

RAILROAD ACCIDENT INVESTIGATION

Report No 4118

THE PENNSYLVANIA RAILROAD COMPANY

LANCASTER, PA.

JUNE 9, 1967

Department of Transportation
Federal Railroad Administration
Washington

Summary

DATE:	June 9, 1967	
RAILROAD:	Pennsylvania	
LOCATION:	Lancaster, Pa	
KIND OF ACCIDENT:	Rear-end collision	
TRAINS INVOLVED:	Freight	Passenger
TRAIN NUMBERS:	Extra 4404 West	607
LOCOMOTIVE NUMBERS:	Electric units 4404, 4407	
CONSISTS:	151 cars, caboose	Electrically- propelled passenger unit 211
ESTIMATED SPEEDS:	4-5 m.p h	15-20 m p h
OPERATION:	Interlocking	
TRACKS:	Double; tangent; 0 40 percent ascending grade westward	
WEATHER:	Clear	
TIME:	1:38 p m	
CASUALTIES:	36 injured	
CAUSE:	Failure of the engineer to stop the following train short of an inter- locking stop-signal, as required	

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

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Synopsis

On June 9, 1967, a rear-end collision occurred between a freight train and a passenger train on the Pennsylvania Railroad at Lancaster, Pa. Thirty passengers and six employees were injured.

The accident was caused by failure of the engineer to stop the following train short of an interlocking stop signal, as required.

Location and Method of Operation

The accident occurred on that part of the Harrisburg Division extending between Atglen and Banks, Pa., a distance of 66.1 miles. Cork interlocking is located at Lancaster, 20.9 miles west of Atglen. The interlocking extends a considerable distance west and 1.8 miles east of the Lancaster station. Within its limits, the railroad is a double-track line over which trains moving with the current of traffic operate by signal indications of the interlocking system, supplemented by cab signal and automatic train stop (ATS) systems. A catenary system is provided for the electric propulsion of trains. From the north, the main tracks are designated as No. 2 (westward) and No. 1 (eastward). East of the interlocking, the railroad is also a double-track line with the westward main track designated as No. 4. Track No. 2 within the interlocking is a continuation of track No. 4.

Two auxiliary tracks designated as the eastward station track and "O" track parallel the main tracks on the south within Cork interlocking limits, as indicated in the sketch appended to this report. The west end of "O" track connects

with a line designated as the Columbia Branch. Another auxiliary track, designated as the westward station track, parallels the main tracks on the north in the Lancaster station area, as also indicated in the sketch.

A series of three crossovers connects track No. 2 to "0" track within Cork interlocking limits. Crossover No. 9, which is 272 feet long, connects tracks No. 2 and No. 1. Its east switch is facing point for westbound movements on track No. 2 and is 1,818 feet east of the Lancaster station. Crossover No. 11, which is 374 feet long, connects track No. 1 and the eastward station track. Its east switch is facing point for westbound movements on track No. 1 and is 21 feet west of the west switch of crossover No. 9. Crossover No. 19, which is 290 feet long, connects the eastward station track and "0" track. Its east switch is facing point for westbound movements on the eastward station track and is 31 feet west of the west switch of crossover No. 11.

The collision occurred on crossover No. 11, within Cork interlocking limits, 168 feet west of the east switch of crossover No. 11 and 1,357 feet east of the Lancaster station.

Controlled signal 10R, governing westbound movements on track No. 2; westbound movements from track No. 2 to "0" track via crossovers 9, 11 and 19, and westbound movements from track No. 2 to the westward station track, is 156 feet east of the east switch of crossover No. 9 and 617 feet east of the collision point. Controlled signal 2R, governing westbound movements on track No. 2, is 1.5 miles east of signal 10R. It is the westward home signal for Cork interlocking.

Signals 2R and 10R are mounted on signal bridges. A train order signal of the flashing light type is mounted on the same bridge as signal 10R and is adjacent to that signal. When the Cork interlocking operator has a train order to be delivered to a westbound train, he causes the train order signal to flash.

The switches and signals of Cork interlocking are controlled from the interlocking machine at the interlocking station, which is on the south side of "0" track 600 feet west of the Lancaster station.

