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HM Railway Inspectorate

RAILWAY ACCIDENT AT COWDEN

A report of the Inquiry into the collision between two passenger trains which occurred at Cowden on 15 October 1994

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The Permanent Under Secretary of State
Department of Transport

HM Railway Inspectorate
Health and Safety Executive
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31 October 1995

Sir

I have the honour to report, for the information of the Secretary of State for Transport, in accordance with the Direction dated 20 October 1994, the result of my Inquiry, held under the provisions of Section 7 of the Regulation of Railways Act 1871, into the collision which occurred on 15 October 1994 at Cowden on the Uckfield branch line of the South Zone of Railtrack plc.

At approximately 08.27 on Saturday 15 October 1994, the 08.00 Uckfield to Oxted passenger train operated by the Network South Central Train Operating Unit of British Railways Board collided head-on with the 08.04 Oxted to Uckfield passenger train operated by the same company on the single line near Cowden Station. The leading two vehicles of each train were extensively damaged and the single line was blocked. I regret to report that there were five fatalities as a result of the collision. Also, twelve persons were injured and conveyed to hospital; none of them, however, was detained. The weather at the time of the accident was foggy.

Because of the complex work required to recover the leading vehicle of the Down train, the line was not restored to traffic until 18.40 on 18 October.

On 14 February 1995 I was appointed, under the provisions of Section 8 of the Regulation of Railways Act 1871, as an Assessor to HM Coroner for West Kent to assist him in holding the Inquest into the deaths of Mrs Maura Pointer, Mr Raymond Pointer, Mr Brian Barton, Mr David Rees and Mr Jonathan Brett-Andrews.

My report is made in two parts. The first part was originally presented to you under cover of my letter dated 23 May 1995, which is reproduced as Appendix 1. However, I have taken this opportunity to make corrections to some minor errors and to clarify one or two points which have been drawn to my attention. The first part addresses the adequacy of the safety mechanisms and procedures on the line. The second part of my report, which is based upon the evidence given at the Inquest, serves as the report required by Section 8 of the 1871 Act and also addresses the question of who was actually driving the train; a question which I had felt unable to answer until after the Inquest.

I have the honour to be
Sir
Your obedient Servant

C B Holden
Major
HM Assistant Chief Inspecting Officer of Railways

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PART 2

SUMMARY OF THE REPORT

Part 1

1 At about 08.27 on Saturday 15 October 1994 in foggy weather, two similar passenger trains, each formed of two Class 205 diesel-electric multiple units (DEMUs), collided head-on near Cowden Station on the single line between Hever and Ashurst on the Uckfield branch line. The infrastructure belonged to the South Zone of Railtrack plc and the trains were operated by the Network South Central Train Operating Unit of British Railways. Five people were killed in the accident and 12 others were taken to hospital suffering from shock or minor injuries. They were not detained in hospital. The five who died were the driver and guard of the Up train, the driver of the Down train and two passengers in the Up train. The guard of the Down train was one of those taken to hospital suffering from shock.

2 The track layout of the branch line, which runs from Oxted to Uckfield in East Sussex via Hurst Green Junction, had been altered in 1989/90 from double line throughout to include three stretches of single line. Modern colour-light signalling fitted with the automatic warning system (AWS) on all signals and driven by a solid state interlocking (SSI) system in Oxted Signal Box was taken into use in 1990. One of the features of SSI is that it contains a data recorder. This recorder was operational and provided an invaluable record of events. It was concluded that the layout of the signals conformed to the standards in force at the time and that even had retrospective action been taken to implement later, applicable, standards these would have had no bearing on the course of the accident. The layout was adequately and safely signalled.

3 Class 205 units, which were built in the late 1950s, are Mark I coaching stock. They are powered by a diesel-motor generator set located in a compartment behind the driver's cab in one of the three vehicles in each unit.

4 British Railways' National Radio Network (NRN) covered the general area of the Uckfield branch but in the topographical conditions the actual coverage along the railway was patchy. This deficiency also applied to the commercial mobile telephone networks. The plan to install the cab secure radio (CSR) system on the Uckfield branch had not been implemented, but one of the units involved in the accident had been fitted with CSR radios. These do not operate on the NRN system. As a temporary expedient, trains on the Uckfield branch were provided with commercial mobile telephones but this expedient had fallen into disuse.

5 Post-accident testing, including the analysis of the SSI data tape, proved conclusively that the Up train from Uckfield to Oxted had passed the signal protecting the entry to the single line from Ashurst to Hever at Danger. On the balance of probabilities it was concluded that the AWS system mounted on the Up train was working correctly. However there was no doubt that the signal had a degraded performance which was exacerbated by the fog. There was some dispute about the degree of degradation, the scientific evidence contrasting markedly with that of experienced signal engineers. Nevertheless it was possible to estimate that, on that morning, the signal aspect should have been discernible at a distance between 50 m and 20 m away. There appeared to be no defects in the controls or the brakes of either of the trains.

6 The guard of the Up train was riding irregularly in the driver's cab. There appears to be no reason for the total disregard of the signal aspect other than distraction of the driver. There is some doubt as to who was actually at the controls of the Up train; this matter will be addressed in Part 2 of my report following the Coroner's Inquest. Nevertheless I conclude that the driver of the Up train, Driver Barton, was wholly responsible for the accident; no fault attaches to the driver of the Down train.

7 The signalman at Oxted was alerted to the inevitability of the accident by an alarm which sounded when the Up train ran through the points onto the single line. Some 2 minutes elapsed between that event and the collision but, in the absence of any form of communication with the trains, he was unable to do anything other than alert the Control Room at Croydon. It was concluded that, in the time available to the signalman, the accident could have been averted had cab secure radio been available but it would not have been if either National Radio Network radios had been fitted to the trains or commercial mobile telephones had been carried by the drivers. The report notes that the decision to install CSR on the Uckfield branch was taken in December 1994.

8 This accident was entirely preventable by an automatic train protection (ATP) system. The reasons for the lack of progress in fitting such systems are discussed in the report which notes that the Health and Safety Commission had accepted the view that it is not reasonably practicable to fit network-wide the ATP systems currently under trial but that the Commission expects provision of ATP as a minimum on all new high-speed lines and that it should be considered for major resignalling schemes. This is reflected in my detailed recommendations on ATP and on the interim measures to reduce and mitigate the consequences of signals passed at Danger (SPAD).

9 The lack of crashworthiness of Mark I rolling stock is discussed, as are the effects of the decision to extend the life of such rolling stock without safety enhancements beyond the period given in the Hidden Recommendations 54 and 55. The consequences of the

decision are that, coupled with the lack of provision of ATP, the conditions under which the continuation in service of Mark I rolling stock is acceptable, have now lapsed. A fresh programme of research and the agreement of a plan to implement its results by HM Railway Inspectorate is recommended. Neither train was fitted with an on train monitor and recorder (OTMR). Had they been, some of the doubts over the working of the AWS on the Up train would have been resolved. Fitting of OTMRs was recommended in the Hidden Report and accepted. However only a percentage of the train fleet has actually received them. It is therefore recommended that a plan for completing the fitting of OTMRs is submitted to the Inspectorate.

Part 2

10 The Inquest into the five deaths was held from 14 to 16 August 1995 at Tunbridge Wells in the presence of a jury. In the main, the evidence was given by those who had given evidence to the Inquiry. Additional evidence was given by a pathologist and by a member of the Kent Fire Brigade. Despite the additional evidence it was still not possible to determine who was at the controls of the Up train and it is considered unsafe to come to a definite conclusion in this respect. The conclusion that Driver Barton, as the driver of the Up train, was wholly responsible for the accident is reiterated. The jury returned verdicts of Accidental Death on the train crew of the Up train and Open verdicts on the other three people who were killed.

Conclusions and recommendations

11 The conclusions and recommendations are given in Appendices 2 and 3 respectively at the end of the report.

PART 1

DESCRIPTION

The course of the collision

12 Shortly after leaving Cowden Station, the 08.04 Oxted to Uckfield passenger train (2E24), the Down train crewed by Driver Rees and Guard Boyd, comprising two three-car Class 205 DEMUs and running under cleared signals, had travelled about 300 m when it collided head-on with a similar train, the 08.00 Uckfield to Oxted (2E27), the Up train crewed by Driver Barton and Guard Brett-Andrews. The two leading vehicles of 2E24 and the leading vehicle of 2E27 were derailed, blocking the single line. The weather at the time of the collision, about 08.27, was very foggy, visibility in places being down to 50 m. Two passengers in the Up train, the train crew of the Up train, and the driver of the Down train were fatally injured and 12 others, who included the guard of the Down train, suffered minor injuries and shock as a result of the collision.

The site

13 Cowden Station lies about one-third of the way along the line from Hurst Green Junction to Uckfield. Before 1969, this line was part of an alternative route from London to Brighton via Lewes, but in February of that year the section beyond Uckfield was closed. The importance of the line was accordingly lessened and, by the mid-1980s, it had deteriorated to such an extent that a number of speed restrictions had been imposed due to the condition of the track. It was apparent that, unless some improvements were made, the line would only deteriorate further and several options were examined. As a result, the decision was made in 1988 to single the line without electrification, but to equip it with modern signalling. This was completed in the early part of 1990 and the line is now single from Hever to Uckfield with long passing loops at Ashurst and Crowborough.

14 The route is fairly heavily graded and passes through wooded country. The single line between Hever and Ashurst, on which the collision occurred, lies more or less north-west to south-east and rises continuously from Ashurst in the Up direction on a series of left- and right-hand curves, culminating in a maximum gradient of 1 in 100 for almost a mile before Cowden Station. The salient features of the line between Ashurst and Cowden are shown in Figure 1. Figure 2 at the back of the report shows the signalling of the single line and of the Ashurst loop and details of the collision site. Both Cowden and Ashurst Stations lie in the county of Kent, although much of the line between them passes through the county of East Sussex.

The overturned leading coach of the Down train with the wreckage of the leading coach of the Up train lying above it

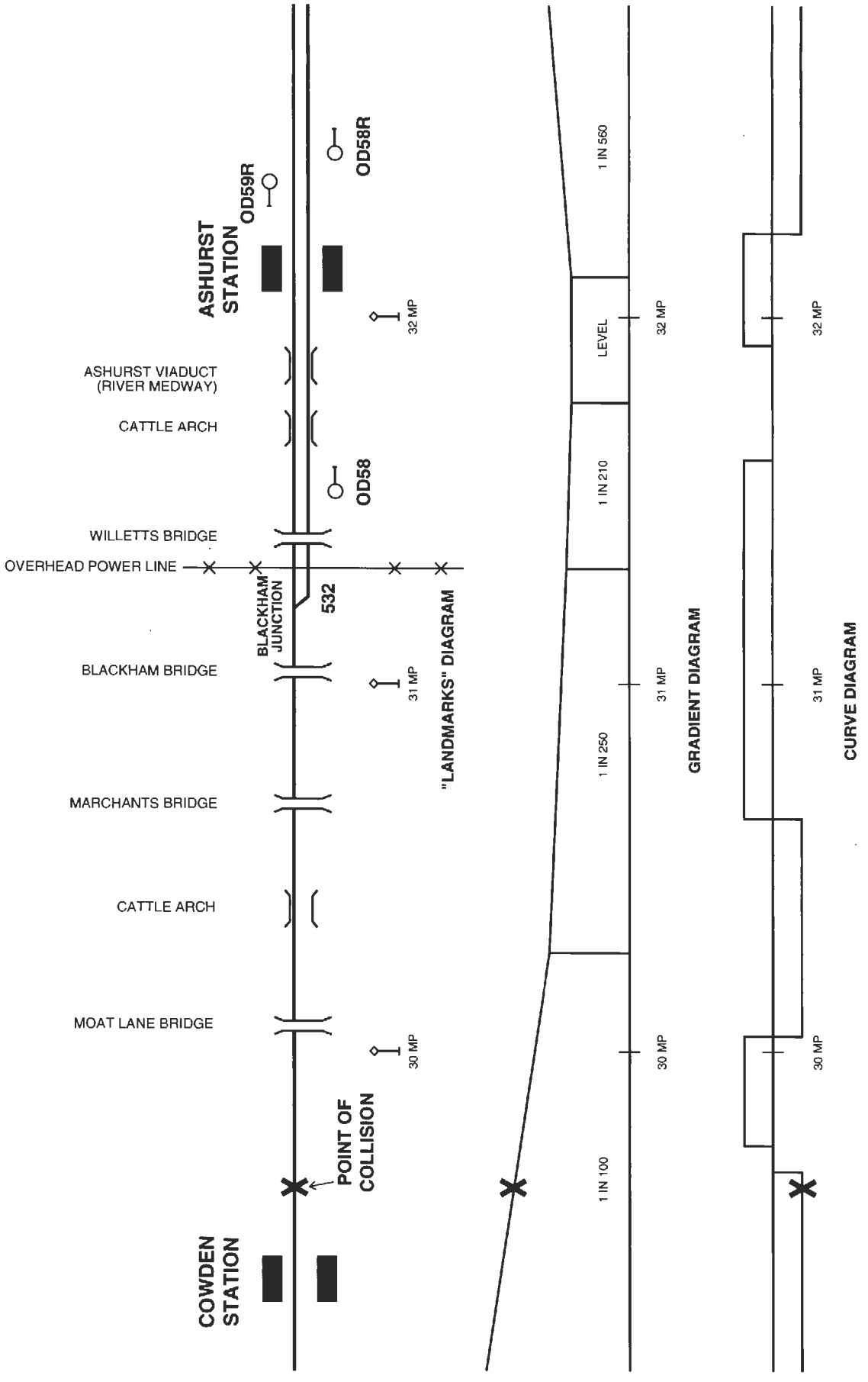


Figure 1 Features of the line

The signalling

15 The line is fully track-circuited, is signalled by colour-light signals which have AWS inductors associated with them and is operated under the Track Circuit Block Regulations from Oxted Signal Box. The signal box is equipped with the SSI system. The signalman's display is a standard entrance-exit (NX) panel driven by duplicated panel-processor microprocessors. The interlocking of points and signals is accomplished by three interlocking microprocessors arranged in a checked, triple-redundant mode. A further microprocessor acts as a diagnostic module which monitors the inputs and outputs to and from the interlocking processors and sounds one of two types of alarm if a fault is detected. The 'critical alarm' sounds, together with a visual indication, if a fault which immediately affects the operation of the signalling system occurs. The 'non-critical alarm' is given when a failure such as the first failure of duplicated signalling equipment occurs. Data link modules (DLMs) connect the signal box processors to the data highway to the outside signalling equipment. DLMs are also used at the field locations to connect the trackside functional modules (TFMs) to the data highway. TFMs are double redundant microprocessors and separate types are used to drive the signals and points. Track-circuit operation is monitored through either type of TFM. All SSI data sent to or from the signal box is logged chronologically on tape which can either be interrogated or removed completely for subsequent investigation. Time on the tape is recorded in 1 minute bands. The SSI cubicle is located in the relay room on the ground floor of the signal box at Oxted but there is a fault printer adjacent to the signalman's panel on the first floor. The train describer and the annunciator for the telephone concentrator at either end of the signalling panel both use VDU displays.

16 From Hurst Green Junction, where the branch diverges from the main line to East Grinstead, all the signals except OD61 at Crowborough are two aspect colour-lights. Entry to the single line between Hever and Ashurst in the Down direction is through Points No 530 at Hever Junction while in the Up direction through Points No 532 at Blackham Junction. The Down signals protecting the single line are OD55 and OD55R while Signals OD58 and OD58R protect it in the Up direction.

The trains and the damage sustained

17 The composition of and damage sustained by each of the two trains is shown in the table overleaf. Each set is 60.99 m long over couplers and weighs 122 tonnes. The DMBSO weighs 57 tonnes.

The damage to the permanent way

18 Points No 532 and their operating connections were damaged as a result of being run through and four concrete sleepers required replacement. Some track realignment was also necessary.

EVIDENCE

As to the background information

19 *Mr C T Jago*, Director Railtrack South Zone, described the line including the signalling and showed a video film taken from the cab of a train similar to those involved in the accident. He also described the outline course of the accident, the functions of the various control rooms and a brief history of the singling and resignalling of the line. He agreed that the loops at Ashurst and Crowborough were long ones.

20 *Mr G C Eccles*, Director Network South Central Train Operating Unit (TOU), described the train operating arrangements on the line. He mentioned that of the trains involved in the accident only one of the four units (205018) actually had a radio fitted in the cab. It had been the policy, where possible, to fit radios to trains in advance of the provision of base station facilities so that whenever and wherever those facilities were available the radios could be used. The Uckfield line had not yet been equipped with radio base stations for cab secure radio. However commercial cellular telephones had been made available to train crews after the line had been singled and he described the operating instructions for them. He said that there were black spots in the telephone cover in that area.

21 *Superintendent A J Clift*, British Transport Police, was the Area Commander for the geographical area in which Cowden lies. He described the involvement of the emergency services following the accident. He also described some of the investigative work which had been undertaken by the police and explained where the fatally injured had been found.

As to the running of the trains and the course of the collision

22 *Signalman S W Webb*, Railtrack South, was on duty in Oxted Signal Box on the day of the accident and had relieved a colleague there at 06.50 after having had a full period of rest. He explained that, although he was classified as a 'rest day relief', he was fully conversant with the train service, also with the operation of Oxted Signal Box, and had worked the morning shift there a number of times. On the morning of 15 October all was in order with the signalling equipment and, before the collision, there were no difficulties with the operation of the signal box.

23 Mr Webb set the route for 2E24, the 08.04 Oxted to Uckfield (the Down train), as far as Signal OD59 in Ashurst Loop and also the route for 2E27, the 08.00 Uckfield to Oxted (the Up train), to Signal OD58. This

Train	*Set no*	*Vehicle type*	*Vehicle no*	*Damage*
2E24 08.04 Oxted to Uckfield (the Down train)	205029	Driving motor brake standard open (DMBSO)	60147 (leading)	Both bogies torn away and all underframe equipment destroyed or torn away. Cab front pushed in approximately 2 m.
		Trailer standard open (TSO)	60674	'B' end bogie displaced, king-pin bent 45°, crown plate torn out and centre destroyed.
		Driving trailer composite (DTC)	60828	Cushions and light fittings displaced.
	205032	Driving motor brake standard open (DMBSO)	60150	Cushions and light fittings displaced.
		Trailer standard open (TSO)	60677	Cushions and light fittings displaced.
		Driving trailer composite (DTC)	60831	Cushions and light fittings displaced.
2E27 08.00 Uckfield to Oxted (the Up train)	205018	Driving trailer composite (DTC)	60817 (leading)	Vehicle body completely torn off. 'A' bogie torn away, 'B' bogie derailed No 3 pair of wheels. 'A' end headstock and underframe pushed back approximately 2 m. Distortion to right-hand side. (The two passengers who lost their lives in the accident were in the leading compartment of this vehicle.)
		Trailer standard open (TSO)	60667	No 2 end body panels torn away from headstock. Bodyside panels torn away on left-hand side.
		Driving motor brake standard open (DMBSO)	60117	Cushions and light fittings displaced.
	205001	Driving trailer composite (DTC)	60800	Cushions and light fittings displaced.
		Trailer standard open (TSO)	60650	Cushions and light fittings displaced.
		Driving motor brake standard open (DMBSO)	60154	Cushions and light fittings displaced.

was his normal practice and was done so that each train would be able to run into the loop and call at Ashurst Station without being delayed. Knowing that the Up train would arrive at Ashurst before the Down train, Mr Webb watched his signalling panel indications and, when it had passed Ashurst Junction, he set the route for the Down train through to Uckfield. At this stage, there was nothing else requiring his attention until the Down train had passed Blackham Junction so, noting from his signalling panel indications that all appeared in order, he decided to prepare his breakfast.

