DEPARTMENT OF TRANSPORT

RAILWAY ACCIDENT

Report on the Collision that occurred on 5th September 1977 at Farnley Junction, Leeds

IN THE
EASTERN REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE

£1 net

RAILWAY INSPECTORATE,
DEPARTMENT OF TRANSPORT,
2 MARSHAM STREET,
LONDON SW1
8th March 1979.

SIR,

I have the honour to report for the information of the Secretary of State, in accordance with the Order dated 9th September 1977, the result of my Inquiry into the head-on collision between a passenger train and a mail train that occurred on Monday, 5th September 1977, at Farnley Junction, near Leeds, in the Eastern Region of British Railways.

On 5th September 1977 industrial action was threatened by the Central Electricity Generating Board power station workers. One of the consequences of such action would have been a serious voltage reduction or a complete cut of power to Leeds Signal Box, which is a large power signal box controlling points and signals over a wide area of the railway in and around Leeds. As a precaution, British Railways engineers provided a mobile generator and this was connected to the signal box during the afternoon. One effect of coupling the generator into the power circuits was a slight lowering of the voltage provided for the signalling power distribution system. This resulted in a number of failures in the indication of track circuits. Most of these were put right but one, affecting two track circuits in the Down Huddersfield line, persisted. Since this failure involved only the indications to the signal box, the working of points and signals, and hence the running of trains, was not affected.

The trouble was traced to a transformer/rectifier in a lineside cabinet near Holbeck East Junction, about two miles to the west of Leeds Station, and at about 22.30 two signal technicians, accompanied by a motor driver, were sent to replace the rectifier. With the signalmen's permission they disconnected the fuse and removed the faulty rectifier and this had the effect of maintaining a number of signals at Danger. The technicians had brought two rectifiers; the first proved to be unsuitable and the second, although having the right characteristics, would not fit on the panel inside the cabinet. They therefore positioned it on the floor of the cabinet and connected it into the circuits by the use of temporary wire leads. Unfortunately, in doing so, they transposed the connections and this had the effect of sending current of the wrong polarity to all the relays fed by the rectifier. The fact that this had happened was not immediately apparent.

Whilst the technicians were working, two trains had been brought to a stand at signals, one on each side of Farnley Junction. On the Up line, the 21.50 York–Shrewsbury mail train was at a stand at Signal L.36, close to the Junction on the Leeds side. On the Down line the 20.40 Liverpool–Hull passenger train, a diesel multiple-unit, was at a stand at Signal L.31, about 650 yards from the Junction. At about 23.10 the technicians replaced the fuse and the altered polarity immediately caused the main-to-main facing crossover at Farnley Junction to move to the reverse position. At about the same time, one of the signalmen claimed to have received a telephone call from which he gathered that the technicians had completed their work, although the evidence regarding this call is conflicting. The routes were therefore re-set from Signals L.31 and L.36 and, due to the change in polarity, these signals cleared to green even though the points ahead of them were reversed. The passenger train was the first to set off and it accelerated down the gradient towards the Junction, reaching a speed of about 40 mile/h before it was diverted over the crossover and into head-on collision with the locomotive of the mail train, which was still at a stand.

I regret to have to report that the driver of the mail train was killed instantly in the collision and that the driver of the passenger train died from his injuries some three hours later. The emergency services were called promptly and were at the site within 12 minutes of the accident occurring. Four of the 29 passengers in the passenger train and 5 of the 20 travelling on the mail train, together with the guard of that train, suffered bruising and shock but all were released from hospital after treatment. The remaining passengers from the two trains were taken by bus to Leeds where they were either accommodated overnight or continued their journeys by alternative means. A special bus service was introduced between Leeds and Huddersfield until the lines were cleared. Normal working was resumed at 10.20 on 6th September.

At the time of the collision the weather was fine with clear visibility.

On 2nd August 1978 I acted as Assessor to Her Majesty's Coroner for the Metropolitan District of Leeds at the resumed Inquest into the deaths of the two drivers. My separate report on this is at Appendix 1.

Description

The Line and Signalling

1. Farnley Junction lies approximately 2 miles to the west of Leeds Station between Leeds and Morley on the Leeds to Huddersfield line. It is 1 mile 150 yards to the west of Holbeck East Junction. At the junction there is a trailing connection in the Down Huddersfield line leading to the single line Farnley Branch, and a facing crossover between the Down and Up main lines. The Down direction is towards Leeds.

2. Signalling throughout the area is by multiple-aspect colour lights controlled from Leeds Signal Box by an 'entrance–exit' route interlocking system. Most of the signalling dates from the time of the major Leeds re-signalling scheme which was completed in June 1967. Train operating on the Huddersfield lines between Leeds and Morley is in accordance with the Track Circuit Block Regulations. Automatic train describing equipment, which normally provides the signalman with a four-character digital display for all trains, is provided but it was out of order at the time of the accident and an extra signalman was on duty in Leeds Signal Box to assist in the manual booking of trains.

3. The main line signals controlling the approaches to Farnley Junction are L.31 on the Down line and L.36 on the Up line. Signal L.31 is a 4-aspect signal positioned 728 yards in rear of the facing points of the crossover. Signal L.36 is a 3-aspect signal with an associated position light subsidiary signal and theatre-type route indicator for movements to the branch mounted on the signal post; it is located 9 yards in rear of the facing points of the crossover. Both signals are normally set to work automatically on the "non-disengaged" principle, which means that unless the signalman pulls up the entry button on the signal box panel, thus cancelling the route, the signals will clear for the main route, i.e. along the main line, providing the necessary track circuit occupation/clearance conditions are satisfied.

4. Between Signal L.31 and the junction, on the route taken by the DMU, the Down line follows a right-hand curve of 70 chains radius, initially in a shallow cutting, the sides of which are covered by bushes and small trees and then on an embankment to the site of the junction. At the junction, a bridge carries the railway across the Lower Wortley Ring Road. The line is on falling gradients between the signal and the junction, initially at 1 in 204 and then steepening to 1 in 104.

5. The general features of the railway and the signalling are shown on the plans and diagrams at the back of the report.

The Trains

6. The passenger train was 1E 89, the 20.40 Liverpool Lime Street to Hull. It was formed of a 4-car DMU marshalled as follows: Motor-Composite E.51959 (leading), Trailer Second (L) E.59773, Motor Brake Second E.51969, and Motor Composite E.51965. Its total weight was 153 tons and the available brake force was 126 tons.

7. The mail train was 1M41, the 21.50 York to Shrewsbury/Manchester. It consisted of diesel locomotive No. 47402 and 10 vehicles; from the front these were BG 81147, TPO 80314, TPO 80310, BG 81093, BSK 35039, CK 15632, CK 15963, BSO 9328, BG 31116, PMV 1511. The total weight of the train was 335 tons and the available brake force was 279 tons.

The Damage Caused

8. In spite of an emergency brake application made by its driver seconds before the collision, the DMU was still travelling at not less than 30 mile/h when it struck the locomotive of the stationary mail train. The force of the collision derailed the leading bogie of the DMU and forced the body of the leading car upwards, bending and twisting its underframe as it rode above the buffers and lower framing of the locomotive. The framing of the front cab was forced out sideways and the entire driving console was driven backwards and downwards, trapping the driver by his legs. Within the leading car there was extensive damage to interior fittings and the underfloor equipment was also badly damaged. There was only minor damage to the other three cars in the train.

9. On the locomotive of the mail train the leading buffers were sheared off and the whole of the cab, between the robust vertical outer members of the framing, was virtually destroyed when the leading end of the DMU rode up over the buffers and impacted into the centre of the cab. Behind the leading cab the locomotive was practically undamaged and there was little or no structural damage to any of the vehicles in the train.

10. There was only minor damage to the track at the point of collision and none to the signalling equipment, cables etc.

Specific Signalling Matters

11. Since so much of the evidence concerns the technicalities of the signalling I shall describe in some detail the particular features that are important to an understanding of the matters at issue. The descriptions are purely factual and include nothing that is contested by any of those who gave evidence during the Inquiry.

Leeds Signal Box

12. As already mentioned, Leeds Signal Box controls all the signalling in the Leeds area. On the Huddersfield line it controls points and signals to just short of Morley Low, some five miles from Leeds. The signalmen operate a standard British Railways entrance–exit (NX) control panel on which routes are set from one signal to the next one in advance by pressing two push buttons. The push button at the entrance to the route is operated first and when a flashing light indication is obtained within the button, a push button at the exit of the route is pressed. Provided no conflicting routes are already in use, the flashing white light will be replaced by a steady one and the route will then be set automatically.

13. The push buttons initiate a sequence of proving operations in the relay interlocking. The interlocking at Leeds was manufactured by the Westinghouse Brake & Signal Co. Ltd. to British Railways' specification and has the trade name of 'WESTPAC'. It consists of 50V signalling relays mounted on racks in a way that follows the geographical layout of points and signals on the ground. The sequence of events initiated by the push buttons can be divided into four stages, as follows:

(*a*) the route required is established provided no conflicting route is already in use.

(*b*) any points that are not in the correct position for the route will be moved to the correct position by a relay in the interlocking which sends a command to the lineside apparatus cupboard concerned.

(*c*) all relays in the interlocking that control points in the route or conflicting routes are locked.

(*d*) all points in the route are detected as being in the correct position and all track circuits required to be clear are proved clear.

14. Provided the result of these proving operations is satisfactory, the signals concerned will clear, the aspect depending on the state of other routes and signals ahead. The signalman receives an indication that the signal has cleared, together with confirmation of the route set by the illumination of a row of white lights on the track diagram. When a train occupies a track circuit within the route the relevant white route lights change to red on the diagram.

15. Signals are restored to Danger automatically by the passage of the train and cannot normally be cleared again unless the signalman has first restored the route. He does this by pulling up the button at the entrance to the route, whereupon the white route lights on the diagram and the steady white light within the entrance button are extinguished. The exceptions are fully-automatic signals, for which no control is provided in the signal box, and a limited number of controlled signals at junctions that are used only occasionally; the signals at Farnley Junction are of this latter type which are known variously as 'non-stick signals', 'non-disengaged signals', or 'controlled signals that can work automatically'.

