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RAILROAD ACCIDENT REPORT

Collision Of
Missouri Pacific Railroad Company
Freight Train Extra 615 South
With A Standing Locomotive

Cotulla, Texas
December 1, 1973

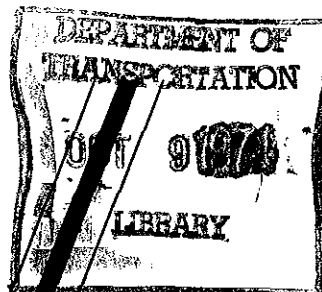
NATIONAL TRANSPORTATION SAFETY BOARD



NATIONAL TRANSPORTATION SAFETY BOARD
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Adop ted: June 27, 1974

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16. Abstract <p>At 8:30 a.m., on Saturday, December 1, 1973, Missouri Pacific Railroad Company freight train Extra 615 South (train DMX) entered Cotulla, Texas. Train DMX was traveling on a nonsignalized main track at a speed of 35 to 40 mph. Just after it passed over a grade crossing, the train was diverted through a switch onto an adjacent track where an unmanned locomotive, a caboose, and 11 cars were standing. Train DMX collided with the standing locomotive before any appreciable braking. The collision derailed all of the locomotive units and 29 railroad cars. Three crewmembers who were riding in the lead locomotive unit of train DMX were killed.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the establishment of a collision route for train DMX by the unauthorized operation of a switch by persons unknown. Contributing to the collision were railroad operating practices which authorize engineers to operate trains at speeds at which they could not stop short of a switch target which indicates the switch is improperly aligned. Contributing to the severity of the collision was the fact that the crewmembers of the locomotive of train DMX did not identify the open switch and apply the train's brakes soon enough to slow the train.</p> <p>The report contains recommendations to the Missouri Pacific Railroad Company and the Federal Railroad Administration.</p>			
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FOREWORD

The accident described in this report was designated a major accident by the National Transportation Safety Board under the criteria established in the Safety Board's regulations.

This report is based on facts obtained from an investigation conducted by the Safety Board, with the cooperation of the Federal Railroad Administration. The conclusions, the determination of probable cause, and the recommendations are those of the Safety Board.

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SYNOPSIS

At 8:30 a.m. on Saturday, December 1, 1973, Missouri Pacific Railroad Company freight train Extra 615 South (train DMX) entered Cotulla, Texas. Train DMX was traveling on a nonsignalized main track at a speed of 35 to 40 mph. Just after it passed over a grade crossing, the train was diverted through a switch onto an adjacent track where an unmanned locomotive, a caboose, and 11 cars were standing. Train DMX collided with the standing locomotive before any appreciable braking. The collision derailed all of the locomotive units and 29 railroad cars. Three crewmembers who were riding in the lead locomotive unit of train DMX were killed.

The National Transportation Safety Board determines that the probable cause of this accident was the establishment of a collision route for train DMX by the unauthorized operation of a switch by persons unknown. Contributing to the collision were railroad operating practices which authorize engineers to operate trains at speeds at which they could not stop short of a switch target which indicates the switch is improperly aligned. Contributing to the severity of the collision was the fact that the crewmembers in the locomotive of train DMX did not identify the open switch and apply the train's brakes soon enough to slow the train.

FACTS

The Accident

Extra 615 South. At 4:15 a.m., on Saturday, December 1, 1973, Missouri Pacific Railroad Company (MP) freight train Extra 615 South (train DMX) departed South San Antonio, Texas, for Laredo, a trip of 148 miles. The crew consisted of an engineer, an engineer-trainee, two brakemen, and a conductor.

Before the train departed South San Antonio, the crew tested the air-brakes. The train stopped for scheduled inspections 27 miles and 49 miles south of South San Antonio. No exceptions were taken during either

inspection. Train DMX then proceeded to Derby and Gardendale to pick up railroad cars destined for Laredo. The brake-line pressure registered 70 psi in the caboose during the trip. All stops were normal.

Train DMX departed Gardendale, 75 miles south of South San Antonio, at 8:15 a.m., with a consist of five locomotive units, 114 loaded cars, 9 empty cars, and a caboose. The weather was clear and bright, and visibility was good. The engineer, the engineer-trainee, and one brakeman rode in the lead locomotive unit, which was operating with the short end forward. The last radio communication between the head-end crew and the two crewmembers in the caboose was the engineer-trainee's acknowledgment of the conductor's instructions to proceed from Gardendale. This communication led the conductor to believe that the engineer-trainee was operating the locomotive.

The collision. Since the 6-mile section of track from Gardendale to Cotulla generally was on a downgrade, train DMX was able to accelerate to 35 to 40 mph when it reached Cotulla at 8:30 a.m. The train's whistle was sounded for the northernmost grade crossing in Cotulla and again as the train approached the crossing with Tilden Street. (See Figure 1.) Just after the lead locomotive passed the Tilden Street grade crossing, train DMX was diverted through a switch onto a house track adjacent to the main track. The north switch of the house track was 45 feet south of the center of the grade crossing. While the last two locomotive units of train DMX were still on the grade crossing, the brakes of the train were applied. Sparks between the locomotive wheels and the rails indicated that braking had become effective just before the lead locomotive unit collided head-on with an unoccupied locomotive which was standing on the house track, approximately 310 feet south of the center of the Tilden Street crossing.

The "Cotulla Switcher." The standing locomotive hit by train DMX was part of the consist of the "Cotulla Switcher," the last train to operate in the accident area before train DMX. The switcher was engaged in putting railroad cars at Gardendale and Cotulla into the proper order for movement to Mexico. The train's assignment was temporary and had been in existence for 2 weeks before the accident. During operation, the train was manned by an engineer, a conductor, and two brakemen; an assistant trainmaster oversaw the overall operation.

The crew of the switcher had reported to work at Cotulla at 6 p.m., on November 30. Most of the work that night was at Gardendale. At some time before 11 p.m., the crew started the return trip to Cotulla to quit work for the night. At that time, the switcher consisted of the single locomotive unit, 11 loaded cars, and a caboose. The engineer and one brakeman were in the locomotive, which had the short end headed in the direction of movement. The other two crewmembers and the assistant trainmaster were riding in the caboose. The crew intended to leave the train on the house track with the locomotive and the caboose coupled

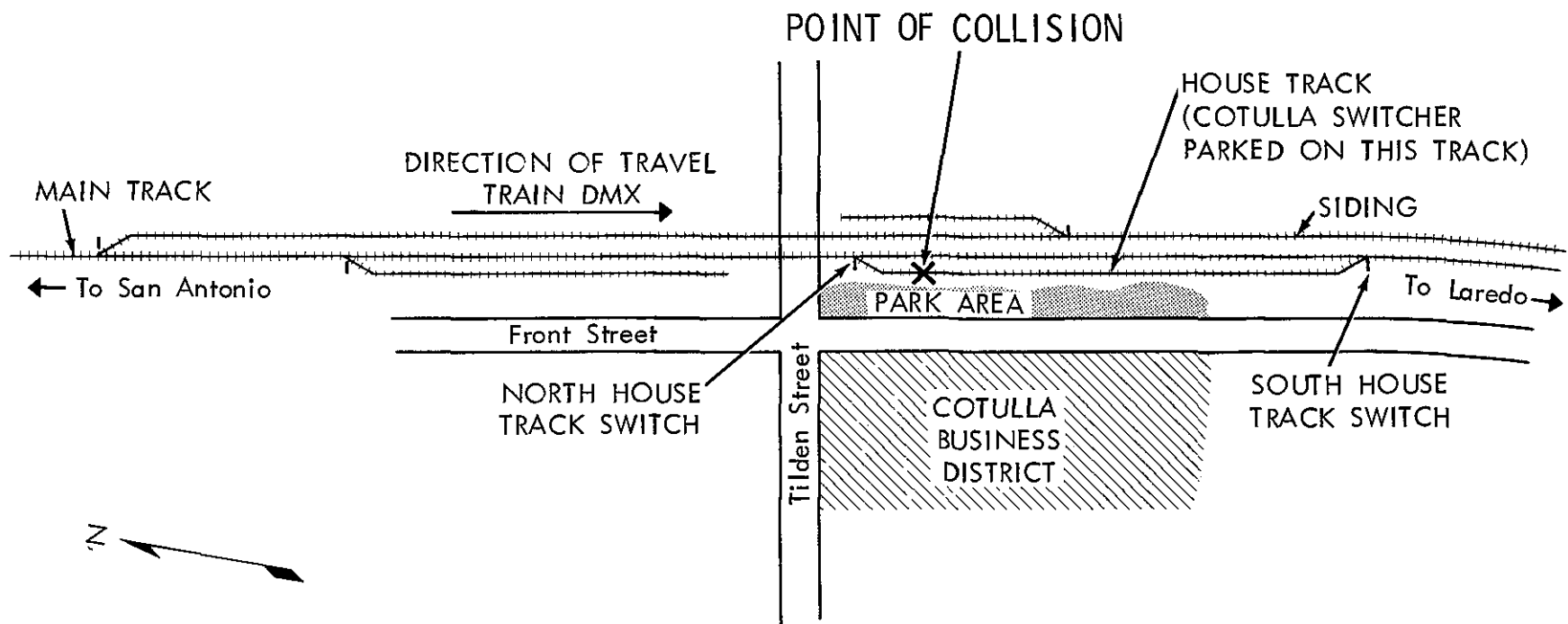


Figure 1. Sketch of Accident Area, Cotulla, Texas

together at the north end of the track, as they had done on previous nights. To accomplish this, the locomotive had to uncouple from the train after it pulled onto the house track and then had to run around the standing cars via the south switch, the main track, and the north switch.