24 Shortly after beginning his preparations, the critical alarm in the signal box sounded to warn him that something was wrong. On turning round to check the signalling panel, he saw that the indicator light above the switch for Points No 532 at Blackham Junction was flashing, showing that the points were 'out of correspondence'. Mr Webb checked the other indications on the panel and, seeing that track-circuits LF and LD were both showing occupied, realised that the Up train had run through the points and that a collision was virtually certain. He was, understandably, somewhat distressed but he immediately rang the Railtrack Control at Croydon to apprise them of the situation and to ask them to call the emergency services, recording the time as 08.28. Mr Webb added that, although there was a time indication obtainable from the SSI equipment, this was not in agreement with the signal box clock. As he was aware that the latter clock was checked daily, all his timing records were made from this. He then placed reminder appliances (collars) on the signal and point controls to preserve their settings and, additionally, set the signals for the East Grinstead line to work automatically.

25 In answer to questions, Mr Webb said that there was nothing else that he could have done; there were no signals ahead of either train, and he was not in radio contact with their drivers. Cellnet telephones had, for some time, been provided for communication between the signal box and drivers, using the British Telecommunications (BT) system but they had proved unreliable and had fallen into disuse. He was conversant with the use of CSR and was of the opinion that, had such equipment been provided, he could have warned the drivers in time for them to have stopped before colliding because, when the alarm sounded, the two trains would have been about a mile and a half apart.

26 *Trainman R Boyd*, Network South Central TOU, was the guard of the Down train. He booked on at Selhurst Depot that morning after more than 12 hours rest and worked the empty stock thence to form the 05.58 East Croydon to Uckfield and its return working, the 07.00 Uckfield to Oxted. On these two journeys the weather was misty and swirling in patches and, although his driver, Mr D Rees, spoke to him when he changed driving cabs, he neither commented particularly upon the mist nor did he mention any difficulty in seeing signals. In Mr Boyd's view, because both he and Mr Rees regularly worked on the Uckfield line, neither of them considered the weather as anything unusual.

27 The Down train was a little late in starting from Oxted owing to the shunting movement into the bay platform there being carried out across the London end crossover at the station instead of, as was usual, the country end. The journey as far as Cowden Station was, in Mr Boyd's opinion, normal and Mr Rees was driving as steadily and smoothly as he normally did. Shortly after leaving Cowden, however, there was an emergency brake application, which Mr Boyd thought was due to the driver having released the driver's safety device (DSD), and almost immediately there was what he described as a 'crunch' and the train came suddenly to a stand.

28 On looking from the window of the guard's compartment, Mr Boyd saw that the leading vehicles of his train were derailed, so he put on his high-visibility vest and climbed down to the track to investigate. At that time, he did not realise that there had been a collision and thought that his train had struck something on the line. He arrived at what he thought was the 'front' of the train and, seeing that the driving cab there was unoccupied, thought that his driver had gone forward to carry out protection in accordance with the Rule Book. So, after obtaining detonators and a red flag from the cab, which he put down ahead of the train, he returned to the rear, checking with and reassuring his passengers as he did so. Mr Boyd continued past the train to Cowden Station to report the incident where he met a colleague, a Mr Hodges. Although there was a telephone at the station, neither of the two men knew the number of Oxted Signal Box and had to obtain the number by telephoning the Oxted Operating Supervisor. It was only after speaking to the Oxted signalman that Mr Boyd realised that his train had been involved in a collision.

29 *Rail Operator V D Hodges*, Network South Central TOU, travelled on the Down train as a passenger from Oxted and alighted at Cowden to attend to station duties there. He did not speak to either the driver or the guard and, when the train left, he went into the booking hall to tidy up when he heard what he described as 'a bang'. Thinking that some contractors' materials left on the station might have exploded, he went to investigate but found nothing amiss and resumed his work. At about 08.35, he decided to telephone the supervisor at Oxted, whose number he knew, to inquire the whereabouts of the Up train which, he realised, was late. He was told that it was at Ashurst and, on putting the telephone down, saw Mr Boyd approaching, walking along the platform. When he asked Mr Boyd what had happened, he was told that the Down train had struck something and that he needed to contact the signalman at Oxted. The relevant telephone number was not displayed at the station so Mr Hodges rang the supervisor again to find out the number of the signal box.

30 *Mr D M Stone*, a passenger on the Up train, boarded it at Buxted Station together with his wife. He had been unable to purchase their tickets on the station and, never having travelled on the line before, was concerned as to whether he could do so on the train. He was, therefore, scanning the train as it approached Buxted to see if there was someone on the train from whom tickets could be obtained. As the train drew closer, he could see that there was a man in uniform standing in the driving cab to the driver's right and near to the middle of the cab.

31 Although Mr Stone had not journeyed on the line before, he felt that, between Crowborough and Ashurst, the Up train was travelling fast; he described the movement of it as 'a rocking motion' which he likened to that of a road vehicle going downhill. *Detective Chief Inspector V M Miller*, British Transport Police, said that, subsequent to the accident, passengers from both of the trains involved had been interviewed and a number of those from the Up train had remarked upon its speed or on the ride as having been 'jerky'. Mr Miller pointed out, however, that not only were these witnesses not qualified to comment upon the riding qualities of trains, but that their recollections may well have been distorted as a result of the accident. Nevertheless, all those interviewed agreed that the weather was foggy in patches and that some of the patches were quite thick.

32 Another passenger on the Up train, *Dr B A Lawton*, has also provided me with her notes written shortly after the day of the accident. She had travelled from Crowborough and had seen Mr and Mrs Pointer

(who were later to be fatally injured) enter the leading first class compartment. She herself travelled in the leading vehicle of the second unit. She noted that it was foggy in patches and that the train seemed to be going faster than usual. After stopping at Eridge the train dropped to its more usual pace for the run to Ashurst. The fog was still patchy and dense in places. Both at Eridge and Ashurst the station stops were just long enough for passengers to board or alight. She noted that there was no Down train at Ashurst as might have been expected. The start from Ashurst was smooth, she did not hear a bang as the points to the single line were traversed and the train continued at its normal pace. Approaching Cowden the train slowed naturally and did not appear to brake (she knows the feel of sudden braking). There was no fog and she could see quite far back down the line towards Ashurst and thought that, but for the bend and the trees, she would have been able to see Cowden Station.

33 *Rail Operator (Rest Day Relief) W Burton*, Network South Central TOU, was engaged in ticket office and platform duties at Edenbridge Station on the morning of the accident. He had travelled to Edenbridge on the 06.48 train from East Croydon, the crew of which were Driver Barton and Guard Brett-Andrews, both of whom he knew. On the train's arrival at East Croydon, Mr Burton noticed that the guard was in the leading cab with the driver. He then got out of the cab and, after having deposited his guard's bag in the brake van in the middle of the train and switching on the train lights from there, returned to the leading cab. When, at Edenbridge, Mr Burton gave a handsignal that the platform work was complete, it was acknowledged by the guard from the driving cab.

As to the events following the collision

34 *Deputy Controller K McManus*, Railtrack South, was on duty in Croydon Control when Signalman Webb telephoned to advise of the impending collision. He realised that the signalman was distraught and was at pains to repeat the message back to ensure that he had the details correctly. After having logged the time that their conversation was finished, 08.34, he reported the situation to his Control Manager. At that time, Mr McManus did not know the site of the collision so the two men consulted ordnance survey maps and a reference book available to them in the Control Office so that accurate directions could be given to the emergency services. They had just decided upon a suitable access point when they received a telephone call via the Kent Police advising them of the collision.

35 *Mr R P Westwood*, also of Railtrack South, was the senior control manager at Croydon and was the Control Manager to whom Mr McManus reported. In addition to controllers from his own company, Railtrack, he also had representatives from Network South Central TOU working under him and, in his capacity as Control Manager, was responsible for dealing with any abnormal situation. He explained the arrangements that had been set up for notification of the emergency services by means of direct telephone calls through the BT system and also the various railway officers who would need to be told of a major incident. The latter were contacted by a telephone pager message through the BR National Telephone Network (NTN) that would be sent out to all Railtrack staff in the entire South Zone but, additionally, the Director, Railtrack, and the on-call officer would be called directly. There was some difficulty, however, in contacting the Department of Transport and it was not until some three-quarters of an hour after Mr McManus had reported to him that contact was made. These procedures were specified in a manual for emergency procedures produced by Railtrack headquarters and dated June 1994.

36 Although he had received training for emergency situations, including simulated incidents, and had visited an ambulance control room, Mr Westwood had not been given any instruction in dealing with people who have suffered from shock. He was, nonetheless, primarily concerned for the welfare of Mr Webb and made arrangements for a man from Oxted Station to go to the signal box and remain with him until relief could be organised, because he was fully aware that a movements inspector would, of necessity, take some time to travel to Oxted.

37 He had just decided, with Mr McManus's assistance, upon the information to be passed to the emergency services when, at 08.40, he received a call from a colleague in the Kent Railtrack Control to say that they had been advised of a collision on the line by the Kent Police and that the location was required. He thereupon spoke directly to the police and told them that Cowden Station was the most suitable point for their control room to be set up.

38 *Area Movements Inspector D G Morgan*, Railtrack South, was 'on-call' at home when, at about 08.30, he was telephoned by Croydon Control and told of the collision. He was aware how Mr Webb would have reacted to the incident so, after speaking to him for a few minutes on the telephone, told him that he was coming to Oxted, arriving there at about 09.00. On entering the signal box, he took notes of the signalling panel indications and signed the Train Register Book, his observations confirming the sequence of events that Mr Webb had reported and also that he had taken the proper steps to protect the route. He had known Mr Webb for about 6 years and was fully satisfied with his performance as a signalman, having last examined him in Rules some 3 months before the accident, a test which he passed with ease.

39 Mr Morgan then made arrangements for Mr Webb to be relieved, a problem that he had turned over in his mind on his way to Oxted. It was his responsibility as the on-call movements inspector to do so because, as it was a weekend, there was no roster clerk on duty who would normally perform this function. Also, there were no relief signalmen available at the time and he had to move staff around to obtain a relief for Mr Webb. In the event, it was some hour and a half after the collision before Mr Webb was able to go off duty. During this time, Mr Morgan assisted with telephone messages, the signals on the East Grinstead line also controlled from Oxted Signal Box having been set to operate automatically.

40 *Mr J A B Street*, a Railtrack Field Manager, was in his office at Epsom when, at approximately 08.35, he received a message on his pager to ring Croydon Control. The message did not give any details, a procedure which he favoured, because he preferred to speak to someone to obtain as much information as he could about an incident before leaving for its site. Having telephoned to Railtrack Control to obtain the information that he wanted, he immediately rang Signalman Webb who seemed badly shaken but advised him what had occurred. He said to Mr Webb that he would get to Oxted Signal Box as soon as he could and that Mr Morgan was, in fact, on his way there. In the event, Mr Street did not go to the signal box; in the course of his journey there, he was again paged and, on telephoning, was told that a passenger from one of the trains had called the emergency services from a farm near to the railway and that Mr Street should, therefore, go to Cowden Station.

41 Upon his arrival, Mr Street made contact with members of the emergency services, all of which were, by that time, at Cowden. He was told that officers from the services were at the scene of the accident so he decided to go there. Although, as the senior railwayman on site Mr Street had assumed the position of Railway Incident Officer, he did not make any arrangements to leave a message at the station as to his movements; he wished first to apprise himself of the situation. At the site, he eventually spoke to the commander of the Kent police who said that he was their incident officer. Mr Street advised the commander that he was acting in the same capacity for the railway, identified himself and informed him of the arrangements that were being made, and also that engineers and other specialists were being called to carry out investigations at the site. He made only a cursory examination of the scene and did not draw any conclusions from his observations, after which he returned to Cowden Station.

42 *Mr C R C Clifton*, Safety and Standards Manager, Railtrack South, was also an on-call officer that week. He was at home when, at 08.56, he was telephoned by Mr Westwood and told of the circumstances of the collision and that the emergency services had been called to the scene. After ensuring that arrangements had been made to provide assistance for Mr Webb and that the necessary engineers had been called, he left to take over as the Railway Incident Officer on site. This requirement was a part of his duties and, although he had no formal training as such, he had attended table-top exercises. Upon his arrival, he went directly to the scene of the accident where he made contact with, among others, Mr Street and Mr Hanson. At that time, although an incident room had been set up at Cowden Station, it was not properly manned, so he posted Mr Hanson there as his representative while he identified himself to the Fire Brigade and BT Police incident officers. As a result of the telephone conversation that he had had with Mr Westwood and from a request by Mr J Collins from the Signal and Telecommunications Department (S&T), he arranged for police officers to guard the sites of Signal OD58 and Points No 532 at Blackham Junction. At that time, so far as he was aware, no representative of the S&T or any of the other technical departments, with the exception of Mr Collins, had arrived on site to carry out any investigations but he pointed out that, had anyone gone to Ashurst Station and walked along the line from there without reporting to the incident room, he would not have known of their presence.

As to the post-accident investigations

43 *Mr J Collins*, the Signal Maintenance Assistant, British Rail Infrastructure Services (BRIS) Brighton, received a group page message at about 09.00 from the Infrastructure Control advising him of 'Collision at Cowden'. He explained that this control, although situated at Croydon, was separate from the Railtrack Control and usually sent such brief messages so that any of the recipients who needed to respond could then telephone for details. This Mr Collins did and, on receiving further information, telephoned his Signal Maintenance Engineer, *Mr V G McLellan*, who, after discussing the accident with him, asked him to attend on site. He arrived at about 12.00 and, after reporting to and discussing with Mr Clifton the requirement for police officers, set off to walk along the line to Points No 532, carrying out a visual inspection as he did so. He was accompanied by a colleague from the S&T and two permanent way engineers.

44 When he reached Signal OD58, Mr Collins checked that it was showing a normal Red aspect, basing his opinion upon his railway experience of 30 years. In view of the urgent necessity to examine the signal head, although a police officer had not arrived, he decided to unlock and open the head and make a visual examination internally, together with a photographic record. In his view, his action was acceptable because his three companions would be able to confirm his findings and that he had not disturbed any of the interior equipment. All was in order except there was

contamination on the insides of both of the signal lenses, the red lens seeming to be more affected than the green. Also, the wooden clamp retaining the signal cables did not look effective; he did not, however, check this by pulling the cables to see if they were loose. Mr Collins then closed and re-locked the signal head case and the group moved on to Points No 532. On their way there, he made visual examinations of the lineside apparatus cases but did not find any fault. He also made notes of the details of the apparatus record cards but could not recall whether or not he had signed them as examined but believed that he did. At Points No 532 there was evidence that they had been run through; the point fittings were bent, a view confirmed by the permanent way engineers with him.

45 On the day following the accident, Mr Collins was a member of the investigating team working under the direction of *Mr R M Bell*. In the presence of a police officer he, with the assistance of colleagues, disconnected and removed the head from Signal OD58 and sent it for examination at the BR Technical Investigation Centre at Crewe.

46 *Mr V G McLellan*, the Signal Maintenance Engineer, BRIS Brighton, also received the pager message from Infrastructure Control. He telephoned the engineer on call, *Mr R Adams*, but on hearing that he was not familiar with Cowden, asked Mr Collins to go to the site and went to Oxted Signal Box himself to set up the site engineers' office there to enable the technical staff, including Mr Collins, to keep in touch. Before leaving, he arranged for a fault team from Croydon, which included *Mr P D Percival*, a specialist in SSI equipment, to go to Oxted Signal Box. There they were to remove the tapes from the data recorder and to note the signalling panel indications. Mr McLellan did not instruct Mr Percival to await the attendance of a police officer at the signal box and in the event, Mr McLellan was told, the tapes were removed, sealed and only subsequently handed to a police officer.

47 On the day following the collision, Mr McLellan visited the site as a member of the investigating team and took particular note of Signal OD58. Upon his approach to the signal, he viewed it with the aid of a periscope to raise his eye level to that of a train driver and thought that it was 'a good red'. Since the accident, however, he had taken a particular interest in the luminosity of signals and had noted that there was a considerable variation. In hindsight, his opinion was that the signal was 'a reasonable red' notwithstanding that he was told that, on test, it had an efficiency of 13.6% only; in his view, this figure was very questionable. He examined the signal both externally and internally, taking notes as he did so, with a police officer present and noted the deposits that Mr Collins had described. He also checked the alignment of the signal and found it to be pointing slightly low and to the right of the driver of a train approaching it.

48 In answer to questions, Mr McLellan explained that signals were subjected to quarterly and annual servicing, the schedules for which were laid down in a Railtrack group standard. The quarterly check consisted of external cleaning, including the lenses, and a visual examination to ensure that all was secure. Internal examination and cleaning is carried out annually and, in addition to internal cleaning, include a functional check. In his opinion, which was also held by other S&T Engineers, the internal examination should be implemented more frequently, the last such for Signal OD58 being in April that year. Mr McLellan added that there was a system provided for drivers to report any problems with signal sighting, their reports being passed to the S&T organisation for action; so far as he was aware, no such reports about Signal OD58 had been received.

49 Evidence was made available to me regarding the maintenance of Signal OD58 by *Technician Officer (S&T) Mr A Pearce* of British Railways Infrastructure Services (BRIS) South Central. He explained that he had carried out quarterly services in February and July and an annual service in April 1994. Although the actual schedule for a quarterly service did not include internal cleaning of the signal he nevertheless did so. Because it is fairly isolated, he had also looked inside the signal on 12 October 1994 while carrying out other maintenance duties. He said that on this out-of-routine visit he had brushed away a few dead flies. On that day he could see the signal from Ashurst Station and considered it to be a good signal. He did not consider Signal OD58 to be particularly prone to contamination by flies. He admitted using an unauthorised spray for the corrosion protection of the internal terminals. He was careful not to let this contaminate the back of the lens or the lamp. It should be noted that subsequent chemical analysis of the contamination on the back of the lens showed that this was not due to the use of the spray.