16. At Farnley Junction the branch line is used only occasionally and therefore the main line protecting signals, L.31, L.36, and L.37, do not have to be re-set for each move along the main line; once the routes concerned have been set no further action is required by the signalman, the signal aspects being governed by track circuit occupation as in the case of automatic signals. To set a route for the branch the signalman must first cancel all the main line routes.

Relay Repeater Stations

17. At Leeds the main interlocking, controlling all signalling in the station area and the immediately surrounding junctions, is located in a relay room under the station. The normal economic limit of direct control of points and signals from an interlocking is about 1½ miles and beyond this range it is usual for remote interlockings to be provided, connected electrically to the main interlocking. In the Leeds area there are six of these remote interlockings.

18. Farnley Junction is about 2 miles from the main interlocking. It has insufficient sets of points to justify a separate remote interlocking and it is therefore controlled directly by the main interlocking. Because of the distance, the voltage drop along the control cables is such that the voltage received at the junction would be insufficient to operate the relays there. The voltage for each of the functional relays at the junction is therefore boosted at an intermediate point, known as a relay repeater station, where a relay is provided for each function to be repeated and is used to control the output from a locally provided power supply. The relay repeater station is located inside a lineside cabinet near Holbeck East Junction, roughly halfway between Farnley Junction and the main interlocking at Leeds Station. It is known as Location 17.

The Mobile Generator and the effects of its introduction

19. Leeds Signal Box depends for its power on two separate incoming supplies from the Yorkshire Electricity Board. To cater for possible loss of both these supplies there is provision for a mobile generator to be connected into the system. The generator is positioned outside the signal box and connected by cable to a termination box on the wall. Permanent cables connect this box to the power supply cubicle in the relay room.

20. On the day of the accident, energisation of the cables between the generator and the relay room had the effect of lowering the voltage of the main signalling power distribution system from 670V to 640V because of the increase in conductor resistance. This in turn resulted in the 650/110V transformers that provide the basic 110V supply in the apparatus cupboards and the 110/50V transformer/rectifiers that supply the 50V D.C. required for the signalling relays giving a reduced output. The reduction was small but it resulted in a number of failures in the indications received at the signal box. All but one of these were corrected by adjustment at the transformer/rectifier concerned; the one that persisted was in the indication circuit for 162 and 163 track circuits, and it caused a "track occupied" indication in the signal box when no train was present.

21. The two relays that had to be energised to give a "track circuit clear" indication were located in the relay room at the signal box. The source of the operating voltage was a 110/50V transformer/rectifier in Location 17 near Holbeck East Junction. The maximum output that could be obtained from this rectifier was 41V D.C. and this was insufficient for the relays to be energised.

The Transformer/Rectifier

22. The rectifier in Location 17 was to a standard BR specification. It was fixed with wood screws to a timber backboard at the top of the apparatus cupboard and the two wires that were terminated on the 110V terminals and the four wires that were terminated on the 50V terminals (2 per terminal) all came through a hole in the backboard. The output from the 50V side went directly to the contacts of the various relays controlling the circuits fed from the rectifier. One fuse, located approximately half way down the cupboard, was provided on the 110V side.

The Effects of Changing the Transformer/Rectifier in Location 17

23. Changing the rectifier necessitated a disconnection of all the circuits fed by it. The circuits affected, and the effects of disconnection, were as follows:

(*a*) *L.68 signal indication circuit.*
This would extinguish the indication on the signal box diagram.

(*b*) *D.41B signal HR circuit.*
This would keep D.41B at red.

(*c*) 163 *TPR circuit.*
This is the circuit that would not operate and which caused a 'track occupied' indication in the signal box when no train was present.

(*d*) 223 *TPR circuit.*
This would cause 223 track circuit to show occupied on the signal box diagram and would also, by means of the interlocking at Leeds Station, prevent the following routes from being used i.e. the signals would be held at red.

(i) L.66 to L.71
(ii) L.67 to L.71
(iii) L.68 to L.71
(iv) L.69 to L.1609
(v) L.69 to L.64
(vi) L.84 to L.69 unless 357 points were in the normal position.
(vii) L.87 to L.69 unless 357 points were in the normal position.

(*e*) *D.39, D.40, D.41 H/DGP2R circuits*
These three circuits control the stepping of the Train Describer on the signal box diagram in conjunction with the passage of a train past signals D.39, D.40, D.41.

(*f*) 316 *LW2R*, 316 *W2R*, 316 *K2R circuits.*
This would prevent the signalman from moving 316 points and would also cut the detection circuit which indicates the position of 316 points to the signal box. In turn, the break of detection would

hold L.31 and L.36 signals at red. It would also hold L.37 signal at red though this signal could be released to a yellow aspect by the occupation of 164 track circuit for 60 seconds. This is the 'delayed yellow' condition brought about automatically should the overlap not be clear. 316 points are sited in the overlap and the loss of detection is equivalent to an occupied overlap.

24. The circuits mentioned in *a*, *b*, *c*, and *d* involve equipment adjacent to Location 17 and also relays remote from the location which will only energise if certain equipment at Location 17 is in the correct state. The circuits mentioned in *e* and *f* involve equipment that is remote from Location 17 and which is not dependent on the state of any equipment there; they are those controlling points and signals and train describer indications at Farnley Junction and beyond and for which Location 17 acts simply as a relay repeater station, as described in paragraphs 17 and 18.

No. 316 *Crossover at Farnley Junction*

25. 316 crossover is a facing crossover and each end is operated by a style 'D' electro-pneumatic point machine manufactured by the Westinghouse Brake & Signal Co. Ltd. The machines have been in service at Farnley since Leeds resignalling was commissioned in June, 1967. They operate by compressed air being applied to the appropriate side of a piston within a double acting cylinder. The piston drives a mechanism which, in moving its full travel, will initially release a locking bolt that ensures that the switch blade is held firmly against the stock rail. The next stage is to shift the blades to the opposite position, achieved by means of an escapement crank, and finally to re-engage the locking bolt. Proof that both the machine and switch blades have completed their movements is achieved by a detector box in which electrical contacts, driven by mechanical connections from both drive mechanism and switch blades, complete a circuit. The detector box is provided with two sets of contacts thus allowing either of the two possible positions of the points to be proved. The completed circuit operates one of two 50V relays in the signal box and these relays in turn control a circuit that operates both the indication circuit on the control panel and forms part of the interlocking for signals that apply over the points.

26. The air supply comes in a pipe line from a compressor at Leeds Station and goes into a valve chest adjacent to each point machine. The air is then controlled by means of 3 electrically operated valves. One valve, the lock valve (LW), operates for each move of the points, whilst the side of the piston to which the air is admitted is controlled by the reverse valve (RW) for a movement from normal to reverse and by the normal valve (NW) for a movement from reverse to normal. Valve (LW) de-energises when the point movement is complete but the other valve i.e. (NW) or (RW), remains energised until the points are called to the opposite position.

27. The feed to the electrical coils of the valves is, in turn, controlled by the contacts of relays in the apparatus cupboards. Relay 316 LW2R controls valve LW, relay 316LW2R (N) and relay 316W2R (R) control valves (NW) and (RW) respectively. Relay 316LW2R has its own pair of conductors from Leeds Station relay room but relays 316W2R (N) and 316W2R (R) share a pair of conductors. Detection relays 316NKR and 316 RKR also share a pair of conductors. All the relays are fed via the relay repeater station (Location 17). Only one relay of each pair can be energised at a time and this is achieved by means of polar circuitry.

Polar Circuits

28. The current flow in a D.C. circuit may be in one of two directions and the one selected is dependent on the way the power supply is connected, i.e. positive to line 1 and negative to line 2 or negative to line 1 and positive to line 2. This feature can be used to operate two relays over two conductors instead of four conductors as would be the case if non-polar circuits are used. All that is required is that the coils of the relays are sensitive to the direction of current flow i.e. they will only operate if the current flow is in the correct direction. The relays at Leeds provided for point control and detection purposes are of the polar sensitive type and are known as biased relays. They are designed and manufactured by Westinghouse to B.R. specification and are coded as type QBA1. It is essential, of course, that the power supply feeding QBA1 relays is correctly connected, otherwise the relays will energise to the opposite position to that required by the control switch.

Effect of Incorrect Polarity at Location 17

29. Reversing the terminals of the transformer rectifier at Location 17 would send current of the wrong polarity to all the relays fed by that rectifier. This would have no effect at all on the circuits listed in *a*, *b*, *c*, *d*, and *e* in paragraph 23 since none of the relays concerned in these circuits are polar sensitive. However, the effect on the polar sensitive relays provided in connection with No. 316 points would be as follows:

(*a*) Although relay 316W1R (N) in Location 17 was energised, as the signal box controls required 316 points to be normal, the repeat circuit would now send a reverse calling current to location 11 thus de-energising 316W2R (N) and energising 316W2R (R).

(*b*) 316LW1R and 316LW2R would energise because detection in this instance was broken i.e. both 316K2R (N) and 316K2R (R) in the relay room at Leeds were de-energised.

(*c*) 316 points would go immediately to the reverse position.

(*d*) 316 detection circuit would send a reverse indication to location 17 thus energising 316K1R (R) and de-energising 316K1R (N).

(*e*) Although 316K1R (R) whould now be energised, the reversed polarity would cause 316K2R (N) in the relay room to energise. Normal indication would be received and signals requiring 316 points to be normal would be free to clear once the signalman operated them, provided of course all other relevant controls were clear.

