, 1981, Norfolk & Western Railway Company freight train No. 6BS78 after receiving a proceed signal indicating a clear main track route, entered a misaligned crossover leading from the eastbound main track onto yard track No. 1 at Crewe, Virginia, sideswiped coal-laden hopper cars being handled by the yard shifter, and then caromed into freight cars of freight train No. 67HNP, which was on the adjacent westbound main track. Two locomotive units and seven cars of train No. 6BS78, nine cars of train No. 67HNP, seven cars on yard track No. 1, and four cars standing on yard track No. 3 were derailed or damaged. The conductor of train No. 67HNP and the front brakeman of train No. 6BS78 received minor injuries as a result of the accident. Damage was estimated to be about \$690,305.

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INVESTIGATION

Events Preceding the Accident

About 6:30 a.m. on November 28, 1981, three locomotive units were dispatched from the engine shop at Crewe, Virginia, and traveled west on the westbound main track, the most northerly of the tracks at Crewe. The eastbound main track is adjacent to and south of the westbound main track. The body of Crewe yard is to the south of the main tracks, and the yard office is on the north side of the main tracks. (See figure 1.)

Two of the locomotive units were intended for train No. 61, which was to depart Crewe yard on yard track No. 1. The third locomotive unit was to be added as an additional locomotive unit to train No. 67HNP, which at this time had not yet arrived at Crewe yard.

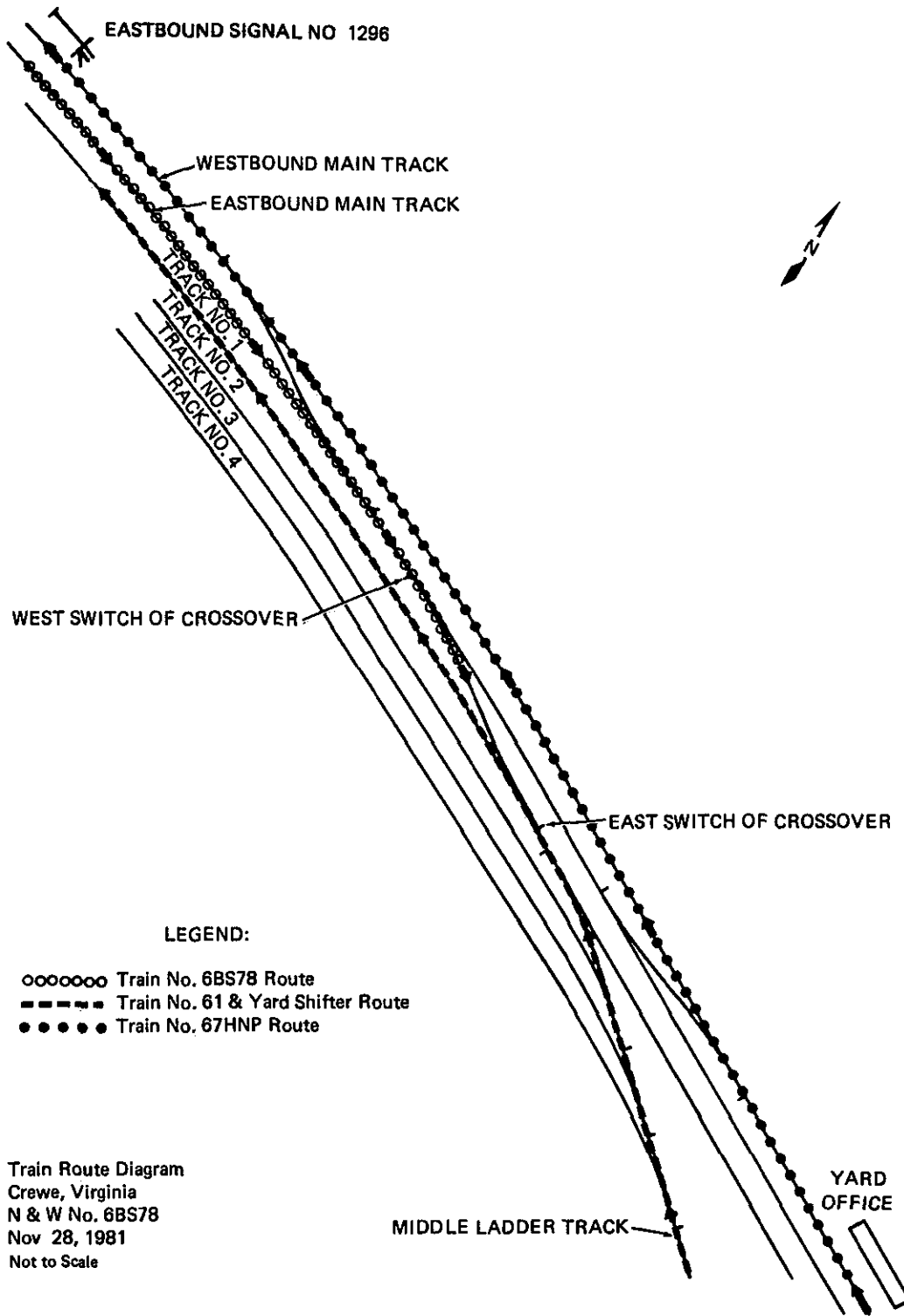


Figure 1.--Crewe Yard.

After the third locomotive unit was positioned on the westbound main track to await the arrival of train No. 67HNP, the yardmaster instructed the switchtender to align the necessary crossovers to route the two locomotive units for train No. 61 from the westbound to the eastbound main track and then from the eastbound main track to yard track No. 1 and the middle ladder track in the yard. The yardmaster testified that he had instructed the switchtender to align the crossovers such that train No. 61 would depart the Crewe yard westwardly on yard track No. 1. The switchtender however testified that he did not receive such instructions. The switchtender testified that after the locomotive units had cleared the crossovers to couple onto train No. 61, he realigned both switches of the crossover between the two main tracks to the normal position and left both switches of the crossover between the eastbound main track and yard track No. 1 in the reverse position. He further testified that he had assumed train No. 61 would depart Crewe yard westwardly by traveling on the eastbound main track to the west end of the yard and then crossing over to the westbound main track. The switchtender then returned to the yard office and did not have any further discussion with the yardmaster concerning the switches or train No. 61. The switchtender's tour of duty ended at 7:30 a.m., and the yardmaster's tour of duty ended at 7:45 a.m. The relief switchtender stated that he did not have any discussion about the switches or train No. 61 with the switchtender going off duty. (The relief switchtender testified that he was instructed by the relief yardmaster to proceed to the west end of the yard to align certain switches there. The relief switchtender further testified that he was at the west end of the yard until after the accident occurred.)

After the front brakeman had coupled the cars and locomotive of train No. 61, shortly before 7:00 a.m., the yardmaster radioed the engineer and instructed him to have train No. 61 depart the Crewe yard westbound on yard track No. 1. The train consisted of 2 locomotive units, 34 cars, and a caboosse. The engineer advanced the train up the middle ladder track and through the east switch of the crossover between the eastbound main track and yard track No. 1 and onto yard track No. 1. He then stopped the train for the initial terminal air brake test. (See figure 1.) At the time the test was being performed, the train extended back through and occupied a portion of the ladder track. At this time, the front brakeman got back on the lead locomotive unit. The engineer initially testified that before he advanced the train onto yard track No. 1 the front brakeman lined the east switch of the crossover. The engineer also testified that he did not observe the west switch of the crossover. He later testified that he did not know if the front brakeman had lined any switches and that the east switch of the crossover was lined for yard track No. 1 when he approached it.

An excerpt from Norfolk & Western operating rules, regarding enginemen states:

582. They are responsible for the vigilance and conduct of other crew members on the engine and will see that they are familiar with their duties, instructing them if necessary.

The front brakeman initially testified that he did line the east switch so that train No. 61 could enter yard track No. 1 but that he did not line the west switch to conform. He also testified that he was not aware of company operating rules which required both switches of a crossover to be lined in conformance. The front brakeman later testified that the east switch of the crossover was already lined into yard track No. 1 and that he did not line that switch or observe the west switch of the crossover. After the brake test was completed, train No. 61 departed Crewe yard at about 7:35 a.m.

About 7:00 a.m., train No. 67HNP, consisting of 4 locomotive units, 196 empty coal hopper cars, and a caboose, arrived at Crewe yard. The locomotive unit which had been positioned on the westbound main track was added to the front of train No. 67HNP to give the train adequate power for the grades it would encounter en route to Roanoke, Virginia. After the locomotive unit had been added and a relief crew arrived, an excessive leakage was noted in the air brake system. The leak was subsequently repaired and train No. 67HNP started to pull out about 8:20 a.m. on the westbound main track.

Just before 8:20 a.m., a yard shifter with 2 locomotive units was pulling about 30 coal-laden hopper cars from the ladder track onto yard track No. 1. The engineer testified that the east switch was already lined for this route. As the crew continued to the west, the engineer and the fireman, who were both in the lead locomotive unit, observed that the west end of the crossover was in the reverse, or red, position. They both testified that they attempted to radio the yardmaster and inform him of the improperly lined switch; however, the radio was in use at the time. When the yard shifter had gone farther west and had passed signal No. 1296, the engineer and the fireman both observed a green (clear) aspect. Because this signal governs the eastbound main track, the engineer and fireman stated that they assumed the yard switchtender had lined the west switch of the crossover to the eastbound main track. At this point, they stated that they could no longer see the switch or its reflectorized target because of the track curvature. Shortly thereafter, the yard shifter crew observed an eastbound train, No. 6BS78, pass on the adjacent eastbound main track.

