

INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE
INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE
DENVER AND RIO GRANDE WESTERN RAILROAD NEAR WACO,
COLO., SEPTEMBER 5, 1926.

October 8, 1926.

To the Commission:

On September 5, 1926, there was a derailment of a passenger train on the Denver and Rio Grande Western Railroad near Waco, Colo., which resulted in the death of 27 passengers, 2 employees on duty and 1 employee off duty, and the injury of 45 passengers, 3 employees on duty, 3 employees off duty, 2 news agents and 1 Pullman porter. The investigation of this accident was made in conjunction with representatives of the Public Utilities Commission of Colorado.

Location and method of operation

This accident occurred on the Third Sub-division of the Salida Division, extending between Minturn and Salida, a distance of 86.84 miles. This is a single-track line over which trains are operated by time-table and train orders, no block-signal system being in use. The accident occurred at a point approximately one-half mile west of Waco; approaching this point from the west there is a tangent 1,941 feet in length, a 2° curve to the left 623 feet in length, 1,201 feet of tangent, and then a curve to the left of $11^{\circ}30'$ which is 285 feet in length, the point of accident being on the last-mentioned curve, near its western end. The grade is descending for eastbound trains for a considerable distance, varying between 0.80 and 0.09 per cent within a distance of 1 mile west of the point of accident, at the point where the accident occurred the grade was 0.32 per cent.

The track in the immediate vicinity of the point of accident is on the north or left bank of the Arkansas River; on the inside of the $11^{\circ}30'$ curve there is a very high wall of rock, space for the roadbed having been cut out of the base of this rock. On the outside of the curve there is a slope of about 15 feet down to the level of the river, which was rather shallow opposite the point of accident. The track is laid with 85 pound rails, 33 feet in length, with an average of 19 ties to the rail-

length, tie-plated, double-spiked on both sides of the rails, and ballasted with about 6 inches of slag. The elevation maintained on the 11°30' curve was 4 inches, while the gauge was 4 feet 9 inches. The general maintenance of the track was good. Under a time-table rule the speed of all trains on sharp curves is restricted to 30 miles an hour.

The weather was clear at the time of the accident, which is thought to have occurred at about 11.05 a.m.

Description

Eastbound passenger train No. 2 consisted of one baggage car, one smoking car, one coach, four Pullman cars, two dining cars and five Pullman cars, in the order named, hauled by engine 1604, and was in charge of Conductor Cope and Engineman Harpending. The 6th, 8th, 9th and 13th cars had steel underframes and vestibules, while the others were of all-steel construction. This train left Tennessee Pass, 21.50 miles from Waco, at 10.26 a.m. according to the train sheet, 56 minutes late, and arrived at Malta, a distance of 9.99 miles, at 10.41 a.m., having maintained an average speed between the two points of 39.96 miles per hour. It departed from Malta, which is approximately 11 miles from the point of accident, at 10.48 a.m., 58 minutes late, and was derailed near Waco while traveling at a speed thought to have been about 40 or 45 miles per hour.

Engine 1604 came to rest on its right side in the Arkansas River, with its head end about 256 feet beyond the approximate point of derailment; the tender was directly in the rear of the engine and was also on its right side. The baggage car was bottom up between the engine and the track and nearly at right angles to the track, with the smoking car resting diagonally across the rear end of the baggage car. The coach came to rest on its right side with one end on top of the smoking car and the rear of the tender and the other end on the opposite bank of the river, this car apparently at one time had been standing perpendicularly in the air. The first Pullman car came to rest on its left side with its forward end jammed into the wreckage of the first three cars at the point where they were on top of one another. The second Pullman car, which was the fifth car in the train, turned over on its right side, the head end remaining on the embankment and the rear end resting in the river, while the sixth car remained upright with its head end close to the river and its rear end resting on the roadway. With the exception of the derailment of the forward truck of the seventh car none of the other cars was derailed or damaged. The majority of the passengers killed were in the rear end of the smoking car and the forward end of the coach, while both

of these cars were so badly damaged as to be considered a total loss. The employees on duty killed were the engine-man and a road foreman of equipment who was operating the engine at the time the accident occurred.