50 *Mr P D Percival*, Engineering Assistant, Signalling Technical Support, BRIS, was present in Oxted Signal Box when the data tapes were removed from the SSI recorder and confirmed that no police officer was present at the time. He sealed the tape and in due course, took it to *Mr D M Warwick* for safe keeping prior to analysis in which he assisted.

51 *Mr H Nixon*, an assistant in the BR Technical Investigation Centre, Crewe, carried out a functional test and an internal examination of the head from Signal OD58. He did not find any fault except looseness of the terminals associated with the attachment of the incoming tail cables which, he gathered, had been disturbed when the signal head was disconnected. He was unable to comment upon the wooden cable clamp

because this had been removed, in order to disconnect the tail cables, and tied to the outside of the head. During the testing, the remark was made that the signal 'appeared a bit dim' and, as a consequence, it was sent to BR Scientifics to check the light intensity.

52 *Mr D A Jack*, the leader of the Optics Section of BR Scientifics at Crewe, carried out the optical tests of the signal head. Before doing so, he examined it internally and externally and, while there was no corrosion present and the general condition was good, there were the dead bodies of a number of insects inside and the internal surfaces of the lenses were contaminated with a waxy substance which, on analysis, proved to be fly excrement. When, subsequently, an attempt was made to remove the contamination, a substance similar to paint stripper was found to be necessary, a chemical which would not be available to signal technicians in the field. The lamp bulbs also showed evidence of fly excrement, as well as a brown discoloration on the insides of their glass envelopes. This, Mr Jack explained, was caused by the deposition of tungsten from the filaments and was typical of lamps that had been in service for a considerable period. He added that he had not previously seen that level of deposit on lamps from the field as they were usually changed due to filament failure as the result of vibration from trains transmitted through the track formation.

53 A series of comparative tests on the whole system and on the lamps individually, both before and after cleaning, was carried out against a signal obtained from the laboratory store. This was neither a reference standard nor a new signal but only a representative one. The lamp fitted to this signal for the tests also was not new but was a 'secondary standard' which had been recalibrated every 20 hours of use. It had actually been used for about 10% of its expected life and, for the purpose of the testing, was considered to have the light output of a new lamp. In Mr Jack's view, the use of this particular signal and this particular lamp was justified as Signal OD58 was to be compared with a normal signal and not with a particular standard. In the event, he found that the luminosity of the red aspect of Signal OD58 to be only 13.6% of that of his 'reference'. He was also of the opinion that, in the misty conditions obtaining at the time of the collision, the driver of the Up train would have had only about 1 second in which to see the signal. He based this opinion upon a table, which he produced, showing the calculated reduction in daylight visual range of the actual signal head from Signal OD58 due to the attenuation caused by increasing densities of fog.

54 *Mr D G Marriott*, Testing and Commissioning Engineer, Railtrack Major Projects Division, was called to the site on the day of the accident. There he met *Mr R M Bell*, his immediate superior, who appointed him as the investigating officer for the incident. Together with Mr Bell and accompanied by a police officer and Mr Short of HM Railway Inspectorate, he went to examine Points No 532, Signal OD58, and Signal OD58R before carrying out a functional test of the system. He confirmed the evidence of other witnesses regarding the points and signals but thought that Signal OD58 was 'a little dim', but he pointed out that he viewed the signal from ground level and not from that of a driver's eye.

55 Mr Marriott, after having decided upon and noting his plan for the functional test, carried this out before conducting any detailed examination of the equipment involved. He preferred to do this so that nothing would be disturbed that might affect the result of his tests. Each action that he took was recorded by the SSI equipment in Oxted Signal Box and printed out at the technicians' terminal there. He also noted the signal controls and called each one out to Mr Bell, who checked them against the control tables. Nothing was found amiss with the interlocking and all the controls associated with Signal OD58 and Points No 532 were in order. The only item that seemed to him to be a little unusual was that there appeared to be two extraneous wires in the SSI cubicle which, he was told, had been installed at the time that the Uckfield line was commissioned. On making subsequent inquiries, he found that the wires could be used to examine the system from within Oxted Signal Box without having to disconnect equipment elsewhere; he understood that the wires had been added to the diagrams.

56 Although at that stage he did not know where the Down train was when the Up train passed Signal OD58, Mr Marriott decided to simulate an Up train passing the signal after the route for a Down train had been set. When he did this, he was interested to note that the occupation of track-circuit DN, the overlap for Signal OD58, did not replace to Danger Signal OD55, the entry signal for the single line. To do this, the occupation of track-circuit LF was necessary and he also noted that the train describer's indication of a Down train then stepped forward to Signal OD59; this arrangement was, he found, entirely in accordance with the control tables. The use of track-circuit LF as the trigger for stepping forward the train description did not surprise him, but he agreed that it would have been equally logical to use track-circuit BL for this purpose. The correct functioning of the trackside AWS equipment was tested. That associated with Signal OD58 was entirely in order but that at Signal OD58R had a slightly loose terminal, the effect of which could have been a right-side failure; in other words the indicator in the cab of a train would have sounded a horn and not a bell when the signal was green. The horn would also have sounded for a yellow signal, the aspect of signal OD58R at the time the Up train passed it.

57 Mr Marriott was also present when the alleged incident of a prolonged blackout of Signal OD58 occurred in January 1990. He was testing following a

run-through of Points No 532 when a train driver reported the loss of the signal aspect despite the panel showing it still to be green. Interrogation by the technician's terminal showed that a lamp filament failure had occurred lasting 4 or 5 seconds, this being the time lapse between the reports of it being off and then on again which was probably longer than the actual occurrence on the ground. The driver had subsequently reported by telephone that the green aspect had come on again. He later conducted a test on another signal at Oxted which showed that the maximum length of blackout during what he discovered to be the power disable test (PDT) was between 1 and 1.5 seconds. *Mr L H Page*, Signal Engineer, Railtrack South, had been the Maintenance Engineer at the time of this incident. He explained that the current record of this incident had not been made contemporaneously and that it was in error in recording the cause as being a power disable test. The precise happening was never really established, but the whole circumstance had been rendered irrelevant to the accident on 15 October 1994 because both the trackside functional module and the signal head had been removed in 1990 for testing and had been replaced by fresh equipment.

58 The analysis of the SSI data tape removed from Oxted Signal Box by Mr Percival was explained by *Mr D M Warwick*, Signalling Strategy Engineer, Railtrack South. He confirmed that interpretation of the recordings from the tape only gave the time stamp to within the minute in which the message occurred and that there is a possibility that from time to time messages are recorded slightly out of order. This tended to occur with fault alarm messages and route calling messages which are generated in a different part of the SSI. In this particular instance it was possible to see the actual event, which caused the fault alarm being shown, some two or three messages earlier. He also drew attention to the series of messages which showed that a PDT had occurred at 07.22 and that no such messages had occurred 1 hour later. He explained that a PDT would occur 1 hour after a previous one and only if there was a change of output state. Failing a change of output state, a PDT would occur 5 hours after the previous one.

59 Mr Warwick described how he, and others, had plotted, from the information on the tape, the movements of trains and the states of signals and track-circuit indications over a time-band of 07.00 to 09.00. This time-band captured the movement of the first two Up and Down trains on the branch on the day of the accident, the accident itself and afterwards to see if anything significant occurred. He detailed the actual movement of the two trains and in particular how and when the routes were set, the attempt by the motor itself of Points No 532 to restore normal detection and of Signalman Webb's attempt to do so using the individual point switch. He was confident that the order of the messages from the same module was the right order. Many of the crucial ones came from the same module. Hence allowing for the time correction between the tape record and the signal box clock, the critical alarm would have sounded at between 08.24 and 08.25 signal box time. He confirmed that the output to the AWS electro-magnet was shown separately from that to the signal lamp and that, in this instance, no failure had occurred at Signal OD58. He also said that, if the electro-magnet was being fed (ie because the signal was green) at the time of a PDT the feed would be cut, but there was just a possibility that a train driver would hear a horn and not a bell with a green signal. It could never happen the other way round. Even when a PDT occurred and the red lamp went out, the permanent magnet of the AWS inductor would not be affected and a horn would be sounded in the cab.

60 The trackside functional modules controlling the operation of Signals OD58 and OD58R were sent to the Technical Investigation Centre, Crewe, where they were examined by *Mr A E Cross*, an Assistant Technical Investigation Engineer. He described the detail of these tests and how the values found during the tests which differed from the precise requirements of the manufacturers' specifications were not significant in terms of their operation in the field. He had also conducted the tests to confirm that PDTs occurred at the specified intervals of 1 and 5 hours and the length of time which the red aspect was disconnected was between 160 and 180 milliseconds. He was of the opinion that because of the decay time of the light from a tungsten lamp during an aspect change, this 'black' period would be imperceptible to a driver. He went on to say that the software modifications to the TFM in relation to the PDT had arisen because in some locations the PDT had occurred in connection with aspect changes in other than the main aspect, an asynchronous change. Hence the PDT had occurred at a time when the main aspect was lit and not when it was changing. Therefore the 'black' period may have been perceptible. The arrangements at Signal OD58 were not such that this asynchronous change could occur. There was therefore no reason why the software for the modules driving Signals OD58 or 58R had to have the modification.

61 The chairman of a special signal sighting committee convened to examine Signal OD58 was *Mr R F Cawley*, Operations Reliability Engineer, Headquarters BRIS. He said that the committee had viewed the signal on the Sunday morning following the accident in as near similar conditions, with the exception of the fog, as had occurred the previous day. From the Down side at Ashurst Station the signal was clearly visible but he described it as very much an average signal, having a somewhat matt appearance unlike the sparkling brightness when the eye is in the beam of the signal. It could clearly be seen at well over the minimum distance on a clear day. He checked the alignment of the signal which was slightly misaligned from the normal position

of 3 m above the left hand rail 180 m from the signal. He considered that the slight misalignment would have affected the long-range sighting only. He also said that when he first saw it the red aspect was affected by flickering which he took to be the effect of the over-hanging twigs between the point where he was standing and the signal. He observed that the short-range sighting was not affected because the vegetation had been cut back. He was questioned about the distance between Signal OD58R and Signal OD58 and in particular how this related to the braking distances for trains using the line. He agreed that the distance was suitable for 85 mile/h running rather than the 70 mile/h for the current rolling stock. He also observed that, ideally, a station platform at which trains normally stopped should not intervene between a distant and a stop signal because the station stop had on occasions caused a lapse in the driver's memory as to the aspect of the previous signal.

62 *Mr R M Bell*, Manager Testing and Commissioning, Railtrack Major Projects Division, who lives close to Ashurst Junction, gave evidence on the weather conditions on the morning of the accident. He said that he had driven under a bridge under the line about 4 km from Points No 532 at about 07.30. At that time the fog was very dense in the valley but cleared quickly on climbing the hill. Later he had been asked to provide the independent testing facilities in connection with the accident. He arranged to go to Oxted Signal Box where he met Mr Marriott, Mr Short from the Inspectorate and a policeman. He confirmed that he had appointed Mr Marriott to undertake the testing. He also said that it was quite evident from the indications on the panel that it was the Up train which was at fault. The four of them then went to Ashurst Station because, in his experience, Signal OD58 suffered from being obscured by vegetation and he wanted to see what the appearance of the signal was. The signal could be seen clearly from the footbridge at Ashurst Station, but from the Up line, it was not visible until they had reached the bridge over the River Medway.

63 In his opinion there was nothing about the appearance of the signal which gave him any concern. However, after the signal head had been opened up and the contamination observed and after viewing the sighting through the peep hole and making further visual observations, he came to the conclusion that there would have been some degradation in performance. Later they had looked at Signal OD59R where the degradation, which was much less, only affected the yellow aspect. They had checked that the electro-magnets of the AWS were disengaged and that there was some magnetism in the permanent magnets by using a bunch of keys; the proper test was done later as part of the test plan. He had been astonished to read Mr Jack's assessment of the performance of Signal OD58 because it was at considerable variance with his own observations and those of other experienced signal engineers. He tended to agree with comments that it was the human eye which was in practice used to observe signals. He was quite clear in his own mind that the aspect of Signal OD58 on the morning of the accident was a perfectly good one.

64 Mr Bell went on to describe some of the technicalities of the power disable test. He was satisfied that one had not occurred at or about 08.22 that morning. The phenomenon, known colloquially as a 'blinking aspect', also affects the green aspects but this was less of a worry to him. He was satisfied that the later software modifications had overcome most of his worries. He did not believe that a PDT could have affected the aspect of Signal OD58 at the time the Up train passed it. He did not believe either that a PDT was the proper explanation of the January 1990 incident at the same signal. He agreed with the observation that the signal spacing was greater than necessary for the current trains using the line, a condition known as 'over-braking'. He also agreed that it was undesirable to have a station stop between the distant and stop signals but disagreed with the suggestion that an extra stop signal should be installed at the end of the Up platform at Ashurst. Its value would be very limited, he considered. He was, he said, perfectly satisfied that the signalling principles, under which the line had been resignalled, led to a safe system on the single line; subsequent changes to the signalling in response to any changes in the principles would merely reflect the benefits of those enhancements.

65 *Mr H A Podciborski*, Contracts Engineer, Railtrack South, was one of two on-call engineers for Railtrack South on the day of the accident, nominally covering the South-Eastern sector. He explained that his normal duties covered the supervision of permanent way maintenance contractors and that he was an experienced permanent way engineer. He responded to a general message from Railtrack Control but when he was at Ashurst Station he was asked to walk from there to Cowden to locate someone who was thought to be unaccounted for and who might have wandered down the track. This he did but observed the state of the permanent way as he did so. At that stage, about 10.35, the weather was quite clear. As he passed it he noted that Signal OD58 was a showing a normal red aspect. He found damage to the switch blades and point operating mechanism of Points No 532 which, in his view, was recent and consistent with the points having been run through in a direction for which they were not set. When he reached Cowden he reported to Mr Clifton, who was the Railtrack Incident Officer, and told him what he had found. He said that, apart from the damage to the points, only about four sleepers had needed changing and the track fettling as a result of the accident.

66 *Mr L F Carroll*, a Principal Technical Officer at Selhurst Traction Maintenance Depot of Network South Central, explained the arrangements for the examination of Class 205 units when they returned to the depot, which, for the units on the Oxted line, was generally every day. The fault repair book would be examined to see if there were any entries for faults requiring attention. He considered that if there had been a pre-existing fault, it would have been attended to on the Friday night before the accident. If the AWS had been isolated, that too would have been noted and attention given to it. As far as he was concerned Set 018, the leading set of the Up train at the time of the collision, would have been in proper working order, as would its AWS equipment. He commented that the latter was the 'simplified' equipment which had a 'yodalarm' fitted in the cab. This, in his view, gave a quieter sound than the alternative air-horn for indicating passage past a signal at Caution or Danger. Other than that, the systems were the same. He described the location of the AWS isolating device and said that the aircock handle was linked mechanically to the electrical isolating switch. He confirmed that tripping the miniature circuit-breaker (MCB) in the cab would have the same effect in that if the brakes were off they would be applied and that if they were applied they would not be released. He said that on 21 occasions out of 25 in the last 4 years a set had come into the depot with its AWS isolated and yet no fault had been found. He could not comment upon why.

67 Mr Carroll went on to explain that there were several ways of applying the air brakes in an emergency if the driver's brake handle failed or jammed, of which releasing the driver's safety device was one. Switching off the engine would not result in an immediate brake application, but the compressor would stop, eventually leading to a loss of brake-air pressure. If the DSD was released when under power, the train pipe was vented and the brakes applied. Loss of pressure in the train pipe resulted in the control governor pressure switch operating which would cut off traction power and revert the engine to idle. He stated that the DSD was specified to act, when released, in not more than 3 seconds and that, when called for, 90% of the braking effort (representing a brake-cylinder pressure of 45 lb/sq in) would be achieved in between 4 and 4.5 seconds.

68 Mr Carroll said that some cabs were fitted with electric windscreen demisters but all had windscreen wipers but not washers on the driver's side of the cab. He was unaware if Unit 018 had demisters. Despite the authorisation being given over a year ago to fit cab secure radio to the units, only one of the units operating on the Uckfield branch had been so fitted. Mr Carroll knew that this unit was one of the units involved in the accident. He also commented upon the fact that there had been corrosion problems both of the body panels and of the ribs. Minor corrosion could be dealt with at Selhurst but more major work had to be done elsewhere.

69 The engineer who was responsible for auditing the effectiveness of the maintenance standards achieved by Selhurst Depot was *Mr M A Moerel*, Audit Engineer, Network South Central. He said that he was satisfied with those standards and that units sent into service would be in a fit condition. On the day of the accident he was acting as on-call rolling stock engineer. He has had experience as a breakdown and recovery supervisor and was also a qualified crane supervisor. He had been a rolling stock inspector attending most of the major accidents which have occurred in the former Network South East sector since the accident at Clapham. He arrived at Cowden at about 09.55 and began his inspection, accompanied by a police officer, by looking at the brakes of the Up train. He recorded brake pressures and piston strokes as he went and the readings of the pressure gauges in each of the cabs. He also took photographs. The temperature of the wheels varied from warm to cool. He could not recall if the brakes were newly blocked but considered that they were in good condition. His opinion was that the train had had a normal service brake application but not an emergency one. None of the brakes had been isolated. He did the same for the Down train and again considered that the brake system was in good order. Clearly there had by then been some loss of air pressure due to leakages but he said that, from the point of view of his examination, the Down train also had had a service brake application. He had also made an examination of the electrical connections. One 8-way jumper on each train had become disconnected. He thought that this would have occurred during the collision because a pre-accident disconnection would have resulted in an immediate brake application. The couplings were also in good condition and were all still coupled, even those between the leading and second vehicles. He had not found any skid marks on rails.

70 Mr Moerel said that, after some necessary isolations had been made, the rear five vehicles of the Up train had been moved back towards Ashurst under their own power. This indicated to him that there was nothing untoward with the braking or control systems of that train. He described how as much of the AWS equipment as it was possible to examine on the vehicles had been examined before it was removed to Crewe for testing. Similarly, sufficient of the parts of the brake control and DSD systems of the leading vehicle of the Up train had been recovered and bench tested. No faults were found. Tests were also done to check the time taken to achieve a brake pressure of 45 lb/sq in by moving the brake handle to the emergency position and by releasing the DSD. The former appeared to be slightly quicker (at 1.24 seconds and 1.29 seconds for two tests) than the latter (at 1.65 seconds and 1.54 seconds for two tests). Similar tests had been conducted on the brake controller of the Down train and they showed that it performed within specification.

