DEPARTMENT OF TRANSPORT

RAILWAY ACCIDENT

Report on the Collision that occurred on 18th January 1986 at Preston

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LONDON MIDLAND REGION
OF BRITISH RAILWAYS

HER MAJESTY'S STATIONERY OFFICE

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RAILWAY INSPECTORATE
DEPARTMENT OF TRANSPORT
2 MARSHAM STREET
LONDON SW1P 3EB
29th May 1987

SIR,

I have the honour to report for the information of the Secretary of State for Transport, in accordance with the Direction dated 22nd January 1986, the result of my Inquiry into the collision between a passenger train and a locomotive that occurred on Saturday 18th January 1986 near Preston Station in the London Midland Region of British Railways.

At about 18.45 a football supporters charter train, formed of a two-car diesel multiple-unit, returning from Carlisle to Accrington failed to respond to a brake application and passed a signal at Danger on the approach to Preston Station. It continued through the station, passed two more signals at Danger before colliding violently with a stationary diesel-electric locomotive.

When the driver realised that the train was not responding to a brake application he warned the passengers in the leading car to move towards the rear one. Of the 115 passengers on the train 44 received injuries which required hospital treatment. Four passengers were detained in hospital but the others were released after treatment. Two of the detained passengers were discharged on 19th January, a third on 20th January and the fourth on 4th February.

The driver and relief driver of the locomotive realised that the train was going to collide with the locomotive and jumped clear. The driver, however, was drenched with diesel fuel oil from a tank that burst in the collision and he too required hospital treatment.

At the time of the accident it was dark, windy and raining.

DESCRIPTION

The Site and Signalling

1. Preston Station lies 209 miles from London on the West Coast Main Line (WCML) to Glasgow. Carlisle Station is also on the WCML 90 miles to the north of Preston. The relevant part of the route is depicted in diagram 1. The mileage used on the WCML is not continuous and the mileage marked at the lineside, used in this report and indicated on the diagrams re-commences at both Wigan and Preston. One of the distinctive features of the route is the descent from Shap Summit 37¼ miles north of Preston and some 275 m above sea level.

2. The WCML runs approximately north south through Preston. Just over 2 miles to the north of Preston lies Oxheys where there is a loop line on the Up side. From there to the trailing connection with the lines from Kirkham at Fylde Junction north of Preston Station there are two lines, the Up and Down Main lines. Preston Station has six bi-directional through platforms as well as a number of other lines. The layout of the lines in the station are shown in diagram 2. To the south of the station there are six running lines, from east to west they are the Up Fast, Down Fast, Up Slow, Down Slow, Up Goods and Down Goods lines.

3. The WCML is electrified on the 25kV ac overhead system. Trains are signalled under the Track-Circuit Block Regulations using multiple-aspect colour-light signals. There are Power Signal Boxes at Preston and Carlisle. The line is equipped with the Automatic Warning System (AWS). The maximum permitted line speed between Preston and Carlisle is 110 mile/h but there is a permanent speed restriction at Fylde Junction of 35 mile/h followed by varying lower speed restrictions through the Preston Station area. An illuminated Advanced Warning Indicator (AWI) with associated AWS equipment is provided for this speed restriction.

The diesel multiple-unit (DMU)

4. The DMU was formed from two Class 104 power cars built by the Birmingham Railway Carriage and Wagon Company in 1957. Each car weighed 31 tonnes and was powered by two 112kW diesel engines. The two cars were linked by a gangway connection and both cars had similar driving cabs at their outer ends. The leading car, No 53482, was a motor composite with 12 former first class seats and 54 second class seats. The trailing car, No 53433, was a motor brake second with 52 second class seats and a guard's brake compartment.

The trailing car was equipped with AWS but the leading car was not. The layout of the two cars is shown in diagram 3. The maximum permitted speed of the unit was 70 mile/h.

5. The DMU was equipped with the British Railway's two-pipe quick-release vacuum brake system. The total brake force normally available was 82 per cent of the total weight of the DMU, that is, 51 tonnes. The brake system has a train pipe continuous throughout the train connecting the two brake cylinders on each car with the driver's brake valve and the emergency application valves. The second pipe, also continuous throughout the train, connects the belt driven exhausters and the high vacuum release reservoirs on each car. This system, which is depicted in simplified form in diagram 4, enables the brakes to be released quickly by allowing both the exhausters and the release reservoirs to withdraw air from the train pipes and compensates for the fact that the diesel engine and the exhauster may be running at slow speed.

6. The high vacuum release reservoirs are maintained at 29 ins of vacuum in the normal running condition with the brakes off. The feed valve ensures that the vacuum in the train pipe and brake cylinders does not exceed 21 ins. The automatic isolating valve prevents the vacuum in the release reservoir falling below 19 ins. Measurements of vacuum throughout this report are in inches of mercury.

7. The driver's brake valve has three positions:

Off or Running — High vacuum release reservoirs at approximately 29 ins, train pipe and brake cylinder at 21 ins. Both are maintained by the exhausters through the driver's brake valve.

Lap — Maintains the high vacuum side of the system at 29 ins and the train pipe at 21 ins or such lower figure as may have resulted from a brake application. The train pipe and brake cylinders are isolated from the exhausters and high vacuum release reservoirs.

On — Maintains the high vacuum side of the system at 29 ins but admits air to the train pipe.

8. The four vacuum brake cylinders were of a standard design. The cylinders are approximately 550 mm (21 ins) in diameter and consist of an outer casing and an inner cylinder and piston. At the top of the piston a groove is machined around the circumference in which, when the brake is in the released position, a rubber rolling ring sits in a relaxed state. When the brake is applied air is admitted to the underside of the piston. This has two effects: it partially destroys the vacuum on the underside of the piston but it also closes a ball valve, which is integral with the piston, thus preventing air getting into the topside of the cylinder. This creates a pressure differential above and below the piston and causes it to rise up the cylinder. As the piston rises the rubber rolling ring is simultaneously compressed and rolled down the piston and up the cylinder wall. In the initial phase of the movement the rolling ring passes over the port to the piston non-return valve effectively sealing the top side vacuum and rendering the ball valve inoperative. The movement of the piston is transmitted to the brake rigging, which applies the brake blocks to the wheels, by a rod which passes through a gland in the bottom of the cylinder. There is an elongated slot in the bottom of the piston rod into which the brake rigging is connected by a pin. This slot allows the brake cylinder piston to begin to move before any load is imposed upon it by the brake rigging. This is called 'Freelift'.

