INTERSTATE COMMERCE COMMISSION

WASHINGTON

INVESTIGATION NO. 2734

THE PENNSYLVANIA RAILROAD COMPANY

REPORT IN RE ACCIDENT

AT MADISON, IND., ON

OCTOBER 25, 1943

SUMMARY

Railroad:	Pennsylvania
Date:	October 25, 1943
Location:	Madison, Ind.
Kind of accident:	Derailment
Train involved:	Engine and cut of cars
Engine number:	8329
Consist:	11 cars
Speed:	35-40 m. p. h.
Operation:	Timetable, train orders and a manual-block system; yard limits
Track:	Single; 4°30' curve; grade practically level
Weather:	Cloudy
Time:	About 1 p. m.
Casualties:	1 killed
Cause:	Excessive speed on curve having irregular surface, as result of train being out of control on descending grade
Recommendation:	That the Pennsylvania Railroad Company so control the braking ratio and percentages of adhesion on this grade that trains may be safely operated in compliance with existing law

INTERSTATE COMMERCE COMMISSION

INVESTIGATION NO. 2734

IN THE MATTER OF MAKING ACCIDENT INVESTIGATION REPORTS
UNDER THE ACCIDENT REPORTS ACT OF MAY 6, 1910.

THE PENNSYLVANIA RAILROAD COMPANY

December 21, 1943.

Accident at Madison, Ind., on October 25, 1943, caused by excessive speed on curve having irregular surface, as result of train being out of control on a descending grade.

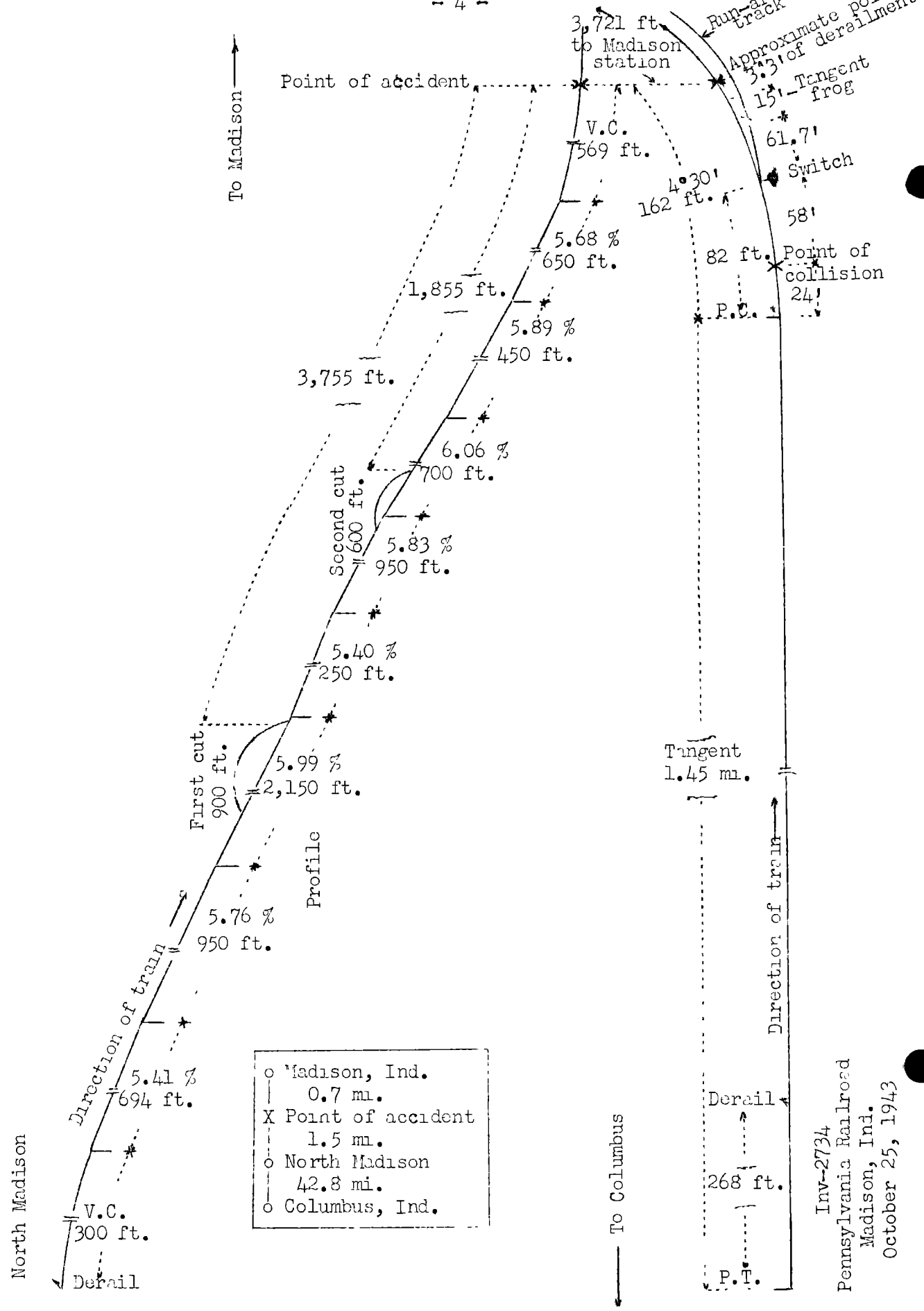
REPORT OF THE COMMISSION[1]