Because of cross members of the catenary system and the trolley wires the engineer of a westbound train cannot discern the aspect displayed by signal 10R until his train reaches a point 1,077 feet from that signal.

Details concerning the tracks; Cork interlocking, cab signal and automatic train stop systems; carrier's operating rules; trains involved, damages, and other factors are set forth in the appendix.

Description and Discussion

Extra 4404 West, a westbound freight train, left Morrisville, Pa., 67.8 miles east of Atglen, at 6:21 a.m., the day of the accident. This train, consisting of 2 electric

units, 152 cars and a caboose, passed Park, 3 2 miles east of Atglen, at 12:19 p m About 35 minutes later it passed signal 2R, which indicated Approach, and proceeded westward on track No 2 within Cork interlocking limits It then stopped short of signal 10R, which displayed a Stop-signal aspect

About 1:08 p m , after an eastbound passenger train proceeded through Cork interlocking on track No 1, the interlocking operator lined the route for Extra 4404 West to proceed from track No 2 to the Columbia Branch via crossovers 9, 11 and 19 and the "0" track He then caused the aspect displayed by signal 10R to change to Restricting, which is the most favorable aspect this signal can display with the switches of crossover No 9 in reverse position, lined for movement from track No 2 to track No 1 Extra 4404 West started to pass signal 10R after its aspect changed to Restricting It then entered crossovers 9, 11, and 19, and proceeded on the "0" track toward the Columbia Branch At 1:22 p m , after entering this branch line, it stopped to set off the first car Because of the length of the train, the caboose stopped on crossover No 9 at a point about 200 feet west of signal 10R At this time it was fouling track No 2 on the time of No 607, a westbound first-class passenger train The conductor and flagman remained inside the caboose, however, and did not provide any flagging protection to the rear of their train, as the carrier's operating rules do not require such protection for a train stopped within limits of an interlocking

About 1:35 p m , after the first car was set off, Extra 4404 West started to move slowly westward The conductor said he looked eastward from the caboose at that time and saw No 607 approaching signal 10R He was not immediately concerned about the approaching train, however, as he expected it to stop on track No 2 short of signal 10R, which should have displayed a Stop-signal aspect When his train had moved a short distance westward and his caboose had entered, or was about to enter, crossover No 11 the conductor again looked eastward and saw that No 607 was proceeding on track No 2 to crossover No 9 without stopping at signal 10R Because he also saw that the switches of crossover No 9 were still in reverse position, he realized that No 607 could follow his train through that crossover to track No 1 and crossover No 11 Soon afterward, apparently as No 607 moved through crossover No 9, the conductor realized that a collision was imminent and called a warning to his flagman Both the conductor and flagman then alighted from the caboose Immediately thereafter, at 1:38 p m , while Extra 4404 West was moving westward at 4 or 5 miles per hour, its rear end was struck by No. 607 on crossover No 11, 617 feet west of signal 10R and 1,357 feet east of the Lancaster station

The conductor and flagman of Extra 4404 West; the engineer, conductor, flagman and 30 passengers of No 607, and a lineman riding that train for an inspection of the catenary system, were injured

No 607 consisted of electrically-propelled passenger

unit 211 It left Suburban Station, Philadelphia, Pa , 47 1 miles east of Atglen, at 12:25 p m , on time The conductor and flagman said that they had conversed with the engineer, the only other crew member, before leaving Philadelphia, and that the engineer appeared normal in all respects The train brakes, ATS apparatus, and the cab signals at the engineer's station, had been tested and had functioned properly

No 607 left Park at 1:19 p m , on time, and passed Atglen soon afterward About 1:38 p m , it approached Cork interlocking at Lancaster while moving on track No 4 at high speed The cab signal and signal 2R were displaying Clear and Approach aspects, respectively As the train neared signal 2R and was about to enter track No 2 at Cork interlocking, the cab signal aspect changed to Approach and the engineer forestalled an automatic ATS emergency brake application by depressing the acknowledging lever In addition, he shut off power and applied the automatic brake to reduce speed as required in approach to signal 10R As the train reduced speed, the conductor and flagman proceeded to the rear vestibule, in preparation for a routine passenger stop on the westward station track at Lancaster, the track customarily used by No 607 When the route is established for movement from track No 2 to the Lancaster station via the westward station track, signal 10R displays a Medium-clear or Slow-approach aspect, depending on the indication of a signal located near the west end of the westward station track