The locomotive

9. The locomotive, No 47111, was of the 1925 kW Class 47/0 diesel-electric type. It had a driving cab at either end and a Co-Co wheel arrangement. In working order it weighed some 120 tonnes.

Evidence

As to the course of the collision

10. *Signalman N. Bulcock* commenced his turn of duty at Preston Signal box at 14.00 on 18th January. He was working on that part of the panel which controls the Preston Station area. He told me that he was unable to set the route into the station for the Football Charter Train (1L10), which was scheduled to use platform No 3, because of an exchange of the locomotives from other trains that was to take place to the south of the station. He was, therefore, able to set the route for 1L10 only as far as Signal PN 145 to the north of the station.

11. The locomotive exchange movements involved the detaching of an electric locomotive from a Glasgow to Nottingham passenger train, which was at platform No 4, and replacing it with a diesel-electric locomotive. The electric locomotive was to be attached to a Preston to Crewe passenger train, which was at platform No 5. These movements did not prevent Mr Bulcock from setting the route for a passenger train from

the Blackpool line into platform No 2. To the south of the station a locomotive from Wigan was approaching Signal PN 76, where is was to be held.

12. Mr. Bulcock said that when he again turned his attention to the Football Charter train he saw that the track circuit indications at Signal PN 145 were not showing occupied but that the train description, 1L10, was still being displayed. He initially thought that there was a track circuit failure but he then saw that the track circuits on the Down Fast line to the south of the station were showing occupied. By that time it was too late for him to reverse the crossover, which would have transferred the DMU to the Up Fast line, and he realised that a collision with the stationary locomotive at Signal PN 76 was likely. He asked the signal box supervisor to call the emergency services and placed all signals to Danger. While the supervisor was contacting the emergency services there was a telephone call from the overhead line controller because all the circuit breakers for the area to the south of Preston had operated and Mr Bulcock asked for an emergency isolation between Euxton Junction and Garstang.

13. At the controls of Locomotive No 47111, which was at Signal PN 76, was *Relief Driver M. Patel*; also in the leading cab was Driver P. Skellern. They had earlier in the day travelled as passengers to Wigan in order to bring the 'light' locomotive back to Preston. Mr Patel had driven the locomotive from Wigan and he told me that the journey was normal until he brought the locomotive to a stand at Signal PN 76 which was displaying a red aspect. Almost immediately he saw a DMU approaching on the Down Fast line and his initial reaction was that it was going to cross ahead of the locomotive onto the Up Fast line. He then realised that the DMU was not crossing to the other line and he and Mr Skellern jumped from the cab. As Mr Patel landed he looked up and saw the collision occur. Before jumping he did not have time to release the air brake of the locomotive.

14. Having picked himself up, he immediately went to a signal post telephone and obtained confirmation that traffic was stopped on all lines and the emergency services had been called. He suggested to the signalman that the best access to the site for the emergency services would be from Factory Lane. He then climbed into the DMU and tried to calm the passengers and check on any injuries they had sustained. When he saw the driver of the DMU he told him that the lines were 'blocked' by the signalman. Later, when he saw the emergency services approaching, he made his way to the road and directed them to the site.

15. The train was chartered by *Mr J. Whitehead*, a coach proprietor, for members of the Blackburn Rovers Supporters' Club. He had organised a number of similar trains. He told me that he always introduced himself to the train crew and advised them to contact him if there were any problems with any of the supporters. When the train arrived at Preston on the outward journey he introduced himself to the driver who took over the train there. He travelled in the cab of the DMU for much of the journey to Carlisle and he told me that he frequently travelled in the driving cab of trains he chartered. On this particular journey he made timings of the journey because, as a railway enthusiast, he considered the running of a DMU over Shap was unusual.

16. Mr Whitehead said that the train departed from Carlisle on the return journey at about 17.30 and that he again travelled in the driving cab. On the approach to Preston he noticed a signal displaying a double yellow aspect and he got up to get his coat and bag. He then heard what he believed to be a full brake application but realised that the speed of the train was not reducing. The driver told him that there was "no brake" and to move the passengers back. Mr Whitehead shouted to one of the Supporters' Club's stewards, who was in the brake van, to tell the guard to put the emergency brake on but she replied that he was not there.

17. He ran to the brake van and tried the brake himself but there was no reaction. With the aid of two of the stewards he moved as many of the passengers as possible into the rear car and got them to lie down on the floor. During this time the train lurched violently throwing many of the passengers to the 'nearside'. Mr Whitehead pulled two 'communication cords' in the rear car and one of the stewards pulled another but there was no reaction and the collision occurred.

18. The train for its journey from Preston to Carlisle and for the return journey to Preston was in the charge of *Guard M. Khan*. The journey from Preston to Carlisle, he said, was smooth and normal. Before the train departed from Carlisle on the return journey he saw on the gauge in the brake van 21 ins of vacuum created from zero. He gave the signal for the train to start from the brake van before moving to the rear driving cab, where he occupied the driver's seat, for the journey to Preston. He did not travel in the brake van because food was being prepared and served from there.

19. The train ran non stop from Carlisle but on the approach to Fylde Junction there was no reduction in speed for the 35 mile/h speed restriction and he realised that something was wrong. He attempted to apply the brakes using the emergency brake valve in the trailing driving cab but when there was no intake of air as he

operated the valve he realised there was no vacuum in the brake pipe. As the train was passing through Preston Station he shouted for the passengers to lie down and shortly afterwards the collision happened.

20. The DMU was driven from Preston to Carlisle and from Carlisle to Preston on the return journey by *Driver H. Blakeley*; he was based at Preston and had 10 years experience as a driver and had considerable experience of driving DMU trains. Mr Blakeley confirmed that he had allowed Mr Whitehead to ride in the cab during the journey to Carlisle and that Mr Whitehead was sitting on the spare seat. During the journey to Carlisle he had used the brake occasionally and it operated normally. After the passengers had left the train at Carlisle he drove the train to Kingmoor Maintenance Depot for fuel and water.