71 *Mr H Nixon* of the Technical Investigation Centre at Crewe had also been responsible for the testing of the AWS equipment from the leading cab of the Up train. The various components had been tested individually as far as the damage to them would allow and some had been tested on a test rig. The testing and examination showed that, with one exception, all the items were either functioning correctly or that the damage that was sustained was consistent with damage caused in the accident and did not pre-exist. The one item which raised concern was the isolating switch mounted under the solebar by the driver's cab. This showed signs of pre-existing contamination and the closed contacts had a high but variable resistance. That resistance could be lowered by continuously making and remaking the contacts. Mr Nixon said that the high resistance, which had been measured with a portable multi-meter, would have been tantamount to an open circuit. This in turn would have either resulted in a brake application if the brakes were not applied, or in the driver not being able to release an already applied brake. However, Mr Nixon was of the opinion that once the necessary contact had been made, it was unlikely to have been broken during the normal course of events. In other words, once the AWS had been powered up and brakes released it would not have been necessary to isolate the AWS. He expected that the AWS had been working correctly at the time of or just before the accident.

72 The person from British Rail Research who examined the damaged vehicles was the team leader of the crashworthiness section, *Mr J H Lewis*. He had arrived at Cowden at about 15.30 and had begun by looking, from a safe position, at the damage to the leading vehicle of the Down train. This appeared to have the top of the front caved in by about 2 m, but the damage became progressively less the lower it was towards the frame. In contrast, the leading vehicle of the Up train had had the first 5.5 m totally demolished. He said: 'In my experience I do not think that I have ever seen a vehicle quite so badly damaged in terms of the amount of bending and twisting of the metal that forms the underframe of the vehicle. The superstructure of the vehicle had been completely wiped off as it had been overridden by the Uckfield-bound train. There was virtually nothing left above floor level at all and the roof structure had been torn off completely and was straddling the two vehicles. The front bogie had come off and the rear bogie was still attached but derailed. Essentially all that was left was the underframe and the superstructure was just a pile of wreckage'. The second vehicle of the Up train had sustained crushing damage to the front half up to 1 m but the remainder of that vehicle and the other vehicles in both trains were essentially intact with no discernible damage at all. He had not examined the interiors of the vehicles and was unable to comment on the damage, if any, to the fittings, seats etc on the remainder of the vehicles.

73 In comparing the damage to that which occurred in the accidents at Clapham Junction and at Cannon Street, Mr Lewis drew attention to the fact that, whereas at Cowden and Clapham the vehicles were BR standard Mark I structures and at Cannon Street they were not Mark Is but of similar construction, the coupling arrangements were very different. Those at Cowden and Clapham were buckeye throughout, but at Cannon Street they were chain link couplings and centre buffers which have little resistance to overriding. He also said that, while at both Clapham and Cowden overriding had taken place, the extent of the deformation of the underframe at Cowden was significantly greater at the impact point and had absorbed considerably more energy in the collision. He accounted for this by saying all underframes varied slightly in their strength due to age, manufacturing tolerances and corrosion, although the latter was probably not a factor at Cowden. Once one frame had started to buckle in a collision, it kept on doing so rather than sharing the deformation between the two frames. He was unable to say whether or not the outcome of a collision was determined by the angle at which the buckeye couplers struck each other. He said that the results of the recent crash tests conducted by BR Research at Derby were still being studied to see what actually happens from the time of coupler contact through to gross deformation. As part of his considerations following his examination of the wreckage, he assessed the likely closing speed at the time of impact to have been between 55 mile/h and 65 mile/h (88 km/h and 104 km/h).

74 During the course of their inquiries, *Detective Chief Inspector V M Miller*, British Transport Police, said that the police had interviewed a number of train crew who had used on the previous day the units involved in the collision at Cowden. None had reported any difficulties in handling these units.

As to the train crew and their training and to the running of the test train

75 Evidence concerning the two train drivers was given by *Supervisor A J Gavin*, Train Crew Supervisor at Norwood, Network South Central TOU and by *Inspector A J Bushell*, Traction Inspector Network South Central TOU. Mr Gavin said that he had been present when both Driver Rees and Driver Barton had booked on duty. He had spoken to them both, Rees for rather longer than Barton, and had considered them fit and ready to take duty. He regarded Driver Rees as a very experienced and competent driver. He had known Driver Barton for only about 3 years but had no misgivings over his competence. After Driver Barton had booked on, slightly late, he had not seen him again and had had no report back that anything was wrong with his train. He said that a notice about weather conditions would be posted on the late notice board only if it had been received from Control. None had been placed that morning.

The twisted frame of the leading coach of the Up train

The frame of the leading coach of the Up train showing the destruction of the superstructure

76 Mr Gavin told me about the system for issuing the cellnet telephones. The telephones used to be kept at Norwood, but later they were issued to the drivers at Oxted. They would normally be handed to them from the station supervisor's office at Oxted, but if not they would have to be asked for. He had preferred it, as a driver, when the telephones were kept at Norwood because the batteries were kept charged. However, the batteries did not keep their charge very well, and neither the telephones themselves nor the area in which they were used gave reliable communications. He regarded their value as being very limited.

77 As a traction inspector, Mr Bushell had not himself taken the controls of a train over the Uckfield line since it was singled although he had ridden with drivers over it. However, he knew it well as a driver when it was a double line. He was quite satisfied as to the general competence as drivers of both Drivers Rees and Barton. He had spoken to Rees the previous day but not Barton, but as far as he knew there was nothing troubling either of them. He had been one of three inspectors who had ridden with Driver Barton in the year following his qualifying as a driver. He was satisfied as to his route knowledge and that, despite Driver Barton's relative inexperience of the branch line, he thought that, even in the foggy conditions which obtained that morning, Driver Barton would not have been lost; there were sufficient landmarks between Ashurst Station and Blackham Junction for him to have been aware that he had passed Signal OD58.

78 Mr Bushell confirmed that the rules required that, if the AWS were to be isolated, then in foggy weather the train should be driven no faster than 40 mile/h (64 km/h). He also said that fog was not one of the authorised reasons for having a guard in the driving cab. He said that these were restricted to those occasions when the DSD had failed or when examination of the line had to take place. He also said that he regarded the proper course of action in fog after passing over the AWS magnet for Signal OD58 would be to drive at no more than walking pace until the actual aspect of the signal could be seen. Equally the proper course of action to have taken if the signal had been inadvertently overrun would be to stop and protect the train.

79 The train crew supervisor at Selhurst Depot responsible for guards was *Supervisor G A Tryon*. Mr Tryon had booked both men on duty on the morning of 15 October 1994. He had only been at Selhurst for some 7 months but felt that he knew them well enough. There was nothing unusual about their demeanour that morning and as far as he was concerned they were both fit and competent for the duty that morning. He knew that Guard Brett-Andrews had occasionally changed turns so as to travel on the Uckfield line and that, having once been based at Norwood, had tended to maintain his social connections there rather than at Selhurst.

Trains Inspector L J Ward of Network South Central TOU based at London, Victoria, was one of those responsible for the competence and fitness of Guards Boyd and Brett-Andrews. Mr Ward said that he did not know the latter that well either although since the time that he had become a trains inspector he was getting to know him better. He agreed that Guard Brett-Andrews was a friendly, somewhat extrovert, and talkative character. He had passed his guard's exams on the first attempt and whenever he had ridden with him Mr Ward considered him to be safe and competent. He was aware that Guard Brett-Andrews had aspirations to be a driver but not why he had failed to become one.

80 It was Mr Ward who had first given Guard Brett-Andrews a verbal warning in mid-1992 for riding in the front cab of a train with the driver. He was later found again to have been riding in the front cab and was given a more severe warning, not amounting to a formal disciplinary action, by a senior manager. This was thought to have been sufficient but on 8 January 1994 he was again caught riding in the front cab and was formally disciplined and given a final warning on 4 February 1994. He said that it was not correct that trains inspectors had suspicions that, on occasions, Guard Brett-Andrews actually drove trains.

81 Mr Ward agreed that a propelling move was one occasion when a guard could legitimately be in the leading driver's cab. However the manoeuvres of the units on leaving Selhurst and reversing at Norwood on the morning of the accident did not involve a propelling move although the reversal at Oxted probably did. Under these circumstances the guard might have a need to touch the brake handle but not the master controller. The latter, in any case, would be non-effective as there would be no driver's key inserted.

82 *Mr M C Bassett*, the Traction and Train Crew Principles Manager, Network South Central, gave evidence on a number of matters including that of some trial trips to establish the likely running pattern of the Up train involved in the accident. He confirmed Mr Bushell's evidence about the occasions upon which the Rule Book authorises the guard to ride in the leading cab with the driver. He also agreed about the rule regarding an isolated AWS in foggy weather. In such conditions his method of driving after leaving Ashurst Station would have been much as Mr Bushell's. He was adamant that, despite there not being at present any formal audit of the effectiveness of driver training, the present method, that of formal traction training followed by route learning, was the most effective method. He was satisfied that the annual rides on Network South Central, which were twice as frequent as the laid-down number, were sufficient to confirm train drivers' route knowledge. He also confirmed that, while both trains had cab heaters, only the Down train had a demister in the leading cab. After listening to the evidence given before his, he was

now of the opinion that having a layout whereby a station stop was interposed between distant and stop signals but more importantly between the AWS magnet and a stop signal was most undesirable and could well result in the driver forgetting the message of the previous signal or AWS.

83 Mr Bassett summarised the results of the test train trips. From a standing start at Ashurst in the Up direction the speed on passing Signal OD58 was 38 mile/h, passing over Points No 532 at Blackham Junction it was 42 mile/h and at the point where it was necessary to shut off power in order to stop at Cowden Station it was 50 mile/h. The speed on passing over the collision site was 42 mile/h. A further run, not stopping at Ashurst, gave a speed at the collision site of 50 mile/h. Similarly, in the Down direction, starting normally from Cowden the train reached 25 mile/h on passing the accident site in a time of 42 seconds. During these test runs a video film had been taken and from it a number of timings had been calculated. The elapsed time between leaving Ashurst Station and receiving the horn indication from the AWS magnet associated with Signal OD58 was 1 minute 6 seconds and a further 12 seconds elapsed before the signal itself was passed. It took 1 minute 50 seconds after leaving Ashurst to pass over Points No 532 and then a further 2 minutes 2 seconds to reach the site of the collision. While most of these timings could reasonably be valid for the actual Up train involved in the accident, they should not be taken as exactly what had happened on the day.

As to the resignalling of the line

84 *Mr J D Child*, a retired senior engineering assistant in the Southern Regional Signal Engineer's department, asked to give evidence to the Inquiry. He said that between January and August 1989 he had been the person in charge of testing the resignalling of the Uckfield line and had expressed his concerns that no signal guarding the entry to the loops had been provided as was later required by Standard Signalling Principle (SSP) 57. He regarded this SSP as codifying a long-held, unwritten, rule. He was also concerned at the time at the configuration of the SSI because, apparently if one of the duplicated data-link systems were disconnected, the panel indications would flash and any green signals would flash red. He did not believe that this phenomenon had ever been put right. After he had ceased to be the tester in charge, he had noticed one occurrence of a PDT at a signal in Oxted which he reported and was told by the signalling contractor that it was a known matter. The dark period he estimated as being about one third of a second, which agreed with the 160 to 180 milliseconds quoted in previous evidence. He also explained that he was concerned at the consequences resulting from a train passing either Signal OD55 at Hever or Signal OD58 at Ashurst at Danger and considered that a form of 'train running away' alarm should be fitted in the signal box.

85 *Mr F P Wiltshire*, Standards Manager (Signalling and Telecommunications) Railtrack, explained the role of standard signalling principles and said that there were no specific ones governing single lines. With modern track-circuited signalling, the older forms of single-line signalling using a tangible authority were no longer necessary, the rules governing the clearance of signals on bidirectionally signalled lines being the same as those with a unidirectional flow. SSPs were designed to rationalise the signalling practices of the pre-nationalised main line companies in meeting the Railway Construction and Operation Requirements of the Department of Transport.

86 He went on to detail the SSPs which were applicable at the time the resignalling of the Uckfield line was designed. While SSP57 had been formally published after that time it was then under discussion. One of the reasons for its introduction was the particular circumstances of the Uckfield line. Nevertheless a positive decision had been taken at the time not to require its provisions to be retrospectively implemented on the Uckfield line. SSP43 governs the requirements for fitting AWS inductors to signals. It does not require them to be fitted to 2-aspect stop signals, merely to distant signals, a hangover from semaphore signalling practice. However the decision was taken to provide them at all signals on the Uckfield line. SSP34 was also applicable. This SSP governs the spacing of the signals in terms of the standardised braking performance of trains. He agreed that, in designing the signal spacing for 85 mile/h running, the signals were unnecessarily far apart for a line speed of 70 mile/h. In practice they have been installed with just under 9% over-braking for 85 mile/h, well within acceptable limits. He did not accept that it was now a practical proposition to reposition the signals for 70 mile/h running in view of the possibility that during the life of the signalling the line speed could be raised.

87 Mr Wiltshire then told me of the effects of SSP78 which governs additional precautions to be taken at particularly risky platform starting signals. Signal OD58 does not fall within the ambit of that SSP but it was considered that additional precautions were advisable at Signal OD55 at Hever. Accordingly an additional AWS magnet was placed so that a train overrunning the signal at Danger would receive an additional audible warning. He went on to consider the practicability of the other possible measures listed in SSP78. He accepted that trap points, while not being a universal panacea, would be more easily installed on the Uckfield line than elsewhere. However his view was that any such installation should depend upon a proper risk study. A general layout risk assessment method was currently being developed which would encompass the circumstances of the Uckfield branch, which SSP78 did not, and which would provide a methodology for determining what extra measures, if any, should be

taken on lines like the Uckfield line. The development of the method was due to be completed in June 1995. Mr Wiltshire also considered the effect of automatic train protection on signalling principles. He felt that in addition to requiring one or more principles purely on ATP itself it would probably be necessary to revise many of the existing SSPs with which it may interact.

88 Regarding ATP itself, Mr Wiltshire explained that part of the problem facing the railways as a whole was that probably any system which might eventually be selected would have to be compatible with the existing line-side signalling. Any attempt to overlay the existing system with a different signalling system with built-in ATP would be likely to prove more complex and less cost-effective than installing a revised system from scratch. He was of the opinion that the accident at Cowden would have been completely prevented if ATP had been installed. Nevertheless his view of the signalling of the line was that it was safe and sufficient for the number of trains using it and that in this respect he disagreed with Mr Child.

89 *Mr D H Burton*, Director, Product Quality South and East Passenger Train Group of British Railways, explained that he was also the Deputy to the General Manager of the passenger group but, at the time the remodelling of the Uckfield branch had been under consideration in 1986, he had been the relevant passenger business manager. He said that because of the condition of the line at the time, some action had to be taken; it was not possible, on safety grounds to 'do nothing'. If nothing had been done, the line would have had to have been closed. Hence a number of alternative schemes were considered on a purely commercial and railway operational basis. No risk assessment of safety factors had been undertaken. He pointed out that the decision pre-dated the accident at Clapham and that the methodology for undertaking such risk assessments now had not been available then. After the initial authorisation there had been a number of revisions both in the scope of the scheme and as a result of fluctuating costs. Each agreed change had resulted in a betterment of the net present value (NPV); a commercial-led, not safety-led response. Neither the question of radio communication nor a risk assessment in the light of the recommendations of the inquiry into the Clapham accident entered into the equation. By the time Sir Anthony Hidden had reported, the scheme was substantially complete.

As to the provision of radio

90 *Mr C Kessell*, Director of Engineering, British Rail Telecommunications, explained the technicalities of both the cab secure radio and National Radio Network systems. He said that CSR was specifically designed to provide secure communication between the signal box and a driver, whereas the NRN was a general purpose radio telephone network. All messages on the CSR system were recorded and the train driver received calls on a loud-speaker in the cab if they were voice messages or on a display if they were data transmissions. The NRN system used a telephone handset. The planned coverage over the country was 98% for the NRN; it had not yet quite been achieved. Reception was doubtful in difficult areas such as tunnels. Because of its nature the coverage for CSR on the lines so fitted had to be 100%. In order to prevent nuisance calls to traction units fitted with NRN they would only receive calls transmitted from a special 'Sitronix' telephone. These telephones would be fitted in principal signal boxes or train control offices. Mr Kessell said that NRN was available in the Cowden area, but its reception quality was doubtful and no trains had been fitted to receive it.

91 Mr Kessell described the results of some tests which had been carried out to determine the likely response times to an emergency message sent out on either of the two systems compared with the likely time of just over 2 minutes taken for the Up train to travel the distance from Points No 532 to the point of collision. He considered that using CSR the accident could have been averted, because by sending individual messages to each train, the first would have been contacted by the signalman and would have stopped in 80 seconds and the second in 105 seconds. If a general alarm had been sent out, and allowing the same reaction times, he calculated that both trains would have stopped in an elapsed time of 107 seconds. He said the extra time taken for the general alarm was caused by having to send the message out in three separate lumps so as to avoid co-channel interference at the base station. Using the same criteria for response times, the same exercise was carried out using NRN. In the first case, the signalman had to contact the train control office by ordinary telephone, explain the situation and the controller then had to send a general broadcast which everyone would hear. The estimated time taken to stop the trains would be not less than 155 seconds, that is assuming the train drivers actually heard and acted on the message. If there had been a Sitronix telephone in the signal box and the telephone numbers of the relevant driving cabs were known to the signalman, the time taken to stop the first train would have been 100 seconds and the second 170 seconds. It would be highly unlikely that in general signalmen using NRN would know the relevant telephone numbers to call because there was no formalised system of linking the numbers to the train descriptions whereas this was done automatically with CSR. His conclusion was that using NRN it would have been most unlikely that the collision could have been averted.

92 The coverage of CSR already extended on the lines of Network South Central as far south as Sanderstead. Mr Kessell said that it would take not less

than 6 months from the date of being given a contract to install the necessary transmitters using an extension of the existing system. If it were a completely new system it would take at least a year. Because the line to Uckfield involved partly an extension and partly a new system, the likely time would be somewhere between the two to achieve CSR coverage of the line. He said that he was not aware that Railtrack had received a letter from Network South Central dated 2 December 1994 requesting the provision of CSR on the Uckfield line.

93 The business background to the development and implementation of a system of radio communication on all traction units was described in detail by *Mr J G Nelson*, Group Managing Director of the South and East Passenger Train Group of British Railways. It was decided in response to Sir Anthony Hidden's Recommendation 43 that in the Network South East sector, which included the Hurst Green to Uckfield line, the preferred system was CSR. In July 1989 the investment proposal was approved. At that time, approval was also given for the purchase of the necessary equipment for installation in the trains, but it had been necessary to improve the cost estimates for the infrastructure work. The target completion date was 1995. The fitting of the cab radios began in September 1990 and some infrastructure equipment had been authorised for purchase in March 1991. However, in November 1991, a review of radio projects was required by British Railways Board, three schemes for CSR in connection with Driver Only Operation having by then been authorised for implementation. These did not include authorisation for CSR on the two lines south of Hurst Green which under the original scheme would have been implemented in October 1992. That it did not happen in October 1992 was because the whole thing had been overtaken by what Mr Nelson described as a 'funding change of seismic proportions'. This resulted in a moratorium on investment in 1991/92 so that BRB would meet its external finance limit.