During this maneuver, the front brakeman accompanied the locomotive, while the rear brakeman remained at the north house-track switch. As the locomotive moved north on the main track past the north switch, the rear brakeman aligned the switch for movement onto the house track. The front brakeman told the rear brakeman to get on the locomotive and that he (the front brakeman) would realign the switch and derail.

As the locomotive passed through the north switch at 2 or 3 mph, the engineer watched the front brakeman intermittently in his rearview mirror. The engineer saw the front brakeman bend over the switch stand. When he looked back again, the engineer did not see the reflectorized switch-stand target, although the locomotive headlight was still shining at the switch. Because the front brakeman had not signaled the engineer to stop, the engineer continued southward and coupled the locomotive onto the caboose. The engineer then left the locomotive idling, with the independent and service brakes fully applied.

The front brakeman stated that he aligned the north house-track switch for main-track movement, locked a padlock in the hasp of the south foot latch of the switch stand, pulled on the chain to ensure that the lock was secured, and directed the beam of his lantern on the switch points to see that they were properly aligned. He indicated that all was in order and that the switch had the normal drag when he had thrown it. He then walked to the north derail, closed it over the rail, and locked it with a padlock. Shortly thereafter, the brakeman departed Cotulla in his automobile for his home in San Antonio.

The rear brakeman, the conductor, and the assistant trainmaster confirmed that the front brakeman locked the north derail. The rear brakeman and the assistant trainmaster did not observe the position of the north house-track switch after the locomotive moved onto the house track. The conductor said that he directed the beam of his lantern toward the switch from the vicinity of the north derail and that he was satisfied that everything was in order. The crew left Cotulla at 11:05 p.m., on November 30, more than 9 hours before the collision.

Accident Site

The main track of the MP through Cotulla had a north/south orientation and was paralleled on the west by Front Street. Cotulla is a city with a population of about 4,000. In the area of the Cotulla house track, a small park, about 100 feet wide, separated the two tracks from

Front Street. On the west side of Front Street were many business establishments; the street was illuminated by street lights. The tracks, however, were shielded from direct view by a row of shrubbery parallel to the house track.

The track. The main track was straight for about 4,000 feet north of the Tilden Street crossing. About 200 feet north of the crossing, the main track began a 0.3-percent upgrade to the south. The house track was 1,225 feet long and was 15 feet center-to-center from the main track.

The north switch of the house track was a No. 10 turnout with 15-foot long switch points. The switch was thrown by a low ground-throw switch stand. The hand lever on the switch stand was operated in a 180° vertical arc. (See Figure 2.) The hand lever could be secured by two foot latches, companions to the Ramapo Ajax Model 109-109B-110 switch stand. Each foot latch was mounted on one of the two head-block ties which supported the switch stand. The switch stand was equipped with a "high" reflectorized target which displayed a red aspect perpendicular to the track when the switch was aligned for a train movement from the main track onto the house track. (See Figure 2.) No indication was displayed when the switch was aligned for train movement along the main track.

The foot latch on the south head-block tie for the north house-track switch had been manufactured by the Elliot Frog and Switch Works in 1928 through 1930. The foot latch was used to secure the hand lever when the switch was aligned for a main-track movement. This was consistent with MP operating policies. A standard MP switch padlock was provided for this securement. The padlock was fastened to the south head-block tie by a chain, which was not long enough to reach the north head-block tie. No chain or padlock was provided for the foot latch on the north tie. Thus, the switch was locked only when it was aligned for a movement on the main track and not for a movement from the main track onto the house track.

The switch stand and associated rods provided the only means of securing the switch points against the stock rail. A derail was located about 225 feet south of the switch. This derail was the "flop-over" type that, when in the derailing condition, fitted on top of the running rail. The derail was designed to derail equipment operating in either direction. The derail, which was installed on the west rail, had a hasp which allowed the derail to be locked in the derailing position.

Railroad sabotage. In the year before this accident, MP property in Cotulla suffered the following damage due to sabotage:

- o In January 1973, cotter keys were removed from all of the switch rod bolts at the south switch of the Cotulla siding. One switch rod bolt had been removed.

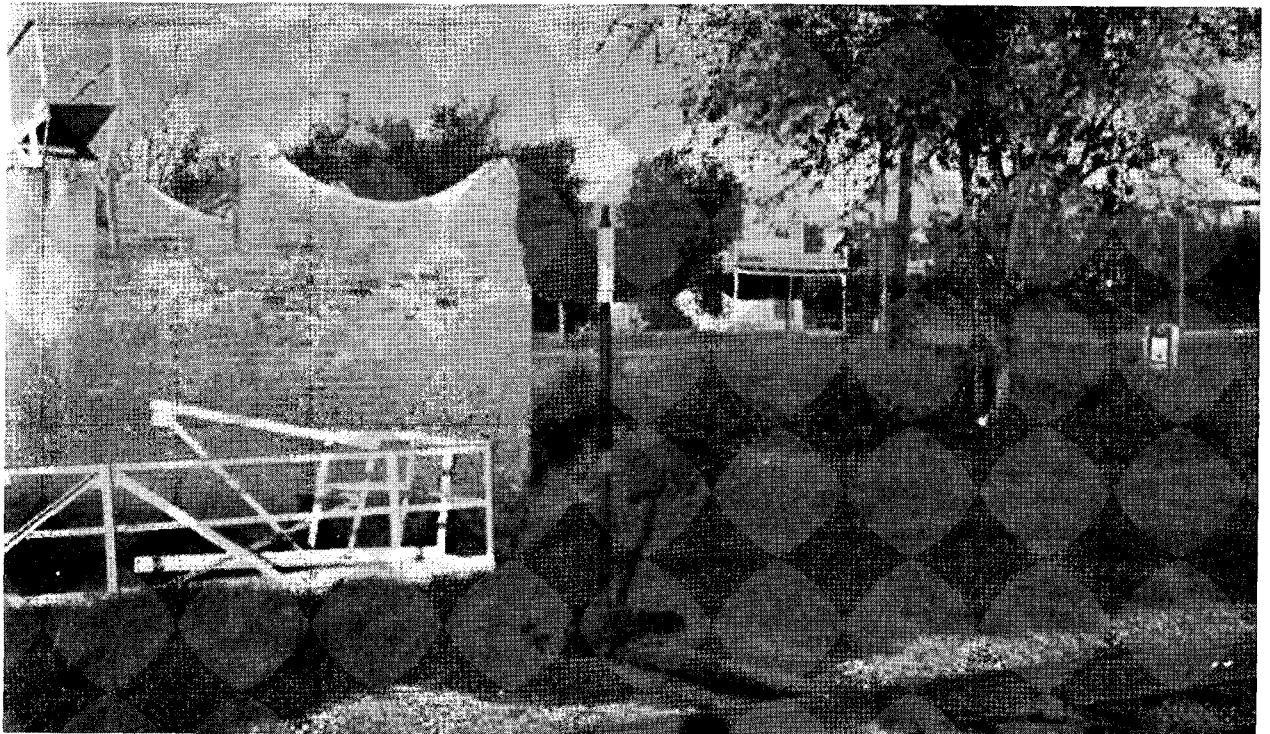
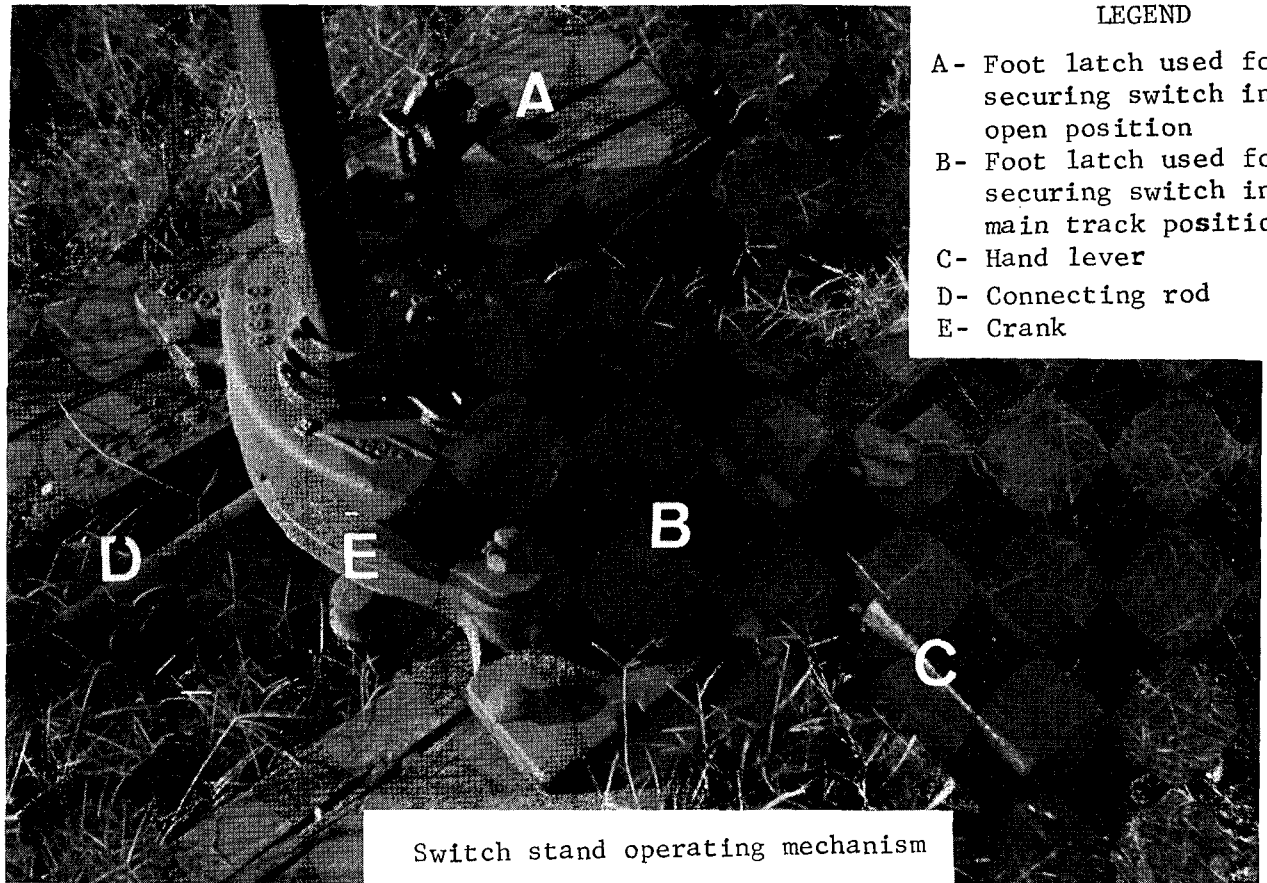