While No 607 was proceeding westward in the block of signal 2R at decelerating speed, the engineer saw the caboose of Extra 4404 West ahead, apparently as it was moving from crossover No 9 to crossover No 11 He said that his train had reduced speed to about 15 miles per hour when signal 10R came into view, and that he observed the signal was displaying a Slow-approach aspect He did not observe whether the train order signal located adjacent to signal 10R was flashing According to his statements, the engineer then apparently assumed that the route had been established for his train to proceed to the Lancaster station via track No 2 or the westward station track, and he released the automatic brake and applied power Soon thereafter, the train passed signal 10R The engineer said the aspect of the cab signal changed to Restricting at this time, and he acknowledged this change by depressing the acknowledging lever, forestalling an automatic ATS emergency brake application A few moments after passing signal 10R, No 607 entered crossover No 9 at about 20 miles per hour, as estimated by all the crew members The conductor and flagman became somewhat concerned when the train entered crossover No 9, as it was not customary for No 607 to be routed through that crossover The conductor immediately left the rear vestibule and started forward to the engineer's station to determine what was taking place He had moved only a few feet forward in the aisle of the passenger compartment when the collision occurred

The engineer's statements were conflicting as to his actions and observations after No 607 passed signal 10R Some statements indicate that he first realized something

was wrong when he felt his train being diverted to track No 1 at crossover No 9, and that he promptly shut off power and applied the train brakes in emergency. Other statements indicate that he did not realize his train had been diverted to the crossover occupied by the caboose of Extra 4404 West until his train had moved through crossover No 9 and had entered the east switch of crossover No 11. According to the latter statements, he then shut off power and applied the train brakes in emergency. In any event, shortly after entering the east switch of crossover No 11, No. 607 struck the caboose of Extra 4404 West while moving between 15 and 20 miles per hour, as estimated by the crew members. The conductor of No 607 could not recall whether the brakes of his train were applied in emergency before the collision. The flagman, who remained in the rear vestibule, said he felt the train brakes apply in emergency immediately before the collision.

The Cork interlocking operator stated that after establishing the route for Extra 4404 West to proceed from track No 2 to the Columbia Branch via crossovers 9, 11, and 19 and the "0" track, he did not manipulate any of the interlocking machine levers before the collision, except the lever controlling signal 10R. He said that after the front end of Extra 4404 West passed signal 10R, he restored this lever to normal, or vertical, position and that it remained in normal position until after the accident. He said that because he had train orders to deliver to No 607, he also caused the train order signal adjacent to signal 10R to flash.

The circuits of the interlocking system are so arranged that when a westbound train routed through crossovers 9, 11 and 19 passes signal 10R, the indication of that signal changes to Stop. The interlocking operator may then move the interlocking machine lever for signal 10R to normal position. In this event the signal continues to indicate Stop. When the rear end of the train reaches a point on crossover No 9, 300 feet west of signal 10R, the interlocking operator may cause that signal to display a Restricting aspect for another westbound train on track No 2 to proceed through crossovers 9, 11 and 19. When the rear end of a westbound train moving through crossovers 9, 11 and 19 reaches a point on crossover No 11, 530 feet west of signal 10R, the interlocking operator may restore the switches of crossover No 9 to normal position.

Tests after the accident disclosed that the portions of the Cork interlocking system involved functioned properly.

After minor repairs were made, the air brake equipment and cab signal apparatus of No 607 were tested and were found to be functioning properly.