The Accident

Shortly before 8:20 a.m., train No. 6BS78 was arriving at the Crewe yard on the eastbound main track. The 3,345-ton train, consisting of 2 locomotive units, 29 loaded and 35 empty cars, and a caboose was equipped with a two-way radio. The engineer radioed the yardmaster and received permission to pass the green (clear) eastbound signal No. 1304 at the west end of the yard. Timetable instructions require all eastbound trains entering Crewe yard limits to contact the yardmaster and receive permission to proceed. The engineer and front brakeman testified that they called out the signal indications to each other as required by the carrier's operating rules. They also called out the green (clear) indication on the eastbound signal No. 1296. As the train approached the crossover from the eastbound main track to yard track No. 1, it was proceeding through a 2-degree curve to the right. Because the engineer was preparing to stop the train for a change of crews, the speed of the train had been reduced from about 45 miles per hour to about 27 miles per hour. The locomotive was equipped with a speed recording tape. (See appendix C.) The engineer and brakeman said that they observed the switch lined into yard track No. 1 when they were about one car length away from the switch and that they both applied the automatic air brake in emergency at the same time. They stated that they then lay on the floor because of the impending collision. The train entered the west switch of the crossover at about 27 miles per hour and was routed from the eastbound main track to yard track No. 1 where it collided with the coal hopper cars being handled by the yard shifter. No. 6BS78 then struck the empty hopper cars of train No. 67HNP on the westbound main track. The locomotive of train No. 6BS78 derailed and jackknifed across the two main tracks. (See figure 2.) Four coal hopper cars on yard track No. 3 were also derailed by impact from the cars on yard track No. 1. The front brakeman on train No. 6BS78 and the conductor on train No. 67HNP received minor injuries as a result of the accident. Damage was estimated at \$690,305.

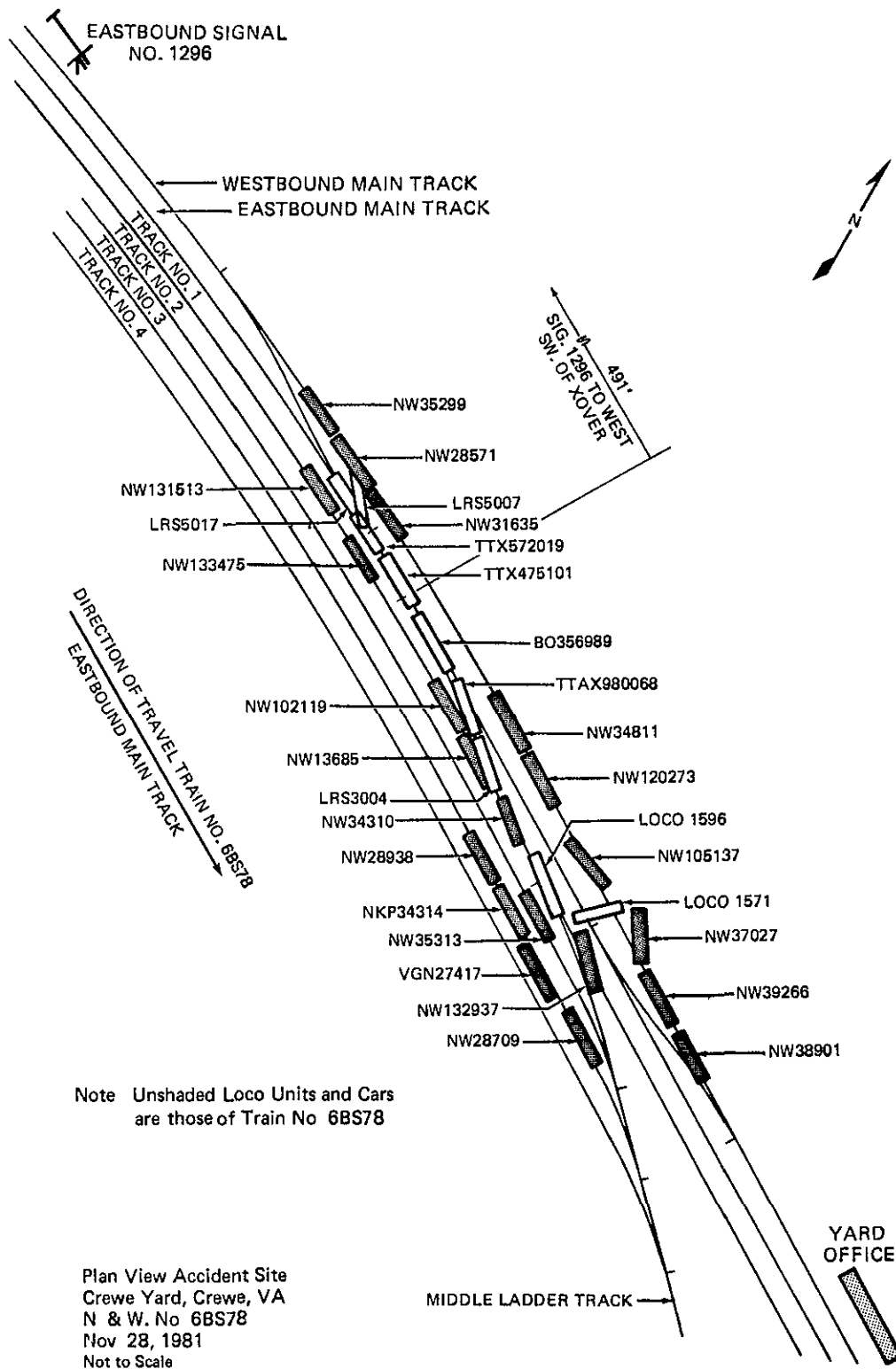


Figure 2.--Plan view of accident site at the Crewe yard.

Damage

The lead unit of train No. 6BS78, locomotive No. 1571, was damaged extensively. The short forward hood was demolished and the forward cab wall and the front right side of the cab were severely damaged. (See figure 3.) The front truck and fuel tanks and the underframe appurtenances were torn from the locomotive in the derailment. Locomotive No. 1571 was a model SD-35, 6-axle, 2,500-horsepower diesel-electric locomotive built by the Electro-Motive-Division (EMD) of General Motors. The locomotive unit weighed about 393,000 pounds and was equipped with type 26-L air brakes. The second locomotive unit, No. 1596, was damaged less severely and received only minor damages. Although the fuel tanks of both units were ruptured, there was no fire. The second locomotive unit of train No. 6BS78 was a model SD-40, 6-axle, 3,000-horsepower diesel-electric locomotive, also built by EMD. The unit weighed approximately 392,000 pounds and was equipped with type 26-L air brakes.

Seven cars of train No. 6BS78 were derailed and/or damaged: two gondolas, one loaded with pipe and equipment and the other with plate glass; three flat cars loaded with trailers; and two empty boxcars. Nine empty hopper cars of train No. 67HNP were derailed and damaged in the rebound collision with train No. 6BS78. One of the empty hopper cars was overturned, the others remained upright. Seven hopper cars laden with coal from the yard shifter job were derailed, overturned, and badly damaged. Four loaded coal hoppers on yard track No. 3 were derailed and damaged when struck by cars from yard track No. 1.

About 400 feet of mainline track and about 320 feet of yard track No. 1 were destroyed. One switch of a crossover between the two main tracks was damaged.

Damage was estimated as follows:

Equipment	\$502,720
Track	80,115
Lading	75,000
Wreck Clearing	32,470
Total	<u>\$690,305</u>

Personnel Information

The engineer of train No. 61, the engineer and fireman of the yard shifter, and the engineer and front brakeman of train No. 6BS78, were all qualified for their respective positions in accordance with N & W requirements. The front brakeman of train No. 61, although qualified for his position according to N & W requirements, had only been employed by N & W for about 4 months before the accident and had not worked on train No. 61 before. As a new man working on an extra board, he had not worked for about 3 weeks during his 4 months of experience. He testified that he had informed the engineer of his inexperience. The yardmaster, the switchtender, the section foreman, and the signal maintainer were also qualified for their respective positions. (See appendix B.)