Figure 2. Switch stand at the south house track switch with the switch aligned for a movement upon the main track.

- o In January 1973, a switch lock at the south switch of the Cotulla siding was battered by a brick, but the lock remained intact.
- o On November 27, 1973, the caboose of the Cotulla Switcher was pilfered while it was standing unattended on the Cotulla house track. Fusees and torpedoes were missing.
- o On November 29, 1973, a northbound train was delayed at Cotulla by persons who pulled uncoupling levers and closed angle cocks.

Method of Operation

The authorized speed on the main track in the accident area was 49 mph; within the Cotulla city limits, a 40-mph speed restriction was applicable. The main track was not equipped with automatic block signals or other switch-position indicators and was therefore referred to as "dark territory" by railroad personnel.

Traffic through Cotulla included two through freight trains daily, one in each direction. The length of each freight train was restricted to 125 cars. Train DMX, one of these through trains, operated as an extra on the day of the accident. An Amtrak passenger train operated through Cotulla northbound three days of the week and southbound on alternate days. On December 1, a train designated as the "Cotulla Turn" also was scheduled to travel from South San Antonio to Cotulla and to return. The Cotulla Switcher was scheduled for operation in the evening.

Train operations were controlled by train orders, timetable, special instructions, and the Uniform Code of Operating Rules. Operating rules applicable to this accident are included in Appendix A.

Train Equipment

The five locomotive units of train DMX were manufactured by the Electro-Motive Division (EMD) of the General Motors Corporation. The lead locomotive unit was a Model GP-35, the next three units were Model GP-18's, and the last unit was a Model GP-7. The interior of the lead locomotive unit was standard, except that the third seat was located on the left side of the cab behind the seat provided for the front brakeman or fireman. The speed recorder on the locomotive was not equipped with a tape. On the MP, speeds were recorded only for purposes specified by management. The locomotive of the Cotulla Switcher was EMD Model GP-18.

Damage

Twenty-five cars and the five locomotive units of train DMX derailed after the collision. The locomotives and cars jackknifed, and all came

to rest within 450 feet of the Tilden Street grade crossing. Major portions of the house track, the main track, a siding, and an industrial track were damaged or destroyed. The north house-track switch was demolished.

The lead locomotive unit of train DMX came to rest at an angle of approximately 45° to the house track, with most of the unit west of the track. The front bed of the locomotive had been bent downward at about 90°. The entire superstructure had been sheared from the bed, and only the diesel engine and main generators remained above the floor level. The bed also was buckled near the rear of the locomotive in the vicinity of the generator. The fuel tank was heavily damaged.

The crew cab of the lead locomotive unit was detached and crushed during the collision, although it remained generally intact and upright. The cab was located 40 feet south of the house track and 20 feet from the locomotive substructure. The cab was facing east, 90° from the direction of movement.

The locomotive and four cars of the Cotulla Switcher were derailed. The locomotive had moved 120 feet southward and 55 feet westward, had turned about 90°, and had tipped partially onto its side. The bed was bent 90° downward at both the front and the rear. The bed also was buckled downward 25° near the front. The long hood which had covered the diesel engine and generator was torn loose, and the fuel tank and trucks had been ripped off.

The impact of the collision caused the caboose of the Cotulla Switcher to uncouple and move upward into the gondola car ahead of it. The other 11 cars that had been standing on the house track were moved southward about 200 feet. Three cars passed over the south derail and left the track.

The MP estimated the cost of the accident as follows:

Lading.....	\$174,394
Locomotive units.....	544,800
Other train equipment...	144,800
Track.....	<u>9,000</u>
Total.....	\$872,994

Train Personnel

. The crew of train DMX. The engineer of train DMX had been employed by the MP for 28 years and had worked as an engineer for 20 years. His last visual and hearing examination was in 1969.

The engineer-trainee had been employed as a fireman by the MP on February 6, 1973. Prior to this he had received a physical examination and had made several student tours. On September 3, 1973, he became an engineer-trainee and was sent to Little Rock, Ark., for 2 weeks of classroom training, which included instruction on the operating rules, the operation of locomotives, and train handling. This training was part of a program initiated by the MP in 1972. After the initial training at Little Rock, trainees were assigned to work in their home territories for 5 months under the guidance of various engineers. Trainees then returned to Little Rock for an additional 2 weeks of classroom instruction and final examinations. The engineer-trainee of train DMX was in the third month of this 6-month training program when the accident occurred.

The front brakeman of train DMX started working for the MP in October 1973. The rear brakeman had about 10 months experience and the conductor about 12 years experience.

The crew of the Cotulla Switcher. The engineer of the Cotulla Switcher was a graduate of the new engineer training program. He had started work in 1972 and was promoted to engineer in August 1973, after he successfully completed the training course and examinations. His training had not included emergency escape procedures. He had been working as the engineer on the switcher for 4 days before the accident.

The conductor of the switcher had nearly 29 years of railroad experience, the last 23 of which were in train service. The conductor had worked on the switcher for 4 days before the accident.

The two brakemen were both new employees. The rear brakeman's first day of compensated service was on November 11, 1973, and the front brakeman's was on November 12. Both men had previously made a number of trips for instructional purposes, which included five 8-hour yard engine shifts, four through freight-train trips, and two local freight-train trips. During this training, there were no assigned instructors. Instead, the new brakemen were expected to learn from the men with whom they were working on a particular assignment. Indoctrination on the operating rules included one class conducted by the trainmaster. The brakemen were furnished copies of the Uniform Code of Operating Rules, with instructions to study as the opportunity arose.

The front brakeman started work on the Cotulla Switcher 5 days before the accident, and the rear brakeman started 1 week before the accident. During their time at Cotulla, the brakeman had been supervised, instructed, and observed by the conductor, the engineer, and the assistant trainmaster. The work performance of the two brakemen was considered satisfactory.

Postaccident Activities

The fire and rescue. The fuel tanks on the colliding locomotives ruptured upon impact, and fire broke out before the derailed equipment came to rest. A large fire started in the vicinity of the derailed locomotives, while a smaller fire started near the detached cab of the locomotive. Townspeople and the Cotulla Volunteer Rescue Squad were on the scene within minutes and the smaller fire was extinguished promptly. The fire in the wreckage of the locomotives was not brought under control until about 10 a.m. and was finally extinguished just before noon.