94 Mr Nelson explained that under the new structure of the railways the mechanism for paying for new investment has changed. In the case of radio the TOU would pay for it by an increased track-access charge, leaving Railtrack the task of finding the capital investment. In the particular case of the Uckfield line it had already been indicated that the TOU, in this case Network South Central, had agreed to pay the necessary increased track-access charge for the provision of CSR. Mr Nelson said that he had been given a plan for the fitment of cab radios to Class 205 units which showed that this was due for completion by February 1995.

95 Mr Nelson categorised his priorities for funding as firstly the completion of contracts, such as for Networker trains, which had already been entered into. Secondly came essential infrastructure renewals. The third category contained other priority renewals such as power-supply schemes which not only had serious performance implications if they failed, but also had potential safety risks. The fourth was the strategic safety schemes which included cab radio. He pointed out that categories one to three contained those schemes which were essential to maintain existing safety standards, whereas the fourth was to enhance them. The fifth and lowest category was the provision of new rolling stock.

As to rolling stock

96 Between them, *Mr B L Clementson*, Engineering Director, Porterbrook Leasing Company and *Mr G C Eccles*, Director Network South Central, TOU, explained how rolling stock, in particular the Class 205 units, were provided, equipped and maintained. Porterbrook Leasing is one of three wholly-owned companies of British Railways which between them hold all the passenger rolling stock previously owned by British Railways. As owners of all the Class 205 units, Mr Clementson said, Porterbrook Leasing had no plans to refurbish them. They were currently in discussion with Network South Central over the signing of a lease for the vehicles for 8 years which began on 1 April 1994. Mr Eccles said that if the lease were signed, which at the time he was speaking it had not been, then unless he bought out the contract he would be unable to stop using the Class 205 units and find other replacements.

97 If the lease were signed, Mr Clementson said that the units would be put into a fit state to last the 8 years, but no enhancements, other than the already-agreed fitting of cab radios, would be provided. The actual ownership of the radio equipment had yet to be decided. He also said that one of the objectives of the rolling stock leasing companies was to provide the opportunity for introducing new rolling stock and therefore he would hope to offer it to the TOU at the end of 8 years or, subject to discussion, sooner. He thought that cascades of existing rolling stock from TOU to TOU were going to be difficult to manage. The question of whether Network South Central would have new or second-hand replacements for the Class 205 units would depend not only on their availability but also the price the TOU was prepared to pay. Porterbrook did not yet have a complete picture of all the rolling stock which was likely to become surplus to requirements in the next year or two, particularly in diesel-powered units, but Mr Clementson thought that there would probably be quite a number of electric units which could be offered were the line to be electrified.

98 Mr Eccles agreed that he would like to hire something better than the Class 205, if it could conveniently be arranged. The question of financing them was not a simple one to answer, but he expected there to be a commercial formula which would tell him the optimum price for which to hire trains for the Uckfield

line. He agreed that he would find it difficult to shop for trains on which any safety enhancements were either, or could be, fitted if such enhancements were recommended as a result of the Inquiry. In the same way Mr Clementson said that he would need access to funds to order new trains and these were unlikely to become available until the rolling stock leasing companies were sold into the private sector in October 1995. That would also be true, if it were possible in engineering terms and this would have to be investigated, should it prove to be economically sound to install any recommended safety enhancements on the Class 205 units or other older rolling stock.

As to the provision of on train monitors and recorders

99 *Mr J G Nelson* explained the position over fitting on train monitors and recorders to rolling stock. Sir Anthony Hidden had endorsed, in his Recommendation 40, the fitting of OTMR and said that it should receive higher priority. Mr Nelson considered that the programme of fitting them had been accelerated and it was still the railway's policy that this should continue but, as always, there was the question of funding. He confirmed that all new build fleets are fitted and approximately 15% of the total current fleet had been retrospectively fitted. The position in the future would depend on the rolling stock leasing companies.

As to the future provision of safety enhancements

100 *Mr D E Rayner,* Director Safety and Standards, Railtrack, said that, following the restructuring of the railways on 1 April 1994, Railtrack had been asked to sponsor the project for the provision of automatic train protection. This project, which had been a railway-wide one, would continue on a joint basis with British Railways. He explained that in any system of ATP the key features would be to prevent a signal being passed at Danger, to prevent a buffer-stop from being hit and to prevent over-speeding in the circumstances which normally occur. He identified three different categories of ATP; firstly that epitomised by the current trials which was designed to provide the three key features in the present infrastructure and rolling stock fleet. He called this BR-ATP. His second category encompassed new technology where ATP was built into a new signalling system. He instanced the possibility of installing transmission-based signalling on the West Coast Main Line (WCML) which would include ATP as part of an automatic train control (ATC) package. The third category was at the other end of the scale. ATP systems of this type would not be network-wide but would be purpose-built for particular circumstances. They would not necessarily include all three of the key features he had earlier identified; that would arise because a feature might not be appropriate or because it might be judged too complicated to embrace all three.

101 Mr Rayner explained that no decision had been taken on the strategy of implementation of any of the categories of ATP he had described. Were funds to be available, the strategy would depend largely on the risk assessments made as a result of the study referred to by Mr Wiltshire and on the actual technology to be used. He considered that Railtrack would be negligent if it did not look at technological innovations, such as that being considered for the WCML, but that strategically it would have to consider the piecemeal solution. He declined to estimate how long an innovative scheme would take to implement.

102 As part of the piecemeal approach, Mr Rayner described the joint Railtrack and British Railways Board Signals Passed at Danger Reduction and Mitigation (SPADRAM) Project. Reduction meant prevention of SPAD incidents and mitigation implied that if a SPAD did occur, then its consequences would be minimised. The starting point had to be a proper analysis of the SPAD statistics. From these SPADRAM had been developed in a number of strands beginning with a value engineering exercise to see if the BR-ATP system could be reduced in cost without losing too many of its benefits. He could not say how long such a consideration would take or whether the objectives of the reduced-cost ATP system would be the same as the full-cost one. Enhanced AWS was also being considered, but Mr Rayner did not accept the view that since this had effectively been rejected in the report on the Clapham accident it was not worth pursuing. He described other mitigating devices both for use in the driving cabs and for installation on the infrastructure. In summary he expressed a personal view that Railtrack would be prepared to take a positive stance to see that protection against SPADs is enhanced, but that it should not be regardless of cost. He thought the piecemeal approach was the right one, but was unable to put a time-scale on its fulfilment. He explained in some detail the basis of the report on ATP made in March 1994 to the Secretary of State for Transport by the British Railways Board before the railways were restructured. He said on a basis of reasonable practicability, and this included financial considerations, the report concluded that BR-ATP should not be installed. His view was that all safety improvements on the railway should represent value for money and that in all such matters it should be an industry-wide, not just a Railtrack, approach.

103 The views of the British Railways Board (BRB) on the provision of ATP were put by *Mr T P Worrall,* Director of Safety. There was no essential difference in this matter between BRB and Railtrack. Clearly there had been developments since the joint board meeting in October, but, he said, British Railways had not abandoned the concept of ATP. Railtrack was aware of BRB's view, but BRB would endorse caution in engaging in an unreserved commitment to any standard without considering the affordability elements. In their response

to Railtrack following the joint meeting BRB made these points. They appreciated the potential of ATC (as exemplified by the WCML proposals) which would need to be effective, affordable and acceptable to the train operating companies. Until such time as ATC was more advanced they would wish to see a continued appraisal of ATP in all new significant investment projects for trains and signalling, together with ATC as an alternative where appropriate. Any assessment of ATP should be on the basis of an integrated reinvestment and renewal project, not just as an overlay on existing systems. They considered that the development of ATC was a long-term project and therefore the potential of existing ATP capability, including possible cost improvements, should still be explored. BRB supported the SPADRAM initiatives. He emphasised that, at this stage, Railtrack had still to consider, formally, BRB's input following the joint meeting.

104 Mr Worrall was of the opinion that, because a line-specific ATP or other piecemeal measure would be subject to a rigorous risk assessment if a proposal was affordable, then it would be acceptable to the train operating companies. That was true also of enhanced AWS which he felt was worth reconsidering in the light of new technology which had arisen since the Clapham report. He emphasised the word affordable because there was a danger of being priced out of the market in that it would be possible to have very safe trains but the fares would be so expensive nobody could afford to travel on them.

105 On particular issues Mr Worrall said that he would like to see the implementation of the provision of radio as quickly as possible but it depended upon Railtrack's resources. He was not aware of any plans to extend the coverage of CSR other than to the lines already agreed. It did not surprise him that doubt had been placed upon the provision of OTMRs on Class 205 units. While he was in favour of the policy of fitting OTMRs throughout the fleet which had an appreciable residual life, he was well aware of the complexities and difficulties which would arise on trying to fit such old units as Class 205. He considered that it was up to the TOUs and the rolling stock leasing companies jointly to decide upon the replacement of rolling stock and that it was not a matter for him. He did not believe that the involvement of private interests would lead to an acceptance by the industry of lower safety standards. He agreed that driver distraction was a recognisable category of circumstance in which either a disregard or misjudgement SPAD might take place and that the presence of others in the driving cab was a recognisable cause of distraction. He did not think there was a prospect of totally eliminating that particular cause of SPADs because there were some people who by virtue of their duty had to travel in cabs. It was a question of being as tight as possible in controlling the authority to ride in a cab.

ASSESSMENT OF THE EVIDENCE AS TO THE CAUSE OF THE ACCIDENT

The issues

106 There are a number of issues which have to be considered when assessing both the direct cause and the immediate consequences of the accident. They are addressed individually in the following paragraphs. The issues are:

(a) Was the accident caused by a signal being passed at Danger?

(b) Was there any malfunction of any equipment either of the signalling or on the trains?

(c) What was the actual visibility of Signal OD58?

(d) Were there adequate means of communication available?

(e) Did the design of the rolling stock have a bearing on the cause or outcome?

(f) Did the procedures for the call-out of the emergency services and railway officials work properly?

(g) Was any relevant evidence lost because of inadequate training or investigative procedures?

(h) Did the track layout and its signalling conform to current standards?

(i) Who was driving the Up train?

Was Signal OD58 passed at Danger?

107 The printout of the tape from the SSI recorder was analysed and the actions of the signalman, the running of the two trains and the reported condition of the signalling equipment, eg AWS magnet at Signal OD58 de-energised, red aspect lit etc determined. Not only did the SSI tape show that Points No 532 were lying normal, but also physical examination of them after the accident showed that they had been run through in the reverse direction. Hence Signalman Webb's evidence that, at the time Driver Barton's train passed Signal OD58, the route was set for the Down and not the Up train is corroborated. At that time, the reported aspect of that signal was that it was red. The trackside functional module was tested and found to be working correctly. Evidence was given of an earlier event at the same signal where it was alleged that the signal had failed to show any aspect at all for between 20 and 25 seconds. A later, non-contemporaneous commentary attributed this to a power disable test; PDTs are the self-diagnostic checks to see if the module is working correctly. That

commentary cannot be relied upon. Besides which both the signal head and the module had been changed after the earlier occurrence, as part of the testing, and what happened then has little or no relevance to the state of the equipment at Signal OD58 on 15 October 1994. The PDT causes a 'blink' of about 180 milliseconds; that is no aspect at all is shown for that length of time. Such tests occur at a change of output state not less than 1 hour after the previous PDT or after 5 hours if no PDT has occurred within that time. These tests are not explicitly recorded on the SSI data tape but can normally, but not always, be inferred. In this instance a PDT was shown as having occurred at 07.22. The next one was therefore due at the next change of output state after 08.22. No such change of state occurred between then and the time of the accident. The TFM was specifically tested to confirm that the PDT intervals (1 hour and 5 hours) were correct. After the accident, the red aspect of Signal OD58 was seen to be alight. Hence it can be inferred that, at the time the Up train passed it, Signal OD58 was showing red.

Was there any equipment malfunction?

108 Extensive testing was carried out on the various components of the signalling system. Couple this with the analysis of the SSI data and **I conclude that there was no malfunction of the signalling equipment** such that a wrong side failure occurred and the driver of the Up train was presented with a green rather than a red signal aspect. **I therefore conclude that the train passed Signal OD58 at Danger.** However there is evidence to show that the brightness of the aspect may not have been as it should and I discuss this later.

109 The individual parts of the AWS equipment from the leading end of Unit 205018, the driving trailer end of the Up train, were examined and tested in the laboratory. This testing showed that, with one exception, all were in working order or that the damage was almost certainly sustained in the accident. The exception was the AWS isolating switch. Isolation of the AWS has to be effected on both the electrical and air parts of the system. The isolating cock (for the air system) is linked mechanically to the isolating switch (for the electrical system) and both are mounted beneath the solebar on the driver's side of the cab. Isolation is effected by turning the handle of the isolating cock. The contacts of the switch were found to be contaminated and their resistance varied considerably during testing; a high resistance being tantamount to open circuit, a condition making it impossible to release the brakes.

Was the AWS isolated?

110 If the isolating switch was in such a condition that the AWS equipment had to be isolated at that end of the train, that fact would have been noticed before the train left Selhurst Depot that morning. The driver and the guard would have prepared the train and the train would have had to have been driven from each end. The AWS equipment would have been required to be operational and in use but, because there are no AWS track magnets associated with the movement in the depot, there was no means of checking whether the whole of the equipment was functional. The inference must be at the time the train left the depot the relevant AWS was not isolated due to a previous malfunction. If it had been, the driver was required, by the terms of the Appendix to the Rule Book, to report it. No such report was made. If the AWS had failed at Uckfield or at any point on the last journey towards Oxted, there were ample telephones available to the driver to report that he had had to isolate the AWS. Again no reports were made and no passenger complained of an overlong stop at an intermediate point or of a lessening of the train's speed. Either Driver Barton was reckless in the extreme, not only in controlling the manner in which the train was being driven, but also of his observance of the rules, or no failure of the AWS occurred. I believe that it would have been outside his character for Driver Barton to have been that reckless. **I conclude therefore at the time of the accident the AWS was operational**. It is relevant to point out that had OTMR been fitted there would have been no doubt whatsoever as to whether or not the AWS was functioning.

Reporting of AWS isolation

111 Appendix 8 to the British Railways Rule Book, which is still the rule book in force, deals with the AWS and in paragraph 6 explicitly about its isolation. At 6.1 it states 'A traction unit must not enter service if the AWS is isolated in any driving cab . . .' and at 6.3 'If it is necessary to isolate the AWS, the Driver must inform the Signalman at the first convenient opportunity. The train must be taken out of service at the first suitable location without causing delay or cancellation . . .' Also, at 6.4, the appendix states 'If the AWS has been isolated, speed must not exceed 40 mph during fog or falling snow'. At Selhurst there are no test inductors at the depot so that drivers can test whether or not the AWS is working. Thus drivers are not really able to comply with the rule at 6.1 which implies that an AWS test should be carried out at each end of a unit before a train enters service. *I recommend therefore that Railtrack should ensure that adequate facilities are in place so that the AWS is properly tested before a train enters service.* I gained the impression that there was a very wide interpretation of when was the first convenient opportunity for reporting an in-service failure of the train-borne AWS which required it to be isolated. *I recommend therefore that this instruction be stiffened to require that such reports should be made immediately either by radio or from the first available telephone.*

What was the actual visibility of Signal OD58?

112 Immediately after the accident, a number of experienced engineers viewed the state of Signal OD58. However, by that time the fog had burnt away and their visual impression could not have been anywhere near the same as that of Driver Barton or Guard Brett-Andrews. The consensus of opinion was that it was a reasonably good signal, although Mr Cawley did say that it lacked the characteristic glow. The alignment of the signal, although not perfect, was nevertheless well within normal expectations. Internal examination of the signal head revealed that the back of the lens and the lamp were both dirty despite regular internal cleaning, in excess of that required by the maintenance manual, which was carried out by the S&T technician concerned, Mr A Pearce. However the latter had admitted using an unauthorised aerosol spray inside the signal head for the purpose of waterproofing the terminals. Testing at the Crewe laboratory showed that the contamination on the rear of the lens was mostly due to fly excrement and that the lamp was probably near to the end of its life and had significant deposits of tungsten on the inside of the envelope (lamp glass). A more-than-ordinarily-powerful cleanser was required to clean the back of the lens. The actual light output of the signal head was measured, but, in the absence of a performance standard, this actual value was useless. To provide some kind of comparison, a similar signal, taken at random from the laboratory shelves, was also tested and showed that, apparently, the light output of the red aspect of the signal head from Ashurst was only 13.6% of that of the other signal head.

113 Was this comparison valid or even worthwhile? For sound reasons, during the testing the Ashurst signal was fed with signalling mains voltage and the voltage used to drive the lamps derived from the signal's internal transformers. Although signal lamps are rated for use at 12 v, they are deliberately underrun at voltages between 10.5 v and 10.9 v. The outputs from the transformers lay within this range both for the Ashurst signal and its comparate but were not the same. A similar exercise was carried out for the lamps themselves; but this time a laboratory 'standard' lamp was used to compare with the output from that from the Ashurst signal. All the lamps were driven at their rated voltage of 12 v. This latter exercise merely told the investigators what proportion of the loss of performance was due to the lamp alone. While this is an interesting by-product it does not contribute to answering the question of whether the driver could see the signal in the fog.

114 The laboratory considered this question by calculating the ability of the human eye to contrast the colour of a signal aspect against the background illuminance of daylight for a range of attenuation due to fog. The daylight visual range was calculated for visibilities between 20 km (clear) and 10 m (dense fog). Assuming the density of fog at Ashurst that morning to have been such that the visibility was approximately 50 m, the daylight visual range of the degraded-performance red signal was 22 m. The evidence was, however, that the fog was patchy but, even if the density gave a visibility as high as 125 m, the daylight visual range would only have risen to 55 m. I consider therefore that the driver of the Up train would not have been able to see the red aspect until the cab was between 50 m and 20 m from Signal OD58. It is not possible, for the reasons given earlier, to estimate at what range a 'normal' signal could have been seen because there is no such thing as a defined normal signal.