21. On the return from the maintenance depot to the station he drove the train from the cab that he was later to use on the journey from Carlisle to Preston. Between the depot and the station he used the brake several times and it operated normally. At the station the train was propelled into a bay platform and stabled there. Mr Blakeley had left the engines running but had applied the hand brake and destroyed the vacuum in the brake. He was taken slightly unawares when the signal was given for the train to start before the scheduled time from Carlisle and had to re-create the train-pipe vacuum from zero. He said that he pushed the brake handle right across, away from him, and as the gauge passed the 15 ins mark he engaged gear and then, as it came up to 21 ins, he opened the throttle.

22. On the journey south from Carlisle to Preston he again allowed Mr Whitehead to ride in the cab, sitting in the spare seat. A boy, introduced by Mr Whitehead, also travelled in the cab for part of the journey, sometimes sitting on the spare seat, while Mr Whitehead was away and at other times standing with his back to the passenger compartment window next to the spare seat. Mr Blakeley said he was not distracted from his duty in any way by them. He had placed the brake handle in the full release position on departure and had not touched it again until the train was approaching Preston. There was no need to make a brake application on the descent from Shap Summit because when he shut off power the speed of the train reduced. Although there were some restrictive signals in the Lancaster area, there was no need to make a brake application.

23. He said that he went to apply the brake at Oxheys, following the sequence of signals from Barton and Broughton, which indicated to him that the train would have to stop at Signal PN 145, but there was no brake application and, as far as he could recall, no audible inrush of air to the brake valve. He tried several more brake applications without result. He then looked at the gauge and saw the train pipe side was reading zero but did not notice what the high side was reading. Meanwhile, he told Mr Whitehead about the problem and asked him to move the passengers.

24. Mr Blakeley stayed in the cab and tried putting the unit into first gear to slow it down but did not think about applying the hand brake. He sounded the horn continuously on approach to Platform No 3 and while going through the station. As the train ran onto the river bridge he saw the headlights of another train and at that point he too left the cab and shortly after the collision happened.

As to the damage and the condition of the braking system

25. *Mr P. D. Whalen*, a Traction and Rolling Stock Inspector based at Preston had just arrived at the station to take up his turn of duty when he was informed of the collision. Immediately, with a colleague, he made his way to the site of the accident. He estimated he arrived there about 19.15. He told me he found the locomotive and DMU some 20 feet apart and both extensively damaged. The cab at the north end of the locomotive was totally destroyed but accompanied by a Fire Officer, he made his way from the rear cab through the engine compartment and forced open the bulkhead door to the wreckage of the front cab sufficiently to confirm that no-one was trapped there. Later he was able to confirm that the brakes of the locomotive were still applied.

26. He said that the front cab and passenger compartment of the DMU were completely destroyed and the leading (No 1) bogie had been forced back to a position under the No 2 engine. He examined the brake blocks, which were in good condition, and the wheels of the DMU and found no overheating or other signs of prolonged or heavy braking. From this he concluded that if the brakes of the DMU had been applied it would only have been for a short distance before the collision. His attention was drawn to the fact that the pistons on the three brake cylinders, which were intact, were in the released position. One of the exhausters had been destroyed but the other three appeared to be in working order and the driving belts were intact and in line.

27. On the trailing car of the DMU it was found that two of the passenger emergency valves had been operated. Later when the two cars had been separated, the vacuum pipes of the trailing car were coupled to a locomotive. Initially it was not possible to create a vacuum because of the operated emergency handles and the

driver's safety device (DSD) was 'blowing through', which it should have been without the control keys in position. Mr Whalen isolated the DSD and reset the emergency handles and 21 ins of vacuum was obtained.

28. *Mr E. Ingles*, the Traction Engineer at the Newton Heath Depot, confirmed that the DMU was one of the units allocated to that depot. Following the accident he examined the DMU's maintenance records and the reported defects. The records showed that all the maintenance and examinations had been carried out in accordance with the laid down schedules. On 26th November 1985 a report was made by a driver that the brake would not hold in the Lap position but when the unit was brought in for a scheduled 'A' examination, which includes a test of the brakes, on the evening of 28th November no fault could be found with the brake system.

29. The most extensive of the scheduled examinations, the 'C' examination, was carried out on the DMU on 4th December 1985. Mr Ingles said that during that examination a minor fault with No 1 brake cylinder of car No 53482 was found and that the protective gaiter on the brake cylinder shaft was renewed. There were also 2 defective brake adjusters which required attention. Following these repairs a full test of the brakes, including a slow application test, was satisfactorily performed.

30. *Mr K. G. Nicholson* the Engineering Assistant (Brakes) for the Regional Mechanical and Electrical Engineer was responsible for co-ordinating the testing of the brake system of the DMU following the accident. On 21st January a brake test was carried out at Preston on the undamaged trailing car No 53433. The test was carried out in accordance with the London Midland Region's Standing Order LG 8, which was the test specified following accidents. The brakes were found to operate satisfactorily during the test and there was nothing to indicate that the brakes were in any way defective.

31. A test of the leakage rate of the vacuum from the train pipe and the vacuum system in general was carried out and the leakage which occurred was within the limits allowed. A slow application test was also carried out. This involved attaching a 'one-eighth leak disc' to one of the hoses of the train pipe and with the brake handle in the Lap position so that the vacuum was not being recreated. It allows the vacuum to be destroyed at a very slow rate. Both cylinders operated satisfactorily in each of the 3 repetitions of the test. Subsequently, another test was carried out during which the vacuum was reduced from 21 ins to zero over a period of 25 minutes. This caused No 2 cylinder to apply but No 1 did not apply.

32. Mr Nicholson was not able to carry out similar tests on the severely damaged leading car No 53482 the leading brake cylinder of which had been destroyed in the collision. The driver's brake valve was removed from the wreckage for examination and was found to be essentially intact although some damage had been caused to it in the collision. The side of the valve body against which the valve handle rotates was heavily scored and was coated in brass dust. This was not untypical of brake valves which had been in use for 20, or more, years and was caused by the spring loaded plunger of the handle rubbing against the valve. The indent in the valve body at the Lap position and into which the plunger engages was worn and there was only a slight depression to indicate the position. When examined the plunger was found to be forced back inside the handle against the spring. It was not possible to identify whether it was like that before the accident or whether it was a result of the collision. It was, however, possible to prise out the plunger indicating that it was not held under any great force.