The three crewmembers riding in the lead locomotive unit of train DMX were killed in the collision. They died from crash injuries rather than from the effects of the postaccident fire. Their bodies were found in the detached cab. The engineer-trainee was on the seat in front of the locomotive controls. The engineer and brakeman were on the opposite side of the cab. It was necessary to pry the wreckage clear before the bodies of the engineer and engineer-trainee could be removed.

Surviving crewmembers on train DMX. The conductor and the rear brakeman in the caboose of train DMX received their first indication of possible trouble from an emergency brake application. The two men braced themselves, but when it became apparent that the stop would not be abrupt, the conductor tried to contact the locomotive crewmembers on the two-way radio. There was no response, and the conductor and the brakeman saw a ball of smoke at the front of the train.

When the train stopped, the brakeman immediately dismounted from the caboose and started to run toward the locomotive. A passing motorist gave the brakeman a ride, and he arrived at the collision point about 5 minutes after impact. Meanwhile the conductor remained in the caboose and used the radio to contact another train (the Cotulla Turn) which was arriving at Gardendale. The conductor advised the crewmembers of the other train that train DMX was in trouble and asked them to stand by. He then left the caboose, got a ride with a passing motorist, and arrived at the collision point at about the same time as the rear brakeman.

After he surveyed the wreckage, the conductor surmised that train DMX had collided with another train which had been standing on the house track. He had not located the locomotive crew when rescue workers arrived. He climbed into the caboose of the Cotulla Switcher and used the radio in the caboose to advise the crew of the Cotulla Turn of the circumstances. He requested that they relay the information to the dispatcher. While the conductor was talking on the radio, the brakeman advised him that the other crewmembers were dead. The conductor relayed this information and was instructed to call the dispatcher himself. After doing so, the conductor remained on the scene to assist the local authorities.

Inspections, Tests, and Investigations

Inspection of the lead locomotive unit of train DMX. When the controls of the lead locomotive unit of train DMX were inspected after the accident, the selector was found in reverse, the throttle in the stop position, and the emergency brakes applied. The wheel measurements of the lead locomotive unit were within the tolerances established by Federal regulations. The wheels did not have flatspots or other indications of severe braking.

Inspection of the north house-track switch. The south foot latch of the north switch was found with the padlock chain intact and fastened to the broken head-block tie. The lock was secured, with the shackle of the lock through the hasps of the foot latch. The foot latch and padlock were undamaged, except that the vertical portion of one side of the hand-lever rest had been broken. The results of a metallurgical examination conducted by the Safety Board on the fractured lever rest are included as Appendix B.

The foot latch used for securing the switch in the open position (the north latch) was bent and broken. The switch-stand housing was also broken. The crank used to link the switch-stand mechanism to the connecting rod was bent downward at about 45°. The crank was positioned in the manner that would occur if the switch were aligned for the house track.

The gauge side of the left-hand switch point was scraped and scarred. There were no unusual marks on the field side, which fitted against the stock rail. A piece was broken from the running surface of the right-hand switch point about 8 inches in front of the point. The metal on the point was rolled back toward the center of the track. The field side of the right-hand switch point was scarred in front of the point and the heads of some of the bolts which fastened the switch-point reinforcing to the point were sheared off.

The connecting rod and switch rod were bent into pretzel-like shapes. The switch-stand target and the target mast also were bent and scarred. One piece of the two-piece target was detached from the mast and was bent nearly 180°. The piece of the switch-stand target that remained attached to the mast was bent 90°. The recovered switch-stand target is shown in Figure 3.

The north end of the derail, i.e., the receiving end for a southward movement, was broken. The spikes were in place in the holes provided for securing the derail to the crossties; however, the spikes were bent by a force applied from a direction parallel to the axis of the track.

Sight distances approaching the north house-track switch. Sightings were made to determine the farthest point from the north switch at which



Figure 3. Switch-stand target of the north house track switch after the accident.

the position of north house-track switch was visible. The test was made at about 8:30 a.m., with visibility conditions similar to those which existed on December 1. When the switch was positioned for a movement onto the house track, the switch-stand target was plainly identifiable 1,408 feet from the switch. With the switch aligned for movement on the main track, it was possible to determine that the target was not perpendicular to the main track 1,056 feet from the switch.

Stopping distance of train DMX. After the accident, the MP computed the braking distance for a southbound train moving at 40 mph with a consist similar to that of train DMX. The computations assumed that an emergency brake application was initiated on the locomotive 1,400 feet north of the north house-track switch. The computed stopping distance was 1,953 feet.

Police investigations. Police officers representing the MP and city, county, State, and Federal authorities investigated this accident. The various investigations did not result in the apprehension of any persons responsible for the accident. As part of the investigation, the crew of the Cotulla Switcher and the assistant trainmaster took voluntary polygraph (lie detector) tests. Test results indicated that the front brakeman did not knowingly fail to line and lock the north house-track switch and that the other involved persons had given truthful answers in responding to questions concerning their activities on November 30.

Applicable Standards

Track. Federal regulations pertinent to the maintenance of the north house-track switch are included in Appendix C. 49 CFR 213.233 requires that the main track through Cotulla be inspected "twice weekly with at least 1 calendar day between inspections." 49 CFR 213.235 requires that the north house track switch be inspected "on foot at least monthly."

When the track foreman had made a cursory inspection of the north house-track switch on the day before the accident he noted that the switch points fitted tightly against the stock rail. The foreman's last previous inspection was on November 26, when he rode over the switch on a motor car at a "walking" speed. He did not observe any deficiencies in either inspection.

The switch had been inspected in detail by the roadmaster on November 29. At that time he had checked the switch points, the connecting rod, all bolts, all cotter keys, the rail braces, and the foot latches. The switch was observed to be in good condition and without defect.

Train speed limits. The Federal requirement which governs the speed at which trains may operate evolves from Interstate Commerce Commission (ICC) Order No. 29543, dated June 19, 1947. That order states in part:

"that each respondent (all Class I railroads are included) be . . . required to install on that part or parts of its lines over which any passenger train is operated at a speed of 60 or more miles per hour, or any freight train is operated at a speed of 50 or more miles per hour an automatic block signal system which shall conform to the rules, standards, and instructions prescribed by . . ."

As a result of this order the MP set the maximum speed limit of 49 mph for this particular territory.

Wrecking trains. The criminal code applicable to the willful wrecking of railroad trains is found in Section 1992, Title 18 USC, which is included in Appendix C.

ANALYSIS

Position of the North House Track Switch

The front brakeman of the Cotulla Switcher stated that when he left the house track more than 9 hours before the collision, the north switch was aligned and locked for a main-track movement, i.e., the hand lever was secured in the south foot latch of the switch stand. Aside from the corroborating statements of the other crewmembers of the Cotulla Switcher and the polygraph tests, the front brakeman's statement is supported by the fact that the switch lock was recovered in the wreckage with the shackle still locked through the hasps of the south foot latch. The brakeman would have had no reason to secure the lock in such a manner unless he closed the switch by moving the hand lever to the south foot latch. However, after the accident, the vertical portion of the hand-lever rest on the south foot latch was found to be broken off. (See Figure 4.) Since the foot latch and the tie on which it was positioned were unscathed, the hand-lever rest was probably not fractured during the collision or subsequent derailment. Therefore, it must have been broken either by the front brakeman as he secured the hand lever in the latch or by someone else after the crew of the Cotulla Switcher left the area.

The condition of the north foot latch provides evidence that the hand lever was secured in the open position at the time of the derailment. The hand-lever rest on the north foot latch was sheared off at the base where the lever would normally rest; the latch mechanism used to secure the lever was bent southward. The counterweight, however, was bent back to the north. (See Figure 5.) This type of damage would not normally result from railroad cars' striking the foot latch during a derailment, since in such a case all parts of the latch would have been bent southward or westward.