Method of Operation

Trains are operated on the main tracks approaching and through Crewe by timetable, train orders, and the indications of an Automatic Block Signal (ABS) system. The accident occurred on the eastbound main track within the Crewe yard limits. According to the Norfolk & Western Railway Company's timetable for the Norfolk

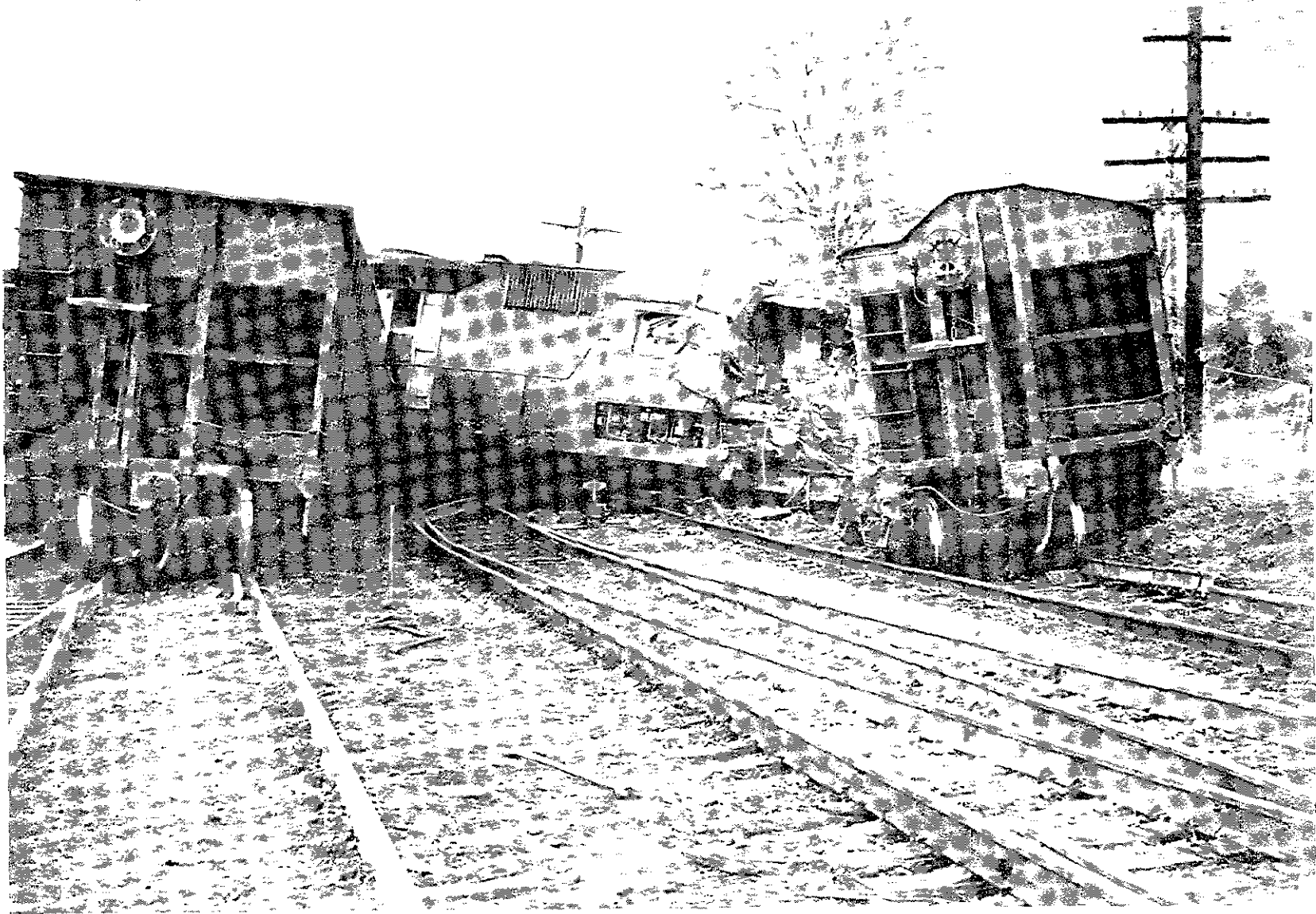


Figure 3.--Lead locomotive 1571.

Division, the yardmaster directs operations on the eastbound main track. Eastbound trains are required to secure permission from the yardmaster before entering the yard limits regardless of the signal aspect at the west end of the yard. Westbound trains are governed by the signal indications.

According to N & W rules, main track switches must be padlocked and left lined for through movement on the main tracks. A switchtender or a crewmember must obtain permission or receive instructions from the yardmaster before throwing a mainline switch.

Excerpts from Norfolk & Western operating rules regarding switches state:

104. The position of a switch or derail being used is the responsibility of the employee handling it. This, however, does not relieve other crewmembers of responsibility if they are in place to observe the position of switches and derails. Switches and derails must be properly lined and secured after having been used.

Enginemen must see that switches and derails within view from their position on engines are properly lined.

A main track switch must not be lined for the diverging movement of an approaching train or engine unless the employee attending the switch is assured of its identity and knows the movement is to use the turnout.

Except when specifically authorized by the train dispatcher or yardmaster, a main track switch must not be left open for another train or engine unless in charge of a crewmember of such train or engine or an employee assigned to handle switches.

During switching operations, an unattended main track switch must not be left open unless it is known that no other train or engine will pass over the switch.

104(a). Except as provided in Rule 104 or by special instructions, an unattended hand-operated main track switch must be left lined and locked for movement on the main track after having been used and lock must be tested to know that the switch is secured.

104(b). Employees operating switches by hand must see that they are properly lined for the movement to be made; that switch points fit up properly; and that each switch is secured by placing lock or hook in hasp, if switch is so equipped. Switches not equipped with lock or hook must be secured to the extent practicable.

During testimony taken after the accident, the Division Superintendent stated that mainline switches must "...be lined and locked for mainline movement after use unless directed differently by the yardmaster." With regard to time limits on lining switches in anticipation of mainline moves, the Division Superintendent further testified, "It would depend on train movements. We have approximately in and out of this terminal, probably anywhere between 40 and 50 trains per day. So you can't line the switch up very far in

advance and leave it." When the switchtender was asked if it was ever a practice to leave a crossover lined against the main track, he responded, "I can't say it is a good habit but it is done a lot." He further stated that, ". . .at times they [supervision] will instruct you to."

The yardmaster had at his disposal a two-way radio and a yard telephone line as well as direct contact for communicating with the switchtender and yard crews. The yardmaster does not remotely operate any switches but has to rely on the dispatcher to line the automatic switches. Track switches at the involved crossover are hand throw switches equipped with reflectorized targets and padlocks.

Position indicator lights (see figure 4) located in the yard office are used to determine if the main track switches are properly lined and if the track is occupied. The yardmaster stated that he recalled seeing that the indicator light for the eastbound main track was illuminated before the accident, indicating a vacant track and properly aligned switches. The indicator lights are operated by the track relay 1/ which is part of the signal control circuit. 2/ The Safety Board was informed that in the 30-day period preceding the accident, approximately 180 trains were operated on the eastbound main track through Crewe, Virginia.

Track Information

The main tracks through Crewe are constructed of 132-lb RE section continuous welded rail (CWR). The crossties were 7 x 9 inches and 8 feet 6 inches long and were laid in crushed granite ballast with compacted full tie cribs. The CWR was box anchored at each crosstie. The crossover at which the accident occurred consisted of two No. 12 turnouts, with bolted frogs and 22-foot switch points. Proceeding eastbound and about 149 feet west of automatic signal No. 1296, the track alignment enters a 2-degree curve to the right, which is about 755 feet long. The track is on an approximate 1/2-percent ascending grade at this location. Investigation of the west switch of the crossover revealed that the right hand (south side), 22-foot switch point and its mating 39-foot stock rail had been recently renewed. The Safety Board also noted that the stock rail had not been drilled to accept the rail connectors for the shunt wires leading to the switch circuit controller. The shunt wires and rail connectors 3/ were found lying unconnected in the ballast under the stock rail (see figure 5). The rail connector studs were bent over and the stud ends exhibited fracture surfaces which were covered with rust. (See figure 6.)

Maintenance of Way and Signal and Communication Departments' Procedures

When interviewed after the accident, the section foreman responsible for track maintenance at Crewe yard recalled renewing the switch point and stock rail but could not recall the exact date the work had been performed. The MW-10, the document used by the Maintenance of Way department (MW) to record materials charged out, indicated that the materials used in the renewal of the switch point and stock rail had been charged out on August 20, 1981. The section foreman testified, on the basis of that date, that he must have performed the work on either the 19 or 20 of August. He further testified

1/ According to the Association of American Railroads' Signal Manual a relay is: A device that is operative by a variation in the conditions of one electrical circuit to affect the operation of other devices in the same or another electric circuit.

2/ 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.

3/ See discussion — Signal Information.

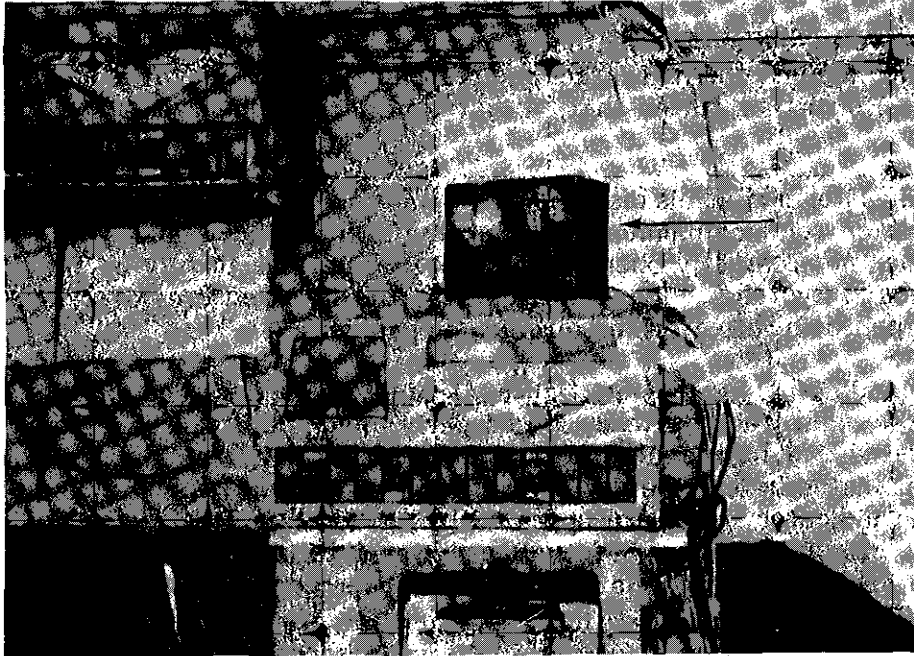


Figure 4.--Indicator lights in yardmaster's office.