Summary of evidence

Fireman Willingham said Road Foreman of Equipment G. M. Lillis took charge of the engine at Tennessee Pass and that he seemed to handle the train properly although when stopping at Malta he ran by the water tank a distance of about one car-length, necessitating a back-up movement. Fireman Willingham thought, however, that this was due to an error of judgment rather than to excessive speed. He said the speed of the train was maintained at about 45 miles per hour, but so far as he knew nothing was said to the road foreman by Engineman Harpending about using the brakes, although at one point the engineman told the fireman that the road foreman was certainly running fast. He also quoted Engineman Harpending as commenting to him on how nicely the engine ran when rounding the curves at high speed. After reaching the tangent track immediately west of the curve on which the accident occurred, Road Foreman Lillis made a light application of the brakes which was held applied for an interval of 7 or 8 seconds, followed by the beginning of a heavier application. The brakes took hold properly but apparently they were not applied soon enough to effect any reduction in the speed of the train before it reached the 11°30' curve, still traveling at a speed of about 45 miles per hour, and Fireman Willingham said he felt sure that the train could not round the curve in safety but that there was nothing for him to do but to hold on. He further stated that the air brakes were tested at Tennessee Pass, that a running test was made when departing from that point, and that the brakes had worked properly at all times.

Conductor Cope said that after collecting transportation from passengers who had boarded the train at Malta he went back into one of the dining cars to deliver a message to the steward and had just turned around for the purpose of leaving the car when the derailment occurred. He had noticed two applications of the air brakes, the last application being very shortly before the accident occurred. He did not think the speed at this time was more than 30 miles per hour and said he had not noticed any excessive speed after leaving Tennessee Pass. Conductor Cope further stated that he looked at his watch as soon as he regained his feet after the shock of the derailment and it was then 11.15 a.m. It is to be noted, however, that if this figure is correct then the time of train No. 2 from Malta to the point of accident was approximately 27 minutes, whereas

its scheduled running time from Malta to Waco, about one-half mile beyond the point of accident, is only 20 minutes.

Head Brakeman Angel said the train had been well handled after leaving Tennessee Pass, and that there had been no excessive speed en route nor any unusual rolling of the train when rounding the curves. When within what he thought was 250 or 300 feet of the point where the accident occurred he felt an application of the air brakes which reduced the speed to the extent of 8 or 10 miles per hour, and he estimated the speed at the time of the accident to have been 30 or 35 miles per hour, although he said he was not paying any particular attention to the matter. He also stated he thought the accident occurred at 11.15 a. m. but that he did not look at his watch until 10 or 15 minutes afterwards. The statements of Head Brakeman Angel were practically corroborated by those of Flagman Grout, except that the flagman stated that the accident occurred at 11.14 or 11.15 a.m. and that he looked at his watch immediately after its occurrence.

Trainmaster Lynch, who was riding on the train, had gotten off when it stopped at Malta and when again boarding the train he went forward as far as the second Pullman from the head end of the train, which was the fifth car, and was visiting with his son, who had been away during the summer, and on account of talking with him he was not paying close attention to the operation of the train or to the speed at which it was running, although he said there was no unusual rolling of the cars. West of the point of accident they crossed over to the right side of the car in order to obtain a better view of some changes which were being made in connection with re-aligning the track. The speed of the train at this time was about 45 miles per hour and Mr. Lynch said that it was when they were crossing back to their seats on the left side of the car that he felt an application of the air brakes, and at about the time they were in their seats he felt the shock of the derailment. He was unable to say to what extent the air-brake application had retarded the speed of the train, although he estimated that the distance between the point where the brakes were applied and the point of the curve probably was 1,500 or 1,800 feet. Trainmaster Lynch further stated that the first marks on the track which he could find were on the ties at the point of the curve, about 2 or 2½ inches from a rail; he was unable to ascertain the cause of the accident, there being no defects either of track or equipment, and that he knew of nothing else which could have caused the accident except excessive speed, saying it was possible that the speed was excessive and that he had not noticed it.