33. When the valve was dismantled both the moving and fixed parts of the valve disc were found to be in good order and there was no evidence of any scoring or marking on either of the discs. Some debris was found in the valve. In the top of the valve were two small pieces of glass and a particle of the coating material put on the inside surfaces of the cab after the removal of asbestos. Beneath the fixed portion of the valve three small pieces of wood were found. The glass and the coating material would probably have entered the valve during the collision. The source of the pieces of wood had not been established. The pieces were heavily coated with lubricating and fuel oil but analysis had indicated it was a hardwood. Mr Nicholson did not consider that there was any indication that the operation of the valve had been affected by the presence of the wood.

34. The brake valve was re-assembled and tested in all the working positions on a vacuum brake test rig. The brake valve operated satisfactorily in all the working positions and was able to hold 21 ins of vacuum for over 10 minutes without loss when in the Lap position. The test was repeated and the valve operated equally satisfactorily.

35. The surviving cylinder from the rear end of the leading car and the two cylinders from the trailing car were removed and tested on the vacuum brake test rig. The cylinder from the leading car had been overhauled in 1983. Under test the cylinder operated in a satisfactory manner and no fault could be found with it. A further test during which air was admitted into the brake pipe at a very slow rate by means of a disc with a $\frac{1}{16}$ of an inch diameter hole, was carried out and again the cylinder operated satisfactorily.

36. The No 1 cylinder from the trailing car, that is, the cylinder from the rear end of the car, had been repaired in October 1983 and it was subjected to the same tests. The cylinder also passed the tests except for the

very slow application test with the disc with a $\frac{1}{32}$ inch diameter hole. This part of the test was particularly rigorous because no 'Free lift' was allowed and the cylinder was required to lift a 56 lb weight directly, without any initial movement of the rolling ring occurring. When 'Free lift' was provided the cylinder operated satisfactorily during the slow application test.

37. The No 2 cylinder from the trailer car had been repaired in May 1984. When this cylinder was tested for 'leakage' with the brake valve in the Lap position and cylinder in the partially applied position the vacuum fell from $18\frac{1}{2}$ ins to zero in four minutes (4.63 ins/min). A satisfactory cylinder would have held the vacuum level for at least 15 minutes. This was found to be due to a leak at the nylon gland around the piston rod. The slow application test was carried out using the disc with a $\frac{1}{32}$ inch diameter hole, but because the leak at the gland was admitting air at a faster rate than the disc was, the cylinder passed the test and operated without 'Free lift'.

38. At the time I heard evidence in public the Feed Valve from car No 53482 had not been recovered from the wreckage of the car, which was heavily contaminated with 'Blue' asbestos. It has also not been possible, for the same reason, to examine the pipework from that vehicle. The pipework from the trailing car had been shown to be free of any blockage.

39. Mr Nicholson confirmed that from the tests carried out that there was no single defect which could have resulted in the failure of the brakes to apply. I asked him if he could envisage any combination of circumstances that could have caused a brake failure. He suggested that, although he had been unable to reproduce such a failure during the static testing on the vacuum brake test rig of the cylinders and brake valve, if the brake valve was placed in the Lap position for a sufficiently long period of time the leak at the gland of one of the cylinders would slowly destroy the vacuum in the train brake pipe and, hence, reduce the 'Topside' vacuum. On a moving train it was possible that the pistons would not rise and, therefore, the brakes would not apply.

As to the further investigations

40. Following that part of my Inquiry when I took evidence in public, I asked that a test should be made using a similar DMU running between Carlisle and Preston, to reproduce the brake failure. This test, which was organised by Mr Nicholson, took place on 13th March 1986. In addition to the Railway Officers and train crews involved with the test and working the train, Mr Blakeley, accompanied by an Officer of his union (ASLEF), was present during the test. During the test it was established that with the driver's brake valve in the Lap position the brake pipe vacuum could be partially destroyed without causing a brake application. Details of this test and the further static tests, which were undertaken, are given in Appendix 1.

Rules and Regulations

41. The written instructions on the driving procedure to be adopted for DMU are contained in a series of booklets, which are collectively known as the 'Drivers Manual'. The instructions on the use of the brake are contained in booklet BR 33056/2. In the section headed 'To Move the Train' the following instructions are given:

> "3.3 When the brake continuity test requirements have been carried out, and with the parking brake released, await the Guard's buzzer code, applying the brake in LAP and keep the power controller handle depressed.
>
> 3.4 When the Guard's signal is received and has been acknowledged.
>
> 3.4.1 With the engines idling, move the gear selector to FIRST GEAR without pausing in the other gears.
>
> 3.4.2 Move the brake valve to OFF, where it MUST remain until a brake application is to be made. Check that 21 inch Hg is registered on the brake pipe gauge and also on the chamber side gauge of single unit power cars."

In the section headed 'Brake Application' the following instructions are given:

> "4.2.5 THE BRAKE VALVE HANDLE MUST NOT BE ALLOWED TO REMAIN AT LAP, OTHER THAN WHEN BRAKING AND IT MUST NOT BE MOVED TO LAP IN READINESS FOR A BRAKE APPLICATION.
>
> 4.2.6 THE BRAKE VALVE HANDLE MUST NOT BE MOVED ALTERNATIVELY BETWEEN 'ON' AND 'OFF' WHEN MAKING A BRAKE APPLICATION."

42. British Railways Board Rules prohibit passengers and staff, whose duties do not require them to be there, from travelling in the driving cab of any train except under special conditions. If passengers are allowed

to travel in a driving cab they must be authorised to do so, issued with a special permit and accompanied by a Supervisor to ensure that the driver is not distracted and there is no interference with any of the controls.

Discussion

43. It is clear from the evidence that when a normal brake application was made as the train approached Preston there was no response from the brake system of the DMU. It is also clear that the brakes functioned properly on the northbound journey and again on the journey from the depot at Kingmoor to Carlisle Station during which the DMU was driven from the same cab as it was on the journey to Preston. The combination of circumstances which affected the brake system must have developed, therefore, between Carlisle and Preston.

44. When Driver Blakeley attempted to apply the brake he was not aware of the inrush of air through the valve that would have normally occurred but Mr Whitehead thought that he recalled hearing air being admitted. Guard Khan was sure that there was no inrush of air when he attempted to apply the brakes using the emergency brake valve in the rear driving cab. It is reasonable to assume, therefore, that at the time the brake application was attempted there was either no vacuum remaining in the train brake pipe or, if Mr Whitehead's recollection is correct, a few inches of vacuum remained which was sufficient for there to be some inrush of air but insufficient to operate the brake system.