115 A paper on the design and performance of colour light signals by *Ms B Perkin*, Signalling Equipment Engineer, British Rail SIGTECH, Signalling Equipment Group which was presented to the Inquiry, explained that the design of the signal head of Signal OD58 was the latest in use on British Railways. Its on-axis beam intensity was probably some four times better than that of other designs of colour-light signals. It was Ms Perkin's view that, given the diversity of lamps, types, ages and conditions, the measured light performance of Signal OD58 was no worse than would be reasonably expected from a significant proportion of the UK railway signal population at any given time. Hence it was perfectly conceivable that, despite the actual loss of performance described by Mr Jack, Signal OD58 could still be regarded by the unscientific, but nevertheless experienced, eyes of senior signal engineers on the morning of the accident as a 'good signal'. I therefore believe that the more realistic assessment of the performance of Signal OD58 at the time it was passed by the Up train is that obtained by using the calculated daylight visual ranges of the signal based upon its performance measured in the laboratory.

116 There was corroborative evidence from the analysis of the SSI tape, the test train trips, and the descriptions by the passengers, to show that the likely speed of the train on passing Signal OD58 was 38 mile/h. This equates to an average speed between 16.5 and 16.7 m/s over the daylight visual ranges given earlier and sighting times of the order of between 3 and 1 seconds. Driving at the speed (38 mile/h) which it is considered that he did and which, in the light of the prevailing conditions, was probably too fast, the driver of the Up train probably had insufficient time to register the aspect of the signal, especially if there was the slightest distraction at the crucial moment such as turning to speak to the other person in the cab.

117 From the foregoing it is possible to construct a number of possible scenarios to try and explain why,

after having made a successful, and presumably accurate, stop at Ashurst the driver of the train should drive it so far into the single line without authority to do so. There is no doubt in my mind that Signal OD58 was at Danger and that the AWS electro-magnet was de-energised. Therefore the signal was passed at Danger (a SPAD) and, because of the distance and manner of the overrun this SPAD falls into the category of a disregard; but why? Was the driver lost in the fog? This is unlikely, even for an inexperienced driver, as the stop at Ashurst without an overshoot or last minute braking shows. Driver Barton could be classed as inexperienced; this was only his 60th trip on the Uckfield branch. If Guard Brett-Andrews was driving he could be classed as a very inexperienced driver in the sense of control of a train but he knew the line well and was unlikely to be lost. It was the considered opinion of the senior drivers that a properly trained driver, as Driver Barton was, would not have been lost. Was the signal aspect missed and the train's AWS isolated? The calculations show that the available sighting time of the signal was very short and, if there was no prior warning from the AWS, the possibility of it being missed would be fairly high. I have concluded earlier that, on balance, the evidence for the AWS to have been working was slightly more persuasive, but the hypothesis that it was not and as a consequence the signal was missed is tenable. But the rules call for a reduction in speed if the AWS is isolated and the evidence against the train being driven at reduced speed or of any other of the rules governing driver's actions if the AWS was isolated being observed is compelling and hence I must reject the hypothesis. Similarly if the signal aspect was out, for example because of the power disable test, and the AWS was legitimately isolated this must also be rejected as a theory. It is conceivable but extremely unlikely that the AWS had a wrong side failure after passing Signal OD58R and before reaching Signal OD58, again with the aspect being missed.

118 I have already stated that I do not consider that a power disable test, which would have caused no signal aspect to be shown, occurred, but I do consider that the fog was such that the sighting time of a lit signal was very short. To have disregarded the audible warning given by the AWS and not to have reduced speed to give ample warning time is therefore inexcusable. A moment's distraction is enough to have caused the driver to have missed seeing the signal aspect but he would have had to have ignored two previous audible warnings and distraction from observation of those is less likely. However, the stop at Ashurst Station may have wiped out the earlier warning in the driver's memory despite the reminder of the visual indicator (the 'sunflower'). Cancellation of the AWS does tend to become an automatic reflex action and in this case there would have been no change of the visual indicator as a second reminder. I am inclined to believe therefore that the driver must have sub-consciously cancelled the AWS warning and was distracted by the other person in the cab at the crucial moment. To have run by the signal in these circumstances is blameworthy but understandable. To have driven on without consciously registering the aspect of the signal to a point where he must have realised that the signal had been passed is not only inexcusable and blameworthy but also totally irresponsible. In this instance it does not matter who was actually at the controls, Driver Barton was in charge of the driving of the train and **I conclude therefore that Driver Barton is wholly responsible for the accident**.

Were there adequate means of communication?

119 Signalman Webb recognised the inevitability of the accident but was powerless to do anything about it because he had no direct means of communicating with either train. If cab secure radio had been available there was sufficient time after he had become aware of the situation for him to have sent an effective 'stop' message to each train. Had the National Radio Network system been available it is very doubtful, because of the way it is engineered, that Signalman Webb would have had enough time to contact both drivers. I consider the matter of radio communications in general later but **I must conclude at this juncture that had cab secure radio been available this accident could have been prevented.**

120 There appears to be more than enough telephones available for use by drivers for them to report if they have had to isolate the AWS and I find no fault on this score. However the provision of mobile telephones, which were regarded as a substitute for an adequate radio system, was unsatisfactory. Carrying one was not mandatory. There was no proper system for issuing them or of recording which trains had which telephone. Their reliability was poor and their battery endurance low. There were notorious black spots on the Uckfield branch where mobile telephones became unusable. Because the object of having them was said to be to enable drivers to call the signal box there were no adequate arrangements for reciprocal calls. In short, despite promises made to various rail users groups, the system fell into disrepute and thence disuse. The similar scheme for use on the Waterloo-Exeter line beyond Salisbury has also fallen into disuse for much the same reasons. For speed of establishing contact between signal box and train, the mobile telephone system might have been marginally better than the National Radio Network, but it suffered from the same drawbacks of the patchy nature of coverage on the Uckfield line. While it might have been possible to contact Driver Barton on the Up train, Driver Rees on the Down train, passing through Mark Beech Tunnel and into the 'black spot' area around Cowden, would probably not have been able to receive a telephone call. **I conclude therefore**

that it is unlikely that the accident would have been prevented entirely by NRN but it might have taken place elsewhere between Cowden and Ashurst and with less violence.

What effect did the design of the rolling stock have?

121 The rolling stock involved in the collision was all in Class 205. These DEMU are based on the standard Mark I carriage design which has a comparatively light body mounted on an underframe. It has drophead buckeye couplers at the outer ends and solid-shank buckeye couplers for the intermediate connections. In this sense it is similar to those trains involved in the Clapham accident but has a different coupling arrangement to the trains at Cannon Street. However, all three accidents involved one train or part of a train overriding another, the frame of one coach slicing through the bodywork of the other. Much of the work of investigation of both previous accidents applied to Cowden, the results of which were entirely predictable in terms of loss of survival space. I consider the future of such rolling stock later in this report.

Was the procedure for the notification of an emergency adequate?

122 The first notification of the accident to the emergency services came from a passenger who made a telephone call from a neighbouring farmhouse. Guard Boyd of the Down train, who was uninjured but in a state of shock, took some time to determine what had happened and return to Cowden Station to use the railway telephone there. Fortunately Mr Hodges, the travelling ticket examiner was there, but they took some time to establish the telephone number of Oxted Signal Box. However, the Railtrack Control Room, which is also used by the Train Operating Unit, was aware of the imminence of an accident from Signalman Webb's earlier call to them about the Up train passing Signal OD58 at Danger. Because site access is difficult, the Control Room deliberately held off alerting the emergency services until they had had confirmation of the actual location of the collision. Thereafter the notification to all, except the Department of Transport, worked adequately. Examination of the relevant pages of the emergency procedures manual showed that that document had not entirely kept up with the organisational changes both internally to the railways or externally to governmental organisations. It is imperative that emergency telephone number lists are kept up to date in control rooms and that the relevant telephone numbers of control rooms and signal boxes are displayed at every railway lineside or station telephone which has dialling facilities. *I therefore recommend that Railtrack review what information is displayed at such telephones* with a view to incorporating all key telephone numbers likely to be required in an emergency and that action be taken to ensure that control room manuals contain up-to-date information.

Was any relevant evidence lost?

123 Although there was some delay in setting up and staffing the incident reporting room at Cowden Station and a not entirely satisfactory hand-over procedure between railway officials which led to some examination of the signalling in the absence of a police officer, **I do not consider that any perishable evidence was lost and I so conclude**. The police view was that the system worked well. However, I cannot allow to pass unchallenged Mr Collins' observation that it was in order for him to examine the inside of Signal OD58 without police presence because other witnesses were present. It was not. Equally it was not in order to remove the SSI data tape in the absence of a police officer. Subsequent events, however, showed that there is a need to decide at the scene of the accident what further evidence needs to be collected so that laboratory testing at a later date can be properly directed. It turned out for example that the internal condition of the AWS isolating switch at the leading end of the Up train gave cause for concern as to whether it would have been necessary to have isolated it. The front end damage was such that the instinctive reaction was that it was not possible to determine what the position of the switch was. With hindsight, a more deliberate probing of the remains might have assisted the investigation. Again with hindsight it is possible to say that some of the testing procedures at the various testing laboratories at Crewe could be improved. It should have been automatic to take voltage, current and resistance measurements across the AWS isolating switch when it was being supplied by the correct operating voltage instead of merely using a multi-meter across the terminals. Similarly, a test procedure for the comparison of the output from Signal OD58 should have involved a properly calibrated reference standard instead of a signal head plucked at random from the laboratory shelves. Such a test was only necessary because there were no written optical performance standards for signals. *I recommend therefore that a review be made of laboratory procedures to ensure that all testing is subject to rigorous protocols and that proper standards are established against which such tests are undertaken.*

124 In this accident a full SSI data recording was available for analysis and this provided vital corroborative evidence as to the actions of Signalman Webb, the state of the lineside equipment and the running of the trains. The recording however suffered from two major disadvantages. The first is that the time-bands are 1 minute broad. It was therefore not possible to determine with an accuracy greater than that when any particular event occurred. Between two events the range therefore is from a few milliseconds to almost 2 minutes and this prevents any significant conclusions being drawn for example about the speed of the trains. The second disadvantage arises from the fact that the SSI processor takes nearly 1 second to poll in a fixed order all the trackside functional modules to which it is

connected. Hence the order in which events occur is absolutely accurate for any given TFM, but events reported by different TFMs may have occurred on the ground in a different sequence from that shown on the recorder. In this particular instance, this phenomenon was not relevant to the reporting of the aspect of Signal OD58, the occupation and clearance of its berth and overlap track-circuits, or the detection of Points No 532 because these were reported by one module. It does however affect any analysis of how far apart trains were at any instant and calculations of elapsed time do need to be made with due regard to the limits of accuracy provided by the data recorder. One other feature is worthy of comment. The clock time of the recorder is not necessarily the same as that in the signal box or of Greenwich. In this case there was some 2 minutes difference. In this accident investigation this was not significant because the recording could be recalibrated against real time. However I have observed before, in connection with inspections of new and altered works, that more and more processor-based systems, each with its own clock and display unit, are being installed in signal boxes and control rooms. None of these clocks are linked, each shows its own time albeit differing by only a few seconds, and with no ready means of accurately synchronising them. I would urge the industry to come to grips with this problem as one day it may otherwise seriously hamper accident investigation.
I recommend that all clocks or other devices in a signal box which show or record the time are properly synchronised.

Did the layout and signalling conform to current standards?

125 When the line was singled it was resignalled in accordance with the then current Standard Signalling Principle 6 which defined the method for signalling at junctions. The ends of a reversibly signalled line (which in this case means the single line part between the remaining double track sections) were to be regarded and signalled as a junction if a driver might be misled into proceeding at an excessive speed for the route at that location. Therefore, although there is no difference in speed between the two possible routes entering the loop at Crowborough in the Down direction, this was signalled as a junction with a protecting signal on the single line. This was not the case at Ashurst where there is only one possible route with no reduction in speed and, although it was considered, no protecting signal from the single line was provided. Similarly SSP30 was applicable. This deals with trapping protection and sets out that the need for the provision of trap points at crossing loops on single lines is determined by the conditions under which trains are permitted to enter the loops. Where an adequate overlap exists in advance of the loop exit signal, no trap points are required. The illustrations attached to this principle do, however, show loop entry signals. Nevertheless, the circumstances at Ashurst would not have required the provision of trap points and the Inspectorate accepted that a loop entry signal was not necessary. However, in excess of the requirements of SSPs, AWS was installed at all signals.

126 Since the time that the Uckfield branch was resignalled, a further SSP, No 57, has been issued which requires the provision of a signal not more than 800 m in rear of a set of facing points. There are some exceptions, but they are not applicable in this case. While this SSP would therefore have imposed a possibly implied but not stated requirement to have a loop entry signal, it is doubtful if the provision of such a signal would have had any bearing on the circumstances of this accident. The probable effect would have been to add an extra stop signal at Ashurst Junction preceded by a distant signal. That stop signal, under conventional arrangements, would have been a 3-aspect signal and would have replaced Signal OD58R. It would have showed caution, but the distance to Signal OD58, at 3600 m, would have been more than twice the distance between Signals OD58R and OD58 which is already overbraked. The net effect on the driver would have been even more unsatisfactory than the present arrangement. If, however, Signal OD58R remained in its existing place and an extra distant signal had been provided in rear of the new 2-aspect stop signal, there would have been no difference whatsoever from the situation which occurred on 15 October 1994.

127 The likelihood of a driver passing a platform starting signal at Danger has long been recognised. A method of measuring that risk has been provided by SSP78, which came into effect as a Group Standard in December 1992. If Signal OD58 were to be treated as a platform starting signal which, strictly speaking it is not, it would fall into the category where additional measures to combat the hazard of a SPAD would not be compulsory. The narrowness of the scope of this signalling principle has been recognised and a more comprehensive study, which seeks to identify and quantify all the risks in any particular layout, is currently in progress. None of this work, however, was relevant at the time the decision was taken to resignal the Uckfield branch in the form in which it was in October 1994. **I conclude therefore that the branch was signalled in accordance with the standards in force at the time** and that none of the relevant standards which have been produced since, even if they had been implemented retrospectively, would have had any bearing on the cause or the outcome of the accident. **Hence I conclude that the line was adequately and safely signalled.** However in the light of the circumstances of the accident it is right that the standards should be reviewed when the results of the layout risk study are available. *I therefore recommend that in future before any major change is made to a layout or signalling a risk assessment is undertaken.* Clearly it is not possible, within a sensible period of time,

to undertake a retrospective risk assessment of all significant layout or signalling changes which have occurred in the last decade. Nevertheless it would be appropriate to undertake such assessments of layouts where double junctions have been replaced by single lead junctions and where, such as on the Uckfield branch, long stretches, but not all, of a double-line railway have been reduced to a single line. Such retrospective risk assessments must also await the outcome of the layout risk study. *I therefore recommend that this study is completed urgently, say within the next 6 months, and that when it is to hand Railtrack should propose for consideration by HM Railway Inspectorate a plan for retrospective assessments.*

Who was driving the Up train?

128 It has been suggested that Guard Brett-Andrews and not Driver Barton was actually driving the Up train. I consider the evidence on this issue together with the evidence to be given at the resumed inquest in Part 2 of my report. However it is relevant to report at this stage that evidence was available to me that both men were properly rested before they booked on duty and were not taking medication.

DISCUSSION ON THE WIDER ISSUES RAISED BY THE ACCIDENT

Post-accident testing

129 Reference has been made in earlier paragraphs to the various tests which were conducted on pieces of equipment, either immediately after the accident itself or subsequently in different laboratories or workshops. What was done was done in a traditional manner, each engineering discipline removing, where possible, its equipment for subsequent examination after a preliminary examination on site. It is easy to be critical after the event and I accept that there are always conflicting pressures at an accident site not the least of which are the rescue of casualties and the restoration of the railway to normal running. However, accident investigation is a complex business. Few on-call railway officials have much, if any, experience of anything other than minor derailments, signals passed at Danger, or very low-key collisions. It is easy to accept the first cause of the accident which fits all the facts gleaned at the site. Hence the natural inclination is, on an individual basis, to determine which, if any, piece of equipment is faulty. If no apparent fault is found then the presumption is made that some individual had made a mistake. The need to re-examine the equipment to see why that person has made a mistake is seldom considered and, even if it is, the chance to have another look at the evidence on site has been rendered valueless by the removal of the equipment for off-site examination. I realise that this is the counsel of perfection but I think that at any accident there is both the need for control of the rescue and recovery operations and for a somewhat more detached view of accident investigation. At major incidents it is probably unwise to saddle the same person with both responsibilities. I have no ready-made solution and I therefore believe that the Inspectorate and Railtrack, who in most cases is expected to co-ordinate the railway's own investigation into accidents which occur on its infrastructure, should jointly review this problem. *I therefore recommend that this be done and that the emergency procedures manual which deals with accident investigation should be revised to cover more than just the preservation of evidence and to emphasise the need for a comprehensive plan for all the subsequent investigation to be made at the site.*

Track layout

130 Having considered the direct causes and implications of the accident I now turn to setting it in a wider context to see if lessons can be learnt which might prevent a recurrence. There is a natural horror of a head-on collision above that of any other. A head-on collision can only take place on a line on which trains are permitted to run in both directions. It is widely felt that much less danger exists on double track lines with unidirectional running. The hazard is however the same, that of passing a signal at Danger, but the consequences on a bidirectional line will be that not only will it be much more difficult to stop both trains and thus the probability of a collision is that much greater but also the closing speed is likely to be greater and therefore the result would be a more severe collision. In that sense and in that sense only the natural instinct is correct. Therefore is it wrong in principle to countenance converting to single line long stretches of formerly double-line railway? If the answer is yes then it throws into doubt the wisdom of providing bidirectional signalling on multi-track railways and negates the benefits which accrue from making use of the full capacity of the railway and from being able to minimise the effects of failure or of carrying out essential maintenance. Modern signalling technology is such that single-line operation is no less safe than that of double-line operation providing train drivers observe the lineside signals. I do not consider that in principle the practice of singling double-line railways should be condemned. However, it would be prudent in each case to subject the proposal to risk assessment as I have earlier recommended. The safety of such single-line operations, including those on bidirectionally signalled lines, depends not only on the correct functioning of the signalling system but also on the observance of the signals. The responsibility for the latter lies squarely on the shoulders of the train drivers, but before I consider whether or not there are sufficient safeguards to prevent or reduce the consequences of driver's errors, I first consider the question of distraction.