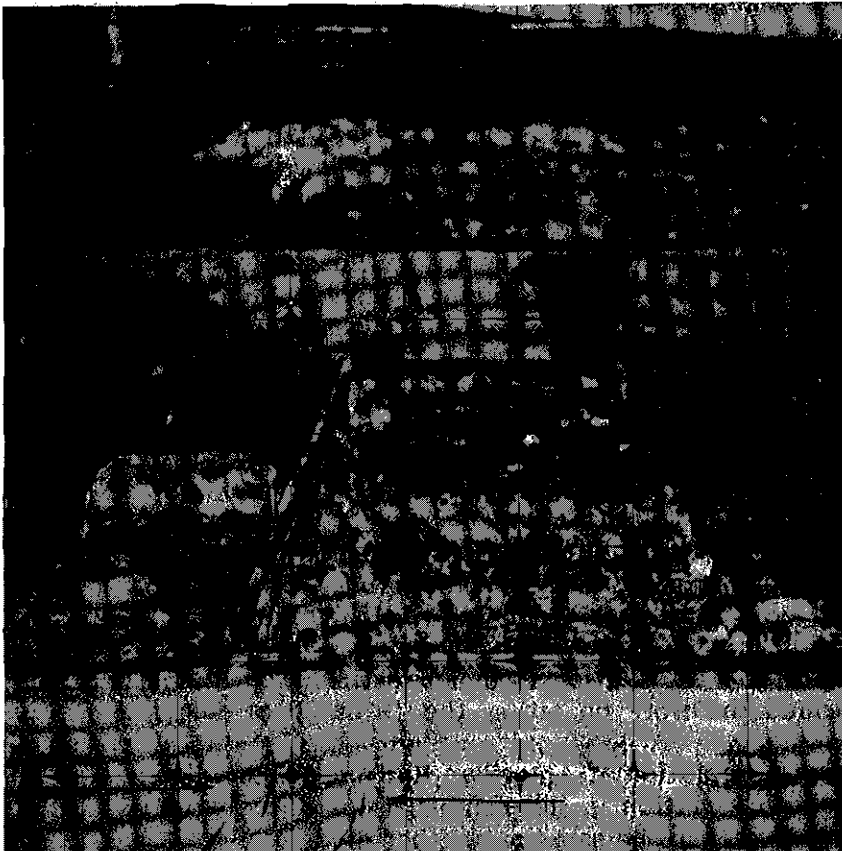


Figure 5.--Note shunt wires connected to north stock rail (arrow, foreground) and the absence of shunt wires to south stock rail (background).



Figure 6.--Shunt wires after removal from west switch of crossover.
Note bent and fractured rail connector studs.

that on the day he performed the work he went directly to the yardmaster's office and requested that the eastbound main track be taken out of service in order that the switch point and stock rail could be renewed. He also testified that he personally telephoned the Signal Supervisor's Office of the Signal and Communication Department (S & C) and requested that a signal maintainer be present at the job site while the work was being performed. The presence of a signal maintainer was required since the switch was connected to the signal system. N & W officials stated that the signal maintainer is responsible for disconnecting and subsequently reconnecting the connecting rod between the switch point and the circuit controller, and for disconnecting and subsequently reconnecting the shunt wires between the stock rail and the circuit controller. (See figure 7.) The section foreman, however, is responsible for securing the services of the signal maintainer.

Excerpts from Norfolk & Western operating rules regarding track foremen state:

644. They are responsible for the proper inspection and safe condition of the track, roadway, and structures under their charge, and shall not do work thereon that will interfere with the safe passage of trains and engines at authorized speed, except under proper protection.

They shall conform to prescribed standards and plans in the execution of work under their charge.

645. They must engage in work personally and see that their workmen safely and efficiently perform their duties. . . .

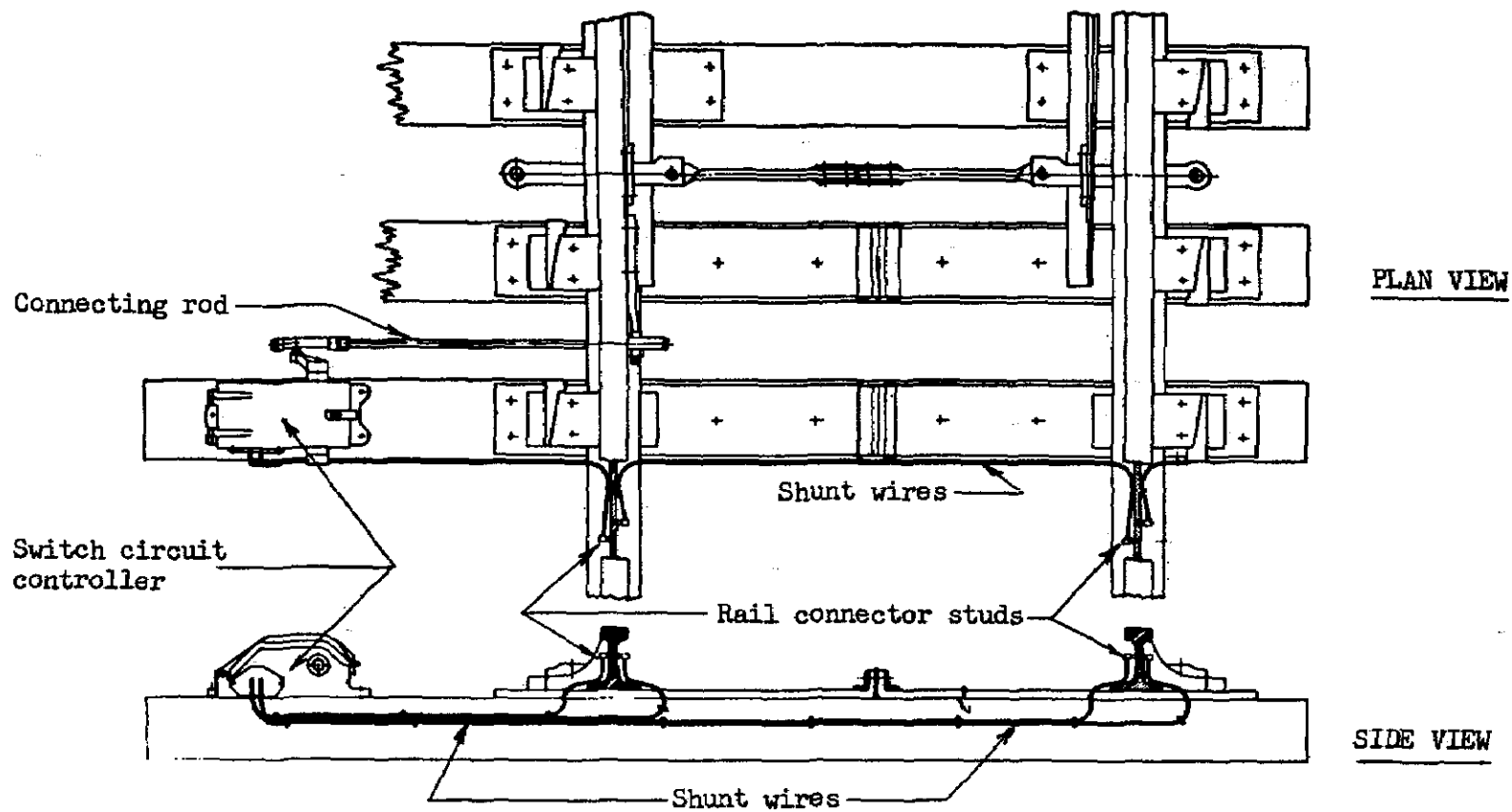


Figure 7.--Switch shunt installation.

647. Foremen should pass over their sections as necessary to inspect the condition of the roadbed track, bridges, culverts, fences, road crossings, water courses, frogs, and switches to see that they are in proper condition, and if repairs are needed, have them attended to at once.

They must properly care for insulated joints in signal territory and see that the system is not interfered with, and call upon the signal maintainer for assistance when necessary.

The section foreman testified that a signal maintainer was present when the switch point and stock rail were renewed but that he could not recall who the man was. He testified that the signal maintainer removed the circuit controller connecting rod and its switch point lug and reapplied them to the new switch point after it was installed. He further testified that the signal maintainer then left, and that he did not witness the signal maintainer remove the shunt wire connecting studs. The section foreman stated that when he completed his work he returned to the yard office and informed the yardmaster that the track could be placed back into service. He stated that he did not know if the shunt wires had been reconnected at that time, and that he did not return to verify if they had been reconnected later.

Excerpts from Norfolk & Western operating rules regarding Signal Maintainers state:

666. Maintainers report to the Supervisor Signal and Communication or other designated officer. They will be held responsible for the proper inspection, maintenance, and operation of all signal and communication devices covered by their assignment.

669. They will make frequent inspection of all apparatus under their charge and see that it is kept in proper operating condition.

