DEPARTMENT OF TRANSPORT

RAILWAY ACCIDENT

Report on the Collision that occurred on 31st May 1985 at Battersea Park Station

IN THE
SOUTHERN REGION
OF BRITISH RAILWAYS

HER MAJESTY'S STATIONERY OFFICE

The scene after the accident, looking towards Victoria

The front of the Gatwick Express is in the foreground and the rear of the DEMU in the background. Signal VC552 is just visible at the extreme right.

Photograph by courtesy of Times Newspapers Ltd

RAILWAY INSPECTORATE
DEPARTMENT OF TRANSPORT
2 MARSHAM STREET
LONDON SW1P 3EB

9th March 1987

SIR,

I have the honour to report for the information of the Secretary of State, in accordance with the Direction dated 6 June 1985, the result of my Inquiry into the collision between two passenger trains that occurred at 09.49 on 31 May 1985 at Battersea Park Station in the Southern Region of British Railways.

The 08.51 East Grinstead to Victoria passenger train, consisting of two 3-car diesel-electric multiple units, was accelerating past a signal at which it had been detained when it was struck from behind by the 09.20 Gatwick Airport to Victoria passenger train, a 'Gatwick Express', comprising a motor luggage van, eight passenger vehicles and an electro-diesel locomotive at the rear. The Gatwick Express had passed at Danger, in fine sunny conditions, a signal behind the other train which should have protected it from a rear-end collision.

The closing speed of one train relative to the other was about 20 mile/h at the moment of impact. Neither train was derailed but all the vehicles sustained damage which, with the exception of one coach, did not seriously affect the passenger accommodation.

Both trains were heavily loaded with passengers, many of those on the Gatwick Express being visitors from overseas. 104 persons were taken to hospital, of whom 18 were detained. The most seriously injured passenger was released from hospital 14 days later.

DESCRIPTION

The Site and Signalling

1. Battersea Park Station is aligned approximately North to South and is 1¼ miles from London Victoria on the main line to Brighton. Six lines run through Battersea Park comprising from west to east the Up Brighton Fast, Down Brighton Fast, Up Brighton Slow and Down Brighton Slow; these will be referred to more simply as Up Fast, Down Fast etc in the remainder of this report. The last two lines, which are known locally as the Up Atlantic and Down Atlantic, form part of a route which loops round south London and returns to London Bridge Station. The Atlantic lines diverge from the Brighton Slow lines immediately north of the station and take a separate route to the south of it. Also just north of the station there are cross-overs from Up Fast to Up Slow lines (traversing the Down Fast) and from Down Slow to Down Fast lines (traversing the Up Slow) and opposite the station is a connection from the Up Fast to a carriage line. Battersea Park has five platform faces; the Up Fast line on the extreme west side has no platform. All of the lines are electrified on the 750V dc third-rail system.

2. The signalling is controlled from Victoria Signalling Centre (which is actually located at Clapham Junction) using the Track-Circuit Block system. All running line signals are of the four-aspect colour-light type and are equipped with British Railways Automatic Warning System (AWS). AWS is an aid to drivers which, by means of magnets in the track on the approach side of a signal, causes a horn to sound in the cab if the signal is displaying a Caution or Stop aspect and applies the brakes after 2-3 seconds. The driver can stop the horn and prevent the brake application by pressing a cancelling button, which causes an otherwise all-black indicator in the cab to show a black-and-yellow 'sunflower' pattern. On approaching a clear signal a bell sounds briefly and no action is required of the driver. Below is a list of the most important signals with topographical notes on the journey on the Up Fast line from Clapham Junction which, at 2¼ miles from Victoria Station, is the station before Battersea Park en route to the London terminus. The signals described are shown on a diagram of the route at the back of this report.

Signal

VC594 Stands at driver's eye level on a single post at the London end of the Up Fast line platform at Clapham Junction station. The line ahead curves slightly to the right, but distantly visible is –

VC584 which together with a corresponding Up Slow line signal is on a long cantilever bracket from the right-hand cess. This signal, situated over straight track, has a left-hand lunar-light junction indicator for Pouparts Junction, at which point the main lines commence a long reverse curve, right-handed initially and then left-handed. The line rises at 1 in 120 from Pouparts Junction in

order to gain height to fly over the lines to Waterloo Station, which the Brighton to Victoria lines parallel between Clapham Junction and Pouparts Junction. First visible from the right-hand curve, but actually situated on the left-hand curve, is -