Section Foreman Gillon, in charge of the section on which the accident occurred, said the track was in good condition and that he had never had any derailment at that point, while on his arrival at the scene, approximately an hour after the accident occurred, he was unable to find any defective condition of the track which could have caused the accident. He further stated that he had walked over this particular portion of the track on the morning of the accident but had not discovered anything wrong.

Roadmaster Chambers said he reached the scene of the accident at about 2.30 p.m. and at once made an examination of the track but was unable to find anything which could have caused the accident. He further stated that particular attention was paid to the track in this vicinity and that it was maintained in as nearly perfect condition as was possible. It also appeared from his statements that he had ridden over this portion of the road on the night preceding the accident and at that time the track appeared to be in good surface and alignment.

Division Engineer Darby, who reached the scene at about 1.10 p.m., said that measurements of the track were taken at every 15 feet for a distance of 150 feet, nothing wrong being discovered. Mr. Darby found a mark on the inside of the ball of the outer rail, which looked as though it had been scraped, but said he thought it was caused by something under the fifth car in the train. Several of the rails were torn out from the track and some were broken, but there was nothing about them to indicate that a broken rail caused the accident. These rails were relaid in 1911, and while he did not know when they were laid in their present location Mr. Darby said he had heard that they were relaid on this curve within the past four or five years. Notwithstanding the fact that these rails were 15 years old, Mr. Darby said they showed no perceptible wear, and expressed the opinion that the accident was due to excessive speed. Mr. Darby was asked if he thought the engine left the rails or whether the pressure against the outer rail was so great as to push that rail outward and he said that the latter might have been the case, although the tie plates were not torn out.

Engine 1604 was one of several which had been delivered to this railroad recently and was somewhat heavier than those which had been previously in use in passenger-train service. It was of the 4-8-2 type and had a total weight, engine and tender loaded, of 710,310 pounds. The examination of the engine showed that there was no indication of the pilot having come in contact with any obstruction on the track, nor was anything discovered tend-

ing to indicate that there was any defective condition about the engine which could have caused the accident. The engines of this type are designed for use on curves up to 15°. The lateral motion on the front driving wheels originally was one-thirty-second of an inch, but this was afterwards increased to one-fourth of an inch in order to avoid hub friction.

The time at which this accident occurred was considerably in dispute. The person best in position to give accurate information on this point would seem to be the train dispatcher, in whose files appears a note to the effect that it was 11.10 a.m. when Trainmaster Lynch reported the accident. Considering the fact that Trainmaster Lynch had to crawl out of the car in which he was riding, climb over another car and up on the roadway, look over the situation, instruct one of the brakemen to protect the rear of the train by flag, and then run a distance of nearly 2,800 feet to a telephone, it is believed that a fair estimate of the time of the accident would be 11.05 a.m., which if correct would show that train No. 2 had traveled at an average speed of 38.8 miles per hour after its departure from Malta.

The investigation developed that the passenger-train performance on this railroad had not been satisfactory from the standpoint of making scheduled running time and that about two months previous to this accident the general superintendent of transportation issued a bulletin calling attention to the matter and advising that he would issue a telegraphic report every morning showing the percentage of passenger trains on each division which made scheduled running time during the preceding 24 hours. It appeared that the issuance of the bulletin referred to, followed up by the daily reports concerning the passenger-train performance, resulted in the subordinate officials continually talking with the train and engine-service employees for the purpose of having them make a better showing. A check of the train sheets covering that part of the Salida Division extending between Malta and Salida, a distance of 55.89 miles, disclosed that during the month of August it was a matter of almost daily occurrence for an eastbound train to make up 30 minutes lost time between these two points, even after allowing for delays on account of station work, in several instances the lost time made up varied from 40 to 45 minutes. It is true that the schedules of the trains involved were comparatively slow in some locations, but when consideration is taken of the size of the trains, the nature of the country traversed and the fact that in the territory in question there are 25 curves varying between 8° and 14°, with innumerable curves of less than 8°, it is apparent that the prompting which