The Signal Post Telephone System

30. All signals and certain other places such as point zones that are not adjacent to signals and fringe signal boxes have telephone communication to the signalman. The signalman has a concentrator and selects the telephone circuit to be used by operating 2 push buttons on it. One push button is marked with the circuit concerned and the other push button completes the circuit to the handset. Only one circuit can be used at a time thus ensuring that anyone attempting to phone the signalman whilst he is talking to someone else cannot overhear the conversation. The telephone circuits to the signals are of the selective type and it is not possible for the signalman to call any telephone on these circuits. Any call has to be initiated by the calling party at the signal, and no other telephone on this circuit can either call or speak during the duration of the conversation and until the signalman clears the circuit. When the signalman wishes a person, for example a technician, on the ground to telephone the signal box he operates one of a number of audible devices located at intervals along the railway and known as 'cuckoos'. On hearing the 'cuckoo' the technician will go to the nearest telephone and call the signalman.

Evidence

31. On the day of the accident, *Driver B. Mountain*, of Holbeck Depot, Leeds, was rostered to work as driver's assistant to Driver Shore on the 22.50 Leeds to Shrewsbury mail train. He booked on duty at 21.44. The train left Leeds on time with Driver Shore driving and proceeded under green signals until passing Signal L.69 which was at single yellow. The next signal, L.37, was at red but cleared to yellow as they approached. As they had passed Holbeck Junction they had noticed S. & T. staff working at a lineside equipment cupboard (Location 17). Signal L.36 at Farnley Junction was at red and Driver Shore stopped, with the locomotive about 25 feet from the signal. Mountain got down and telephoned to Leeds Signal Box. When the signalman answered he identified his train and the signal from which he was speaking and the signalman then challenged him with having passed the previous signal (L.37) at Danger. Mountain replied that this signal had been at red as they approached but had cleared to single yellow before they passed it. The signalman then said that the signal had been showing red on the signalbox panel but that there were S. & T. technicians at work in the area repairing a fault. He added that they were supposed to have been finished in two minutes or so but had already taken much longer than that. Mountain said that he would telephone again in about five minutes time if the signal had not by then cleared and the signalman agreed. Having got back into the locomotive and told Driver Shore what the signalman had said he looked at his watch and noted the time as 23.05.

32. At 23.10 Mountain returned to the telephone but this time he could not get through. On picking up the handset he heard the 'answering' tone, as if someone in the signal box had picked up the 'phone, and then the 'bleeping' tone which is normally received before the signalman answers. He repeated several times "Hello Bobby, are you there" but said nothing else. After about a minute he heard the sound of the points immediately ahead of the signal changing and he saw that they had moved from 'normal' to 'reverse' and were now set for a movement across to the Down line. Still with the telephone in his hand he took a step back and looked up at the signal and saw that it had cleared to green. With the points reversed he would have expected the subsidiary signal to have cleared, with a route indication for the Branch, but only the main aspect had cleared. His first thought was that such an irregular clearance must be connected with the signalling faults and that the technicians were probably testing the points and the signal. At this stage he had no premonition of danger and no thought that a train might be approaching on the opposite line, towards the crossover. He replaced the telephone, went to the locomotive and told Shore that the points were set for the crossover. Shore, who was in his seat and leaning out of his window, said that he too had seen the points move to reverse. Mountain then returned to the telephone and was still trying without success to contact the signalman when he saw a train approaching on the Down line. It was about 400 or 500 yards away and appeared to be moving at normal speed. He watched it approach and until the last moment he still expected it to continue past on the other line. However, it suddenly started coming towards him over the crossover and he had time only to shout a warning to Driver Shore and to jump clear before the trains collided. After

the collision he tried again to contact the signal box, without success, and then placed track circuit operating clips on the Down line to protect the obstruction, having told passengers to remain on the train.

33. The guard of the 22.50 Leeds to Shrewsbury train was *Guard U. A. Jordan*, of Leeds. He confirmed that the train left Leeds on time. After departure he walked through the train counting the passengers and noticed that the train was running slowly as though under caution signals. By the time he returned to his brake compartment, which was in the fifth vehicle from the locomotive, the train was coming to a stand. He looked out of the left-hand window in the direction of travel and saw that they had stopped at Signal L.36 which was at Danger. He had not observed the aspect of any of the preceding signals. He continued looking out of the window at intervals for some eight to ten minutes, during which time the signal had remained at red, and than he saw it change to green. The aspect changed directly from red to green. He glanced at the brake gauge, which showed 21 in. of vacuum, but instead of the train moving off the gauge needle dropped back to zero showing that the brakes had re-applied. He again looked out of the window and saw the lights of a train approaching round the curve. Almost immediately he heard a shout from the front of the train and an instant later the collision occurred and he struck his head against the edge of the window. He thought that the signal had remained at green until the moment of impact after which it changed to red. Jordan then left the train and ran to Signal D.41, which was not far from the back of his train, and from there advised the signalman at Leeds of the accident. He then continued to protect his train before returning to the front of the train where he collapsed and was taken away by ambulance.

34. The guard of the 20.40 Liverpool to Hull DMU was *Guard S. R. Johnson* of Huddersfield. Although due to finish duty at 17.17 he had agreed to act as guard on the 16.50 Leeds to Liverpool train and the return working as the 20.40 from Liverpool. The train had left Liverpool on time and at Manchester the Liverpool driver had been relieved by Driver Watson of Leeds. Approaching Leeds they were running about 5 minutes late when they were stopped at Signal L.31 at approximately 22.52. Johnson was travelling in his brake compartment at the rear of the third vehicle and from there he saw that Signal L.31 was at red. After about four or five minutes, the signal still being at red, he went forward to the driver's cab where Driver Watson was just climbing back into the cab after speaking to the signalman on the signal post telephone. Watson told him that the signalman had said that there was a signalling fault but that this was being rectified and that they would not be delayed more than another two minutes. He remained in the cab with Watson for some ten or fifteen minutes during which time the signal remained at red. Neither of them attempted to contact the signalman again during this period. The signal then changed to green, going directly from red to green, and Johnson returned to his brake compartment. The train started soon after he left the cab and he estimated that it was travelling at about 25 mile/h when, just as he reached the brake compartment, he felt the brakes apply in what was clearly an emergency application and this was followed almost immediately by a violent deceleration. He was thrown against the end of the compartment, striking his head. He looked out of the window and saw that the train had traversed the crossover and had collided with another train. After looking after his passengers he went to protect the train.

35. On the day of the accident the automatic train describer (ATD) system was out of action in Leeds Signal Box. This meant that details of all trains entering the area controlled by Leeds had to be telephoned in from the fringe signal boxes and to cope with the volume of telephone calls an additional signalman was required. *Signalman H. R. Scholey*, who was aged 57, had worked in Leeds Signal Box for about 18 months and he was familiar with the operation of all sections of the panel. On 5th September he finished duty at 06.00 having worked an 8-hour shift and went straight home to bed. At about 09.30 he was woken by a telephone call asking whether he would be prepared to work another turn from 14.00 because of the failure of the ATD. He agreed to this and got some more sleep before returning to duty. In the signal box he dealt with the telephone calls giving details of trains coming into the Leeds area. During the evening there was trouble with the indications of various track circuits but by about 20.00 all but one of these had been rectified. Scholey knew that S. & T. technicians were going out to attend to this remaining fault.

36. At about 22.35 Scholey received a call from the signal post telephone at Signal L.68. The caller did not identify himself by name but said that he was "the S. & T. technician" and that he needed permission to change a defective part. Scholey passed the handset to the supervisor, Mr. Jennison, who was next to him. From the ensuing conversation he got the impression that the work to be done by the technicians would affect signalling in the Farnley, Wortley Junction and Holbeck area but that it would not take more than a few minutes. He heard Mr. Jennison give permission for the work to start. Mr. Jennison himself replaced the telephone handset but having done so the light continued to flash and the buzzer to sound on the telephone concentrator and Scholey assumed that the caller at Signal L.68 had not replaced his handset correctly. He therefore put out a 'cuckoo' call, and almost immediately someone answered from Signal L.68. Scholey asked the caller to replace the handset properly and this was done, the light and buzzer ceasing to operate. This second caller did not identify himself but Scholey was sure that it was not the same person who had made the first call; the second caller had a foreign accent quite unlike the first one. Mr. Jennison then ordered the signalman on the West panel, Signalman Marsh, to pull up the route buttons on Signals L.31

and L.36 and put reminder appliances on them. Scholey, who was sitting immediately alongside Marsh, saw him put the reminder appliances, or 'cans' over the two buttons. He could not be positive that Marsh had actually pulled up the buttons, but he explained that a signalman will pull up the button and place the 'can' as one co-ordinated movement and that, having seen Marsh place the 'cans', he thought it extremely unlikely that the buttons had not been pulled up. He had not particularly noticed the route lights on the diagram, either before or after Marsh had placed the cans. He had, however, noticed that, shortly after the technicians had been given permission to start work, the indication for the crossover points at Farnley Junction, points 316, were flashing 'out of correspondence'.

37. At about 22.50 the 20.40 Liverpool to Hull DMU had come to a stand at Signal L.31 and the driver spoke to Scholey, who told him that the technicians were working on a signalling fault. At this point Mr. Jennison initiated a 'cuckoo' call for the technicians and Scholey saw the light for Signal L.68 on his concentrator operate. Mr. Jennison took the call and Scholey gathered from the conversation that the technicians would only be another few minutes. Some time afterwards Scholey received a call from the drivers' assistant of the 21.50 York to Shrewsbury train at Signal L.36. He had watched the movement of this train on the diagram, and had thought that the previous signal, L.37, had been at red as the train passed it. He therefore challenged the caller with having passed the signal at Danger. However, when the driver's assistant explained that the signal had changed to yellow as the train approached Scholey realised that, with L.36 at Danger, L.37 was approach released and that he might have missed seeing it clear on the diagram. He told the assistant about the signal fault and asked him to telephone again in 5 minutes if the signal had not cleared. Five minutes later, the telephone button for Signal L.36 lit up but on picking up the handset and pressing the button he heard a voice say "M41" (the number of the York to Shrewsbury train) or something like that and then the telephone appeared to go dead. He repeated what he had said earlier, that the delay would only be a few minutes, but there was no reply and he could not tell whether the person who was trying to call from Signal L.36 had received the message or not.