VC572 which is mounted on a single post to the left, with a right-hand-bracketed Up Slow line signal beside it. Still curving left and rising, the high bowed girders of two parts of the flyover come into sight, and soon after passing VC572 there becomes visible beyond the flyover a Tee-shaped bracket bearing at its left-hand end –

VC564 At the right-hand end of the same structure is an Up Slow line signal, which is visible moments before VC564, but only for such a short time at long range as to be insignificant. Because of the line curvature, the structures of the two bowed-girder bridges each briefly interrupt the view of VC564, before the line straightens over the second bridge, when the signal is clearly and continuously visible above the track to which it applies. At the permitted line speed of 45 mile/h, signal VC564 first comes into view at about 22 seconds running time away, and its sighting is twice interrupted for 1 to 1.5 seconds, before it comes into full view above the track for about 11 seconds before passing under it. The AWS inductor for VC564 is located in the interval between the two bowed bridge girders, but the signal is in full view before the AWS bell or horn sounds in the driving cab. The bridges are at the summit of the rising gradient; from them the lines fall at 1 in 120 to Battersea Park Station. After passing VC564 the line curves left again, and a building on the left initially obscures the view forward to the next signal.

VC552 comes into view about 5 seconds after passing VC564; because of the curvature and obstructions on the left, the signal head becomes visible first, and the track leading up to it shortly afterwards. This signal is mounted above the track on a bracket from the left, and the corresponding Slow line signal VC554 is on a post at the end of Battersea Park Up Slow line platform. VC552, in addition to the main aspects, has a lunar light junction indicator to the right. which, when illuminated, indicates a route via the crossover ahead onto the Up Slow line. After VC552 comes into view the left hand curve eases and then reverses to become a very slight right hand curve past Battersea Park Station but the curvature is so slight as to provide a virtually straight line view along the track approaching VC552.

The Trains

3. The 08.51 East Grinstead to Victoria Train, identified as 2L51, consisted of two 3-car diesel-electric multiple units (DEMU) of classes 205 and 207. The two types are technically similar, having variations in body width and seating accommodation only. In order of running, this train comprised:

Class 205 Unit 1113

(i) A diesel power car having a driving cab, a 448kW diesel-electric power unit, a guard's compartment and a passenger saloon in that order from the front.

(ii) A non-powered coach with passenger accommodation only.

(iii) A non-powered passenger coach with a driving cab at its outer end.

Class 207 Unit 1309 Similar to unit 1113 described above, but running reverse order, that is with its power car at the trailing end.

All six coaches of this train were of BR Mk 1 construction, having trussed steel load-bearing underframes and steel bodies. This train had a mass of 240t, was 121m long, and had seats for 381 passengers. Buck-eye automatic couplers were in use throughout the train.

4. The 09.20 Gatwick to Victoria, train No 1D91, was of a formation specially devised for the Gatwick Airport shuttle service, and in order from the leading end it comprised:

Class 489. Unit No 9101 A Gatwick Luggage Van (GLV) which was a 373kW motored electric bogie van, with a driving cab at its leading end and guard's compartment at the trailing end. This vehicle was also of BR Mk I construction.

Class 488. Unit No 8301 Three passenger coaches, semi-permanently coupled within the set by bolted-together bar couplers. These vehicles were of BR Mk IIf design and were of integral steel construction, that is having a load-bearing body structure integral with the underframe. They were built in 1973 and 1974, and modified in 1983

	as regards couplings, brakes, and through-control cables, specially for the Gatwick Express service.
Class 488. Unit No 8203	Two passenger coaches, bar-coupled, similar to Unit 8301.
Class 488. Unit No 8313	Three passenger coaches, bar-coupled to each other, similar to Unit 8301.
Class 73. Locomotive No 73117	A Bo-Bo electro-diesel locomotive, having a 448kW diesel power unit as an alternative to its normal operation as a 1194kW 3rd-rail contact electric locomotive. When, as in this case, the locomotive is at the rear of the train it is remotely controlled from the driving cab in the motor luggage van.

The train was operated on the 750V dc third-rail electrified system, and its maximum permissible speed was 90 mile/h. Its service brakes were electro-pneumatic, supported by an automatic air system for emergency application. Other than where solid bar couplers were used between coaches, the vehicles were all coupled with buck-eye couplers. The total mass of train 1D91 was 382t, its length 200m and it had seats for 433 passengers.