45. Accepting Mr Blakeley's evidence as to his actions before the train departed from Carlisle and the positive evidence from Mr Khan that he saw 21 ins of vacuum indicated on the gauge in the guards brake van, a gauge which shows just the train brake pipe vacuum and is not likely to be misread, and it is clear that the proper level of vacuum had been created in the system. The vacuum must, therefore, have been lost during the journey from Carlisle and its rate of fall must have been so slow that it did not activate the brake cylinders.

46. There is no evidence to suggest that there was any rowdyism, consumption of alcohol or misbehaviour on the DMU and it appears to have been a well organised Football Charter train. A total of 118 seats was available on the train for the 115 passengers on board the DMU and, although full, the train was not overloaded. The guards brake van was being used by the Supporters' Club as a 'Buffet Car'. Cans of soft drinks and food were stacked on the guards seats and the small cooker in the van was being used for heating meat pies. Mr Khan decided because of this to travel in the rear driving cab for the rest of the journey and, consequently, there was no member of British Railway staff in the van; nevertheless there is nothing to suggest that the emergency brake valve in the van was interfered with, either deliberately or accidently. Indeed, it is extremely unlikely that this could have been the cause of the failure.

47. The tests carried out on the braking system found no single fault which could have accounted for what occurred. It was not possible to test the brake cylinder from the leading bogie because the cylinder was destroyed in the collision. Despite extensive searches, the Feed Valve from the leading car was not found. I am advised that no known defect of either the cylinder or the valve could have caused the brake failure that occurred. The pieces of wood found in the driver's brake valve were unidentifiable. They were analysed and found to be a form of hardwood which was heavily coated with lubricating and fuel oil. It was considered that it was not sufficiently hard to cause any damage to the valve, or to impair its working in any way. The examination of the valve showed no sign of internal damage or scoring.

48. With the DMU formed of two power cars each with two vacuum exhausters working, and with the diesel engines, and hence also the exhausters, running at speed, any leak in the system, such as a leak at the piston rod gland, should have been effectively overcome leaving the brake system fully operational. For a leak to have resulted in the train brake pipe vacuum being lost, the train brake pipe must have been isolated from the exhausters and the high vacuum side of the system.

49. The single point in the system where the train brake pipe can be isolated from the high vacuum side of the system is at the driver's brake valve. With the brake valve in proper working order this can be achieved only by placing the valve in the Lap position. The purpose of the running tests on 13th March and the subsequent static tests carried out at the Newton Heath Depot was to try to recreate the failure of the braking system with the brake valve in the Lap position and also to establish the mechanism of the failure.

50. Although during the running tests a complete failure of the brake system did not occur, it was shown that such a failure was possible. These tests showed that the train pipe vacuum could be destroyed but the further tests at the Newton Heath Depot, when additional gauges were connected to the brake cylinders, showed that the topside vacuum could also be lost. With the topside vacuum, as well as the train brake pipe vacuum lost, the brake cylinders would be inoperative.

51. However properly assembled and maintained the brake cylinders are, there is always, because of the form of construction, the likelihood of minor leaks existing. Such leaks are also likely to be intermittent. In

the tests on the rebuilt unit, cylinders A and D both failed to operate when the train brake pipe vacuum fell at a comparatively fast rate. A failure of cylinders B and C could not be induced. Even though a variety of fall rates were used in the static tests at Newton Heath, they were not as slow as those achieved during the running tests the majority being somewhat slower than those used on a static rig used for testing overhauled cylinders. The leak at the piston rod gland of cylinder C, which was observed with the cylinder on the static testing, was not apparent during the other tests.

52. There is a possibility that the brake valve handle could have been accidently knocked into the Lap position at some point in the journey. Once the handle has been moved approximately one third of the way from the fully released position towards the Lap position, the handle projects beyond the edge of the driver's desk. It is possible that the handle could have been nudged by one of the passengers in the driving cab whilst standing beside the driver. Both Driver Blakeley and Mr Whitehead were however, absolutely certain that this did not happen.

53. Mr Blakeley was equally certain that at no point on the southbound journey did he touch the brake handle in preparation to making a brake application and which may have moved the handle sufficiently for it to have been placed in the Lap position. He should, of course, have tested the brake, in accordance with the General Appendix instructions, prior to the descent from Shap Summit but this he failed to do. Had he done so it is unlikely that the brake handle would have been placed into the Lap position and the train brake pipe vacuum would have been recreated.

54. When the brake failure occurred at Preston it would in theory have been possible to recreate some if not full vacuum if the brake valve handle had been replaced in the release position. However, once the emergency brake valves and the passenger alarm handles had been operated it was no longer possible to recreate the vacuum. The hand brakes provided on a DMU are for securing the train when it is stabled and are not a practicable way of bringing a train travelling at speed to a halt.

Conclusion

55. The collision occurred because there was insufficient vacuum in the brake system to cause the brakes to operate when a brake application was attempted as the DMU approached Preston Station. I consider it most likely that this was because the driver's brake valve had been placed in the Lap position and the train brake pipe and 'Topside' vacuum had been gradually destroyed during the journey from Carlisle. There is no reason why Driver Blakeley should have deliberately done this but despite his sincerely held belief that he had not done so, I believe he had not paid sufficient attention to the position of the brake handle. He also failed to make a running brake test or observe the vacuum gauges before him.

56. I can only attribute what I believe was an uncharacteristic failing on Mr Blakeley's part to the irregular and distracting presence of passengers in the driving cab.

Remarks and Recommendations

57. Despite his failings Mr Blakeley showed considerable courage in remaining in the driving cab and attempting to control the speed of the train until the last moment before the collision occurred. Guard Khan and Drivers Skellern and Patel of the light locomotive also behaved in a commendable manner. The behaviour of the passengers and the orderly way in which they moved away from the front of the train undoubtedly helped to minimise the consequences of the collision.

58. The British Railways Board's Rules prohibits unauthorised and unaccompanied passengers travelling in the driving cab of any train. It is the driver who has to refuse an unauthorised approach and it can be difficult for them to refuse an enthusiast, especially when the person concerned is in a position of some authority, such as Mr Whitehead, the organiser of the charter. Appreciating the pressures that can be placed upon drivers, the Regional Operations Manager of the London Midland Region wrote a letter intended for publication to a number of the specialist railway magazines. The letter asked enthusiasts not to attempt to persuade drivers to allow them to travel in the driving cab and thus not to put the driver in the position of having to refuse. Unfortunately the letter was not widely published.