Subsequent to the accident an electrically-propelled passenger unit similar to the unit comprising No 607 on the day involved was utilized at Cork interlocking for tests to determine stopping distances. In one test, the unit passed signal 10R while moving westward on track No 2 at 21 miles per hour, and its brakes were applied in emergency at the east switch of crossover No 9. The unit stopped in 149 feet, or 314 feet short of the collision point. In

six other tests, the unit approached signal 10R and crossover No 9 at various speeds between 21 and 39 miles per hour, and its brakes were applied in emergency in the vicinity of the signal or the crossover. In these tests, the unit stopped within distances between 180 and 415 feet. In each test, the anti-wheel slip apparatus functioned several times

Findings

Signal 10R was evidently displaying a Stop-signal aspect when the caboose of Extra 4404 West stopped on crossover No 9 fouling track No 2, and it evidently continued to display that aspect as the caboose moved westward from crossover No 9 to crossover No 11, where the collision occurred. Under these circumstances, No 607 was required to stop short of signal 10R and was restricted from passing that signal until the operator caused it to display a proceed aspect. The crew members of Extra 4404 West were not required to protect against No 607 within interlocking limits.

No 607 passed signal 10R at approximately 20 miles per hour, without stopping as required, and the engineer evidently was mistaken when he said this signal displayed a Slow-approach aspect for his train. From all indications, he did not realize his train had been diverted through crossover No 9 to crossover No 11 until it entered the east switch of the latter crossover. He apparently then recognized that his train was closely approaching the caboose of Extra 4404 West and applied its brakes in emergency. This action, however, was taken too late to stop short of the preceding train and immediately thereafter, before its speed was materially reduced, No 607 struck the caboose of Extra 4404 West on crossover No 11.

Since the engineer of No 607 failed to observe that signal 10R displayed a Stop-signal aspect, to see that the train order signal adjacent to signal 10R was flashing, and to take prompt action to stop his train before it was diverted through crossover No. 9 toward the crossover occupied by the rear end of Extra 4404 West, it is evident that he was not properly attentive and responsive to conditions affecting the movement of his train as it moved in the vicinity of signal 10R and the crossovers involved. Had he maintained a proper lookout ahead he could have seen that signal 10R was displaying a Stop-signal aspect, and could have noticed that the route was lined toward the crossover occupied by the rear end of Extra 4404 West, in sufficient time to stop his train short of a collision.

Although both the conductor and the flagman of No 607 were standing in the rear vestibule while approaching Cork interlocking they did not observe the stop-aspect of signal 10R and the adjacent flashing train order signal. Consequently, they were not able to effectively take necessary action to insure the safety of their train when the engineer failed to stop No 607 short of interlocking signal 10R as required.

Cause

The accident was caused by failure of the engineer to stop the following train short of an interlocking stop-signal, as required

Dated at Washington, D C , this 13th
day of November 1967
By the Federal Railroad Administration,
Railroad Safety Board

Bette E Holt
Acting Executive Secretary

(SEAL)

Appendix

Tracks

Westward on track No 2 from the east end of Cork interlocking there are, in succession, a tangent 1,626 feet, a 1°00' curve to the left 912 feet, and a tangent 1 0 mile to signal 10R and a considerable distance westward. In this area, the grade for westbound trains is 0.40 percent ascending.

Cork Interlocking, Cab Signal, and ATS Systems

Signals 2R and 10R are of the position-light type and are continuously lighted. The aspects applicable to this investigation and the corresponding indications and names are as follows:

<u>Signal</u>	<u>Aspect</u>	<u>Indication</u>	<u>Name</u>
2R	3 amber lights in diagonal position to the right	Proceed prepared to stop at next signal. Train exceeding Medium speed must at once reduce to that speed.	Approach
10R	3 amber lights in horizontal position	Stop	Stop-signal
	3 amber lights in horizontal position over 3 amber lights in diagonal position to the left	Proceed at Restricted speed	Restricting
	3 amber lights in horizontal position over 3 amber lights in vertical position	Proceed; Medium Speed within interlocking limits	Medium-clear
	3 amber lights in horizontal position over 3 amber lights in diagonal position to the right	Proceed prepared to stop at next signal. Slow speed within interlocking limits	Slow-Approach