Other onsite evidence supports the conclusion that at the time of the accident the north house-track switch was open and aligned for train

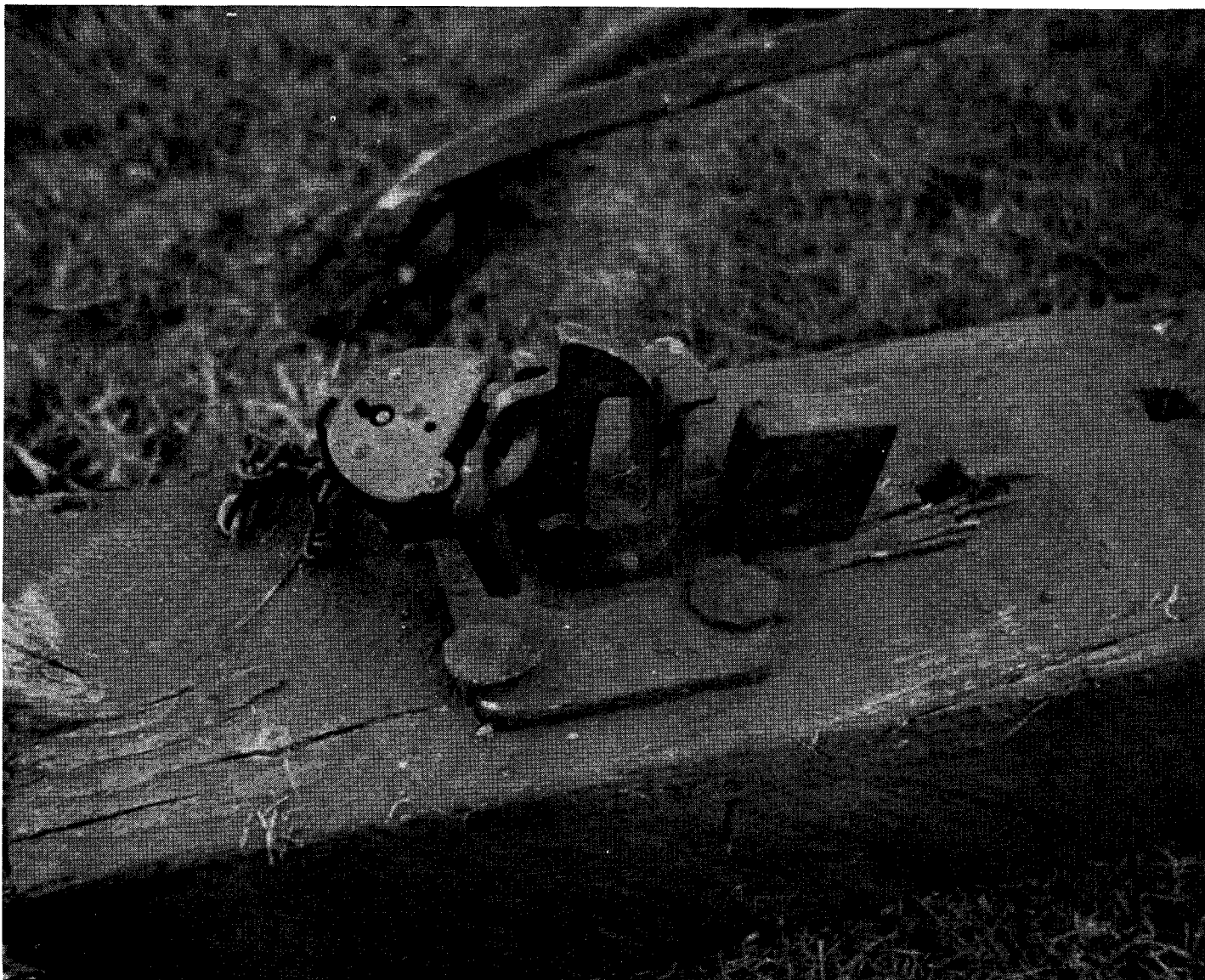


Figure 4. South foot latch of the switch stand for the north house-track switch after the accident. Note broken hand-lever rest and padlock through the hasps.



Figure 5. North foot latch of the switch stand for the north house-track switch after the accident.

movement onto the house track. The westward deflection of the colliding locomotives, the marks on the recovered derail, and the postaccident condition of the switch points and the wheels of the lead locomotive unit of train DMX indicate that train DMX did not split the switch and that the switch had not been run through. The scars on the left-hand switch point indicate that when the derailed cars passed over the north switch, the left-hand switch point was positioned against the stock rail. The scars on the field side of the right-hand switch point would be expected if the switch had been aligned for the house track. In addition, the position of the switch stand crank provides further evidence that the switch was in the open position. Thus, it can be concluded that the north switch was open and aligned for a house-track movement.

A witness to the accident stated that the braking of train DMX became effective when the last two locomotive units were on the Tilden Street grade crossing. At that instant, the lead locomotive would have been 130 feet south of the switch point. For the train to be in that position when braking became effective, the braking would have had to have been initiated 2 to 3 seconds earlier. Therefore, when the brakes were first applied, the lead locomotive unit had probably just entered the north switch of the house track or was immediately north of the switch. This would suggest that the crewmembers on the lead locomotive unit recognized the misalignment of the north switch as they entered it.

Possibility of Sabotage

There are two alternatives to explain how the north house-track switch could have been aligned to the open position. First, the front brakeman of the Cotulla Switcher could have left the switch open, inserted the switch lock in the hasps of the empty south foot latch, and snapped and tested the lock. Second, some other person or persons opened the switch after the crew of the switcher left the scene.

In view of the front brakeman's statement, which was not controverted and is also supported in part by the physical evidence, that he aligned the house-track switch for main-track movement, the Board rejects the first alternative and accepts the second as being more reasonable.

The Safety Board's metallurgical examination of the fractured hand-lever rest showed that a small defect had existed since the switch stand was manufactured 43 to 45 years ago. The placement of the weighted hand lever into the latch by the brakeman could have caused the hand-lever rest to fracture. (If this had occurred, some other person still would have had to throw the switch to the open position.) However, if the lever rest broke as the brakeman aligned the switch, he probably would have noticed the broken lever rest when he pulled the chain to test the lock, since the fractured lever rest would have been free to dangle on the lock shackle.

It seems more probable and realistic that the lever rest broke as the result of a deliberate act to sabotage the switch. The fact that neither the switch lock nor the foot latch was battered does not negate the possibility of sabotage. After the accident, a similar foot latch without defect was broken as a test by a railroad employee with little difficulty and without causing batter marks. Certain circumstances involved in the accident tend to substantiate the possibility that the north switch was deliberately realigned.

- o The two-piece switch-stand target was bent. This could have occurred either in the derailment or in an attempt to disguise switch position.
- o The misaligned switch was located just beyond the most heavily traveled grade crossing in Cotulla, where an engineer's attention was likely to be diverted.
- o The misaligned switch was a facing-point switch for southbound movements; the first trains expected through Cotulla on the day of the accident were southbound.
- o Locomotive equipment had been standing idling on the house track every night for about 2 weeks.
- o The accident occurred on a Saturday, a day when railroad employees would not be expected to be patrolling the track.
- o The vicinity of the house track normally was deserted at night, and the north switch was shielded by shrubbery from direct view from the adjacent business district.
- o Previous railroad vandalism had been experienced in the immediate area.

Operating Rules

Rule 34. Although the open position of the north house-track switch could be identified 1,408 feet in advance of the switch, the brakes of train DMX were not applied until the lead locomotive unit was on the switch. This suggests that the crewmembers in the locomotive were not looking for open switches, which is likely since the crew was probably more concerned about the possibility of colliding with a motor vehicle at the Tilden Street grade crossing. The crew's failure to identify the switch position nevertheless raises a question as to the adequacy of the operating rules and the switch-position indicators.

The two surviving crewmembers of train DMX stated that they understood that switch-stand targets were not signals. Therefore, they general-

ly had not called switch positions when they rode in the locomotive on the main track during previous trips with the engineer who was supervising the operation of train DMX at the time of the collision. Nonetheless, Rule 34 states that:

"All members of engine and train crews must, when practicable, communicate to each other by its name the indication of each signal affecting the movement of their train or engine. Signal indications (except audible signals) must be seen before being communicated to each other."

The relation of Rule 34 to the collision at Cotulla depends on the definition of "signal." In the MP's Uniform Code of Operating Rules, the definition of a fixed signal ("A Signal of fixed location indicating a condition affecting the movement of a train or engine.") specifically includes "such signals as switch, train order, block, interlocking, semaphore, stop signs, yard limit signs, restricted speed signs, resume speed signs, or other means for displaying indications that govern the movement of a train or engine." Since it is not clear from these words whether a switch-stand target is a signal, the crew of train DMX was able to conclude that a switch-stand target was not a signal which had to be called out. The word "signal" was not defined accordingly. Nevertheless, this target was visible; it did indicate that the switch was open and should have been seen earlier.

There are further problems with Rule 34. The General Superintendent Rules and Safety on the MP said, "In the application of Rule 34 if a switch is aligned against the movement of a train or engine, the crew would be obligated to call the position since this would affect their movement; otherwise, they would not call the position of switches." This interpretation was not consistent with that of the surviving crewmembers of train DMX. It suggests that it is not necessary to indicate proceed indications and thereby fails to promote an effort by crewmembers to clearly identify the position of each switch. Since most main-track switches are aligned for main-track movement, traincrews might tend to presume they all are. The General Superintendent's interpretation of Rule 34 does not counteract such a tendency.

Rule 27. A conflict also existed between the method of operation at Cotulla and Rule 27, which states that an imperfectly displayed signal, or the absence of a signal at a place where a signal is usually shown, must be regarded as the most restrictive indication that can be given by that signal. The MP interprets a switch-stand target as a signal. In applying Rule 27, an engineer must identify the location and aspect of a signal before he can determine that it is imperfectly displayed or absent. Therefore, according to the rule, an engineer of an approaching train should regard a switch as aligned for the side track, i.e., the most restrictive indication, until he can determine that the switch-stand

target is actually there and that the switch is aligned for the main track. If an engineer does not interpret Rule 27 in this way, he could choose to regard the absence of the switch-stand target as no signal, which would allow the train to proceed without restriction. This interpretation, however, assumes that switches will not be tampered with or damaged inadvertently by motor-vehicle traffic or previous trains. Such an assumption is unrealistic.