59. If Signalman Bulcock had been alerted immediately to the DMU passing the first signal at Danger it is possible that he may have been able to set up a clear route for the train, avoiding the collision and allowing the train to be brought under control. By the time he realised that the DMU had not stopped at the signal and then established where the train was on the signal box diagram it was too late. It is for consideration whether

signals such as PN 145 which control admission to a complex station or junction area, should be provided with a distinctive audible alarm which will sound if the signal is passed at Danger.

I have the honour to be,

Sir,

Your obedient Servant,

A COOKSEY
Inspecting Officer of Railways

The Permanent Under Secretary of State
Department of Transport

Details of Tests

1. The three surviving brake cylinders were fitted to another two-car Class 104 DMU formed of vehicles Nos 53523 and 53471; the fourth cylinder being one that was already fitted to the unit. The cylinders were fitted as follows:

53523 No 1 cylinder — No 1 cylinder from 53433 (A)
No 2 cylinder — No 2 cylinder from 53482 (B)

53471 No 2 cylinder — No 2 cylinder from 53433 (C)
No 1 cylinder — Unchanged (D).

The driver's brake valve from car No 53482 was fitted to car No 53523 in place of the existing one.

2. When the re-assembled system was statically tested prior to the running tests the unchanged cylinder on car No 53471 (D) was found to have a similar leak at the piston rod nylon gland as was found on the No 2 cylinder from car No 53433 (C). See paragraph 37.

3. For safety the running tests were carried out on falling sections of the line with the test unit marshalled to the rear of another DMU. The test unit was coupled to the other DMU but the brake systems of the two units were not connected. This allowed brake applications to be made on the test unit without any corresponding brake application being made on the other DMU. Two running tests were carried out on the northbound journey from Preston to Carlisle and a third on the return journey from Carlisle. The test unit was marshalled with car No 53471 to the north.

4. Test 1 commenced as soon as 70 mile/h was reached after leaving Preston. The brake valve handle of car No 53471 was moved from the Release to the Lap position. Train pipe vacuum began to leak away at approximately one inch in 2 minutes. An examination stop was made at Lancaster with the brake being applied from the leading DMU only and the brake valve handle on car No 53471 remaining in the Lap position. The train came to a stand 19 minutes 20 seconds from the start of the test, by which time the train pipe vacuum on the test unit had fallen from 20½ ins to 10¼ ins (0.5 ins/min). The examination revealed that cylinders B and C had operated and the brake blocks were all firmly applied to the wheels but that cylinders A and D had failed to operate.

5. There was evidence that one of the tyres on the No 2 bogie of car No 53471 (cylinder C) had become loosened by a sustained brake application and it was decided to proceed but to stop at Harrison Sidings for a further examination. This second examination indicated that no movement of the suspect tyre had taken place. It was agreed to carry out test 2 on the descent from Shap Summit to Carlisle but a further stop would be made at Penrith in case further brake drag should occur and aggravate the loose tyre.

6. For test 2 the brake valve was again moved to the Lap position but evidently not to exactly the same position as for test 1 as the vacuum initially fell at a somewhat slower rate of one inch in three minutes. A stop was made at the south end of the Down loop at Penrith, again with the brake being applied from the leading unit, after 9 minutes 45 seconds by which time the train pipe vacuum on the test unit had fallen to 17 ins (0.41 ins/min). At this point none of the brake cylinders on the test train had begun to apply and all the brake blocks were clear of the wheels.

7. The brake valve was left in the Lap position while a suitable path became available on the main line. During the delay the train was moved to the north end of the loop. While the train was stationary the vacuum continued to fall but at a somewhat different rate. Prior to the movement along the loop the rate of fall slowed to one inch in four minutes but following the move the rate had increased to one inch in 1½ minutes. On departure from Penrith the rate of fall again slowed to one inch in three minutes (0.66 ins/min). The train left Penrith some 22 minutes after the start of the test by which time the train pipe vacuum had fallen to 12 ins (0.41 ins/min). After 28 minutes 30 seconds with the vacuum reduced to 9½ ins (0.40 ins/min) it became evident that cylinder C had operated and because of the previously loosened tyre the test was abandoned.

8. On the southbound journey test 3 was started as the train passed over Shap Summit with the driver's brake valve in car No 53523 being placed in the Lap position. The train pipe vacuum fell at a very slow rate of one inch in five minutes so that after 33 minutes 20 seconds it had fallen to 14.75 ins (0.19 ins/min) without any brake cylinders applying.

9. The brake valve handle was placed in the release position to recreate the train pipe vacuum and sufficient time allowed to lapse to ensure that the top side vacuum had been fully restored in all the brake cylinders. Test

4 was started as the train passed Lancaster and the train pipe vacuum fell at a similar rate to that which occurred during test 2. After 18 minutes 45 seconds the train was brought to a stand at Preston Station by a brake application from the leading DMU by which time the train pipe vacuum had fallen to 14½ ins (0.35 ins/min) but none of the brake cylinders on the test unit had operated.

10. Following the running tests it was decided to carry out further static tests. The purpose of these further tests was to try to establish what was occurring to the topside vacuum in the brake cylinders above the pistons. It was not possible to measure the topside vacuum during the running tests because of the difficulties of securing the equipment necessary against the movement of the travelling DMU. The tests were carried out at the Newton Heath Depot.

11. The following test procedure was employed:

(i) A gauge to record the topside vacuum was attached to the cylinder.

(ii) A load cell was inserted in place of one of the brake blocks.

(iii) From vehicle No 53523 a full emergency brake application was made which reduced the train pipe vacuum rapidly to zero.

(iv) The topside vacuum before and after the application, and the brake block load created were noted.

(v) The train brake vacuum was recreated and the brakes released.

(vi) The brake valve handle was placed in the Lap position and a slow fall in the train pipe vacuum initiated.

(vii) The rate of fall of the train brake pipe vacuum was monitored together with the fall of the topside vacuum and/or the increase in the brake block force if the cylinder operated.

The full tests were carried out on cylinders A, B and C but not on cylinder D which was not involved in the accident.