PATTERSON, Commissioner:

On October 25, 1943, there was a derailment of an engine and a cut of cars on the Pennsylvania Railroad at Madison, Ind., which resulted in the death of one employee. This accident was investigated in conjunction with a representative of the Indiana Public Service Commission.

---

[1]Under authority of section 17 (2) of the Interstate Commerce Act the above-entitled proceeding was referred by the Commission to Commissioner Patterson for consideration and disposition.



Inv-2734
Pennsylvania Railroad
Madison, Ind.
October 25, 1943

Location of Accident and Method of Operation

This accident occurred on that part of the Indianapolis Division designated as the Madison Branch and extending between Columbus and Madison, Ind., 45 miles. This was a single-track line over which trains were operated by timetable, train orders and a manual-block system. The accident occurred within yard limits, 3,721 feet west of the station at Madison. At Madison, a track designated as the run-around track paralleled the main track on the south. Entry to this track was through a facing-point switch for east-bound movements located 3,801 feet west of the station. From the west there were, in succession, a tangent 1.45 miles, a 4°30' curve to the left 82 feet, a 4°15' curve to the left 61.7 feet, a 15-foot tangent frog and a 4°30' curve to the left 3.3 feet to the point of derailment and 1,439 feet beyond. The grade for east-bound trains was descending, successively, 5.41 percent 694 feet, 5.76 percent 950 feet, 5.99 percent 2,150 feet, 5.40 percent 250 feet, 5.83 percent 950 feet, 6.06 percent 700 feet, 5.89 percent 450 feet and 5.68 percent 650 feet, then there was a vertical curve 569 feet to the point of derailment, where it was practically level. The descending grade passed through two rock cuts, 900 feet and 600 feet in length. The areas adjacent to these cuts were thickly covered by trees. Their eastern ends were 3,755 feet and 1,855 feet west of the point of derailment.

At the point of derailment the track structure consisted of 70-pound rail, 28 feet in length, laid in 1899 on 14 ties to the rail length. It was fully tieplated, double-spiked outside and single-spiked inside each rail, provided with 6-hole angle bars, and was ballasted with cinders and gravel to a depth of 12 inches. At the point of derailment the gage was 4 feet 8-3/4 inches. There was no superelevation.

Time-table special instructions read in part as follows:

2405. Madison Hill:

> All movements on Madison Hill east of derail at top of hill must be handled by engines specially equipped with vacuum brake, engine must be headed west and operated on east end of train. Descending movements must be controlled by vacuum, air and hand brakes, retaining valves set in retaining position on all loaded cars and on sufficient empty cars to enable a uniform speed to be maintained. Speed of 6 miles per hour must not be exceeded. * * *

Brake and Train Air Signal Instructions read in part as follows:

10-d. Before a train is operated down a grade requiring the use of retaining valves, it must be known that they are in such condition that the speed of the train can be safely controlled by the engineman.

15. Hand Brakes--All trains must be controlled by the air brake, supplemented on heavy descending grades by hand brakes when necessary to insure the safe movement of the train.