Signals 2R and 10R are controlled from the interlocking machine at Cork interlocking station. The machine is of the electro-pneumatic type and has 49 working levers in a 67-lever frame. A track model board is associated with the

interlocking machine and is provided with indicator lights to show track occupancy. Approach, time, route, and signal indication locking are provided. The controlling circuits are so arranged that when the route had been established for a westbound train to proceed from track No 2 to the Columbia Branch via crossovers 9, 11, 19 and "0" track, signal 10R displays a Restricting aspect. When the front of such train passes signal 10R, the aspect displayed by that signal changes to a Stop-signal aspect. When signal 10R displays a Stop-signal aspect and the block of signal 2R is unoccupied, the latter signal displays an Approach aspect.

After the rear end of a westbound train routed through crossovers 9, 11, and 19 passes signal 10R and reaches a point on crossover No 9 300 feet west of that signal, the interlocking operator may cause signal 10R to display a Restricting aspect for another westbound movement on track No 2 to proceed through crossover No 9. With the switches of this crossover in reverse position, signal 10R cannot display other than a Stop-signal or Restricting aspect.

If the route has been established for a westbound train on track No 2 to proceed to the Lancaster station via the westward station track, signal 10R displays a Medium-clear or Slow-Approach aspect, depending on the aspect displayed by a wayside signal near the west end of the westward station track.

When a locomotive equipped with ATS apparatus and a cab signal passes a wayside signal, the aspect displayed by the cab signal changes, if necessary, to conform with the aspect displayed by the wayside signal. A whistle at the engineer's control station sounds when the aspect of the cab signal changes to a more restrictive aspect and continues to sound until the engineer actuates an acknowledging lever switch by depressing a pedal in front of his position. If the engineer does not depress this pedal within six seconds after the cab signal aspect changes to a more restrictive aspect, the ATS apparatus is actuated and the train brakes automatically apply in emergency.

Carrier's Operating Rules

MEDIUM SPEED - Not exceeding one-half the speed authorized for passenger trains but not exceeding 30 miles per hour.

RESTRICTED SPEED - Not exceeding 15 miles per hour prepared to stop short of train, obstruction or switch not properly lined ***

663 A train or engine must stop clear of an interlocking signal indicating Stop ***

Trains Involved

Extra 4404 West consisted of electric units 4404 and 4407, coupled in multiple-unit control, 151 cars and a caboose. Its brakes had been tested and had functioned properly. At the time of the accident, the engineer and front brakeman, the only crew members on the locomotive,

were in the control compartment of the first electric unit. The conductor and flagman were on or near the track structure in the vicinity of the caboose.

No 607 consisted of electrically-propelled passenger unit 211. This unit is of all-steel construction and weighs 101,400 pounds. It is 85 feet long, and has a single passenger compartment with a seating capacity for 127 persons. It is powered by four 155-horsepower electric traction motors and is mounted on two 4-wheel trucks. It is provided with disc brakes, an anti-wheel slip device, and automatic train stop apparatus. An engineer's station is at the right side of the vestibule at each end. Each station is provided with a cab signal and a safety control feature actuated by the power controller. If the engineer releases his grip on the power controller while power is applied, the controller returns to center position, which causes power to shut off and the train brakes to apply in emergency.

Damages

Extra 4404 West stopped with its rear end 59 feet west of the collision point. None of its equipment was derailed. The last two cars and the caboose were slightly damaged.