12. The results of the emergency application tests on three cylinders were as follows:

Cylinder	Topside Vacuum before	Topside Vacuum after	Brake block load
A	18.75 ins	17.00 ins	1,125 lb
B	18.00 ins	17.25 ins	1,450 lb
C	19.00 ins	17.00 ins	1,500 lb
D	—	—	1,100 lb

The results of the slow application tests with the brake valve in the Lap position were as follows:

Cylinder A

The train brake pipe pressure fell at a rate of one inch in 35 seconds (1.71 ins/min). The cylinder failed to operate and no brake block pressure had been measured until the vacuum had fallen to five ins when the brake applied rapidly. In a repeat test the brake was applied rapidly when the train brake pipe vacuum had fallen to 10 ins and the 'Topside' vacuum to slightly less. The brake block force was 150 lb and the topside vacuum after the application falling to 5 ins.

Cylinder B

The train brake pipe vacuum fell at a rate of one inch in 25 seconds (2.40 ins/min); the cylinder began to operate at 18 ins. In a second test the vacuum fell at a rate of one inch in one minute and the cylinder began to operate at 17 ins. In a third test the vacuum fell at a rate of one inch in one minute 40 seconds (0.60 ins/min). The cylinder began to operate at 17 ins and the brake block force when the brake rapidly applied at 7 ins of vacuum was 1,150 lb. The 'Topside' vacuum after the full brake application was 16.75 ins.

Cylinder C

The train brake pipe vacuum fell at a rate of one inch in 1 minute 30 seconds (0.66 ins/min) and the cylinder began to operate at 17 ins. The brake block force when the brake applied rapidly from five ins of vacuum was

1,250 lb. The topside vacuum after the full brake application was 17 ins. In a second test the vacuum fell at a rate of one inch in two minutes 15 seconds (0.44 ins/min) and the cylinder began to operate at 17 ins.

Cylinder D

The train brake pipe vacuum fell at a rate of one inch in one minute 30 seconds (0.66 ins/min) and the cylinder failed to operate.

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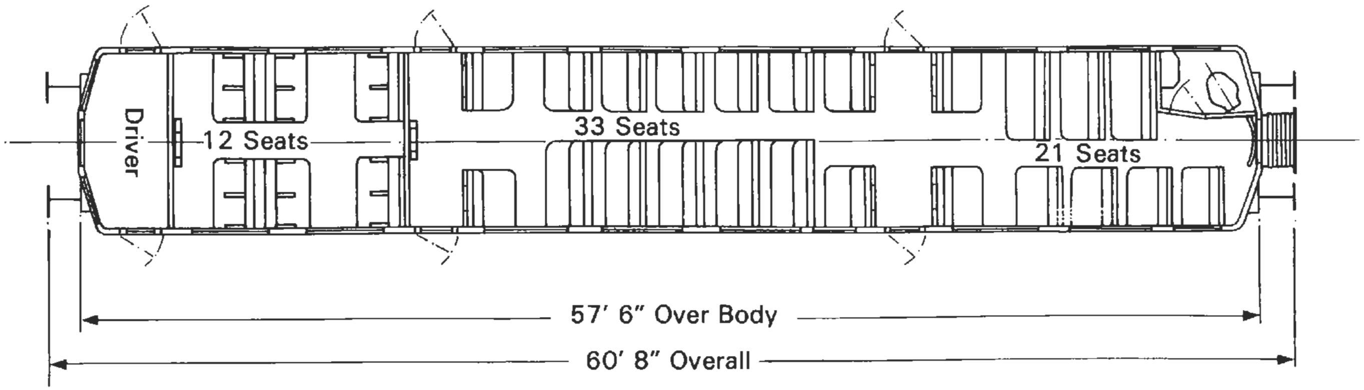
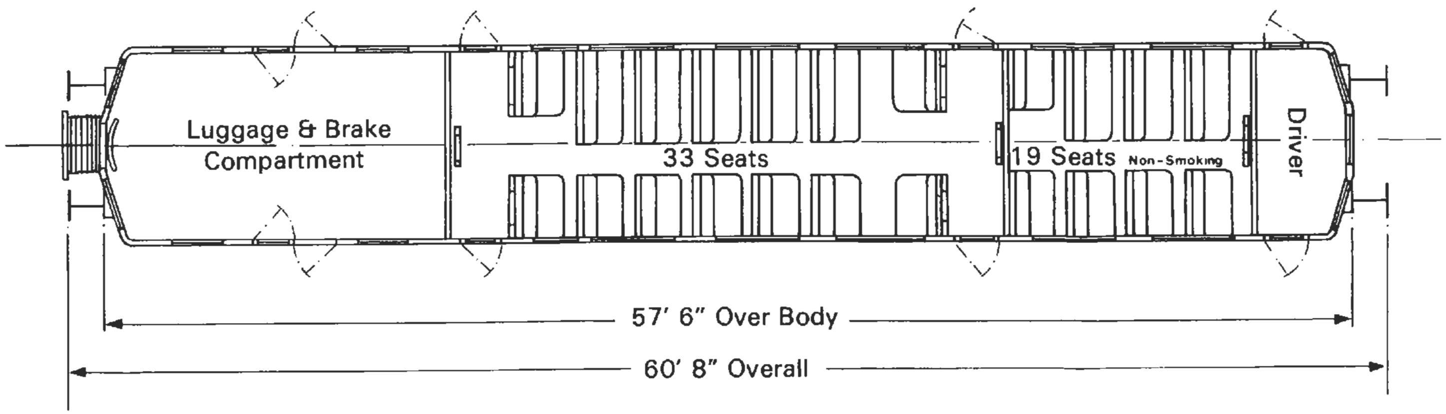