The maximum authorized speed for all trains in the territory involved was 6 miles per hour.

Description of Accident

Extra 8329 East, an east-bound freight train, consisted of engine 8329, of the 2-8-0 type, headed west, 11 loaded cars and a caboose, in the order named. At North Madison, 2.2 miles west of Madison, the caboose was detached and left on the main track, and the front portion of the train proceeded eastward about 12:55 p. m. Soon afterward, the control of this portion was lost on the descending grade, and while it was moving at an estimated speed of 35 to 40 miles per hour the engine and the first nine cars were derailed to the right on a curve to the left.

The tender was not derailed. The engine stopped upright on the roadbed, 556 feet east of the point of derailment. The first car overturned. The first four cars were badly damaged. All tender wheels had slid-flat spots at three locations, which varied between 1 and 1-1/2 inches in length and 3/4 inch in width. All driving-wheel tires had slid-flat spots, which varied between 1 and 1-3/8 inches in length. All wheels of the eleven cars had slid-flat spots, which varied from 1/2 to 2-1/2 inches in length, at more than one location. The brakes of the engine and the eleven cars had been tested and had functioned properly. After the accident, inspection disclosed that all retaining valves were set for use.

It was cloudy at the time of the accident, which occurred about 1 p. m.

The conductor of Extra 8329 was killed.

After the caboose was detached at North Madison, the consist, weight and braking power of each unit of Extra 8329 were as follows:

Unit	Number	Light weight	Gross weight	Total braking power	Braking power gross weight
		Pounds	Pounds	Pounds	Percent
Engine	8329	185,200	204,800	111,120	54.0
Tender		67,200	160,600	40,320	17.2
DUPX	1805	33,800	99,820	21,636	21.7
CNW	59966	46,900	107,800	30,016	28.3
Soo Line	41468	43,500	104,100	27,840	26.7
MP	48334	43,200	133,200	26,620	19.6
Milw	705200	42,900	135,000	24,680	18.2
MP	48050	44,300	134,300	26,620	19.6
Milw	711112	42,500	132,500	27,200	20.0
CNW	66688	45,600	135,600	29,284	21.5
URT	100139	52,000	102,270	33,280	32.5
PRR	292996	37,000	123,400	28,850	15.3
BMX	4702	46,200	143,346	29,568	20.4
Totals			1,716,736	457,034	26.6

Note: All brake cylinders, except those of the engine and the first car, were 10 inches in diameter. The engine and the tender were provided with No. 6-ET equipment, 4 cars with AB valves, 6 with K-2 triple valves, 1 with a K-1 triple valve, 9 with 3-position retaining valves, and 2 with 2-position retaining valves. Seven cars were equipped with the conventional vertical-shaft type of hand brake, and 4 with hand brakes having gears adjacent to the brake wheel. After the accident, tests of 7 cars disclosed that the brake-cylinder piston travel varied between 7-1/2 and 7-3/4 inches. The brake equipment of the other 4 cars was badly damaged.

Inspection of engine 8329 failed to disclose any defective condition having existed prior to the accident. This engine was of the 2-8-0 type. The Nos. 1 and 4 pairs of driving-wheel tires were flanged, and the Nos. 2 and 3 pairs had plain tires. The total weight in working order was 204,800 pounds, distributed as follows: Engine truck 23,900 pounds, and driving wheels 180,900 pounds. The specified diameters of the engine-truck wheels and the driving wheels were, respectively, 30 inches and 56 inches. The tender was rectangular in shape, and was equipped with two 4-wheel trucks. Its weight when loaded was 160,600 pounds. The rigid wheelbase of the engine was 16 feet 3 inches. The bore of the cylinders was 25-1/2

inches and the stroke of the pistons was 28 inches. The tender was not provided with splash plates.