The crew of a southbound train approaching the Cotulla house track in daylight at the maximum authorized speed of 40 mph cannot determine if the switch-stand target is present and is properly displaying the indication that the switch is aligned for the main track until the train overruns its stopping limits. In darkness, when the switch is aligned for the main track, the train would have to be very close to the switch before a crewmember could actually distinguish the switch-stand target, because only the nonreflecting mast and the edge of the target are visible. If trains continue to operate on the main track in the vicinity of Cotulla at 49 mph without an automatic-block signal system, the engineer should be given adequate notice of switch position by other means. Unless an engineer can approach a switch with assurance that it is properly aligned for his route, he must take a risk of assuming that the switch is closed, or control the speed of his train so that an accident will not result if it is open.

Rule 99. When the train DMX stopped, the rear brakeman immediately proceeded to the accident site while the conductor contacted the crewmembers of the following train by radio. The conductor stated that he felt that this radio contact was sufficient to protect his train and that flagging in accordance with Rule 99 was not necessary. This was inconsistent with the interpretation of the MP which indicated that this radio contact was not sufficient. Thus, this accident demonstrates another instance in which the requirements of Rule 99 were not understood in the same way by different individuals.

Survival Aspects

The bodies of the crewmembers in the lead locomotive unit of train DMX were found in the detached cab. None of the crewmembers had received training in escape procedures. Although the engineer-trainee had moved the controls to the standard emergency positions, he did not leave his seat, which was in an extremely vulnerable position.

From a practical standpoint, the collision was nonsurvivable within the lead locomotive unit. The risk of leaping from a fast-moving engine and possibly being crushed by overturning cars would have been unacceptable. Yet refuge within the frame or the bed of the locomotive would have exposed the crewmembers to a fire which was not brought under control until 1½ hours after the collision. Thus, only if the crewmembers

of train DMX had been able to identify the open switch soon enough to have slowed the train before impact would the collision have been survivable.

Federal Standards

The 49-mph speed limit for the track in the vicinity of Cotulla evolved from ICC Order No. 29543. Since the order was originally issued 27 years ago, many of the risks involved in railroad operation may have changed. The effect of these changes, however, has not been recently addressed.

This accident indicates that ICC Order No. 29543 should be reviewed. The order, enforced by the FRA, permitted train DMX to transport 124 cars, carrying unspecified commodities, in the Cotulla area at 49 mph. Although the braking distance for train DMX at 40 mph was computed to be 1,953 feet, the position of the north house-track switch at Cotulla could not be identified under good visibility until the lead locomotive unit was 1,408 feet north of the switch. Once the north switch was misaligned, train DMX, operating at 40 mph, was on an inevitable collision course with the standing locomotive on the house track.

Speed is the only criterion in the ICC order which determines whether a signal system is required for a particular track. As long as train speed on the track does not exceed 49 mph neither Federal regulations nor the ICC order requires an assessment of other possible operational hazards. For example, although the switch-stand target for the north house-track switch conformed to Federal regulations, it did not provide adequate warning for a train traveling at 40 mph to stop short of an open switch.

On the other hand, if train speed on a particular track is 50 mph or greater, the ICC order requires use of a block signal system. Installation and maintenance of automatic block signal systems is governed by Federal regulations, which include requirements that warning signals be spaced to exceed the braking capability of trains that will operate on the track and that these warnings indicate switch position. Thus, if an automatic block signal system had been required on the track in the Cotulla area the position of the north house-track switch would have been more adequately delineated.

The ICC order does not require that carriers select a safe operating speed on nonsignaled track; it only requires that trains travel no faster than 49 mph on such track. This accident, however, implies that the effect of the ICC order may be to promote operations at 49 mph where local ordinances and track conditions allow. This is unfair to train-crews and the public, since the ICC order apparently assumes that all switches are properly aligned and secure and such an assumption is not

justified. In establishing a rule which permits operation at a certain speed, the assumptions on which the speed was based should be stated clearly and the validity of those assumptions should be verified before train operations are allowed at that speed on a particular track. Similarly, the railroads have a professional responsibility to assess the risks of their operations, even if not covered by Government regulation. Many of the risks are local and can be controlled only by the railroad.

The Switch Mechanism

The type of switch mechanism used to serve the north house-track switch is used by railroads throughout the nation. Although the Safety Board's investigation did not reveal any history of failure for this particular type of foot latch, it did suggest that problems with sabotaged switches have increased in recent years. According to FRA accident statistics, in 1961, 34 train accidents were attributed to tampering with switches, derails, and switch and derail locks as compared with 108 such accidents in 1972. Switch position also has been a problem in accidents attributed to employee negligence; improperly aligned switches was the third most numerous cause of such accidents in the 10 years from 1961-1970. ^{1/} The number of accidents attributed to improperly aligned switches doubled from 1961-1970.

These problems suggest the need for a reappraisal of the means used to identify switch position as well as the methods of securing switches. For instance, the MP's stated policy for the use of switch stands and switch-stand latches is to employ performance-type specifications. However, the specifications do not include visibility requirements for switch-position indicators, nor do they indicate to what degree switch stands or latches should be resistant to vandalism or sabotage.

CONCLUSIONS

1. Train DMX was traveling at 35 to 40 mph at the moment of impact. This speed was within the 40-mph speed limit specified by the MP and within the 49-mph speed limit authorized by Federal regulations.
2. With the train traveling at 40 mph, the crew could not discern the aspect of the switch-stand target at the north house-track switch soon enough to stop the train before it entered the house track; the switch-stand target complied with Federal regulations.
3. The engineer-trainee was operating train DMX when the collision occurred. Whether his inexperience was a factor in the collision could not be determined.

^{1/} National Transportation Safety Board, Special Study--Train Accidents Attributed to the "Negligence of Employees", NTSB-RSS-72-1.

4. The MP program for training locomotive engineers permitted the engineer-trainees to be assigned to work with experienced engineers without consideration of the engineers' qualifications as instructors.
5. The track, the train equipment, and the frequency and type of track inspections involved in this accident complied with Federal regulations.
6. The north house-track switch was aligned and locked for a train movement on the main track when the crew of the Cotulla Switcher quit work the night before the accident.
7. The north house-track switch was aligned and latched for a movement from the main track onto the house track when train DMX approached. The switch lock was still secured through the hasps of the south foot latch of the switch stand, i.e., the foot latch which secured the hand lever for a main-track movement. Although it could not be definitely concluded that the target showed the switch to be open, the Board considers that the target did show the switch to be open.
8. The derail at the north end of the house track was left in a derailing position by the front brakeman of the Cotulla Switcher and remained in that position until it was struck and dislodged by train DMX. The derail did not successfully derail the locomotives of train DMX.
9. The hand-lever rest of the south foot latch of the north switch stand broke before the cars of train DMX derailed. This fracture permitted the hand lever of the switch stand to be operated while the padlock that secured the hand lever was locked.
10. The broken hand-lever rest on the south foot latch contained a manufacturing defect which had gone unnoticed for 43 to 45 years. The exact effect of the defect on the fracture could not be determined.
11. Whether the switch-stand target for the north house-track switch was bent in the derailment or in an attempt to disguise the position of the switch before train DMX approached could not be determined.
12. The crew in the locomotive of train DMX did not identify the north house-track switch as open until they were upon it, although it should have been visible for a distance of 1,408 feet.
13. The crew of train DMX did not normally consider switch-stand targets to be signals covered by Rule 34 and therefore did not normally call out switch positions. This interpretation of Rule 34 was not consistent with that offered by MP officials.

14. The demonstrated ambiguity of Rule 34 resulted from the failure of the MP to define its scope and to enforce its requirements.
15. Train DMX was not operated in accordance with the requirements of Rule 27, since the speed of the train exceeded 15 mph as the train approached the north house-track switch and the switch position had not been identified.
16. When train DMX stopped, flagging protection to the rear was not provided. Instead the conductor established radio contact with crewmembers of the following train. In this instance, the radio contact sufficed, although the procedure was not in accordance with Rule 99.
17. Whether the crewmembers in the lead locomotive unit of train DMX remained in the cab by choice or for some other reason could not be determined.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the establishment of a collision route for train DMX by the unauthorized operation of a switch by persons unknown. Contributing to the collision were railroad operating practices which authorize engineers to operate trains at speeds at which they could not stop short of a switch target which indicates the switch is improperly aligned. Contributing to the severity of the collision was the fact that the crewmembers in the locomotive of train DMX did not identify the open switch and apply the train's brakes soon enough to slow the train.