38. At 23.10 Scholey received a call from Signal L.68. The caller identified himself as "the S. & T. technician". Scholey told me that it could have been the same person who had called from Signal L.68 at 22.35 and who had similarly identified himself; he was quite sure that it was not the second person who had called from this signal, the person with the foreign voice. Having said that he was the S. & T. technician the caller said "We have finished. It is in order". Scholey repeated this and then said "Oh well, we can start working then". The caller replied "Yes", so Scholey put the 'phone down. He had repeated the message out loud and both Mr. Jennison and Signalman Marsh had heard him. He nevertheless repeated the message again to Mr. Jennison who said "Lets get trains moving" and Signalman Marsh removed the 'cans' from the buttons at Signals L.31 and L.36. Scholey could not be positive that he saw Marsh actually re-set the buttons but again he thought that the action of removing the 'cans' and re-pressing the buttons would be automatic. He looked at the panel and saw that the faulty indication on track circuits 162 and 163 had cleared and also that the indication for 316 points had ceased to show 'out of correspondence'. He could not, however, recall noticing the state of the route lights ahead of signals L.31 and L.36. Two minutes later, at 23.12, he received the call from Guard Jordan at Signal D.41 reporting the accident.

39. In answer to questions, Scholey confirmed that he had not received calls from S. & T. personnel on any telephone other than L.68 during the evening and that so far as he knew there were no other technicians at work in the area. He was quite certain that he could not have confused any of the calls he received from Signals L.36 and L.68; the buttons for these two telephones were at opposite sides of the concentrator and each was clearly marked with its number. As regards the voices of the S. & T. staff, he said that he would have recognised the voices of the technicians who worked on his normal shift but that the voices of those who spoke to him that night were unfamiliar. Finally, he assured me that although by 23.00 he had been on duty for 17 out of the previous 25 hours and was being kept busy on the telephone he was not feeling in the least tired.

40. *Mr. J. Jennison* took up duty at 22.00 as Supervisor in Leeds Signal Box. At the time he started duty there were indication failures on track circuits 162 and 163 but these were not affecting the running of trains. At 22.15 he was told that it would be necessary for S. & T. technicians to change a rectifier on site and that they were setting out to do this. Shortly after 22.30 Signalman Scholey received a telephone call from the technicians asking permission to start and Jennison took the phone. He immediately recognised the voice of Technician Mitchell whom he knew well. Mitchell asked for permission to change the rectifier which he said would take "2 to 3 minutes". Jennison understood this to mean that it might take up to about 10 minutes but not more. There followed some conversation about which points and signals would be affected. Jennison could not recall the details but he remembered 316 points at Farnley Junction being mentioned because he had gone to locate them on the diagram after Mitchell had said they would be affected. He was certainly under the impression that only points and signals on the Huddersfield line would be involved. With no trains likely to be delayed on the Huddersfield line if the job could be done within 10 minutes Mr. Jennison gave permission for the work to proceed under Section E.5.3. of the Rule Book. During their conversation Mitchell had mentioned a train or trains passing on the Bradford lines.

41. Mr. Jennison's next action was to tell Signalman Marsh to cancel the routes over 316 points. In going to check on the location of 316 points, before giving permission for Mitchell to proceed, he had seen that the route lights on both main lines through Farnley Junction were lit and that signals L.31 and L.36 were each showing a proceed aspect. He saw Marsh pull up the route buttons and place 'cans' over them. Shortly afterwards he looked at the diagram and saw that the route lights had been extinguished.

42. Several minutes after giving permission for Mitchell to start, Jennison became aware that the Liverpool–Hull DMU was approaching Signal L.31. He therefore initiated a 'cuckoo' call and seconds later the telephone from Signal L.68 rang. He picked up the handset and, hearing Mitchell's voice, asked him how long the work was going to take. Mitchell replied that it should be finished within a few minutes so Jennison told him to carry on. Shortly afterwards, the York to Shrewsbury train approached Farnley Junction on the Up line and came to a stand at Signal L.36. Jennison heard Signalman Scholey challenge the driver, or driver's assistant, with having passed Signal L.37 at Danger but he did not intervene.

43. At 23.10 Mr. Jennison was sitting at his desk when he saw a telephone button light up on the telephone concentrator. He saw Signalman Scholey pick up the handset. After listening for a moment Scholey called out in a loud voice "The line is clear—the job is done" or words to that effect. Jennison was in no doubt that this was the call from the technicians that they had been waiting for so he told the signalman (Marsh) to reset the routes and get the delayed trains moving. He saw Marsh operate the buttons and he saw the main line route lights from signals L.31 and L.36 light up. He recorded the finish of work by the technicians in the log as at 23.10 and he also telephoned to Control to report the completion. About two minutes later, at 23.12, Scholey called him to the telephone and the guard of the York to Shrewsbury train reported the accident. Jennison took the necessary action to call the emergency services and to protect the obstruction.

44. Regarding the recording of times, Mr. Jennison agreed that his recorded time of 22.35 for Mitchell's first call, in which he asked for permission to start work, might have been a few minutes out since he did not make the entry immediately. He was sure that the subsequent entries were accurate. Regarding the reported completion of work by the technicians, Mr. Jennison said that he would not have expected the signalmen to be involved in any testing since the work involved nothing more than the like-for-like changing of a rectifier.

45. *Relief Signalman C. Marsh* was working the west panel in Leeds Signal Box from 22.00 onwards. At about 22.40 he heard Mr. Jennison give permission for the technicians to start work and, acting on Mr. Jennison's instructions, he pulled up the buttons on the panel for the routes from signals L.31 and L.36 and put reminder appliances over them. He saw the route lights on the panel go out and the signal indications go to red. After the technicians had started work he noticed that the panel indications for 316 points were flashing 'out of correspondence'. Some five or ten minutes after Mr. Jennison had given permission for the technicians to start work, Marsh heard Mr. Jennison put out a 'cuckoo' call and he then heard him apparently speaking to the technicians and asking them how much longer they were going to be. Shortly afterwards, at about the time that two trains on the Huddersfield lines were coming to a stand at signals L.31 and L.36, he attempted to set a route from Signal L.66 on the Bradford line but found that he could not do so.

46. At about 23.10, Signalman Scholey, who was not more than two feet or so away from him, answered the telephone and said out loud "S. & T.—this completes the job, we can start running trains again" or something similar. Marsh could not be certain on which particular telephone the call was coming in, but he saw the light on the telephone button and it was at the end of the concentrator nearest to the panel. Mr. Jennison at once said "let's get the trains moving" and Marsh removed the 'cans' from the buttons on signals L.31 and L.36 and reset the routes from these signals. The indications for 316 points were by then steady and as he set the routes the route lights came up and the signal indications cleared to green. He could not be sure which route he set first but thought it likely it would have been the one from Signal L.36. There was no delay between Mr. Jennison calling for him to re-set the routes and his pressing the route buttons and the whole operation was done in seconds. Some two minutes later the guard of the York to Shrewsbury train reported the accident and he pulled up all the route buttons on that section of the Huddersfield lines in order to replace signals to danger. In answer to questions, Marsh said that he could not recall speaking to Technician Mitchell on the telephone after the accident had been reported and requesting him to go down to Farnley Junction; he did not think that he had spoken to any of the technicians that evening.

47. *Mr. J. S. Firth, the Area Signals and Telecommunications Engineer, Leeds*, arrived at Farnley Junction just after midnight. The two S. & T. technicians who had been working at Location 17 were already there, together with their driver. On inspecting 316 points Mr. Firth found that both ends were fully reversed and locked and in Location 11 the relay controlling the points was set to call them reversed. On testing the voltage on the lock relay for the points he found that, when the detection on the points was broken, the lock relay operated but the operating voltage was opposite in polarity to what he would have expected. He next went to Location 17 where he saw that the transformer/rectifier had been changed, the replacement unit being on the floor of the cabinet. He checked the Normal relay for 316 points and found it to be energised. On checking the voltage output from the transformer/rectifier he found that its polarity was reversed. This had

occurred because the temporary wires connecting the transformer/rectifier to the relay contacts at the top of the cabinet had become crossed and the two output wires had been inserted the wrong way round in the rectifier. It was immediately apparent to Mr. Firth that the effect of this cross-connection was to call the points reversed when the signal box was calling them normal and for the signal box to receive a normal detection for the points when they were in fact reversed. Furthermore, with the interlocking being at the signal box, signals L.31 and L.36, which required 316 points to be normal before they could clear, could now be cleared with the points reversed.

48. Mr. Firth explained that, at Location 17, it was not a simple matter to test for polarity. The wiring from the rectifier goes straight into the relay contacts and these are difficult to get at. The only readily accessible place where a test can be made is in the links in the centre of the cabinet, and testing here depends on a proper identification of the links. This in turn can only be done by reference to the circuit diagrams, a copy of which is kept in the cabinet. Mr. Firth considered that a proper test for polarity might take up to four or five minutes. The fuse would have to be replaced before a test could be made on the links.

49. In answer to my questions Mr. Firth said that he considered the work of changing a rectifier to be routine maintenance under the terms of Rule E.5.3. He did not consider it essential that technicians, once they had received authority from the controlling signal box to undertake work that called for the removal of a fuse in a lineside cabinet, should inform the signal box that they were going to replace the fuse.

50. *S. & T. Technician R. Mitchell* had worked as a signalling technician in the Leeds area for over seven years. On the day of the accident he arrived at Leeds Station at about 21.45 for the night shift. The Senior Technician was away on a training course and Mitchell was acting in his place. His previous turn of duty had finished at 14.00 on Saturday 3rd September. On arrival he met Mr. Firth and they discussed the possible loss of power supplies due to the CEGB dispute and the problems associated with the stand-by generator. Mr. Firth mentioned that there was an indication failure affecting track circuit 162 and said that he, Mitchell, would have to go out and change a rectifier at Location 17. There were two spare rectifiers on the table in the technicians cabin where they were speaking; one was a small compact one, the other much larger and Mitchell understood that the small one might be faulty. After going to look at the stand-by generator, he left at about 22.30 in company with Assistant Technician McGuire and Motor Driver Panesar, taking the two rectifiers with him.