Engine 8329 was equipped with a compression-control arrangement consisting of a 2-inch pipe tapped into the front exhaust passage of the right valve-chamber and extending upward at the right side of the smokebox. A U-bend was joined to the top of this pipe, a 2-inch globe valve was connected immediately below the U-bend, then a 2-inch pipe extended downward and was connected to a 2-inch crossover pipe extending between the admission passages of the valve chambers. The globe valve was operated by an extension handle extending into the right side of the cab, and was accessible to the engineer. When it was desired to reduce speed through use of this arrangement, the valve gear was placed in position opposite to the direction of movement. As a result, air was drawn through the exhaust nozzle, compressed in the cylinders and steam-pipe system back to the closed throttle valve, and a retarding effect was transmitted by the pistons to the main rods and side rods. When compression increased to the extent that the driving wheels stopped revolving, the engineer released pressure to the atmosphere by opening the globe valve. This engine was equipped with special sand boxes so arranged that sand could be deposited back of the No. 4 driving wheels. Sand pipes attached to the conventional sand box were so arranged that sand could be deposited in front of the No. 1 driving wheels and to the rear of the No. 3 driving wheels. All engines used on this grade were headed westward so that water would be over the front end of the crown sheet.

After the accident, measurements of the track between points 160.5 feet and 108.5 feet west of the point of derailment were as follows:

Distance west of point of derailment	Cross level	Gage	
Feet	Inches	Feet	Inches
160.5	1	4	8-1/2
145.0	1/2	4	8-1/2
129.5	3/4	4	8-3/4
114.0	1/2	4	8-5/8
108.5	7/8	4	8-3/4

Note: Measurements throughout a distance of 108.5 feet west of the point of derailment could not be made, because the alinement was distorted as a result of a subsequent accident.

Discussion

Extra 8329 East stopped at North Madison about 12:25 p. m., and the tender cistern was filled with water. About 12:30 p. m., the engine, headed westward, was recoupled to the east end of a cut of 11 loaded cars. Brake-pipe pressure of 90 pounds was being maintained. After the train air-brake system was fully recharged, this cut of cars was moved eastward and the engine stopped about 600 feet east of the top of the grade, where the grade was 5.41 percent descending. This stop was made as a result of a 15-pound brake-pipe reduction, which was not released until after all hand brakes had been fully applied and the retaining valves on all cars set for use. The engineer then placed the brake valve in running position and waited until normal brake-pipe and auxiliary-reservoir pressures were restored. He attempted to start the train, but was unsuccessful until the hand brakes of the second, fifth and ninth cars were released. After slack was closed, the engineer placed the reverse lever in position for back-up motion and opened the throttle fully to start the cut of cars. As soon as the cut of cars started to move, the conductor, the flagman and the brakeman, who were, respectively, on the second, fifth and ninth cars, reapplied the hand brakes on those cars. After the engine had moved about 100 feet, the engineer placed the reverse gear in position for forward motion, opened the back-up sand valves, partially opened the compression-device release valve, and made a 15-pound brake-pipe reduction, which was not released. At a point about 1,500 feet east of the top of the grade the speed had increased to more than 6 miles per hour, and the engineer made two more brake-pipe reductions. The three reductions totaled 30 pounds. The speed continued to increase, and the engineer opened the throttle fully in an attempt to provide greater retarding force, but was unsuccessful. When the engine was about 4,000 feet east of the top of the grade, the speed was about 20 miles per hour, and the driving wheels stopped rotating. The engineer immediately released the engine and tender brakes. After the driving wheels started to rotate, he opened the throttle fully to retard the speed, and the driving wheels again stopped rotating about 1 mile east of the top of the grade. At this point all sand valves were opened and sand was flowing from 3 pipes on each side of the engine. The engine continued to slide throughout a distance of about 2,000 feet, and entered a 4°30' curve to the left at an estimated speed of 35 or 40 miles per hour. The engine and first nine cars were derailed to the right between points from 162 to 185 feet east of the west end of the curve, where the gage was 4 feet 8-3/4 inches. There was no superelevation. Immediately after the first car was derailed, it became separated from the engine. The tender was not derailed.

The maximum authorized speed was 6 miles per hour and the maximum safe speed on a 4°30' curve having no superelevation was about 43 miles per hour. There was no defective condition of the engine prior to the accident, and there was no indication of dragging equipment, nor of any obstruction having been on the track. A rail on the outside of the curve was found broken between two ties at a point 3.3 feet east of the receiving end of the rail. The most westerly mark on the track structure was a flange mark on the first tie east of the break and about 6 inches outside the rail. At a point 1-1/2 feet farther east, an angle bar inside the left rail bore marks indicating it had been struck by a wheel. The portion of the rail east of the break was considerably marked. Apparently the first wheel to be derailed crossed the head of this portion and following wheels canted the rail outward, and the rail became broken west of the point where the first wheels crossed it.