672. Signal Maintainers will call upon track men to assist in renewal of insulated joints or do any other track work required for the safe and proper functioning of the signal system, and will be responsible for proper bonding of track.

677. They shall conform to prescribed standards and plans in the execution of work in their charge.

679. They must provide themselves with a copy of, be conversant with, and obey rules and instructions issued by the head of the Signal and Communication Department.

During testimony after the accident, the signal maintainer stated that he had not received any request nor had been given any instructions regarding the maintenance work performed on the west switch of the crossover. The signal supervisor at Crewe also stated that he was not aware of any such request for a signal maintainer on or about August 19 or 20. The supervisor, however, stated that he was away from his office for a part of each day tending to other duties. No written records are kept of requests by maintenance of way personnel for signal maintainers.

Signal Information

Automatic signal No. 1296, a color position light signal, governs movements on the eastbound main track through the signal block in which the accident occurred. Signal No. 1304 is the signal in approach to signal No. 1296 and is located 4,856 feet west of

signal No. 1296. When the signal block governed by signal No. 1296 is unoccupied and there are no conflicting routes lined in the block, signal No. 1296 should display a green (clear) aspect. If the block is occupied, or if one of the switches of a crossover leading from the main track is reversed, or if a switch is not fully closed for movement on the main track, signal No. 1296 should display a red (stop and proceed) aspect. When signal No. 1296 displays this aspect, signal No. 1304 should display a yellow (approach) aspect, which requires the engineer to reduce train speed and be prepared to stop for the next signal.

A red (stop and proceed) aspect on signal No. 1296 is normally caused by the imposition of a shunt ^{4/} between the two rails of a track. A shunt can be imposed by the presence of a train or by a switch that is not completely closed in the normal position. A switch lined for a diverging move should result in a shunt circuit. The track shunt removes voltage from the track relay which in turn affects the signal circuit and causes the signal to display a red aspect. The shunt is imposed by the closure of electrical contacts within a switch circuit controller. The connecting rod between the switch points and the switch circuit controller activates the closure of the contacts. The shunt circuit path proceeds through these contacts within the circuit controller through the shunt wires to the rails. (See figures 7 and 8.) The shunt wires are stranded insulated wires which have four tapered rail connectors, one at each rail end of each wire. The rail connector studs are driven into 3/8-inch holes in the web of the rails. Each running rail normally accepts two of the rail connectors.

Paragraph 236.5 of the Rules, Standards, and Instructions for signal systems (R S & I), of the Federal Railroad Administration (FRA) requires that; "All control circuits the functioning of which affects safety of train operation shall be designed on the closed circuit principle, ^{5/} except circuits for roadway equipment of intermittent automatic train stop system." The R S & I, paragraph 235.103, also requires the test and inspection of the system "... at least once every three months." N & W's Signal and Communication Rules and Instructions, in Section 359.a, require that shunt wires "...be inspected at least once each two months." The signal maintainers are required to record results of tests of switch circuit controllers on N & W's S & C Form 44. The form is specified as a 3-month test record. The last inspection form indicated that the subject switch had been tested on September 2, 1981. (See appendix E.) The form does not show that there were any exceptions taken to the condition or functioning of the switch circuit controller and connections. The signal maintainer testified that he had actually performed the inspection at Crewe on the 17 and 18 of August, 1981. He further testified that he did not fill out S & C Form 44 until early September and erroneously entered September 2, 1981, as the date for inspection of the circuit involved in the accident. The inspection form for the period prior to the one dated September 2, 1981, indicated that the switch circuit controller and connections had been inspected on May 6, 1981. There were no defects noted on this report for the circuit involved. The signal maintainer also testified that he always used a bond punch and hammer to punch out the shunt wire rail connectors because that was the only way the rail connector studs would be fit for reuse. The rail connector has a tapered stud which fits into a hole in the rail web and is driven in place and secured by a pressure fit.

^{4/} According to the Association of American Railroads' Signal Manual a shunt is: A by-path in an electrical circuit.

^{5/} 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.

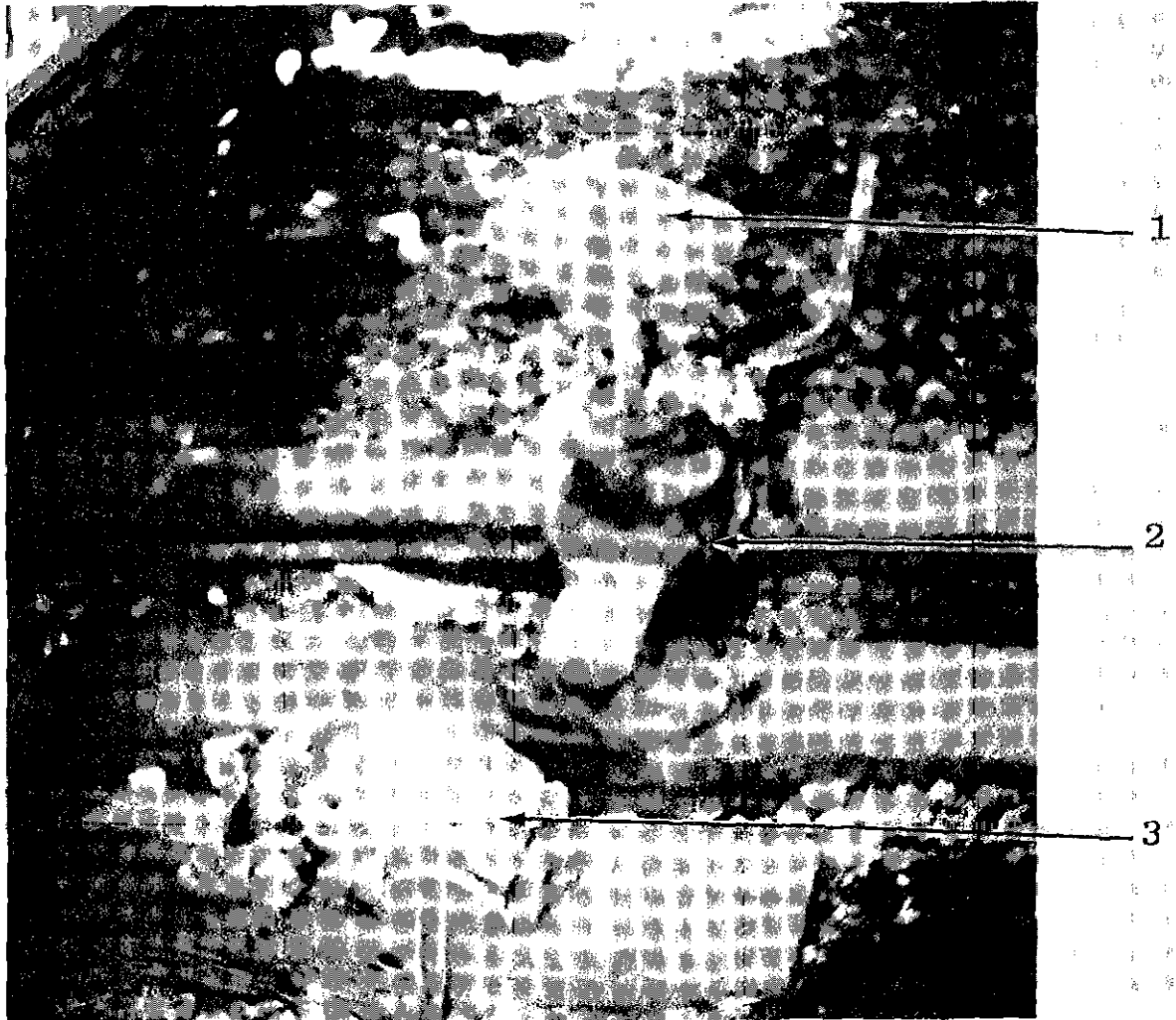


Figure 8.--Switch stand and circuit controller at west switch of crossover.

1. Reflectorized switch position indicator.
2. Hand throw switch stand.
3. Switch circuit controller.

Meteorological Information

At the time of the accident, visibility was good. The temperature was about 46° F, the humidity was about 60 percent, and winds were northerly at about 4 knots.

Tests and Research

After the accident, the circuit controller at the west switch of the crossover was opened to determine its condition. There was no external damage to the circuit controller. The contacts were found to be in proper physical correlation with the switch points being in the reversed position. Each of the contacts was found to be clean, and the pressure on each was sufficient to ensure good contact closure. After the damaged track had been replaced and the rail ends bonded, a new set of shunt wires, replacing those which were not connected before the accident, was put into service between the rails and the switch circuit controller. Signal No. 1296 was found to function in the manner in which it was designed to at this time. Officials of N & W's Signal & Communication Department (S & C) stated that signal No. 1296 would display a green (clear) aspect with the west switch of the crossover reversed, given that the shunt wires were not connected to the stock rail and that the east switch of the crossover was lined for the normal movement. The east switch circuit controller and shunt wires were in place. The N & W notified the FRA on November 30, 1981, of this failure of the signal system. (See appendix F.)

Medical and Pathological Information

The conductor of train No. 67HNP struck his back on the seat in the caboose when the train stopped in emergency. Although he stated he had pain in his lower back, he continued on duty and did not seek medical attention.

The front brakeman on train No. 6BS78 was thrown against the control stand when the locomotive derailed. He received a cut and a bruise on his left leg. He also declined medical attention and continued on duty.