51. It took them only a short time to get to Location 17 where they parked the van so that its lights shone on the cabinet. Having opened the cabinet doors Mitchell spent a few minutes studying the circuit diagrams. He then went to the telephone at Signal L.68 and rang the signal box. Someone answered whose voice he did not recognise and, after identifying himself either by name or as the S. & T. technician, he could not remember which, he asked permission to change the rectifier and was passed on to Mr. Jennison. He said to Mr. Jennison "I understand you have a track circuit failure at 68 signal." Jennison replied "Correct" and Mitchell went on "I will have to change a rectifier which will affect 68 signal, 316 points and 223 track circuit." Jennison replied that there were two trains on the Bradford line. Mitchell told Jennison that he could see them passing, one of them having no lights on and being presumably an empty carriage train. Jennison then asked the location of 316 points and Mitchell said he thought they were at Holbeck. After a pause Jennison said "No, they are at Farnley, how long will you be?" Mitchell told him "Three to four minutes" and Jennison said "You can start now. I have an express stood." He did not mention where this express was standing and Mitchell could not see any train at a stand. He returned to the cabinet and told the others that they had permission to start and that there was an express at a stand somewhere. The 'cuckoo' then sounded and Driver Panesar went to the telephone. He returned after a few seconds and said that the telephone box lid had not been replaced properly and this was causing a ringing in the signal box.

52. At the cabinet Mitchell first measured the voltages on the rectifier, finding that it was only 41V on the D.C. side. He then took out the fuse, disconnected the wires from the terminals on the rectifier, and removed the rectifier. Having replaced it with the smaller of the two rectifiers he had brought, which was identical in shape and size to the one he had just removed, he replaced the fuse and measured the voltages. The reading on the DC side was zero. He spent two or three minutes checking the connections but was unable to obtain a DC voltage. He therefore took out the fuse and removed the rectifier. With McGuire assisting he next tried to fit the larger replacement rectifier to the backboard but the small screws would not hold it. He therefore placed it on the floor of the cabinet and instructed Panesar to prepare some leads from a coil of wire in the van. Up to this time Panesar had been by the door of the cabinet, holding a torch.

53. Panesar prepared four leads and Mitchell, assisted by McGuire, joined them to the four wires that had been attached to the original transformer/rectifier. These wires were protruding through the back-board at the top of the cabinet. There was no problem in identification since the two crimps for the 110V A.C. supply had one wire on each whilst the two crimps for the 50V D.C. supply each had two wires. Mitchell then connected each of the four wires into the terminal block of the transformer/rectifier on the floor, putting the A.C. side into terminals 1 and 2 and the D.C. side into terminals 3 and 4 and tightening

the grub screws that secured the wires in the block. He then replaced the fuse and measured the output voltage on the D.C. terminals, which was 50V. In view of the voltage losses associated with the standby generator he decided that it might be prudent to increase the output voltage to 60V D.C. and he did this by altering the tapping on the transformer. Having done so he checked that the voltage was now 60V D.C. During this operation he was fairly sure that the fuse had remained in.

54. Having obtained a 60V D.C. output, Mitchell and McGuire checked each of the connections for tightness and at this stage the 'cuckoo' sounded. Mitchell himself went to the telephone and said "What do you want?" Signalman Marsh answered and said "I don't know what you have been doing but there's been an accident up at Farnley. Get up there as quick as you can." Mitchell put down the telephone and told the others. They locked the front door of the cabinet, the side containing the rectifier, but did not lock the back because they could not find the lock. They went to Farnley Junction. Mitchell could not remember whether or not there had been a piece of concrete on the lid of the telephone box when he went to answer the telephone.

55. Mitchell was questioned closely about the tests he would have made after obtaining the 60V D.C. output and before telling the signalman that the work was satisfactorily completed. He claimed that he would have asked the signalman to try 316 points whilst he observed the operation of the relays in Location 17. He confirmed that he knew at the time that there were polarised circuits in Location 17 and he claimed that he would have tested for polarity by using the links. He said, however, that there had been no time to make any of these tests because they were still checking the wiring when they were told about the accident.

56. I pointed out to Mitchell the considerable inconsistencies between his evidence and that of the signal box staff regarding the various telephone conversations. He had heard Mr. Jennison and the two signalmen give their account of these conversations and yet he remained adamant that the signal post telephone had been used on three occasions only whilst they were at Location 17; once when he had spoken to Mr. Jennison and requested permission to start work; immediately after this first conversation when Panesar had been asked to replace the lid properly; and finally when he had been called to the telephone and notified of the accident. He strongly denied that he had had a second conversation with Mr. Jennison, some 10 minutes or so after receiving permission to start work, in which Mr. Jennison had questioned him about how much longer he was going to be. He was also quite sure that neither he nor either of his two companions had telephoned the signal box to say that the work had been completed and that trains could run.

57. Mitchell agreed that it would have been unusual for Mr. Jennison to have given permission for work to start, on a non-essential job, if an express was already being delayed at a signal. Yet he insisted that Mr. Jennison had mentioned an express standing when he had given him permission to start. On the signalman's evidence, there were no trains at a stand when Mr. Jennison had authorised the work to start but trains were being delayed by the time Mr. Jennison says that he spoke a second time to Mitchell. It was put to Mitchell that his evidence regarding his single conversation with Mr. Jennison seemed to contain elements of the two conversations reported by Mr. Jennison and that perhaps he had linked the two separate conversations in his mind. He continued to insist that he had spoken only once to Mr. Jennison.

58. *Assistant Technician J. McGuire* confirmed in detail Mitchell's evidence about the events at Location 17. On arrival he saw Mitchell go to the signal post telephone and heard him request permission to start work. Moments afterwards he heard the 'cuckoo' and saw Panesar go to the 'phone although on this occasion he did not hear what Panesar said. The next occasion that the telephone was used was nearly half an hour later when, in response to a second 'cuckoo' call, Mitchell answered the telephone and was told about the collision. On no occasion did he, McGuire, use the telephone and he did not see or hear either of his companions use the telephone other than on the three occasions mentioned.

59. *Motor Driver S. S. Panesar* also confirmed Mitchell's evidence. He said that on arrival at Location 17 he parked the van a few yards from the front of the cabinet with the lights shining on it. He left the engine running and as far as he could remember it continued running all the time they were at the site. He saw Mitchell go to the 'phone and heard him mention 162 track circuit and 316 points. Moments later, when Mitchell and McGuire had started work, the 'cuckoo' sounded and he went to the telephone. The signalman asked him to replace the lid properly and he did so, placing a lump of concrete on it. Later, he was holding the torch when Mitchell replaced the fuse and started testing the rectifier. A short time afterwards the 'cuckoo' sounded and Mitchell went to the telephone and was told about the collision. To the best of his knowledge these were the only occasions on which the telephone had been used. Shortly before Mitchell had told him to prepare the four wire leads he had seen the mail train pass by on the Up Huddersfield line. After Mitchell had been told about the accident they had gone to Farnley Junction and had later returned to Location 17 with Mr. Firth and discovered the reversed polarity. On completion at Location 17 he had driven Mitchell and McGuire back to Leeds in the van.

60. *Mr. G. W. Vincent, Divisional Operating Manager, Leeds*, gave evidence on his efforts to trace other calls made to the signal box from signal post telephones between about 23.00 and 23.15. He had first

established that no other S. & T. technicians were working at this time in the Leeds area. Details of the other calls traced were as follows:

At approx. 23.02. Guard Zagorski travelling on the 22.45 Bradford–Leeds passenger train telephoned from Signal L.66 to say that his train was delayed. He was told that there was a signalling fault. No other call was made from this telephone and the train departed some 7 or 8 minutes later when the signal cleared.

At approx. 23.09. Driver Holdsworth, driving the 23.05 Leeds to Bradford train, spoke to the signal box from Signal L.69. His train had departed from Leeds on time and had run on yellow aspects until being stopped at Signal L.69. Holdsworth had just got to the stage of reporting his train number and the signal at which he was standing when the signal cleared. The signalman advised him that there had been a signalling fault which was now in order.

At approx. 23.12. Driver Ford, driving the 21.47 Bradford–Wolverhampton from Leeds Parcels Depot, telephoned from Signal L.69. He told the signalman that he had been held at Signal L.84 and that, after being at a stand for about half a minute, the aspect had changed from red to yellow. He had started the train but the aspect had then changed back to red and almost immediately back to yellow. He had driven forward to Signal L.69, which was at red, and reported to the signalman.

I questioned Signalmen Marsh and Scholey about these calls. Scholey was fairly sure that he had not received any of them. Marsh thought it probable that he had received them but he could not recall the details.

Discussion

The Direct Cause of the Collision

61. The technical evidence establishes that the direct cause of the collision was the reversal of polarity at Location 17 which resulted when the technicians inadvertently crossed over the temporary wires joining the fixed wiring in the location cabinet to the floor-mounted transformer/rectifier. As is explained in detail in paragraph 29, the reversal in polarity had the effect of reversing the electrical instructions and indications passing between the signal box and 316 points at Farnley Junction. Thus, when the fuse was replaced in Location 17 the instruction from the signal box for the points to remain Normal (as they had been before the fuse was removed) was transformed into one calling them Reverse and the points reversed. At the same time, the indications originating at the points and showing that they were locked and detected Reverse were transformed at Location 17 and relayed to the signal box as Normal indications. With the interlocking being at the signal box, this meant that as soon as a route which required 316 points to be Normal was set, Signals L.31 and L.36 could be cleared even though the points were reversed. This is what happened and the two trains both received green signals even though reversal of the points meant that they were on a collision course.