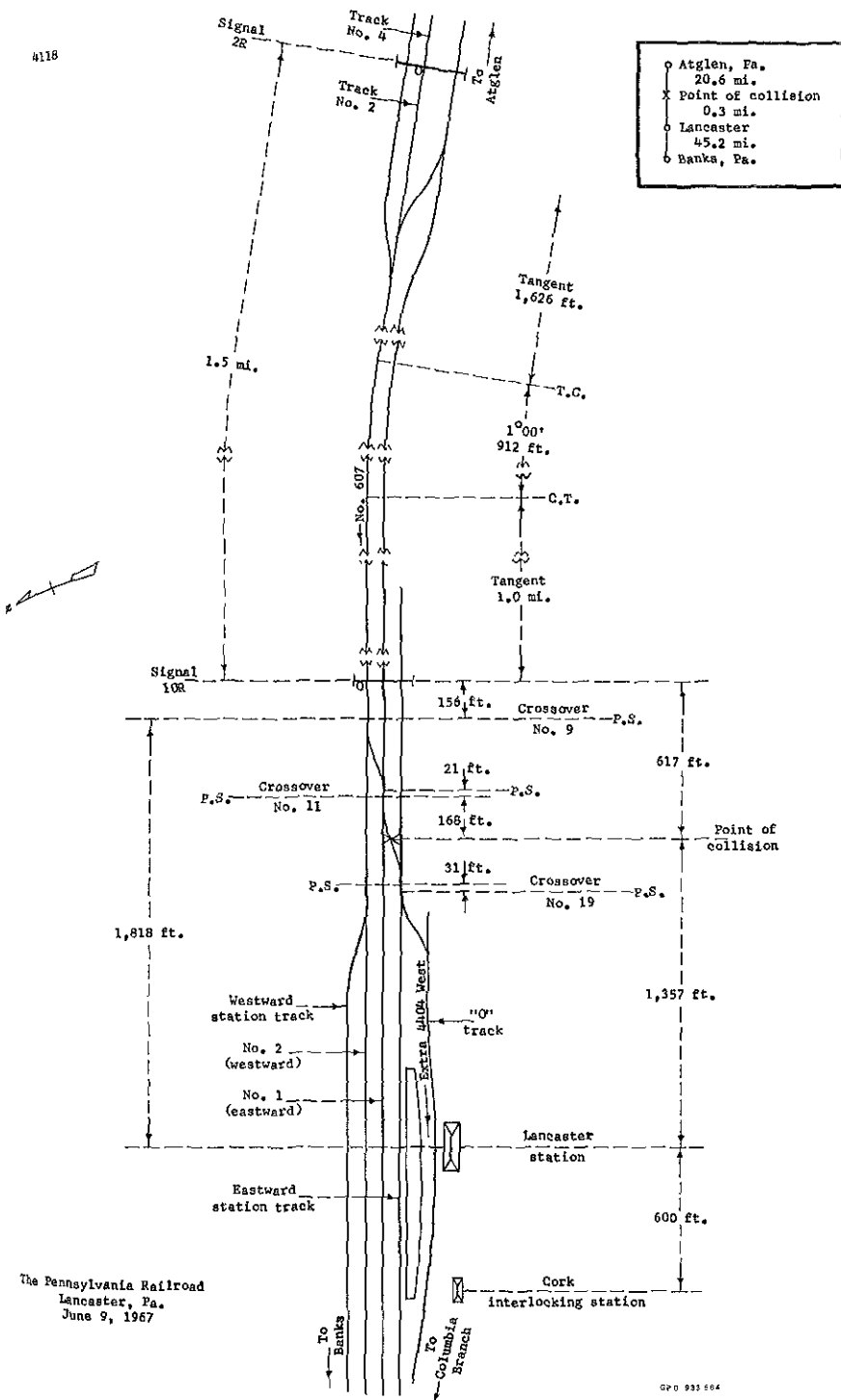
No 607 stopped with the front end about 12 feet to the rear of the caboose of Extra 4404 West. It was not derailed. The front portion of the unit was considerably damaged.

Other Factors

The accident occurred at 1:38 p m , in clear weather.

The maximum authorized speed for passenger trains in the Lancaster area is 75 miles per hour.

According to their daily time returns, the engineer, front brakeman, conductor, and flagman of Extra 4404 West had been continuously on duty 9 hours 38 minutes at the time of the accident, after having been off duty 11 hours 30 minutes. The engineer of No 607 had been on duty 3 hours 53 minutes in the aggregate after having been off duty more than 12 hours, and the conductor and flagman had been continuously on duty 1 hour 38 minutes after having been off duty over eight hours.



- Atglen, Pa. 20.6 mi.
- X Point of collision 0.3 mi.
- Lancaster 45.2 mi.
- Banks, Pa.

The Pennsylvania Railroad
 Lancaster, Pa.
 June 9, 1967