Other Information

About 8:30 a.m. on November 28, 1981, the Crewe Volunteer Fire Department received a call from the N & W. The fire department immediately dispatched two fire vehicles and nine volunteer personnel responded to the scene. Although there was a fuel oil spill from the locomotives, there was no fire. The equipment and volunteers stayed at the scene, rendering assistance for a little over 1 hour, and departed at 9:45 a.m.

ANALYSIS

The Accident

The engineer and brakeman of train No. 6BS78 were alert and were operating their train in accordance with the applicable rules and regulations. They had called out the clear indications at signal Nos. 1304 and 1296 and had obtained radio permission to enter the Crewe yard. The engineer was effectively reducing the train speed for the crew change stop. Because the tracks on either side of train No. 6BS78 were occupied and because of the curve, the crew of train No. 6BS78 could not see the improperly lined switch until they were within one or two car lengths. Although they both initiated an emergency brake application as soon as they realized a collision was imminent, there was

insufficient braking distance to stop or effectively slow their train. Since signal No. 1296 displayed a green (clear) aspect while a conflicting route was lined in the block, the Safety Board concludes that when the engineer and brakeman on train No. 6BS78 viewed the green (clear) aspect on signal No. 1296 as corroborated by the engineer and fireman on the yard shifter, it was displaying a false proceed aspect. 6/

The potential false proceed condition 7/ existed because of several factors including the lack of shunt protection at the west switch of the crossover, the alignment of the east switch in the normal position while the west switch was lined in the reverse position, inadequate inspection procedures, and N & W operating practices.

Signal System Safety

The installation of a series break-type circuit, a variation of the shunt circuit which was involved in this accident, would have provided more positive protection. The involved shunt circuit was not designed on the closed-circuit principle and did not have the inherent fail-safe feature of the series break-type circuit. If the involved shunt circuit had been so designed, signal No. 1296 would have displayed a red (stop and proceed) aspect because of the unconnected shunt wires. The display of such a red (stop and proceed) aspect, even with no train occupying the governed signal block, would have indicated a fault within the signal system. The Safety Board believes that had a series break-type circuit been in place at the time of the accident, a red aspect would have been indicated, and the accident could have been avoided.

Even though the Safety Board believes that the section foreman may have requested the services of a signal maintainer, the Board believes that a signal maintainer was not present during the replacement of the switch point and stock rail. In the absence of any evidence indicating otherwise, it is reasonable to assume that this work was performed on or about August 20, 1981, the date indicated when the necessary materials had been charged out. A qualified and experienced signal maintainer would not have broken off the connector studs in a manner that rendered them unfit for reuse and would not have left the shunt wires unconnected to the new stock rail, since doing so could create a potential false proceed condition. Even though the section foreman was not qualified technically to perform signal work, he should have known that a switch without shunt wires in signalled territory would compromise the safety of the signal system. The MW and S & C Departments' lack of specific procedures and guidelines to coordinate requests for a signal maintainer's assistance may have contributed to the failure to establish a working arrangement between the section foreman and the signal maintainer.

N & W's Signal and Communication Rules and Instructions required that shunt wires ". . .be inspected at least once each two months." If the tests and inspections as required by the RS & I, had been performed on September 2, 1981, as they were reported, the signal maintainer would have discovered the lack of shunt protection at the switch. If the test and inspections of signals were actually performed on August 17 and 18, 1981, as testimony indicated, then the next test and inspection should have been performed by November 17 or 18, 1981. Since the accident occurred on November 28, 1981, the Board

6/ According to the Association of American Railroads' 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.

7/ According to the Association of American Railroads' Signal Manual a potential false proceed condition is: A condition existing in signal systems, devices or appliances, when no train is present, under which a false proceed failure would have occurred had a locomotive or train approached or entered a section of track occupied by another train.

believes that tests and inspections were not being performed within 90 days in a timely and proper manner as required by Federal Regulation. S & C supervision should have been aware that the test and inspection period of 90 days was being exceeded since that department maintains the test and inspection file records. The Safety Board concludes that had the tests and inspections been performed within the required time period, the unconnected shunt wires would have been discovered, and as a result the accident could have been avoided.

The Safety Board believes that the potential false proceed condition existed for more than 3 months. The position indicator lights in the yardmaster's office did not disclose this potential false proceed condition. The indicator lights were connected to and reflected the indication of the automatic block signal. The broken shunt wires prevented the shunt of the misaligned switch from being imposed on the signal circuit.

In its report of the investigation of a signal failure leading to the collision of a passenger train at Spencer, North Carolina, on October 8, 1977, ^{8/} the Safety Board noted several factors that have also been revealed in this accident. The circuit controller and shunt circuit which failed and caused a false proceed aspect at Spencer was the same type system which failed and caused a false proceed aspect at Crewe. In both accidents, the operating procedures that were used to augment the signal system for the protection of trains proved inadequate. As a result of its investigation at Spencer, the Safety Board recommended that the Federal Railroad Administration (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. (Class II, Priority Action) (R-78-23)

The FRA has not yet taken any action in response to the recommendation and it remains in an "Open--Unacceptable Action" status. The FRA responded that a shunt circuit is not an electrical circuit and therefore not subject to the provisions of 49 CFR 236.5. The Safety Board believes 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. The sequence of events that occurred in this accident is not the only means by which shunt wires become disconnected. Routine maintenance operations, such as machine switch tamping, can and often does result in broken shunt wires. If the track shunt circuit protection is not a fail-safe design, a potential false proceed condition may then occur.

The FRA further responded that the conversion costs would be prohibitive. The Safety Board recognizes that the implementation of this recommendation would be a large undertaking. However, the replacement of switch shunting circuits with series break-type

^{8/} For more detailed information read Railroad Accident Report--"Side Collision of Southern Railway Company Trains Nos. 1 and 152, Spencer, North Carolina, October 8, 1977" (NTSB-RAR-78-3).

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 based on a lifespan replacement cycle.

Operating Practices

The switchtender's testimony and actions in having lined both switches of the crossover from the eastbound main track to yard track No. 1 in the reverse position indicated that he had not completely understood the yardmaster's instructions. The yardmaster was unable to discern the improperly lined switches because the hopper train on the westbound main track obstructed his view and the indicator lights in the yard office reflected the false proceed aspect on signal No. 1296. The switchtender testified that switches have been left lined against the main tracks and that yardmasters and switchtenders may have been leaving crossover switches improperly aligned routinely. Even though the signal system was ineffective, the Safety Board believes that this accident could have been averted if local supervision had ensured strict compliance with the operating rules regarding the requirement to line crossover switches in their normal position when not in use for an immediate move through the crossover. The Board believes that supervisory personnel should ensure adherence to these operating rules.

Train No. 61 was the first to use the east switch of the crossover between the eastbound main track and yard track No. 1. Since that switch had been previously lined into the main track by the switchtender, the Safety Board concludes that a crewmember of that train must have relined the east switch of the crossover to its normal position for yard track No. 1. In the absence of a switchtender, the front brakeman is responsible for lining switches. The front brakeman on train No. 61 was inexperienced and had admitted that he was unaware of the operating rule requiring both ends of a crossover to be lined in agreement. This accident could have been averted if the west or main track switch of the crossover as well as the east or yard track switch had been lined to their normal positions as required by N & W rules 104, 104(a) and 104(b). In addition, the engineer of train No. 61 failed to exercise good judgment and violated N & W rule 582 by not monitoring the activities of the inexperienced front brakeman. The engineer was aware of the brakeman's inexperience and should have monitored his actions.

Survivability

The engineer and front brakeman on train No. 6BS78 did not have an opportunity to escape before the collision. They could not have been aware of an imminent collision until they were almost upon the misaligned switch. At a speed of about 27 miles per hour, and given the available sight distance of about two car lengths, the crew would have had approximately 3 seconds of warning. Also, the adjacent tracks on both sides of their locomotive were occupied, further negating any opportunity to jump clear. The shallow angle of convergence of the locomotive of train No. 6BS78 into the side of the coal-laden hopper cars on track No. 1 probably lessened the effect of the collision forces attenuated during the primary impact. The glancing effect of the first side collision to the right served in maintaining the structural integrity (crashworthiness) of the locomotive operating compartment. After the first impact, the locomotive was deflected to the left into the empty hopper cars on the westbound main track. The substantial mass of the locomotive, in contrast with the hopper cars, further served to minimize the crash damage sustained by the locomotive.