The Cancelling and Re-setting of Routes from Signals L.31 and L.36

62. As already mentioned (paragraphs 3 and 16) Signals L.31 and L.36 work on the 'non-disengaged' principle. This means that unless the routes from them are cancelled by the signalman 'pulling-up' the operating buttons they will clear automatically in response to track circuit clearance, provided 316 points are shown as locked and detected Normal at the signal box. In his evidence, Signalman Marsh says that he pulled up the operating buttons and put reminder appliances (cans) over them. Mr. Jennison said that he saw Marsh pull up the buttons and place the cans, and Signalman Scholey saw him place the cans although he could not say positively that he saw him pull up the buttons. If the buttons had not been pulled up, but merely covered by the cans, the white route lights would remain displayed on the panel. Tests subsequent to the accident showed that, with routes set from Signals L.31 and L.36, removal of the fuse at Location 17 extinguishes one route light only in each 'strip' and that the difference this makes is hardly noticeable. In evidence, Scholey did not observe the state of the route lights before or after Marsh was instructed to pull up the buttons. Mr. Jennison saw the route lights displayed before he instructed Marsh to cancel the routes and saw that they were extinguished shortly afterwards. And Marsh said that he saw the route lights go out after he had pulled up the buttons.

63. As regards the re-setting of the routes after the alleged receipt of the telephone call from the technicians saying that their work was complete, Signalman Marsh says that he re-set the route and saw the route lights illuminate and the aspect indications for the two signals change from red to green, the indications for 316 points having been steady before he re-set. Scholey saw Marsh remove the cans but could not say that he saw him actually re-set the buttons, nor did he notice the route lights. Mr. Jennison saw Marsh re-set the buttons and saw the route lights become illuminated.

64. Also relevant is the evidence of Driver Mountain (paragraph 32). He said that there was only a short time lag between his observing 316 points change from Normal to Reverse and his observing that

Signal L.36 had changed to green. This must be compared with the time interval between the fuse being replaced at Location 17, which would cause the points to reverse, and the re-setting of routes in the signal box which would be necessary for the signal to clear to green, assuming that the routes had been cancelled in the first place. Tests made after the accident showed that to remove the cans and set up a route from Signal L.31 and then one from L.36 takes about 8 seconds. A similar length of time between Driver Mountain hearing the points reverse and seeing the signal at green is credible, but it implies that replacement of the fuse at Location 17 and the start of action to re-set the routes must have been virtually coincidental. This in turn implies that the telephone call from the technicians allegedly received by Signalman Scholey must have been made at, or just before, the time that the fuse was replaced.

The Telephone Calls between Location 17 and the Signal Box

65. There are basic inconsistencies between the account of these calls given by the signal box staff and by the technicians. Mitchell, supported by McGuire and Panesar, maintains that the telephone was used on three occasions only; his initial conversation with Mr. Jennison, the request to Panesar to replace the lid properly, and his being informed by Marsh of the accident. The evidence of Jennison, Marsh, and Scholey confirms that these calls were made but in addition all three claim that, as a result of a 'cuckoo' call put out by Jennison, the latter spoke again to Mitchell some ten minutes or so after their initial conversation. Scholey also received a telephone call at 23.10 which he said was from the technicians although he could not be sure about the exact wording of the message and did not identify the caller by name. At substantially the same time, Driver Mountain was attempting to telephone the signal box from Signal L.36 but was not getting through properly, and Driver Holdsworth was speaking to one of the signalmen from Signal L.69.

Timings

66. The timing of events (and alleged events) is important. The following are estimates of the main occurrences between 22.30 and 23.15. Where the timing is approximate or controversial the source of the estimate is shown in brackets.

22.35 Technician Mitchell telephoned to the signal box to request permission to start work. (Jennison's entry in the occurrence book; Marsh said this call received "about 22.35"; Scholey said "between 22.30 and 22.40").

22.40 The technicians arrived at Location 17 (Mitchell's estimate).

22.42 The empty stock train, which had passed Hammerton Street at 22.32, passed Signal L.66. The passage of this train was mentioned during the initial telephone conversation between Mitchell and Jennison.

22.43 Mitchell's estimate of the time he made his telephone call to the signal box to request permission to start work.

22.45 First 'cuckoo' call (handset not properly replaced). Panesar speaks to the signal box. (Panesar and Mitchell).

22.50 York–Shrewsbury train departed Leeds. Driver of Liverpool–Hull DMU telephoned from Signal L.31 (Scholey). 'Cuckoo' call and second conversation between Jennison and Mitchell (Jennison).

22.52 Liverpool–Hull DMU came to a stand at Signal L.31 (Marsh. Johnson).

22.56 Driver Watson seen to climb back into cab, having used telephone at Signal L.31 (Johnson).

22.59 21.30 Manchester–York train detained at Signal L.66.

23.00 Marsh unable to set a route from Signal L.66.

23.02 Guard Zagorski telephoned from Signal L.66.

23.04 Mountain telephoned the signal box from Signal L.36.

23.09 23.05 Leeds–Bradford train detained at Signal L.69. Driver Holdsworth telephoned to the signal box; signal cleared whilst he was speaking. Mountain attempted to telephone the signal box from Signal L.36, the call received by Scholey but Mountain unable to make himself understood.

23.10 Alleged telephone call from technicians saying that all was in order (Scholey). Marsh re-sets routes from Signals L.31 and L.36. Mountain still attempting to contact signal box, hears 316 points move and sees Signal L.36 at green. Leeds Control receives advice from Jennison that technicians work complete.

23.11 The collision occurred.

23.13 Jordan telephoned signal box from Signal D.41 and reported the accident. Driver Ford of the 21.47 Bradford–Wolverhampton train telephoned the signal box whilst stopped at Signal L.69 and reported that he had been delayed for half a minute at Signal L.84 and that this signal had 'flashed' between red and yellow aspects.

23.14 'Cuckoo' call to the technicians at Location 17 advising them of the accident.

Conclusions

67. The direct cause of the accident was the inadvertent crossing of wires by the signal technicians, Mitchell and McGuire, when they replaced a transformer/rectifier in Location 17. This caused a reversal in polarity of the transformer/rectifier output and in consequence, when the fuse was replaced in the Location cabinet, No. 316 points at Farnley Junction moved to the Reverse position. At the same time the reversal in polarity allowed Signals L.31 and L.36 to be cleared for routes along the respective main lines even though the points were reversed.

68. The changing of the transformer/rectifier was necessary to cure a failure in the indication of two track circuits. This failure was not in itself a serious matter and it was not interfering with the running of trains. Nevertheless, it was undesirable that there should be a "false occupied" indication of track circuits in the signal box and it was right and proper that the technicians should have been sent to put it right.

69. In the event it was unfortunate that the technicians took with them a transformer/rectifier that was identical in shape and size to the one that needed to be changed at Location 17 but which proved to be of the wrong output voltage. Identification of the output voltage on this kind of transformer/rectifier is not easy and it probably did not occur to the technicians to check it. They had been given to understand that the unit might in any case be faulty and for this reason they took with them a second, larger, unit.

70. If the first transformer/rectifier had been of the correct type, substituting it for the faulty one in the Location cabinet should have been a simple task and should not have taken more than a few minutes. On the information available to him when Technician Mitchell first spoke to him from Location 17, Supervisor Jennison was justified in regarding the work as routine maintenance and in allowing it to be done under the terms of Rule E.5.3(b). However, this rule makes it clear that if the work cannot be completed in a short period the apparatus concerned must be treated as being defective. In this case, the work took very much longer than expected and this being so I would have expected both the technician and the signalmen to apply the full requirements of Rule E.5.1, in particular Clauses 5.1.8 and 5.1.9.

71. I believe that the weight of the evidence supports the view that, in the signal box, Signalman Marsh properly cancelled the routes from Signals L.31 and L.36 and re-set them when instructed to do so by Mr. Jennison. Had Marsh not cancelled these routes, the route lights would have remained substantially alight during the whole time between the commencement of the technicians' work, at about 22.40, and 23.10, and would have been clearly visible to the signal box staff. Convincing evidence was given that the route lights were extinguished during this period, as well as the direct evidence as to the cancellation and re-setting of the routes given by Jennison, Marsh, and Scholey. Acceptance of the cancellation and re-setting of the routes has, however, implications that are further discussed in paragraph 73.

72. The main inconsistencies in the evidence relate to the various telephone messages that passed between Location 17, via the telephone at Signal L.68, and the signal box. There is agreement about three of the calls and I am sure that these were made as described. I also believe that the disputed 'second call', when Mr. Jennison said that he spoke again to Technician Mitchell, was in fact made. The signal box staff were unanimous in saying that this call was made and, with trains being delayed because the technicians had not completed their work, it was entirely natural that Mr. Jennison should have made such a call at the time he stated. I believe that, at some stage after learning of the accident, Mitchell's memory of the two separate conversations he had had with Mr. Jennison became blurred and he convinced himself that there had been only one. The evidence shows that, at the time of the first conversation, there were no trains at a stand and I am quite sure that if there had been Mr. Jennison would not have given permission for Mitchell to start work. Nevertheless, Mitchell thought that Jennison had said something about an express being at a stand, and Mr. Jennison said that he made such a remark during the course of the second conversation. Mitchell's account of the conversation thus contains elements from the two separate conversations reported by Mr. Jennison and I think this supports the view that before giving evidence Mitchell unconsciously combined the two events. If this is what happened it is quite understandable and in any case it had no direct bearing on the cause of the accident. However, in denying the 'second call', Mitchell had the support of his two companions and here I can only assume that there had been some discussion between them before they gave evidence since it is not credible that both McGuire and Panesar should have been unaware of this second conversation.