About 2 hours prior to the time of the derailment, the section foreman inspected the track in the vicinity, and there was no defective condition. The rail involved was laid at the point of accident in 1899. The cross-sectional area of the head was considerably reduced, but there was no internal defect. The surface of the track a short distance west of the point of derailment was irregular. At five stations in a section 52 feet long, the surface varied from 1/2 to 1 inch low. The irregularity in surface combined with excessive speed on the curve apparently caused lateral rolling sufficient to permit a flange to mount the outside rail. Since the tender was not derailed, apparently the left No. 4 driving wheel crossed the outside rail, and the other wheels of the engine became derailed immediately thereafter.

Throughout several months prior to the day of the accident, there had been but little rainfall in the vicinity of Madison. During this period, leaves, sand and oil, and grease drippings from glue-stock commodities accumulated on top of the rails. On the day of the accident a mist fell at intervals. The resultant slippery condition of the rails so lessened the factor of adhesion between the wheels and the rails that the retarding force of the brake system was greater than the adhesion, and the wheels slid. The braking ratio for this train was 26.6 percent. The investigation disclosed that on previous occasions trains had been out of control on this grade. In fact, about 5-1/2 hours after the derailment, the engine of Extra 8565, a wrecking train, moved down the grade and out of control. In this case, the engine without cars left North Madison in backward motion. When it entered the descending grade a mist was falling. The valve gear was placed

in position for forward movement, the sander valves were opened, the compression-device release valve was partially open, and the engineer applied and released the engine and tender brakes at intervals to assist in controlling the speed. Throughout the first 5,000 feet the speed was 4 or 5 miles per hour, then the driving wheels stopped rotating, and the engineer opened the compression release valve, released the engine and tender brakes, and opened the throttle valve. The engine slid about 400 feet, then the driving wheels rotated. The engineer partially closed the release valve to obtain more compression, and the driving wheels again stopped rotating. At this point the engine was about 2,000 feet from the bottom of the grade, and the speed was about 25 miles per hour. The engineer opened the throttle fully, but the driving wheels did not revolve, and the speed increased as the engine slid down the grade. Employees on the engine jumped shortly before the engine collided, at a speed of 40 to 50 miles per hour, with the rear car of the cut that had been derailed earlier that day. The collision occurred 24 feet east of the west end of the curve.

Section 1 of the Safety Appliance Acts, 45 U. S. Code Sec. 1, reads as follows:

> It shall be unlawful for any common carrier engaged in interstate commerce by railroad to use on its line any locomotive engine in moving interstate traffic not equipped with a power driving-wheel brake and appliances for operating the train-brake system, or to run any train in such traffic that has not a sufficient number of cars in it so equipped with power or train brakes that the engineer on the locomotive drawing such train can control its speed without requiring brakemen to use the common hand brake for that purpose.

The investigation disclosed that the engines and all cars were equipped with operative air brakes, and that appliances were provided for the operation of the train brake system. However, time-table special instructions required the use of hand brakes to assist in controlling the speed. Before engine 8329 and the cut of cars started to descend the grade, all hand brakes were fully applied while the train air brakes were applied. Officials said this resulted in braking force being applied at the brake shoes theoretically equal to a full-service air-brake application. They said the use of hand brakes was for extra precaution. No train had been operated down the grade without the use of hand brakes, and no test had been made to determine if the speed of a train could be controlled properly by use of

power brakes only. The movement on the grade was not properly under control at any time, because of numerous car wheels sliding. The use of hand brakes in controlling the speed of trains is in violation of the Safety Appliance law, and should be discontinued.

Cause

It is found that this accident was caused by excessive speed on a curve having irregular surface, as a result of train being out of control on a descending grade.

Recommendation

It is recommended that the Pennsylvania Railroad Company so control the braking ratio and percentages of adhesion on this grade that trains may be safely operated in compliance with existing law.

Dated at Washington, D. C., this twenty-first day of December, 1943.

By the Commission, Commissioner Patterson.

W. P. BARTEL,

(SEAL)

Secretary.