Leading Car 53482



Trailing Car 53433

Diagram 3 : Layout of the Diesel Multiple Unit

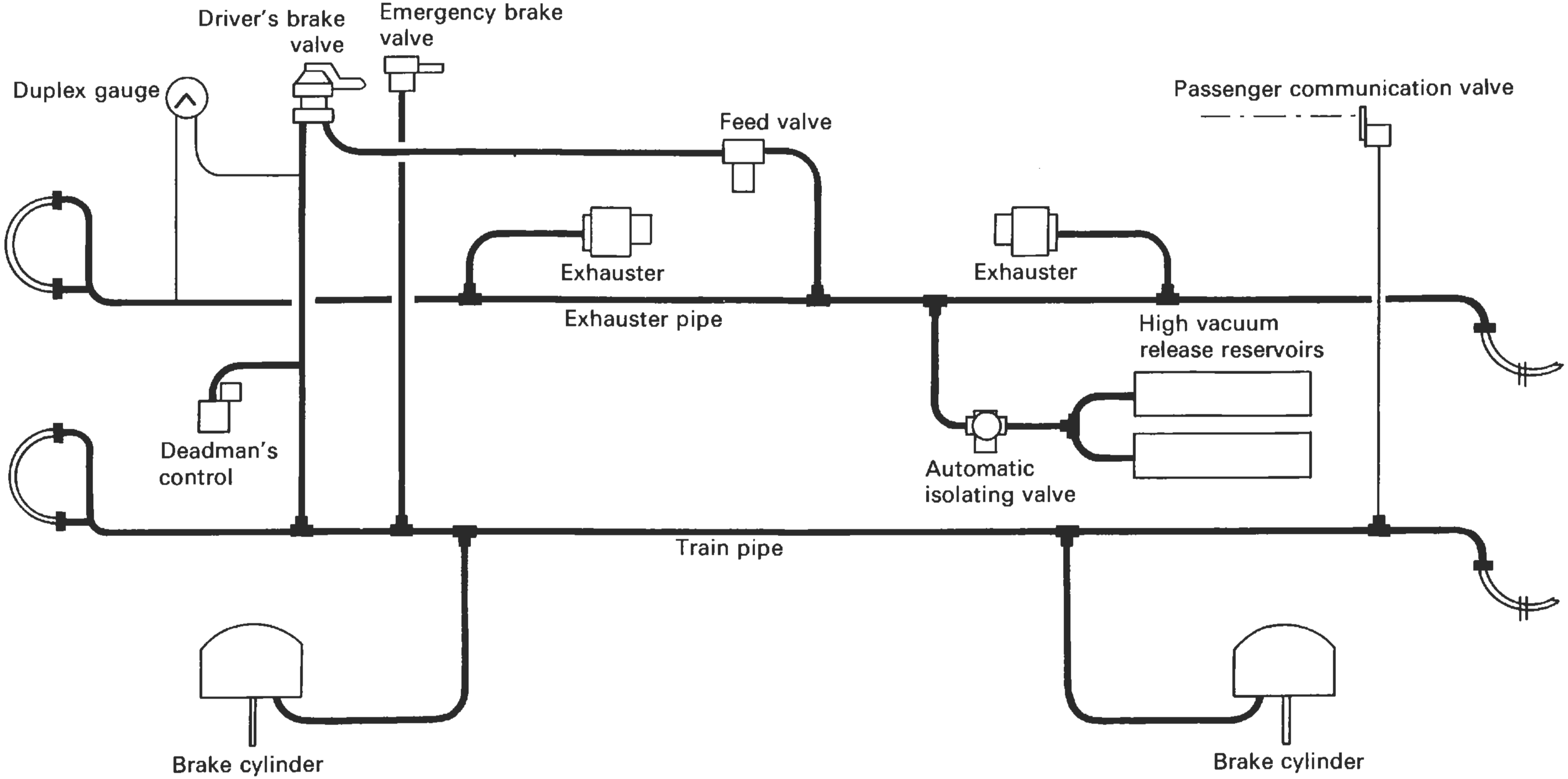


Diagram 4 : Diesel Multiple-Unit Brake System

COLLISION AT PRESTON ON 18th JANUARY 1986

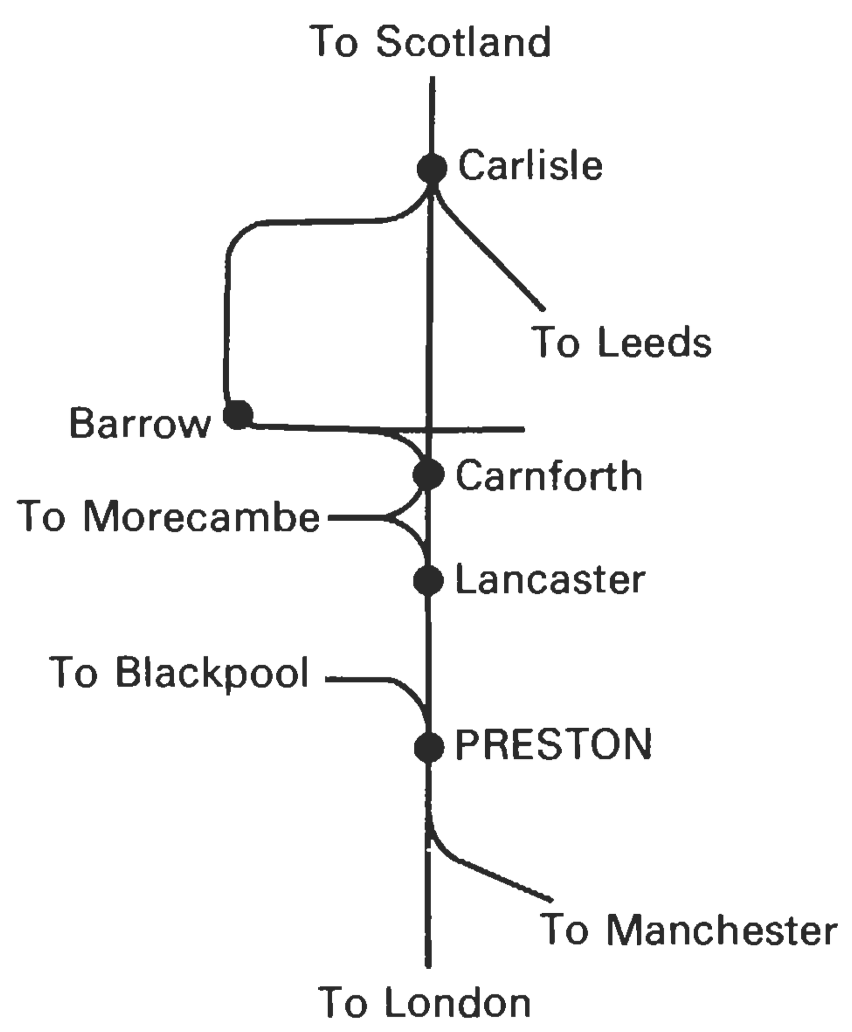


Diagram 1.

Diagram 2 : Layout of lines in Preston Station

NOTE: Only those signals relevant to the accident shown.