73. The vital issue is whether or not the technicians made a telephone call to the signal box to say that they had completed their work. They say emphatically that they did not: Signalman Scholey says equally emphatically that they did. I believe that here the timings are important. The evidence points to the fact that once Mitchell replaced the fuse, and thus caused 316 points to reverse, the fuse remained in. Assuming as I have that the routes from Signals L.31 and L.36 were properly cancelled it follows that the necessary re-setting of the routes was done seconds only after the fuse had been replaced. This occurred at or very near to 23.10. It is perfectly possible that, as soon as or even just before the fuse was replaced, Mitchell might have called out that the job was done and that either he, or McGuire acting on what Mitchell had said, immediately telephoned the signal box. This would just have allowed time for Marsh to re-set the routes and for Signal

L.36 to change to green, as it was observed to do by Driver Mountain. On the other hand, it is also possible that the effects of the replacement of the fuse were observed on the panel by Signalman Scholey at the very moment that Driver Mountain was attempting to get through to him. For the best part of half an hour the signal box diagram had shown a considerable number of track circuits as 'occupied' where no trains were present and the indication light for 316 points had been continuously flashing 'out of correspondence'. It is probable that, at around 23.10, with trains being delayed, Scholey and the signalmen would have been looking at the diagram for signs that the technicians had cleared the faults. As soon as Mitchell and McGuire had completed the installation of the second transformer/rectifier and Mitchell had replaced the fuse, the 'false occupied' track circuit indications would have gone out and the indication light for 316 points would have stopped flashing. If Scholey had been looking at the diagram when this occurred and if, as seems almost certain, Driver Mountain was at the same moment attempting to speak to him, it is possible that Scholey might have assumed that the call was from the technicians and have called out to Mr. Jennison and the others accordingly. Such an explanation would explain the very short interval between the reversal of 316 points and the clearance of Signal L.36, as seen by Mountain. It would also accord with the fact that during the time that Mountain was attempting to contact the signal box—which he was undoubtedly doing in the moments before 316 points reversed and the signal cleared—Scholey could not have been dealing with his call and at the same time have received a separate call from the technicians; the two calls would have been mutually exclusive.

74. I believe that either of the explanations I have given would accord with the established facts, although in view of the total incompatibility of some of the evidence I find it impossible to decide positively which of them is the correct one. Nevertheless, on balance, I believe it to be slightly more likely that Signalman Scholey, who had been on duty for 17 out of the previous 25 hours and who must have been getting very tired, was unwittingly led into thinking that the indistinct call from Driver Mountain was in fact from the technicians. The fact that he had been expecting a call from the technicians and that he probably saw the evidence on the diagram in front of him that the technicians had finished their work would have made it all too easy for him to have convinced himself that the incoming call was from the technicians, especially after the accident had been reported when he would have been trying to recall exactly what had happened. Certainly, by the time he gave his evidence, Scholey was totally convinced that the technicians had telephoned to report the completion of the work and I am sure that he gave me what he believed to be a truthful account of what had happened.

75. In deciding on the balance of probabilities I have considered the period of some 4 minutes between the replacement of the fuse, at or close to 23.10, and the passing of the message to Mitchell, at about 23.14, to say that the accident had occurred. It was during this period, after the second rectifier had been found to be giving a satisfactory output voltage and with trains known to be at a stand, that one might have expected a telephone call from the technicians to tell the signalmen that traffic could resume. During this 4 minutes Mitchell claimed that he was adjusting the output voltage to give 60V and checking the connections and that on completion of this he would have tested for polarity before telephoning the signal box. It is probable that he should have been able to do all this inside 4 minutes but the timings are not certain and in any case a telephone call from the technicians made appreciably *after* the fuse had been replaced would not fit in with the evidence as to the clearance of Signals L.31 and L.36.

Remarks and Recommendations

76. Leaving aside the disputed evidence concerning the telephone calls between the technicians and the signalmen, the accident resulted from a chain of unfortunate events; the threat of industrial action, the indication failures caused by the coupling in of the standby generator, the use by the technicians of a replacement transformer/rectifier that would not fit on the cabinet backboard, the crossing of the wires, and finally the restoring of the routes and the clearing of signals before the error in the wiring could be discovered. The chances of a similar series of events happening again must be extremely remote. Nevertheless, there have been other occasions when errors on the part of technicians, or a failure by technicians and signalmen to come to a proper understanding, have led to accidents or to potentially dangerous occurrences. I have considered these other cases, some of which have been reportable to the Inspectorate whilst others have been notified to us informally by the Railways Board or the trades unions, as part of this Inquiry.

77. One at least of the events which led to the accident will not recur at Leeds. Arrangements have been made for the provision of a permanent standby generator at Leeds Signal Box, coupled into the electric supply system. This will be installed early in 1979 and will ensure that the reductions in voltage associated with the temporary generator will no longer occur.

78. With the spread of modern, multi-aspect signalling controlled by a relatively few large power signal boxes, accidents caused by errors and omissions on the part of signalmen have declined dramatically. During the past ten years, collisions caused by signalmen's error have averaged about 3 a year; during the

previous decade the comparable figure was 16. However, the growing complexity of modern signalling has increased the scope for error on the part of signal technicians and has increased the need for proper liaison between the signalman and the technician, who will often be working at a considerable distance from the controlling signal box.

79. In examining ways in which the risk of a recurrence might be reduced I have concentrated on the measures for regulating maintenance and repair work done by technicians and on the liaison between them and the signalmen. But first there is the question of the use of polar sensitive relays. These have been used for many years as an integral part of railway signalling circuits and they have some obvious advantages; whereas a neutral relay will detect the presence of current in a circuit and hence give one positive indication, the polar sensitive relay will in addition detect the direction of the current and thus give two positive indications. This makes possible considerable economies in cabling, and in certain cases can be used to enhance the security of the circuits. Being part of the basic technique of modern signalling it would be a complex and expensive exercise to move away from the use of polar relays and arguably such a move would not be in the best interests of safety. It might, however, prove possible to reduce the risk of the kind of accident that occurred at Farnley Junction by making it simpler for a technician to verify and ensure that, following the replacement of a transformer/rectifier associated with polar relays, the power supply polarities are correct before the working circuits are reconnected. I recommend that this be examined.

80. The basic rules for dealing with failures, repairs and renewals of signalling equipment are contained in Section E of the British Railways' Rule Book. Relevant extracts of these rules are reproduced in Appendix 2 at the back of this report. Section E.5 deals with the failure of signalling apparatus and clauses 5.1 to 5.3 spell out the procedures to be adopted by the technician and the signalman when dealing with a failure. Clause 5.3 covers the routine maintenance of signalling equipment and 5.3(*b*) permits work that will make points, signals, or automatic half-barriers inoperative for "a very short period" to be carried out between trains. Work so carried out is exempt from the rigorous demands of Clause 5.1 (and in this the requirements of Clause 5.1.8 are important) although 5.3(*b*) says that "if the work cannot be completed in this short period, the apparatus concerned must be treated as being defective." The changing of the transformer/rectifier at Location 17 was initially authorised under Clause 5.3(*b*).

81. One criticism that can be levelled at Clause 5.3 is that, implicitly if not explicitly, it links the undefined "very short period" with a "suitable interval between trains". In allowing work that will affect points or signals to be done between trains it is the latter that influences the signalman's decision; on some lines it might be entirely reasonable to undertake a 20 minutes task between the passage of trains whilst on others anything taking more than 20 seconds might be unacceptable. The clause also draws no distinction between tasks that can only affect a strictly limited range of equipment, such as changing a lamp in a multi-aspect signal, and those which can affect a large number of other points and signals, such as the transformer/rectifier at Location 17. I discussed these points at a number of meetings with the Board's Chief Operations Manager and Chief Signal and Telecommunications Engineer. Consideration of ways in which Section E of the Rule Book might be modified is continuing.

82. The instructions to technicians on the testing of signalling apparatus are contained in a booklet "Instructions to Staff engaged on Maintenance of Signalling Apparatus" issued by the Signal and Telecommunications Engineering Department. Relevant extracts of this booklet are reproduced at Appendix 3. Section 16–5 is of particular relevance and I discussed it with the Board's Chief Signal and Telecommunications Engineer. His view was that the replacement transformer/rectifier in Location 17 could not be regarded as a "plug-in or similar type of unit" and that the technician was therefore required to prove by actual test that it was correctly positioned in the circuit and to confirm to the signalman that such a test had been carried out. The necessary tests would have included verification of both the voltage and polarity of the unit's output, but would not necessarily involve functional testing of any of the points and signals affected by the changeover of the transformer/rectifier since these had not been disturbed. The current booklet was last revised in 1972 and a further revision was already in hand at the time of the accident. As part of the revision the Chief S. & T. Engineer has agreed to define more clearly the types of plug-in equipment mentioned in the second part of Section 16–5 and to include in this section a specific requirement for polarity tests to be carried out whenever polar sensitive equipment is involved.

83. One suggestion made shortly after the accident was that all telephone messages between signalmen and technicians should be tape recorded. On examination this has appeared more complicated than might have been expected and in discussing the idea with railwaymen of various grades I have found opinion sharply divided. There was a general feeling, with which I agree, that if tape recording is done it must make a positive contribution to safe working; it would not be justified if its only use was as a 'black box' to establish the facts *after* an accident had happened. This means that it would have to be possible for a signalman to play back messages to check on timings and remind himself of arrangements made with staff on the ground. The difficulty arises in deciding what messages need to be taped. At a busy period, when the need for recording might be greatest, telephone messages in a large power signal box are being passed almost continuously.

It could be argued that all calls should be recorded; such matters as engineering possessions and the isolation of electric traction equipment have at least as great a safety content as the work of signal technicians. Clearly, to tape all such messages and to give to each signalman or supervisor the ability to check back on individual messages would need a fairly sophisticated system. Of course, it might be that the very fact that messages were being recorded would lead to a greatly improved standard of message passing and that this alone would make a major contribution to safe working, but my own view is that, once recording had become commonplace, this effect could quickly become lost. On balance I feel that the concept of tape recording merits further examination and I recommend that the Railways Board undertake a study to see whether a workable system, making a positive contribution to safe working, could be developed and, if so, at what financial cost.