Driver distraction

131 How much of a distraction to a driver is the presence of another person or persons in the cab? There is some evidence in the study on SPADs to suggest that this form of distraction is significant. While it has been pointed out, not least at my Inquiry by Counsel for the train drivers, that single-manning of trains is comparatively recent and that historically the presence of a second man was not held to be a contributory cause of SPADs, I believe this ignores two things. Historically, data on SPADs was neither collected nor collated and that, in the days of steam locomotives, two people were required for the actual purpose of driving a train. Locomotive firemen were aspirant drivers. A knowledge of the road could make a good deal of difference to their effectiveness. The construction of and sighting from steam locomotives made the observation of semaphore signals difficult at times and hence a second pair of trained eyes was a valuable addition. The purpose of firemen ceased when steam gave way to diesel or electric motive power. Also, anecdotally but recorded in the railway accident reports of the National Transportation Safety Board of the United States of America, there is considerable evidence that, despite the rule which required others in the cab to call the aspect of a signal when it was seen, this was frequently not observed and furthermore the presence of a large head-end crew was distracting. Therefore, in general, I endorse the rule which does not allow persons other than drivers in the cab unless authorised and for a specific and legitimate purpose on each occasion. There clearly must be, however, exceptions to the general rule, most obviously when for some reason monitoring of the driver's vigilance is impaired by equipment failure or when the train crew are required to search the line. The presence of a second person in the cab with the specific tasks, in the first instance of ensuring the driver's vigilance is maintained, and in the second of allowing the driver to concentrate only on the task of driving, should be, as it is, mandatory. I do not believe the circumstances on 15 October 1994 to have been such as to require a second person in the cab and **I am forced to the conclusion that Guard Brett-Andrews must be regarded as having been an unnecessary distraction**, heightened by his acknowledged extrovert character. The Rule Book is already explicit enough in laying out the circumstances when more than one person is permitted in the cab and I have no recommendations to make on that score. However I believe that train operating companies should be more severe on contravention of this rule and that insufficient action was taken in the case of Guard Brett-Andrews. This specific case must not be permitted to divert attention from the wider issues of what the causes and effects of driver distraction truly are. For example, is the increased use other than at signals of AWS permanent magnets which give additional identical caution warnings but which have different meanings a help or a hindrance? I consider therefore that it is right and proper to extend the investigation into the causes of SPADs to include this subject. *I therefore recommend that the question of driver distraction in all its forms in the environment of a modern driving cab be added to the SPADRAM research project.*

Automatic train protection

132 'Time as a resource is not infinite and what there is of it should be spent wisely . . . However in any event both [ATP and Cab Radios] are devices vital to the safety of BR whose introduction must not be the subject of any unnecessary delays. It is because of the Court's concern at the potential for delay that I begin this Chapter with this emphasis'. Those words are taken from the introduction to Chapter 15 - The Future of Safety - of Sir Anthony Hidden's report on his investigation into the railway accident at Clapham Junction. In the chapter he quoted extensively from successive annual reports on the safety of Britain's railways. Each had looked forward to the development of ATP, saying in effect that, particularly in Continental Europe, railways were developing various systems. The higher levels of the advanced train control system (ATCS) being discussed in the USA at about the same time also incorporated a form of ATP. Similarly the more recent European effort in trying to develop common standards towards a European train control system (ETCS) has ATP as its cornerstone. Britain is taking a full part in ETCS and indeed Mr Rayner in evidence suggested that Railtrack was looking very closely at ETCS for the planned resignalling of the West Coast Main Line. However he declined to give a time-scale for this isolated project. He himself said that such a system would probably never be fitted countrywide.

133 It is convenient to classify the safeguards to prevent or to minimise the consequences of a driver's error in passing a signal at Danger. In the first group, Railtrack place the development of transmission-based signalling for the WCML which will, as part of the package for automatic train control, include ATP. Railtrack place the current pilot schemes on the Great Western Main Line and the Chiltern lines in a second group referred to as BR-ATP. All other measures fall within the Railtrack research project known as Signals Passed at Danger Reduction and Mitigation (SPADRAM). An alternative way at looking the measures is to divide them into those which are supervisory, such as ATP, and those which are purely advisory, such as AWS or drivers' reminder appliances.

134 There is no doubt that the accident at Cowden would have been entirely preventable had a system of automatic train protection been fitted to both track and train. It is equally clear that if all SPADs are to be prevented, then some form of ATP or an equivalent supervisory system will have eventually to be provided

throughout the railways in Great Britain. However it has been accepted that BR-ATP is too expensive, in terms of cost per life saved, and therefore fitting it to the nation-wide network cannot be justified. The SPADRAM project covers a wide range of measures from reduced-cost ATP to drivers' reminder appliances. The higher level measures will all require development and I am mindful of the history of the introduction of AWS and of BR-ATP. It is all too easy for valuable time to be lost. Development is necessary because, as BR-ATP showed, commercially available systems designed for use on other railways are not directly able to cope with the very different operating conditions on British Railways and with the cost and complexity of fitting the on-board equipment to the majority of the current fleet of British Railway's rolling stock.

135 It is not easy to distinguish between a reduced-cost ATP system and an enhanced AWS system. For the latter to be regarded as a supervisory system, not only must it be able to distinguish a Danger aspect from a Caution aspect, but it must also give an irrevocable brake application for the former and one which can be overridden for the latter. It would, in effect, be a combination of the current AWS, an advisory system, with a train stop, a supervisory system. In this simple form it would have no speed supervision and would therefore only be effective in preventing the consequences of a SPAD if full speed overlaps were provided. Such overlaps would be totally impracticable to provide except on a new railway or, on an existing railway, where the signalling and track layout can be sufficiently altered to provide them. A possible avenue lies in providing some type of speed supervisory device which would have reduced the speed of an overrunning train at the signal such that it can be stopped within the available overlap. Were such a device to be track-borne it would need to be able to cater for the mixed traffic conditions to be found on most of Britain's main line railway, a task which has, in the past, been beyond attainment.

136 Train stops on their own are not suitable for mainline railway application with mixed traffic running. It was put to me that this was not the case in the limited context of the Uckfield branch. It is true that space exists for overrun trap points to be installed at the loop ends which, together with a train stop, would enable a train to be safely brought to a stop in the event of a SPAD without endangering an oncoming train. It is also true that because it is, or can be, mechanical in nature, the Class 205 units operating on the line can have a trip-cock installed without the need for anything other than a minor addition to the brake air-pipes. I am reluctant to recommend such action because I believe it would cure only one symptom, not the whole problem. It would be limited, at most, to six signals on the line and would cover only a small part of the bidirectionally signalled lines which trains using the branch line also traverse. Also to recommend such action on its own would be counter to the more universal recommendation which I have already made regarding the layout risk assessment. Nevertheless it remains a viable idea but one which needs to be considered within the ambit of that assessment.

137 There are a number of other technical options being considered as part of the SPADRAM research. Some relate to ancillary work which would improve the value of the existing or proposed main measures for reducing the number of or consequences of SPADs. The worth of these options needs to be carefully considered in relation to whether they should be location-specific or network-wide. While most of them are advisory rather than supervisory, I nevertheless endorse the objectives of the research programme and *I recommend that it be completed with the utmost priority.* I have earlier alluded to the problem of driver distraction and of the multiplicity of meanings for a single warning and therefore I reiterate my recommendation that the SPADRAM project should embrace further research into the human factors aspects of driver distraction and driver training.

138 Not all forms of ATP will prevent all signals being passed at Danger but all must prevent an errant train from dangerous consequences of a SPAD; that is the train must be stopped within the safety overlap. It is therefore my considered belief that some form of ATP must eventually be provided throughout the railways in Great Britain. As a first step, all new high-speed lines should be provided, as a minimum, with ATP and similar provisions should be considered for all major resignalling schemes; this being the expectation of the Health and Safety Commission in their response to the Secretary of State for Transport on the British Railways Board report of March 1994 on automatic train protection. I accept that any one system of ATP need not be of universal application throughout the network so long as a traction unit which is unfitted with the ATP system installed on a line is not, except under stringent conditions which would give the same level of security, permitted access to that line. Therefore *I recommend that:*

(a) *as a minimum all new high-speed railways should be fitted with a form of ATP;*

(b) *every major resignalling scheme submitted for approval which does not have a specific proposal for the fitting of ATP should demonstrate that full consideration has been given to its fitting later, together with the risk assessment called for in (d) below;*

(c) *every resignalling scheme should be so designed that the incremental cost of providing the selected form of ATP (which need not be universal throughout the railway network) is minimised;*

(d) *every signalling or resignalling scheme which does not incorporate ATP should be accompanied by a risk assessment of the measures selected for the mitigation of SPADs until such time as ATP is fitted;*

(e) *once a line is fitted with automatic train control, automatic train protection or some interim measure, no train in normal service which is unfitted to operate that system is permitted, except under stringent conditions which would give the same level of security, access to that line.*

Radio and other communications

139 It was wrong and reprehensible to pretend that the provision of commercial mobile telephones was anything more than an ineffective substitute for proper radio communications. The underlying reason for their provision was the unreliability of the trains and hence there was a need for train crew to be able to call for assistance when the nearest fixed telephone was some distance away. It became apparent that the uncertainty of such a means of communication on the Uckfield line had not been taken into account. No proper control over the issuing of the telephones was instituted and no real attempt was made to ensure they were in full working order for the period when they were issued to drivers. Because it was believed that the only calls would be those initiated by the drivers, no proper system was devised so that the signalmen in Oxted Signal Box knew which telephone (and hence its number) had been issued to which train. The implication of the wording in the Sectional Appendix was such that it did not matter if there was a telephone on the train or not. The whole arrangement was a total shambles and no wonder it fell into disrepute. Anecdotal evidence suggests that this was also true of the only other line to be equipped with these commercial mobile telephones, the Salisbury to Exeter line.

140 As far as the safe operation of a railway operated under the control of lineside signals is concerned, the principal requirement for a means of communication between a train driver and the signalman arises when that system of signalling fails. Under those circumstances direct, discrete or secure conversation between the driver and the signalman is required. When signals were comparatively close to the operating signal box, that requirement was satisfied by the direct, personal contact when the driver or fireman walked to the signal box. As signals became more remote, direct-line telephones at stop signals were provided. Advances in technology have now enabled the same standard of secure communications to be radio-based. Cab secure radio, as it is now known, provides that essential element and is a prerequisite for the operation of trains crewed by one person only because it avoids the need for the driver to leave the train to speak on a signalpost or other lineside telephone should they still exist. Not only are the standards of security, in the radio sense, high but also the coverage along the railway needs to be 100%. Both these elements are expensive to provide.

141 At the same time not only did the railways recognise that they had a need for a more effective communication system for commercial reasons, but also there was a general explosion in the provision of cellular mobile telephone networks. The railway's National Radio Network was therefore instituted. By its nature it is an area-based system and therefore suffers, as do the commercial networks, from black spots. The target coverage in engineering terms for NRN is 98%. In other words it is recognised that on 2% of the railway, radio telephone communications are not possible using NRN. NRN does not provide direct communication between driver and signal box and, when a link via a control room is established, the conversation is not necessarily discrete. In order to protect drivers from being distracted by 'wrong number' or other improper calls the telephones in traction units can only be called by special telephones; there is no bar on the driver making any outgoing call but in normal operation the telephone will connect the driving cab with the local control room for the area.

142 At the time of the inquiry into the accident at Clapham, the installation of both CSR and NRN was in its infancy. Recognising that decisions to be made on what type of radio system should be installed where had yet, in many instances, still to be taken, Sir Anthony Hidden's Recommendation 43 merely called for a system of radio communication between driver and signalman. He did however note in the body of the report that, at that time, BR favoured what is now known as CSR. Nowhere in his recommendations did he lay down a time-scale for this, but it was given in evidence and noted in the report that the target completion date was 1992. However, between then and now a funding hiatus occurred as was explained by Mr Nelson in his evidence. While the Uckfield line had been on the list for the provision of CSR, no action had been taken to implement it at the time the hiatus occurred. NRN in fact covered the area served by the Uckfield line at the time of the accident, but with one exception the trains had not been equipped for any form of radio. However, NRN would have operated no better than the commercial mobile telephone networks did and its value in preventing the accident would have been nil as has been demonstrated in incidents elsewhere since October 1994.

143 I will forebear to comment upon the fact that 3 days before I opened my Inquiry a decision was taken to implement the provision of CSR on the Uckfield line. I will merely content myself with endorsing that decision. I do however have the following more general

recommendations concerning radio telephone systems on the railways. *I recommend that:*

(a) *Railtrack produce a timed and costed plan for the completion of CSR on the agreed routes and of NRN to its planned engineering target coverage;*

(b) *the railway should improve the capacity of NRN to handle emergency messages to and from trains.*

Rolling stock

144 Cowden was the latest in a long line of railway accidents which have demonstrated the lack of crashworthiness of Mark I, Mark I derived, or similarly constructed rolling stock. At the inquiry into the Clapham accident British Railways proffered a programme of research into ways of improving the resistance of Mark I rolling stock to the kind of accident damage which leads to injuries to train crew and passengers. Sir Anthony Hidden accepted this and recommended that, after the programme of research had been completed, its results should be discussed with the Railway Inspectorate. Those improvements which were accepted were to be installed on rolling stock having a planned life of over 8 years. The results of that programme were discussed as recommended and the decision was taken that, in view of the likely cost of such modifications, it was not reasonably practicable even to install them on stock with a life of over 8 years. Because at that time it was anticipated that virtually all, if not all, Mark I or similar rolling stock would have been withdrawn from service within the eight year time-scale, no further action was required.

145 Two things have since happened: firstly, Mark I rolling stock is likely to continue in service beyond the eight year point, which effectively ends in 1997. Mr Clementson's evidence on this was the first formal statement which the Inspectorate had had. Secondly, further research, partly in connection with a pan-European research programme, has taken place on improving the response of Mark I vehicles to a collision. It has been shown that, at speeds up to 60 km/h (17 m/s) in a head-on collision, passenger compartments in Mark I rolling stock can be protected from primary damage. However the likely cost of doing so is estimated at not less than £300 000 per vehicle.

146 The conditions under which the 'do-nothing' case was accepted in the light of the Hidden Recommendations 54 and 55 have now lapsed. There appears to be no intention to implement a programme for the installation of measures to improve the crashworthiness of rolling stock having a life of over 8 years and a network-wide fitting of ATP is not contemplated. There is therefore no concerted programme to reduce the likelihood of fatalities or injuries in accidents involving older designs of rolling stock which are the consequence of SPADs, overspeeding or collisions with bufferstops. I do not believe that this situation is acceptable now any more than it was in 1989 when Sir Anthony Hidden made his report. In particular the accidents at Clapham, Bellgrove, Cannon Street and now Cowden have shown that the chance of survival in an end-on collision in Mark I rolling stock is very low and is in marked contrast with the performance of the Super Sprinters in the nearly end-on collision (at much the same closing speed as at Cowden) which occurred near Kirkby Stephen on 31 January 1995.

147 I have referred earlier to the programme of research into crashworthiness. This programme is not yet complete. Its main aim is to enhance the design of future rolling stock in the light of lessons learnt not only as a result of accidents such as at Cowden but also from other industries and academic studies. I endorse this programme of research but consider that it ought now also to encompass another look at the practicability of implementing some or all of the originally proposed measures to improve the survivability of passengers in existing designs of rolling stock which pre-date the latest standards. It is also necessary that rolling stock design keeps pace with the fitting of ATC, ATP or other SPADRAM measures to the infrastructure and can accommodate the necessary on-board equipment. *I therefore recommend in the absence of the complete replacement of Mark I rolling stock which would be the preferred solution that:*

(a) *an urgent programme of research into the practicability of improving the crashworthiness of older designs of rolling stock again be undertaken;*

(b) *the results of this research are discussed with HM Railway Inspectorate so that an agreed programme of implementation can be drawn up;*

(c) *the opportunity is taken in the design of new rolling stock or major refurbishment of old rolling stock to provide accommodation for the installation at the time or later of ATC, ATP or other agreed SPADRAM measures.*

On train monitors and recorders

148 The fitting of OTMRs was proffered to and accepted by Sir Anthony Hidden. It was welcomed by the train drivers. It was agreed by all that they should be fitted, beginning with the actual fitment in all new builds and retrospectively in the remainder in a programme that took into account the ease of doing so and the likely life of the stock. That programme has now fallen far behind schedule, only partly due to the engineering difficulties encountered in the retrospective fitment. As with ATP there is more than a hint that the

best has been the enemy of the good. While fitting OTMRs does not lead directly to an improvement in safety, these instruments add much to the understanding of normal operations and are especially of value in accident investigation. A number of uncertainties in the investigation of the accident at Cowden would have been totally resolved had the trains been fitted with OTMRs. The value of having them was accepted by the railway industry as a whole, as was the cost of providing them. The value of them is still to the industry as a whole, not least to those responsible for accident investigation. I therefore reiterate Sir Anthony's recommendation and *I recommend that a timed and costed programme, to be funded by the railway industry as a whole, for the fitting of all traction units having a planned life of more than 3 years with OTMRs be prepared and submitted to HM Railway Inspectorate for consideration.*

PART 2 OF THE REPORT

149 I have been appointed as Assessor to HM Coroner for West Kent who will be conducting the inquest into the fatalities which occurred at Cowden. I require the further evidence which will be given at the inquest in order to make my judgement as to who was actually at the controls of the Up train. I will be considering that evidence in Part 2 of my report which will also include the report required by Section 8 of the Regulation of Railways Act 1871.

CONCLUSIONS AND RECOMMENDATIONS

150 My conclusions and my recommendations contained in this first part of my report are gathered together in Appendices 2 and 3 respectively.

PART 2

INTRODUCTION

151 Part 1 of the report was presented before the Inquest into the five fatalities which occurred in the accident had been held and in paragraph 149 I explained that, until it had been held, I felt unable to come to any conclusions as to who was at the controls of the Up train at the time of the collision. This second part of my report addresses that issue and also serves as the formal report required by my appointment as an Assessor to HM Coroner for West Kent. The description given at the beginning of Part 1 (paragraphs 12 to 18) applies equally to this part of the report.

EVIDENCE GIVEN AT THE INQUEST

As to the running of the train and the condition of its equipment

152 Not all those who gave evidence to my Inquiry gave evidence at the Inquest. Those who did largely reiterated their original evidence but *Mr M A Moerel* was able to elaborate on the condition of the train-borne AWS equipment when he had first inspected the vehicles. He explained that the lever joining the air-cock to the AWS isolating switch was broken and that the air-cock itself was in a half open position. He considered that if the AWS cock had been in the 'isolated' position it would have been broken in the collision rather than been moved to the position in which he found it. He therefore concluded that on the balance of probabilities the AWS had not been isolated. *Trainman R Boyd* now thought that perhaps the Down train had actually stopped before the impact and *Rail Operator V D Hodges* said that at the time when Guard Boyd first walked up Cowden platform the visibility in the fog was about 50 to 60 m.

153 *Dr B A Lawton*, who appeared in person at the Inquest, confirmed the written details she had sent to me shortly after the accident. On the other hand *Rail Operator W Burton* somewhat altered his story of exactly where Guard Brett-Andrews had been when he acknowledged the hand-signal at Edenbridge Station. He originally told me in evidence that the guard was hanging out of the driver's door thinking, erroneously, that there was one. There is neither an external door into the cab nor, in the actual configuration of the train, a door into a vestibule behind the cab. In evidence to the Inquest Mr Burton said that the guard had got out of a door; this was later changed to hanging out of a door. The only door to which this could have referred was the external door into the engine compartment. The only safe conclusion on this evidence remains that Guard Brett-Andrews was at the leading end of the train. This is a slight variance on paragraph 33.