CONCLUSIONS

Findings

1. Maintenance of Way and Signal and Communication Departments' procedures were ineffective in ensuring that a signal maintainer was present when maintenance of way work involved the signal system and its connections to the track.
2. Tests and inspections, as required by the Rules, Standards, and Instructions of the Federal Railroad Administration were not being performed by the Signal and Communication Department.
3. Inspection of shunt wires, as required by Norfolk and Western Signal and Communication Rules and Instructions, was not being performed properly by the Signal and Communication Department.
4. The type of shunt circuit system involved in this accident was not designed on the closed-circuit principle, and did not have an inherent fail-safe feature when the shunt wires were removed or broken from the rails.
5. The potential false proceed condition of signal No. 1296 existed for more than 3 months before the accident when the shunt wires at the west switch of the crossover were probably broken off during replacement of the stock rail on or about August 20, 1981.
6. Both switches of the crossover from the eastbound main track to yard track No. 1 were left unattended and lined in the reverse positions by the yard switchtender.
7. The east switch of the crossover from the eastbound main track to yard track No. 1 was probably lined to the normal position and the west or main track switch was left in the reverse position, by the inexperienced brakeman of train No. 61.
8. Local supervisory procedures at Crewe did not ensure consistent compliance with operating rules regarding switches.
9. Automatic signal No. 1296 was displaying a green (false proceed) aspect when train No. 6BS78 approached the signal on November 28, 1981, because the shunt wires at the misaligned west switch of the crossover were not connected.
10. Position indicator lights in the yardmaster's office were not effective in disclosing the false proceed condition.
11. Train No. 6BS78 was operated in accordance with applicable rules and regulations.
12. The dynamics of the collisions were favorable to maintaining the structural integrity (crashworthiness) of the locomotive's operating compartment.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the display of a false proceed aspect at the entrance to the signal block in which a conflicting route had been lined and the fact that the crew of train No. 6BS78 could not see the misaligned switch in time to stop their train short of a collision. Contributing to the accident were (1) inadequate supervision to insure compliance with operating rules regarding the alignment of switches, (2) the lack of coordinating procedures in the Maintenance of Way and Signal and Communication Departments which would insure the presence of a signal maintainer when maintenance of way work which might affect signals was undertaken, and (3) careless performance of scheduled inspections of signalized switches.

RECOMMENDATIONS

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

--to the Norfolk and Western Railway Company (N & W)

Replace, as soon as practicable on a priority basis, track shunt circuit switch protection that does not have series break-type circuits, with series break-type circuits. (Class II, Priority Action) (R-82-43)

Establish effective coordination procedures in the Maintenance of Way and Signal and Communication Departments, to make certain that maintenance of way work which involves the signal system will not result in improper functioning of the signal system. (Class II, Priority Action) (R-82-44)

Review and revise, where necessary, procedures presently in effect in the Signal and Communication Department governing the maintenance and tests of signals to make certain that tests and inspections are performed in accordance with the Federal Railroad Administration's Rules, Standards, and Instructions. (Class II, Priority Action) (R-82-45)

Enforce effective supervisory monitoring practices in the Operating Department to seek consistent compliance with operating rules regarding switches. (Class II, Priority Action) (R-82-46)

--to the Association of American Railroads:

Inform its membership of the facts and circumstances of the accident which occurred at Crewe, Virginia, on November 28, 1981, and recommend to its member railroads that they assess their track shunt circuit protection systems and inspection procedures, and take corrective action as necessary to prevent similar accidents. (Class II, Priority Action) (R-82-47)

--to the Federal Railroad Administration:

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 series break-type circuits on a priority basis. (Class II, Priority Action) (R-82-48)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES E. BURNETT, JR.
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G. H. PATRICK BURSLEY
Member

May 18, 1982

APPENDIXES

APPENDIX A

INVESTIGATION

Investigation

The National Transportation Safety Board was notified of the accident about 3:45 p.m., on November 28, 1981. The Safety Board immediately dispatched an investigator from the Railroad Accident Division in Washington, D.C. Subsequently, two other investigators joined the investigation. The investigators were specialists in the fields of operations, signal engineering, and track engineering. The Norfolk and Western Railway Company cooperated in the investigation. Sworn statements of seven principals involved in the derailment were taken by the Safety Board investigators.

APPENDIX B

PERSONNEL INFORMATION

Engineer - Train No. 61

Gray, Albert Wayne, was first employed by the N & W as a road brakeman on April 5, 1966. He was promoted to a road conductor on December 15, 1971. On June 12, 1978, he entered a fireman's trainee program, and on November 20, 1978, he was promoted to a locomotive engineer. He was last examined on N & W operating rules on November 3, 1981. He passed a company physical examination on June 12, 1979.

Brakeman - Train No. 61

Shrewsbury, Allan Lee, was first employed by the N & W as a yard brakeman at Roanoke, Virginia, on July 17, 1981. He transferred to a road brakeman position on August 25, 1981. He was examined on N & W operating rules on November 3, 1981. He passed a company physical examination on July 7, 1981, prior to his acceptance for employment. He was not a promoted conductor.

Engineer - Yard Shifter

Craig, James Russel, was first employed by the N & W as a yard fireman at Crewe, Virginia, on May 3, 1955. He was promoted to yard engineer on May 9, 1957. He was last examined on N & W operating rules on March 17, 1981. He passed a company physical examination on August 18, 1981.

Fireman - Yard Shifter

Phelps, Clarence Edwin, was first employed by the N & W as a yard fireman at Crewe, Virginia, on October 20, 1955. He was promoted to yard engineer on October 1, 1962. He was last examined on N & W operating rules on March 16, 1981. He passed a company physical examination on August 24, 1981.

Engineer - Train No. 6BS78

Deck, Wiley Lavelle, was first employed by the N & W as a fireman on February 10, 1947. He was promoted to engineer on November 2, 1955. He was last examined on N & W operating rules on March 16, 1981. He passed a company physical examination on June 26, 1980.

Brakeman - Train No. 6BS78

Peters, Theron Daniels, was first employed by the N & W as a brakeman on August 15, 1951. He was promoted to conductor on May 20, 1964. He was last examined on N & W operating rules on March 10, 1981. He passed a company physical examination on May 14, 1981.

Yardmaster - Crew Yard

Moring, Percy William Jr., was first employed by the N & W as clerk on September 13, 1955, at Crewe, Virginia. He was awarded a position as a relief yardmaster on July 4, 1966, and as a base agent on June 25, 1979. He was appointed yardmaster at

Crewe on September 1, 1979. He was last examined on N & W operating rules on March 17, 1981. He passed a company physical examination in October, 1981.

Switchtender - Crewe Yard

Queensberry, Floyd Gill, was first employed by the N & W as a yard brakeman at Crewe, Virginia, on September 6, 1960. He was promoted to a yard conductor on February 5, 1970. He was last examined on N & W operating rules on September 24, 1981. He passed a company physical examination on July 5, 1979.

Section Foreman - Crewe Yard

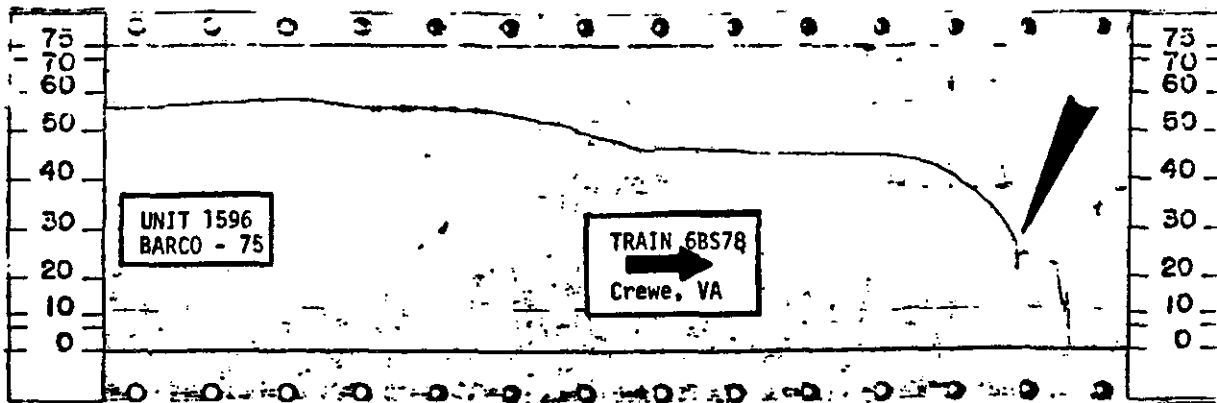
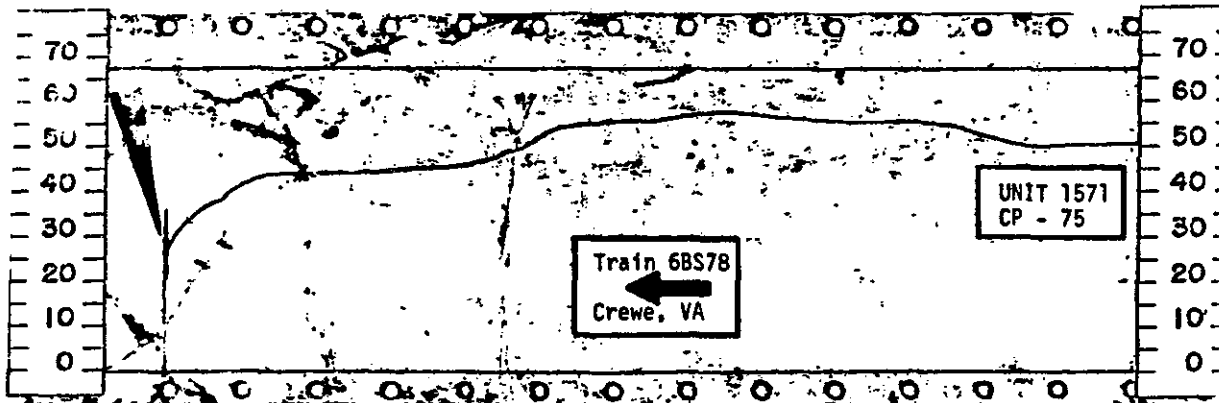
Robertson, Clarence Henry, was first employed by the N & W on May 20, 1947, as a track laborer. He was promoted to assistant section foreman on December 16, 1968, and to section foreman on August 3, 1970. He was disqualified as a foreman on May 31, 1977, and on June 9, 1977, returned to the position of laborer. He was promoted to section foreman again on April 1, 1979. He was last examined on N & W operating rules on July 8, 1981. He passed a company physical examination on August 14, 1972.