RECOMMENDATIONS

The National Transportation Safety Board recommends that:

1. The Missouri Pacific Railroad Company:
 - (a) Review its operations on main tracks that are not equipped with automatic block signals and take appropriate action to ensure the capability of engineers to stop trains in advance of misaligned switches. This action could include reducing the size or speed of trains, installing automatic block signals or advance-position indicators, or improving the visibility of switch-stand targets. (Recommendation R-74-22)
 - (b) Review the problems demonstrated in the application of Rule 27 and Rule 34 in this accident and make any changes necessary to ensure that the language and interpretation of the rules are consistent with the intended operating practices. (Recommendation R-74-23)

- (c) Ensure that all employees understand and comply with the intent of Rules 27, 34, and 99. (Recommendation R-74-24)

2. The Federal Railroad Administration:

- (a) During its consideration of the need for uniform operating rules, consider the inconsistencies demonstrated in the application of Rules 27, 34, and 99 in this accident. (Recommendation R-74-25)
- (b) Determine and assess the current risks of train accidents involving misaligned switches, collisions, broken rails, and other route obstructions on main tracks where automatic block signal systems do not exist. The FRA should then promulgate regulations to replace Interstate Commerce Commission Order No. 29543. These regulations should detail the major risks and controls assumed, should set guidelines for safe operations below the maximum operating speed, and assign responsibility to the carrier for safe operations. (Recommendation R-74-26)
- (c) Require positive indications of both normal and reversed switch positions on main tracks not equipped with automatic block signals. (Recommendation R-74-27)
- (d) Sponsor a program to develop and test devices for the securement of manually operated switch stands so that they are more resistant to operation by unauthorized persons. (Recommendation R-74-28)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

June 27, 1974

APPENDIX A

EXCERPTS FROM MISSOURI PACIFIC'S UNIFORM CODE OF OPERATING RULES

DEFINITIONS

FIXED SIGNAL.--A signal of fixed location indicating a condition affecting the movement of a train or engine

NOTE TO DEFINITION OF FIXED SIGNAL.--The definition of a "Fixed Signal" covers such signals as switch, train order, block, interlocking, semaphore, stop signs, yard limit signs, restricted speed signs, resume speed signs, or other means for displaying indications that govern the movement of a train or engine.

* * *

SIGNALS AND THEIR USE

27. IMPERFECTLY DISPLAYED SIGNALS.--A signal imperfectly displayed, or the absence of a signal at a place where a signal is usually shown, must be regarded as the most restrictive indication that can be given by that signal, except that when the day indication is plainly seen it will govern.

A signal imperfectly displayed or the absence of a signal at a place where a signal is usually shown, must be promptly reported to the train dispatcher.

* * *

34. CALLING OF SIGNALS.--All members of engine and train crews must, when practicable, communicate to each other by its name the indication of each signal affecting the movement of their train or engine.

Signal indications (except audible signals) must be seen before being communicated to each other.

* * *

MOVEMENT OF TRAINS AND ENGINES

99. FLAGGING RULE.--When a train is moving under circumstances in which it may be overtaken by another train, the flagman must drop lighted red fusees at proper intervals, and must continue observation to rear, and take necessary action to insure full protection.

When a train stops under circumstances in which it may be overtaken by another train, the flagman must go back immediately with flagman's

signals a sufficient distance to insure full protection, placing two torpedoes and, when necessary, in addition, displaying lighted red fusees. When recalled and safety to the train will permit, he may return, and when conditions require, he will leave the torpedoes and a lighted red fuse.

When a train is seen or heard approaching before a flagman has reached a sufficient distance, he must immediately place torpedoes and continue toward the approaching train, giving stop signals.

* * *

104. HAND OPERATED SWITCHES.---

(1) Main track switches must be lined and locked for main track when not in use. Other than main track switches, equipped with switch locks, must be lined and locked for normal position when not in use.

* * *

(4) When practicable, the engineer must see that switches and derails near the engine are properly lined and must require other members of crew on engine to observe same.

* * *

(7) After restoring a main track switch to normal position, employe must test the lock to know that it is secured and see that switch points fit properly. Defective or missing main track switch locks must be replaced immediately or switch securely spiked for main track movement.

APPENDIX B

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Aviation Safety
Washington, D. C.

March 20, 1974

Metallurgical Laboratory
Report No. 74-44

METALLURGISTS FACTUAL REPORT

A. ACCIDENT

Place : Cotulla, Texas
Date : December 1, 1973
Vehicles : Collision of freight train with standing locomotive

B. COMPONENT EXAMINED

Fractured lockarm on railroad switchstand foot latch.

C. DETAILS OF EXAMINATION

The lock arm on the switchstand foot latch fractured transversely near the base as shown by arrows "A" and "B" in Figure 6.

A closeup view of the lock arm fracture surface is shown in Figure 7. The fracture appearance was indicative of an overload condition except for a light brown and dark gray discolored area extending from one of the corners. This discolored area on the fracture is shown between arrow "A" and the curved boundary denoted by arrows "e" in Figure 7.

The fracture surface on the upper part of the arm (arrow "B", Figure 6) was placed in a hot solution of ammonium citrate and subsequently ultrasonically cleaned. This was done in an attempt to remove the substance believed to be partly rust masking the fracture surface in the corner area. The characteristics of the fracture in the corner area remained the same after the cleaning except for the color which turned dark gray.

Photomicrographs of a metallographic cross section taken through the discolored corner area are shown in Figures 8 through 11.

The microstructure of the material below the surface appeared normal for ferritic malleable iron. The microstructure on the case surface of the lockarm (see Figure 10) indicated that the structure was excessively decarburized.

D. DETAILS OF EXAMINATION

Decarburization also occurred along the fracture surface in the area shown by the bracket in Figure 8. The typical microstructure within this area is depicted in Figure 11.

Hardness measurements taken on a section through the lockarm gave results averaging 63 Rockwell "B" which using Wilson Mechanical instrument chart No. 60 converts to approximately 90 Brinnell. Typical hardness values for ferritic malleable iron (as indicated in Metals Handbook No. 1) are between 110 and 145 Brinnell. The hardness of the lockarm therefore appeared to be below that normally expected for ferritic malleable iron.

/s/ Michael Marx

Michael Marx
Metallurgist

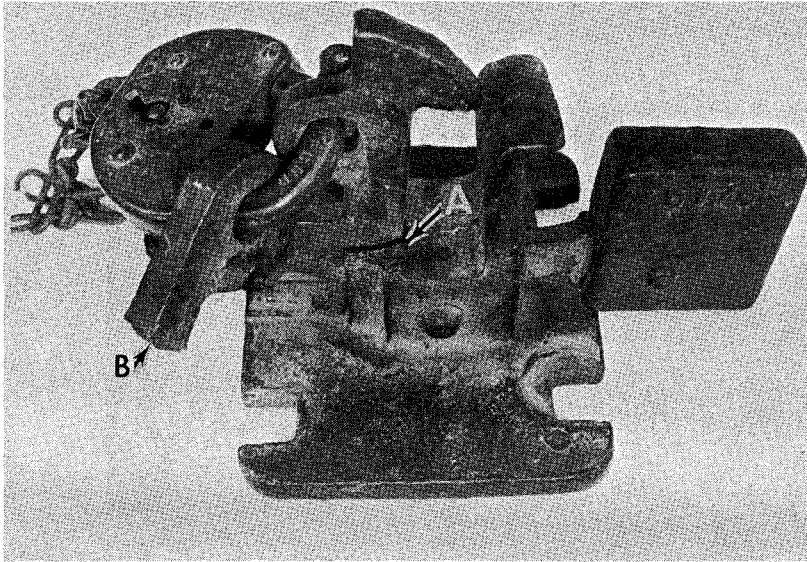


Figure 6. Switchstand as received. Arrows "A" and "B" denote mating fracture surfaces on lock arm. X 1/5

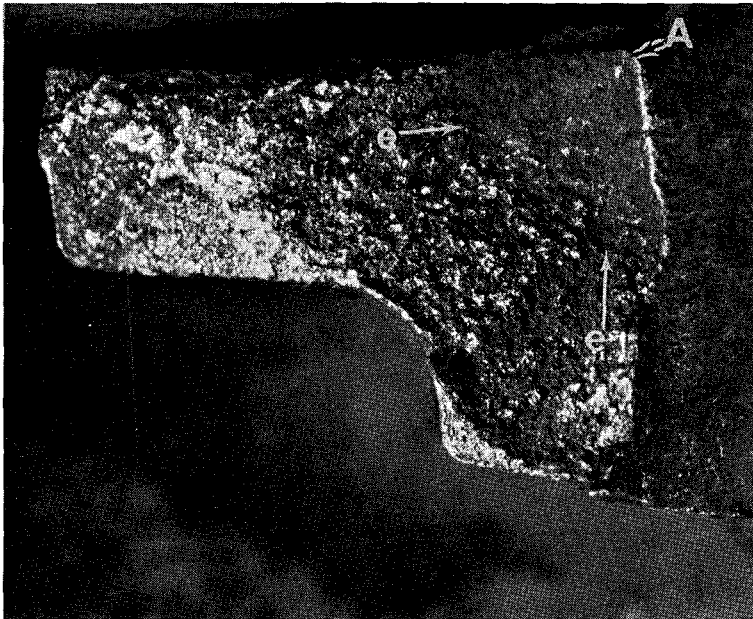


Figure 7. Fracture on lockarm. Note the discolored fracture area between the corner, shown by arrow "A" to the curved line indicated by arrows "e". X4