154 In the absence of *Mr H Nixon* the evidence about the testing of the train-borne AWS equipment and of the head of Signal OD58 was given by *Mr D R Bailey*, Prism Engineering, Technical Investigation Centre, Crewe, who had approved Mr Nixon's written reports. He pointed out that the contamination on the contacts of the AWS isolation switch (paragraph 71) was the result of ingress of material from outside the switch, for example brake dust, and not from inside. He emphasised that the effect, if any, of this contamination would have rendered the brakes impossible to release without isolating the AWS rather than in a wrong-side failure. He has since told me that further tests than those mentioned in paragraphs 71 and 123 had been conducted on the contacts of the AWS isolating switch. It was found that 90 v DC, the operating voltage of the AWS, was incapable of breaking down the insulating film of the contamination. He remained convinced that either the switch was passing current at the time or the contacts were totally isolated and thus failed safely.

155 The last railwayman, other than Guard Brett-Andrews, to have spoken to Driver Barton was *Supervisor H W Dennis*, Network South Central TOU, who was on duty in Uckfield Station Ticket Office. Driver Barton had asked him if he could make a cup of tea in the office. They had chatted while he did so and Barton had seemed to be in a perfectly normal mood. Mr Dennis did not see Driver Barton actually rejoin the train. However, he said that it would have been unlikely that the driver would have had time to isolate the AWS before the train moved off. He, Mr Dennis, had been a guard and knew where and what had to be done to isolate the AWS on Class 205 units. He also said that he had not seen Guard Brett-Andrews that morning.

As to their injuries and the places where those who died were found

156 Evidence as to the injuries suffered by each of those who died was given by *Dr P G Jerreat*, Home Office Pathologist. He said that there were significant differences between the injuries of Driver Barton and Guard Brett-Andrews. He was however unable to tell which, if either, of them had been at the controls at the moment of impact. Driver Barton had received more severe injuries to his legs and Guard Brett-Andrews' chest injuries were of a different nature. It was not possible to distinguish between those injuries received at the moment of impact and those which occurred as a result of them both being flung around afterwards. He said that neither of them showed any evidence of natural disease which would have accounted for their deaths and neither of them were suffering from the effects of drugs or alcohol.

157 *Station Officer S P Batchelor*, Kent Fire Brigade, explained where each of the bodies had been found. Mr and Mrs Pointer had been flung out of the Up train but Driver Barton and Guard Brett-Andrews were trapped between the wreckage of the two trains. It was certainly not possible from the positions in which they were found to determine their positions at the time of impact. He described how it had not been possible to release the body of Driver Rees from where it had been trapped beneath the engine until such time as DMBSO No 60147 had been lifted into the field at the foot of the embankment and had been righted.

158 *Detective Chief Inspector V M Miller*, British Transport Police added that some tests had been done to see how long it would have taken Driver Rees to leave his driving position and reach the place where he was found. The likely length of time was 5 seconds.

REVIEW OF THE EVIDENCE GIVEN AT THE INQUEST

Review of the evidence

159 It was estimated that Driver Rees would have taken approximately 5 seconds to reach the engine compartment of his train. This is also the probable time taken for the brakes to have become 90% effective after he had released the Driver's Safety Device. Therefore I believe that the impact took place at about the same time as the brakes were almost fully applied but, while the train would have been slowing, it would certainly not have stopped. I believe therefore that Guard Boyd was mistaken and that the Down train was still moving at the moment of collision.

160 There was some difference in the views of Mr Hodges and Dr Lawton as to the density of the fog. I do not believe that this was due to the patchy nature of the fog but rather to the time difference when their observations were made, those of Mr Hodges being made earlier than those of Dr Lawton. It would seem from other evidence that the fog was lifting fairly quickly. However neither of these two observations were indicative of the actual conditions at Signal OD58 at the time Driver Barton's train passed it.

161 The evidence given by Messrs Moerel and Bailey tends to reinforce my earlier view that the AWS was working or rather was not isolated. However even if the contacts in the AWS isolating switch were made during the manoeuvres in getting to East Croydon from the depot they would have been broken while the country-end cab was in use on the journey down to Uckfield. The question therefore arises as to whether the contacts closed properly when Driver Barton changed ends at Uckfield. In answer to a specific question on whether Driver Barton would have had time to isolate the AWS after leaving the ticket office before the train departed, Mr Dennis said he thought that there had been insufficient time. Nevertheless isolating the AWS does not take long. Alternatively there is also the possibility that Driver Barton could have handed his key to Guard Brett-Andrews to open up the cab while he was making his tea and the latter, who had some traction knowledge, finding that the AWS was faulty, isolated it himself. He would then have had to have compounded this by failing to tell Driver Barton what he had done and for Driver Barton not to have noticed that the AWS was not working during the journey from Uckfield to Ashurst. I find this so unlikely a scenario that I believe that, if the AWS was isolated then either Driver Barton was aware of it or had isolated it himself.

Why was there a disregard of the aspect of Signal OD58?

162 Both before and after my Inquiry there has been considerable speculation as to the underlying reason for the total disregard of the Danger aspect of Signal OD58 because the Up train was driven as it would have been if the signal had been green. The speculation has centred around the possibilities that either the AWS was isolated, or Guard Brett-Andrews was driving the train, or both. If the former were true then it would also have needed the overriding conviction of one or both men in the cab that the signal was green. I do not believe that there is any real evidence to support the contention that the AWS was isolated, although there was opportunity enough for it to have been done. The lack of a report of the isolation is not conclusive in itself because, although there were autodial telephones at Uckfield, one was at the ticket office at the other end of the train and the other on the platform. A report of an isolation of the AWS is required by the rules, but there is no urgency attached to the making of the report. Couple this lack of urgency with the disincentive of the location of the telephones, then even less reliance can be placed upon lack of a report of the isolation of the AWS as being indicative of there being no isolation.

163 If it were true that one of the reasons for Guard Brett-Andrews' failure to become a driver was a lack of ability to respond to the significance of lineside signals then he may have been convinced that Signal OD58 was at Green. However this error would have had to have been compounded by Driver Barton not seeing the signal which, together with the absence of an AWS warning, might have led to Driver Barton believing that they had a clear run to Hever. Nevertheless, this does not drive one to conclude that Guard Brett-Andrews was actually driving, merely that he may have contributed to Driver Barton's error.

Who was driving the Up train?

164 Neither the medical evidence nor that of the Kent Fire Brigade shed any positive light on the question as

to who was driving. Although pressed fairly hard, Dr Jerreat was reluctant to commit himself. He had not seen the actual site of the accident and it was not possible to sort out the order in which the various injuries occurred either to Driver Barton or to Guard Brett-Andrews. He was able to say only that their injuries were different but not what was the actual cause of each. The bodies of both men were found pinned between the roof of their driving trailer and the frame of the leading vehicle of the Down train. There was no direct evidence as to where they had been before the impact.

165 It was put to me that the manner in which the Up train was being driven was more indicative of an inexperienced rather than an experienced driver. It is true from a comparison of the timings from the SSI tape that Driver Barton's train travelled some 8 km/h (5 mile/h) faster than had Driver Rees' on the same journey earlier that day. That may or may not have been due to the relative density of the fog. On the other hand, Dr Lawton described the first part of her journey from Crowborough as being rather jerky compared to the second part from Eridge. If Railtrack's submission on the quality of driving were to mean anything it would indicate that it was Driver Barton at the controls at the time of collision, not, as Railtrack contends, the other way round.

166 Most of the considerable support for the view that Guard Brett-Andrews was driving at the time of the collision rests on four issues. The first is his admitted history of desire to be a driver and some unverifiable statements made to the police. The second is the alleged reasons for his failure to become a driver which again were not produced in evidence, either directly to me or to HM Coroner or contained in documents made available to me. The third is some alleged opinions which related the position in which the bodies were found relative to where they had been on impact and the type of injury which they suffered and the fourth is one possible reading of Rail Operator Burton's evidence.

167 These issues are not supported by factual evidence. There was a considerable difference of view as to the characters of the two men depending on whether the view was being put forward by their relatives or by their colleagues at work. The former considered neither man as being particularly assertive, whereas Guard Brett-Andrews was regarded as an extrovert by his supervisors and, it was even suggested in submission, was capable of exerting undue influence over Driver Barton. I do not regard this latter allegation as at all tenable in view of the evidence given to me of Driver Barton's own character.

168 The question of the use of the AWS is less easy to answer. There is no good evidence either way as to whether it was working and not isolated or not working and isolated. I am inclined to the belief that it was working but can reach no definite conclusion. If it was working, then I consider the subconscious cancellation of the warning to be more likely from an experienced driver than one with little or no experience, the sound of the 'yodalarm' rather than the slightly more commonplace air-horn having no appreciable affect on this. I have already discussed the speed of the Up train and quality of the driving. If anything I am more inclined to think that it was Driver Barton at the controls rather than the reverse.

CONCLUSIONS

169 None of the arguments rehearsed above, in the absence of positive proof to the contrary, are enough to upset the basic presumption that Driver Barton was actually driving his train. It would however, in my view, be unsafe to come to a definite conclusion in this respect. I am therefore able only to **reiterate the conclusion reached in Part 1 of my report that, as the appointed driver of the Up train despite whatever else might have occurred, Driver Barton is wholly responsible for the accident.**

THE FINDINGS OF THE INQUEST

170 After hearing legal submissions before addressing the jury at the Inquest, HM Coroner for West Kent, *Mr F H Warriner* in summing up said that he considered that there was insufficient evidence to sustain a verdict of unlawful killing. Such a verdict would have required, as in a case of manslaughter, proof beyond all reasonable doubt that an individual had either acted, or failed to act as the case may be, in a manner which was culpable. Whereas the standard of proof required for a verdict of accidental death was only that of 'balance of probabilities'. He therefore directed the jury that a verdict of unlawful killing was not available to them. After due consideration the jury returned unanimous verdicts of accidental death on Driver Barton and Guard Brett-Andrews; verdicts with which I am in complete agreement. However I consider that the evidence was sufficient to allow a more definite verdict than the one reached by a 10 to 1 majority on the deaths of Mr and Mrs Pointer and Driver Rees on whom the jury returned Open verdicts.

RECOMMENDATIONS

171 I have no further recommendations to make arising from the second part of my report. Those arising from the first part are gathered together in Appendix 3.

APPENDIX 1 COVERING LETTER TO THE FIRST PART OF THE REPORT

The Permanent Under Secretary of State
Department of Transport

HM Railway Inspectorate
Health and Safety Executive
Rose Court
2 Southwark Bridge
London SE1 9HS

23 May 1995

Sir

I have the honour to report, for the information of the Secretary of State for Transport, in accordance with the Direction dated 20 October 1994, the result of my Inquiry, held under the provisions of Section 7 of the Regulation of Railways Act 1871, into the collision which occurred on 15 October 1994 at Cowden on the Uckfield branch line of the South Zone of Railtrack plc.

My report is made in two parts. This first part addresses the adequacy of the safety mechanisms and procedures on the line and has been called for in advance of the Coroner's Inquest in order to allay public concern. The second part will solely address the question of who was driving the train and will take account of the additional forensic evidence to be given at the Inquest. This will be published after the conclusion of the Inquest.

At approximately 08.27 on Saturday, 15 October 1994, the 08.00 Uckfield to Oxted passenger train operated by the Network South Central Train Operating Unit of British Railways Board collided head-on with the 08.04 Oxted to Uckfield passenger train operated by the same company on the single line near Cowden Station. The leading two vehicles of each train were extensively damaged and the single line was blocked. I regret to report that there were five fatalities as a result of the collision. Also, twelve persons were injured and conveyed to hospital; none of them, however, was detained. The weather at the time of the accident was foggy.

Because of the complex work required to recover the leading vehicle of the Down train, the line was not restored to traffic until 18.40 on 18 October.

I have the honour to be
Sir
Your obedient Servant

C B Holden
Major
HM Assistant Chief Inspecting Officer of Railways

APPENDIX 2 LIST OF CONCLUSIONS

1 There was no malfunction of the signalling equipment (paragraph 108).

2 The Up train passed Signal OD58 at Danger (paragraph 108).

3 At the time of the accident the AWS of the Up train was operational (paragraph 110).

4 The driver of the Up train, Driver Barton is wholly responsible for the accident (paragraphs 118 and 169).

5 Had cab secure radio been available this accident could have been prevented (paragraph 119).

6 It is unlikely that the accident would have been prevented entirely by NRN but it might have taken place elsewhere between Cowden and Ashurst and with less violence (paragraph 120).

7 No perishable evidence was lost (paragraph 123).

8 The Uckfield branch was signalled in accordance with the standards in force at the time (paragraph 127).

9 The line was adequately and safely signalled (paragraph 127).

10 The presence of Guard Brett-Andrews in the driving cab must be regarded as having been an unnecessary distraction (paragraph 131).

APPENDIX 3 LIST OF RECOMMENDATIONS

1 Railtrack should ensure that adequate facilities are in place so that the AWS is properly tested before a train enters service (paragraph 111).

2 The instruction to report the isolation of the AWS should be stiffened to require that such reports should be made immediately either by radio or from the first available telephone (paragraph 111).

3 Railtrack should review what information is displayed at telephones (paragraph 122).

4 Action should be taken to ensure that control room manuals contain up-to-date information (paragraph 122).

5 A review should be made of laboratory procedures to ensure that all testing is subject to rigorous protocols and that proper standards are established against which such tests are undertaken (paragraph 123).

6 All clocks or other devices in a signal box which show or record the time should be properly synchronised (paragraph 124).

7 In future before any major change is made to a layout or signalling a risk assessment should be undertaken (paragraph 127).

8 The layout risk study should be completed urgently, say within the next 6 months, and that when it is to hand Railtrack should propose for consideration by HM Railway Inspectorate a plan for retrospective assessments (paragraph 127).

9 The emergency procedures manual which deals with accident investigation should be revised to cover more than just the preservation of evidence and to emphasise the need for a comprehensive plan for all the subsequent investigation to be made at the site (paragraph 129).

10 The question of driver distraction in all its forms in the environment of the modern driving cab should be added to the SPADRAM research project (paragraph 131).

11 The SPADRAM research programme should be completed with the utmost priority (paragraph 137).

12 (a) As a minimum all new high-speed railways should be fitted with a form of ATP (paragraph 138);

(b) Every major resignalling scheme submitted for approval which does not have a specific proposal for the fitting of ATP should demonstrate that full consideration has been given to its fitting later together with the risk assessment called for in paragraph 12(d);

(c) every resignalling scheme should be so designed that the incremental cost of providing the selected form of ATP (which need not be universal throughout the railway network) is minimised;

(d) every signalling or resignalling scheme which does not incorporate ATP should be accompanied by a risk assessment of the measures selected for the mitigation of SPADs until such time as ATP is fitted;

(e) once a line is fitted with automatic train control, automatic train protection or some interim measure, no train in normal service which is unfitted to operate that system is permitted, except under stringent conditions which would give the same level of security, access to that line.

13 (a) Railtrack should produce a timed and costed plan for the completion of CSR on the agreed routes and of NRN to its planned engineering target coverage (paragraph 143);

(b) the railway should improve the capacity of NRN to handle emergency messages to and from trains.

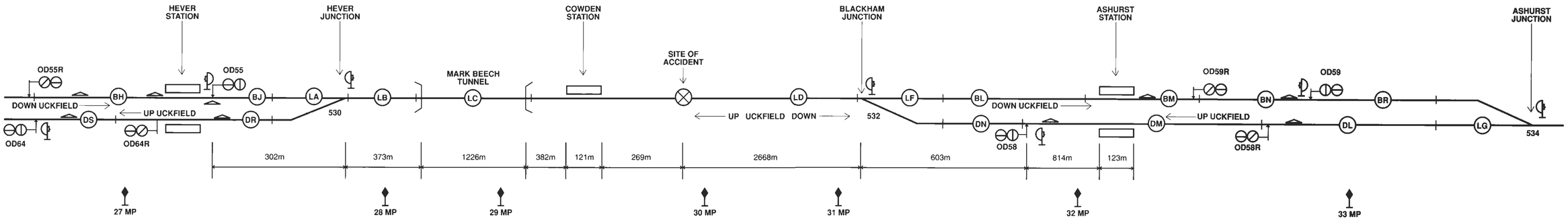
14 In the absence of the complete replacement of Mark I rolling stock, which would be the preferred solution (paragraph 147):

(a) an urgent programme of research into the practicability of improving the crashworthiness of older designs of rolling stock should again be undertaken;

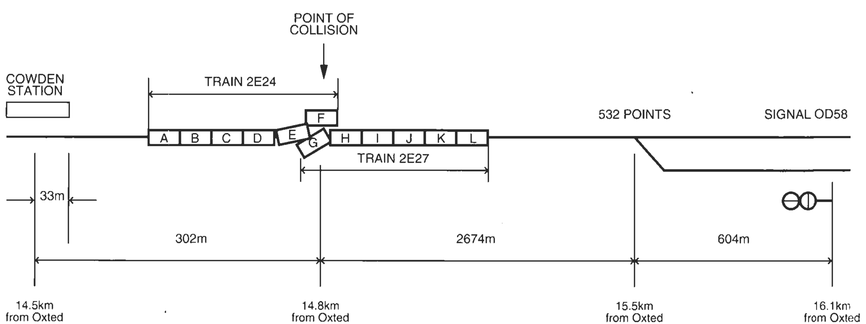
(b) the results of this research should be discussed with HM Railway Inspectorate within one year so that an agreed programme of implementation can be drawn up;

(c) the opportunity should be taken in the design of new rolling stock or major refurbishment of old rolling stock to provide accommodation for the installation at the time or later of ATC, ATP or other agreed SPADRAM measures.

15 A timed and costed programme, to be funded by the railway industry as a whole, for the fitting of all traction units having a planned life of more than 3 years with OTMRs should be prepared and submitted to HM Railway Inspectorate for consideration (paragraph 148).



Signalling Plan



LEGEND:

A – 60831 B – 60677 C – 60150 Driving Motor Coach D – 60828	Set 205 032
E – 60674 (trailing bogie on track) F – 60147 Driving Motor Coach (lying on side on embankment) G – 60817 (totally destroyed above floor level) H – 60667	Set 205 029
I – 60117 Driving Motor Coach J – 60800	Set 205 018
K – 60650 L – 60154 Driving Motor Coach	Set 205 001

Figure 2 The site of the accident (not to scale)

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RAILWAY ACCIDENT AT COWDEN

A report of the Inquiry into the collision between two passenger trains which occurred at Cowden on 15 October 1994

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