84. Finally, a feature of the accident was the minor injury to a number of Post Office employees who were at work in the TPO vehicles in the mail train. A review of the working conditions, from a health and safety point of view, in this type of vehicle has been carried out by the Railway Inspectorate as part of its agency work for the Health and Safety Commission.

I have the honour to be,

Sir,

Your obedient Servant,

C. F. Rose,
Major

The Permanent Secretary,
Department of Transport.

APPENDIX 1

RAILWAY INSPECTORATE,
DEPARTMENT OF TRANSPORT,
2 MARSHAM STREET,
LONDON SW
8th March 1979.

SIR,

I have the honour to report for the information of the Secretary of State that, in accordance with the Appointment dated 31st July 1978, I acted as Assessor to Her Majesty's Coroner for the Metropolitan District of Leeds, Mr. J. D. Walker M.B.E., at the resumed Inquest into the deaths of two railway employees who lost their lives as a result of the accident at Farnley Junction, Leeds, on 5th September 1977.

The resumed Inquest was held at Leeds on 2nd August 1978, and the Jury returned a verdict of Accidental Death in each case, a finding with which I was in full agreement.

I have the honour to be,

Sir,

Your obedient Servant,

C. F. ROSE,
Major.

The Permanent Secretary,
Department of Transport.

EXTRACTS FROM THE BRITISH RAILWAYS RULE BOOK

SECTION E—SIGNALS, POINTS, TRACK CIRCUITS AND OTHER SIGNALLING EQUIPMENT—FAILURES, REPAIRS AND RENEWALS

1. Principle

1.1. Signalling equipment is designed so that in the event of failure, signals should show a safety aspect to the Driver—Caution in the case of a distant signal and Stop in the case of a stop signal. During a failure of signalling equipment, or during repairs or renewals, appropriate action must be taken to enable trains to be run with safety.

1.2. The signalling equipment covered by this Section is as follows:

(*a*) Any part of a lever frame or ground frame or associated interlocking;

(*b*) Any part of a route setting panel or other panel, including electrical circuits associated therewith;

(*c*) Fixed signals or any equipment, including electrical circuits, associated therewith;

(*d*) Points, switch diamonds, swing nose crossings, derailers or any locking, protective devices or any equipment, including electrical circuits, associated therewith;

(*e*) Detonator placers;

(*f*) Any type of bolt lock including bridge bolts;

(*g*) Level crossing gates or barriers, or associated mechanism and locking devices, including electrical circuits associated therewith;

(*h*) Track circuits or other apparatus performing a similar function, or treadles;

(*j*) Annunciators or similar warning devices.

5. Duties of Signalmen and S. & T. Technicians Jointly

5.1. **Entries in Train Register**

5.1.1. When a failure has occurred, the Signalman must, when the S. & T. Technician reports, advise him full details of the failure.

5.1.2. When work has to be carried out on any signalling equipment detailed in clause 1.2 of this Section, the S. & T. Technician must give to the Signalman full details of what is to be done, together with the number(s) or title(s) of lever(s), switch(es) or push button(s) or particulars of other apparatus affected. He must be careful to explain the effect of any disconnection so far as it concerns the Signalman, particularly in the case of electrical equipment which may perform two or more functions.

5.1.3. When both men are satisfied, the Signalman must enter the details in the Train Register and this entry must be signed by both men, and the time inserted.

5.1.4. Where the failure or the work involves more than one Signalman in the same signal box, one must write and sign the entries in the Train Register and the other(s) must countersign them.

5.1.5. The signature of the S. & T. Technician and the Signalman constitute a firm agreement of what is being done and no alteration of the system of working agreed for the period of the repair or renewal must be permitted without another entry in the Train Register, which must be signed by both men and the time inserted.

5.1.6. Should the whole of the work not be completed at one time, details of the completed portion must be recorded by the Signalman in the Train Register and a fresh entry of the remaining disconnections must be made and signed, and the time inserted.

5.1.7. If the S. & T. Technician and/or the Signalman are relieved, the men coming on duty must countersign the entries in the Train Register before taking duty, in the presence of the men who are being relieved.

5.1.8. When the Signalman has been informed that the work has been completed, that any failure has been rectified and the equipment bas been tested and found to be in order, he must make an appropriate entry in the Train Register, together with the time. The S. & T. Technician must sign the entry and the Signalman must countersign it. After this the Signalman may release any Handsignalman and, where appropriate, he must also inform the Signalmen at adjoining signal boxes that normal working may be resumed.

5.1.9. Where, owing to the distance involved, it is impracticable for the S. & T. Technician to go to the signal box, the foregoing procedures may be carried out by telephone and the S. & T. Technician need not sign/countersign the Train Register entries. The S. & T. Technician must, however, reach a clear understanding with the Signalman by telephone and give his name, the place from where he is speaking and the time. The Signalman must endorse the Train Register entry accordingly.

5.2. **Operation of levers, switches or buttons**

The S. &. T. Technician must not move any lever or operate any switch or button (except for testing purposes, and then only with the permission of the Signalman) but must ask the Signalman to operate it for him; nor, when interlocking/electrical circuitry is being repaired, altered or cleaned, must the Signalman move any lever or operate any switch or button concerned without first obtaining the permission of the S. & T. Technician.

5.3. **Routine maintenance**

The provisions of this Section must be carried out in connection with day-to-day maintenance, except:

(*a*) where there is no interference with the working of points, signals or automatic half-barriers, or

(*b*) work which will make points, signals or automatic half-barriers inoperative for a very short period, when the Signalman must select a suitable opportunity between trains to enable the work to be completed without detriment either to safety or train working.

If the work cannot be completed in this short period, the apparatus concerned must be treated as being defective.

Before undertaking any day-to-day maintenance authorised by clause (*b*) above, the S. & T. Technician must advise the Signalman what requires to be done and come to an agreement with him as to when the work shall be carried out. Both men must co-operate throughout as necessary.

It will not be necessary for the Signalman to make an entry in the Train Register in connection with day-to-day maintenance but the S. & T. Technician must make the usual entry when attending at a signal box.

EXTRACTS FROM THE BRITISH RAILWAYS "INSTRUCTIONS TO STAFF ENGAGED ON MAINTENANCE OF SIGNALLING APPARATUS"

16. Testing of Signalling Apparatus

16–1. All electrical and mechanical apparatus must be tested by the Technician at regular intervals and particular attention must be given to facing point locks and detectors.

16–2. When testing the operation of signalling apparatus the Technician must observe the provisions of the Rule Book, Section E, particularly the appointment of Handsignalmen when necessary, and he must have a clear understanding with both Signalmen and Handsignalmen as to the nature of the work involved.

16–3. When testing points, note should be taken of the firmness of the track and, if any undue movement of the track under traffic is observed, the Permanent Way Track Chargeman must be informed.

16–4. After repairs or alterations to signals or points, the apparatus must be carefully tested to see that it responds correctly to the lever or switch. It is important to see that signals which are back locked do, in fact, return to the ON position when the lever is in the backlock position in the frame.

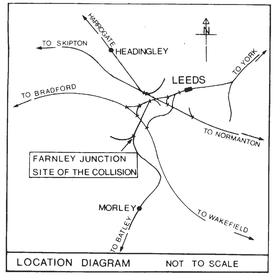
16–5. Where electrical apparatus or wiring has been disconnected, it must be proved by actual test that each contact or piece of apparatus which has been disturbed is in its proper position in the circuit, before the whole circuit is restored to service.

When a plug-in or similar type of unit has been removed and replaced it is not necessary to test the entire circuitry but it must be ensured that the unit functions correctly.

16–6. Assurance that mechanical or electrical signalling apparatus is in order must not be given to the Signalman until it has been tested and found correct.

Printed in Scotland by Her Majesty's Stationery Office at HMSO Press, Edinburgh
Dd 597638 K7 7/79 (16429)

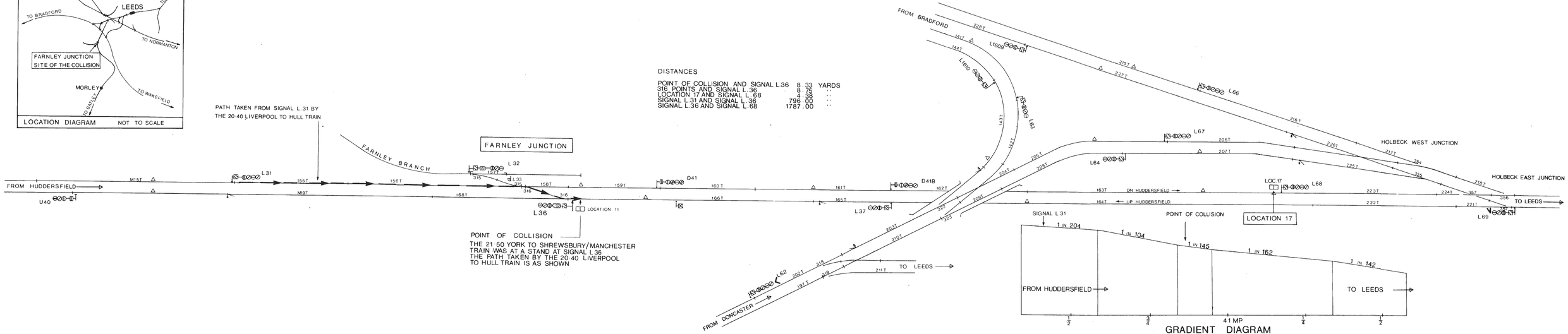
COLLISION AT FARNLEY JUNCTION, LEEDS, ON 5th SEPTEMBER 1977



LOCATION DIAGRAM NOT TO SCALE

DISTANCES

POINT OF COLLISION AND SIGNAL L.36	8·33	YARDS
316 POINTS AND SIGNAL L.36	8·75	"
LOCATION 17 AND SIGNAL L.68	4·38	"
SIGNAL L.31 AND SIGNAL L.36	796·00	"
SIGNAL L.36 AND SIGNAL L.68	1787·00	"



GRADIENT DIAGRAM
NOT TO SCALE