originated in the office of the superintendent of transportation has had considerable effect. On August 17 the superintendent of the Pueblo and Denver Divisions issued a bulletin to the effect that enginemen on passenger trains were running at excessive speed on curves, although a check of the train sheets of those divisions did not indicate that the average speeds were quite as high as those attained on the Salida Division, nor were there as many trains which ran at those higher rates of speed. A check of the records did not reveal any warning of a similar nature issued by the superintendent of the Salida Division. To what extent this desire for making up lost time influenced Road Foreman Lillis in taking control of the engine away from Engineman Harpending is a matter of conjecture.

Under the time-table rules the speed of all trains on sharp curves is restricted to 30 miles an hour. While it is the practice of the engineering department to limit the elevation of such curves to 4 inches, yet according to the recommended practice of the American Railway Engineering Association the theoretical elevation on a curve of $11^{\circ}30'$ for a speed of 30 miles per hour would be 6.81 inches, and while it can not be said that with an elevation of 4 inches instead of 6.81 inches there would be serious danger of the overturning limit being reached, yet it is clearly apparent that the speeds allowed can not be exceeded without approaching the danger point for a curve of such a high degree. In this connection attention is called to the fact that the maximum curvature between Malta and Salida is 14° which according to the same recommended practice previously referred to would call for a theoretical elevation of 8.32 inches if a speed of 30 miles per hour is to be permitted.

Conclusions.

This accident was caused by excessive speed.

While conflicting in some details the best evidence indicates that train No. 2 approached the curve on which the accident occurred at a speed of approximately 40 or 45 miles per hour and that although Road Foreman of Equipment Lillis, who was operating the engine in the place of Engineman Harpending, made an application of the air brakes before the curve was reached, yet this application was not made soon enough to effect any appreciable reduction in speed before the curve was reached. The speed on this and all other sharp curves on this railroad is restricted to 30 miles per hour, and in view of the fact that an elevation of only 4 inches is provided for it is not considered that the prescribed limit can with

reasonable safety be exceeded. It did not appear that there was anything defective either about the track or equipment, and it is believed that had the speed been reduced at least to 30 miles an hour before the curve was reached the accident would not have occurred. As previously stated, the reason why Road Foreman Lillis relieved Engineman Harpending is not known but it would appear probable, in view of Engineman Harpending's greater familiarity with the territory, that had he remained in charge of the engine he would have reduced the speed, when approaching the curve, in time to have averted the occurrence of the accident.

It is well recognized that in mountain territory where there are many heavy grades and sharp curves it is desirable to keep down the amount of elevation on curves in order to facilitate the movement of heavy trains when ascending grades. This requirement, however, has a very necessary corollary which is even more important and that is that trains capable of moving at high rates of speed shall not exceed the limits beyond which they can not go with any reasonable degree of safety, in view of the limited elevation provided. If the desire to expedite the handling of heavy tonnage trains is paramount, resulting in low elevation on curves, then it is necessary very materially to restrict the speed of passenger trains when rounding such curves. But if passenger trains are to be operated at speed, then the elevation provided on these curves should be increased accordingly, keeping in mind the necessity for providing an adequate margin of safety between the authorized speed and the speed beyond which trains can not be operated with any degree of safety. This is a matter which has been referred to on previous occasions; it is one of primary importance, and should not be overlooked in the desire to make up lost time.

Road Foreman of Equipment Lillis had been an engineman on the Pueblo Division and had been a road foreman of equipment on the Gunnison and Salida Divisions since August 10, 1924. Since that time he had been riding trains over the Salida Division to a greater or lesser extent, although he had done very little actual running in that territory. All the other employees were experienced men and at the time of the accident none of them had been on duty in violation of any of the provisions of the hours of service law.

Respectfully submitted,

W. P. BORLAND,

Director.