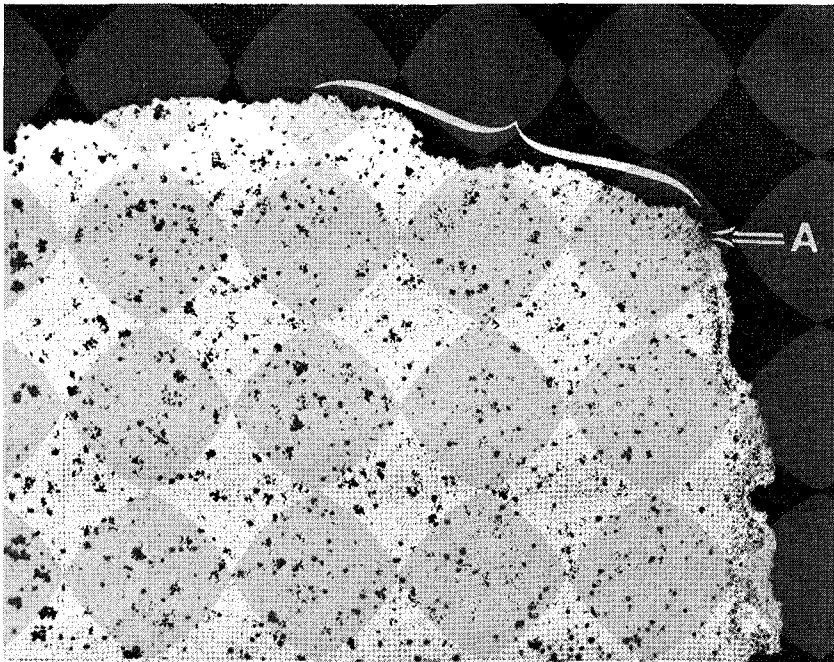


Figure 8. Metallographic cross section through the discolored fracture area indicated in Figure 7. Arrow "A" denotes corner area shown by arrow "A" in Figure 7. Profile of the fracture surface is along the top of the photograph and the lockarm side surface is along the right side of the photograph. X25 unetched

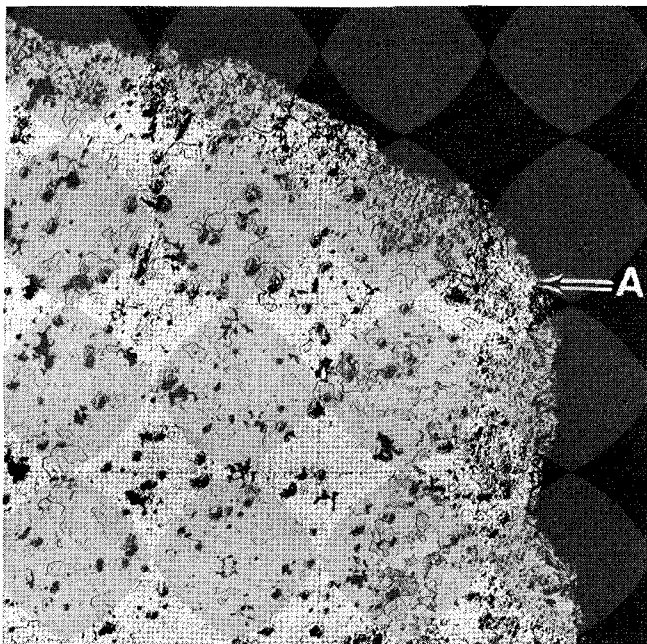


Figure 9. Photomicrograph after etching microsection the area shown by arrow "A" in Figure 8. X50 nital etched



Figure 10. Typical surface along the side of the lockarm showing excessive decarburization that formed a ferritic skin on the casting surface and underlying rum of pearlite. X200 nital etched

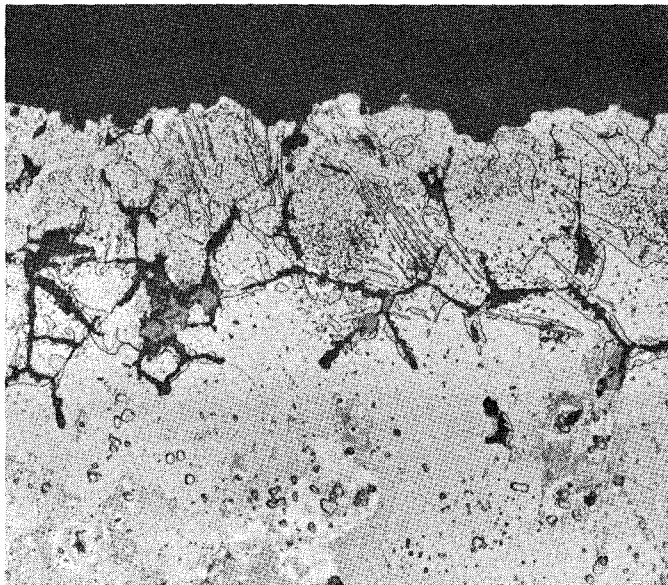


Figure 11. High magnification photomicrograph showing typical underlying surface of the fracture within the bracket area depicted in Figure 8. X500 nital etched

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Aviation Safety
Washington, D. C.

March 20, 1974

Metallurgical Laboratory
Report No. 74-44A

METALLURGISTS ANALYSIS REPORT

A. ACCIDENT

Place : Cotulla, Texas
Date : December 1, 1973
Vehicles : Collision of Freight train with standing locomotive

B. COMPONENTS EXAMINED

Fractured lockarm on railroad switch stand foot latch.

C. DETAILS OF ANALYSIS

The underlying microstructure along part of the fracture indicated a crack was present in the lock arm during heat treatment of the casting. This crack probably grew during service of the foot latch to the extent indicated in the factual report. A crack of this magnitude would severely weaken the arm to impact loads.

The hardness of the lockarm indicated the material would have a tensile strength slightly below that normally expected for ferritic malleable iron. There was however no minimum required tensile strength on the engineering drawing.

The excessive decarburization on the as cast surface would occur on heat treatment of the casting and is undesirable since it further weakens the material in this area. No control of the heat treatment was noted, however, on the engineering drawing.

/s/ Michael Marx

Michael Marx
Metallurgist

APPENDIX C

FEDERAL REGULATIONS PERTAINING

TO THE MAINTENANCE OF SWITCHES

AND THE WRECKING OF TRAINS

Title 49 - Transportation

§ 213.135 Switches.

(a) Each stock rail must be securely seated in switch plates, but care must be used to avoid canting the rail by over-tightening the rail braces

(b) Each switch point must fit its stock rail properly, with the switch stand in either of its closed positions to allow wheels to pass the switch point. Lateral and vertical movement of a stock rail in the switch plates or of a switch plate on a tie must not adversely affect the fit of the switch point to the stock rail

(c) Each switch must be maintained so that the outer edge of the wheel tread

cannot contact the gage side of the stock rail

(d) The heel of each switch rail must be secure and the bolts in each heel must be kept tight

(e) Each switch stand and connecting rod must be securely fastened and operable without excessive lost motion

(f) Each throw lever must be maintained so that it cannot be operated with the lock or keeper in place.

(g) Each switch position indicator must be clearly visible at all times

(h) Unusually chipped or worn switch points must be repaired or replaced. Metal flow must be removed to insure proper closure.

Title 18 - Crimes and Criminal Procedures

§ 1992 Wrecking trains.

Whoever willfully derails, disables, or wrecks any train, engine, motor unit, or car used, operated, or employed in interstate or foreign commerce by any railroad; or

Whoever willfully sets fire to, or places any explosive substance on or near, or undermines any tunnel, bridge, viaduct, trestle, track, signal, station, depot, warehouse, terminal, or any other way, structure, property, or appurtenance used in the operation of any such railroad in interstate or foreign commerce, or otherwise makes any such tunnel, bridge, viaduct, trestle, track, signal, station, depot, warehouse, terminal, or any other way, structure, property, or appurtenance unworkable or unusable or hazardous to work or use, with the intent to derail, disable, or wreck a train, engine, motor unit, or car used, operated, or employed in interstate or foreign commerce; or

Whoever willfully attempts to do any of the foregoing acts or things—

Shall be fined not more than \$10,000 or imprisoned not more than twenty years, or both

Whoever is convicted of any such crime, which has resulted in the death of any person, shall be subject also to the death penalty or to imprisonment for life, if the jury shall in its discretion so direct, or, in the case of a plea of guilty, if the court in its discretion shall so order.

A judgment of conviction or acquittal on the merits under the laws of any State shall be a bar to any prosecution hereunder for the same act or acts (June 25, 1948, ch. 645, 62 Stat. 794)