Signal Maintainer

Schenck, Phillip Robert, Jr., was first employed by the N & W as a clerk on January 25, 1968. On December 3, 1970, he entered train service as a yard brakeman at Crewe, Virginia. He was assigned a position as an assistant signal maintainer on September 24, 1973. He was promoted to signal maintainer on October 5, 1973. He was last examined on N & W operating rules on April 7, 1977. He passed a company physical examination in March 1973.

APPENDIX C
SPEED RECORDING TAPE

DERAILMENT TRAIN 6BS78 - November 28, 1981
Norfolk Division Crewe, VA
Locomotives 1571 - 1596
29 Loads 35 Empties 3,337 Tons



Office General Manager Motive Power & Equipment
Roanoke, Va., November 30, 1981

H. Miller
11/30/81

APPENDIX D

MW-10--MATERIALS CHARGEOUT DOCUMENT

EXHIBIT 16

C. H. Pittman
 Location: Camden, Md.
 Date: Aug 3 1981
 Transferred by: John Laman

0422 122 65
 040793970 EA P.O. BOX 30132 RR
 060832214 0 EA P.O. BOX 30132 RR
 340 30132 / 30 P.O. BOX 30132 RR
 3 040 70225 / 19 P.O. BOX 30132 RR

QTY	CLASS	DESCRIPTION	UNIT	DATE	BY	TRUCK OR TRAILER	NO. OF SERIALS	DATE	BY	TRUCK OR TRAILER
3	040 025088	BOLT, TRACK	EA							
3	040 003713	3/8" SPIKE, TRACK	EA							
150	040 001319	3/8" ANCHOR, RAIL	EA							
	040 071891	3/8" CROSSING; FEED X-ING	EA							
	040 115988	3/8" FEET, BOLTED O.H.	EA							
	040 192675	3/8" JOINT, OVER	EA							
1	040 77629	3/8" BOLT, 5/16"	EA							
1	040 82256	3/8" BOLT, 5/16"	EA							

All Date Received: AUG 27 1981
 All Date Forwarded: AUG 3 1981
 I/O Date Received: _____
 I/O Date Forwarded: _____

Norfolk and Western Railway Company

S & C 44-4M
Revised 6-1-74

TEST 14 - SWITCH CIRCUIT CONTROLLERS
TEST 15 - INSULATED RAIL JOINTS AND SWITCH INSULATION
TEST 16 - FOULING CIRCUITS OF SWITCHES
3-MONTH TEST RECORD

MAINTAINER'S SECTION						DISTRICT										DIVISION									
<i>Chew, Jr</i>						<i>#1</i>										<i>Norfolk</i>									
SWITCH	DERAIL	END COVER	LOCATION OR NUMBER	SW CIR CONTL ADJUST		FOULING CIRCUIT TEST		SW POINT BAR TEST	BOOTLEGS & C-NECT'NS	FOUL WIRE & BONDS	INSULATED JOINTS	SW STAND DR MECH	OPERATING RODS & FITTINGS	LOCK RODS & FITTINGS	POINT DET RODS & FITTINGS	HEAD BLOCK & CRANK TIES	P. C. DERAIL OR B. L.	PIPE LINE & FITTINGS	STOCK RAILS & BRACES	SWITCHES & HEEL BLOCKS	TRACK GAUGE	SPRING SWITCH	ELEC LOCK	SW CIR CONTL. C-NECT'NS	DATE TESTED
				NIR	RFV	WITH SHUNT AT FOULING POINT	WITH SW OR DERAIL OBSTRUCTED																		
A	✓	✓	1207-7	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-2-81	
B	✓	✓	-8	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-2-81	
C	✓	✓	1293-1	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-2-81	
D	✓	✓	-2	OK	OK	.1	.1	OK	OK	OK	OK												OK	9-2-81	
E	✓	✓	-3	OK	OK	.1	.1	OK	OK	OK	OK												OK	9-2-81	
F	✓	✓	-4	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-2-81	
G	✓	✓	-5	OK	OK	.1	.1	OK	OK	OK	OK												OK	9-2-81	
H	✓	✓	-6	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-2-81	
I	✓	✓	-7	OK	OK	.0	.0	OK	OK	OK	OK						OK	OK					OK	9-2-81	
J	✓	✓	1301-1	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-3-81	
K	✓	✓	1301-2 (D)	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-3-81	
L	✓	✓	-3	OK	OK	.1	.1	OK	OK	OK	OK						OK	OK					OK	9-3-81	
M	✓	✓	200L-1	OK	OK	.0	.0	OK	OK	OK	OK						OK	OK					OK	9-3-81	
N	✓	✓	1882-1	OK	OK	.1	.1	OK	OK	OK	OK						OK	OK					OK	9-3-81	
O	✓	✓	1901-1	OK	OK	.1	.1	OK	OK	OK	OK						OK	OK					OK	9-3-81	
P	✓	✓	-2	OK	OK	.0	.0	OK	OK	OK	OK						OK	OK					OK	9-3-81	
Q	✓	✓	1784-1	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-3-81	
R	✓	✓	-2	OK	OK	.0	.0	OK	OK	OK	OK												OK	9-3-81	
S																									
T																									
U																									
V																									
W																									
X																									
Y																									
Z																									

2 removed pages here

SIG MTR. *[Signature]*
SECT. FOR 'N'
SECT FOR 'N'

S & C 44--SIGNALS TEST RECORD

APPENDIX E

APPENDIX F

DOT, FRA, FALSE PROCEED SIGNAL REPORT

DEPARTMENT OF TRANSPORTATION FEDERAL RAILROAD ADMINISTRATION FALSE PROCEED SIGNAL REPORT	REPORT DATE (month and year) November 1981 DATE November 30, 1981
All false proceed signal reports of the Federal Railroad Administration shall submit a false proceed signal report only to the Federal Railroad Administration within 30 days after a false proceed signal is later proved to be one during any calendar month, a report using "False Proceed" must be filed within ten days after the end of the month. Copies of this form will be furnished upon request to the Department of Transportation, Federal Railroad Administration, Office of Safety, Washington, D.C. 20598 MAIL TO:	REPORTING CARRIER (railroad & region or division) Norfolk and Western Ry. Co. Eastern Region Norfolk Division
Director of Railroad Safety, Region I Federal Railroad Administration Independence Building, Room 1020 434 Walnut Street Philadelphia, Pennsylvania 19106	REPORTING OFFICER (signature/title) H. L. Scott, Jr. Vice President-Operations

A failure should not be counted more than one time in items 1, 2, 3, and 4 the failure should be classified under the basic system or application of which it forms an essential part. For example, ground to cause a block signal to indicate a false proceed causing corresponding indications of a cab signal system on each train approaching this point, such failures should be included in item 1 Block Systems.
 A false proceed failure is a failure of a system, device or appliance to indicate or function as intended which results in less restriction than intended.

The following abbreviations may be used in the report:
 A-Automatic
 AB-Automatic block
 ACS-Automatic cab signal
 APB-Absolute permissive block
 ATC-Automatic train control
 ATS-Automatic train stop
 CL-Color light
 CPL-Color position light
 E-Electric
 EM-Electromechanical
 EP-Electropneumatic
 FP-False proceed
 MB-Manual block
 M-Mechanical
 P-Pneumatic
 PL-Position light
 SA-Semi-automatic
 TC-Traffic control

TYPE OF SYSTEM	DATE	LOCOMOTIVE NUMBER	DEVICE THAT FAILED	LOCATION (city and state)
1 BLOCK SYSTEMS <input checked="" type="checkbox"/> AB <input type="checkbox"/> APB <input type="checkbox"/> TC	11/28/81	1571	Hand-Throw Switch Protection	Crewe, Virginia
2 INTERLOCKING <input type="checkbox"/> REMOTE <input type="checkbox"/> MANUAL <input type="checkbox"/> AUTO MATIC				
3 AUTOMATIC SYSTEMS <input type="checkbox"/> ATS <input type="checkbox"/> ATC <input type="checkbox"/> ACS				
4 OTHER (specify)				

NATURE AND CAUSE OF FAILURE CORRECTIVE ACTION TAKEN
 At approximately 8:20 a.m., Saturday, November 28, 1981, NW Train No. 78, Units 1571 and 1596, Engineer D. L. Deck and Conductor R. A. St. Clair, passed CPL Automatic Block Signal 1296 displaying a clear aspect. After passing Signal 1296, the Enginemen noticed the facing point hand-operated main track switch, leading from the eastward main track to the No. 1 yard lead at Mile Post 129.5, was lined reverse for movement to the yard track. Being unable to stop, Train No. 78 entered the crossover and collided with a standing cut of cars on the yard track.

Investigation determined that switch protection on the main track switch was not effective due to broken shunt wires from the switch circuit controller to the south stock rail, which allowed Signal 1296 to display a clear aspect for main line movement with the facing point hand-operated switch lined in the reverse position.

After the derailment was cleared and track damage was repaired, the broken shunt wires were replaced and the signal system was checked out and found to be operating properly before being restored to service.

Formal investigation will be held to determine responsibility in connection with the ineffective switch protection.