The Course of the Accident and Damage Caused

5. Train 1D91 was following 2L51 along the Up Fast line, through Clapham Junction station, at which the latter train had made a scheduled stop, and beyond towards Battersea Park. 1D91 had closed sufficiently on 2L51 that the former passed a series of signals displaying a 'single yellow' caution aspect, at which the driver cancelled the AWS warning and continued, as he was entitled to, at a speed of around 30 mile/h. Train 2L51 was then stopped for 1–2 minutes at signal VC552 displaying a red aspect. When that signal cleared, 2L51 was accelerating past it when it was struck from behind by 1D91 which had passed the protecting signal, VC564, at Danger. A concensus of evidence suggests that at the moment of collision 2L51 had reached a speed of between 5 and 10 mile/h, whilst 1D91 was still travelling at between 25 and 30 mile/h, so that the net collision speed was about 20 mile/h. After the collision the trains separated and came to rest 20m apart. Their positions at the point of impact and afterwards are shown on the drawing at the back of the Report.

6. There was no derailment but the shock of collision passing down each train caused damage throughout the length of both. Only one vehicle sustained severe structural damage; this was the leading passenger coach of 1D91, running immediately behind the GLV. This coach sustained a small degree of telescoping at underframe level, and hinging down of its trailing end, so that the saloon floor buckled upwards by about 600mm with consequent displacement of seats in one bay. One window each side was broken when this deformation occurred through the window opening, but the general integrity of the vehicles could be judged by the fact that these were the only external windows broken throughout the two trains.

7. The trains were conveying a large number of passengers, one estimate being as high as 800. In the collision 104 persons suffered injury and were taken to two hospitals by means of ten ambulances, the first of which arrived at 09.58. Most of the injured suffered only cuts and bruises and were discharged after treatment, but eighteen had serious injuries requiring detention in hospital for periods between one and fourteen nights. Twenty other passengers later reported having suffered injury. The uninjured passengers were conveyed forward to Victoria at 10.58 by a special train, the unobstructed Slow lines having been re-energised for electric trains at 10.45 after an initial complete isolation of the conductor rails in the area. During the day the damaged trains were made fit to move and hauled into sidings so that, there being no damage to the track or signalling equipment, normal working was resumed at 16.12.

Evidence

As to the Course of the Accident

8. *Signalman S Thompson* was operating Panel 1 in Victoria signalbox immediately prior to the accident; he was doing so as a trainee under the instruction of Signalman Stoney, but was familiar with the panel and its normal working. Thompson said that Stoney told him to re-route train 2L51, which was running on the Up Fast Line, onto the Up Slow line in advance of signal VC552 after the passage of the 09.45 Victoria to Gatwick on the Down Fast line. As soon as this train had cleared the relevant track circuits Thompson set the route to eross 2L51 to the Up Slow line, and all the way into Platform 15 at Victoria. He estimated that 2L51 had been detained for one or two minutes only and was aware that 1D91 was following behind it. Very shortly after clearing signal VC552 Thompson received two calls in quick

succession from Signal Post Telephones (SPT), both reporting a collision and requesting emergency services. Thompson reported this to Stoney and, since Thompson was a trainee, another signalman took his place in assisting to deal with the emergency. Thompson did note, however, that after the accident the train description (2L51) had stepped ahead of VC552 on the panel, but the description (1D91) remained at VC564, although the track circuits were occupied ahead of that signal.

9. *Signalman A Stoney* was in charge of Panel 1 in the signalbox. He told me that shortly before the accident a member of the permanent way department had telephoned him from an SPT to say that he wanted to look at an end-post in the Up Fast line at a location on the normal route of 2L51 into Victoria. Stoney understood that an end-post was a nylon insulator between two rails to insulate one track circuit from the next. He was not specifically asked to block the line, but in case the attention given by the permanent-way staff accidentally affected a track-circuit Stoney told Thompson to detain 2L51 at signal VC552 until the 09.45 down train to Gatwick had passed, and then to route it into Platform 15 via the Up Slow line and thus clear of the possible track defect. Shortly afterwards Thompson took a call from an SPT and reported there had been a collision. Stoney requested Asst Traffic Regulator Morgan to call the emergency services and another signalman, Rubie, came to assist at Panel 1 in place of Thompson. Stoney told me that Rubie promptly telephoned the Electrical Control Operator at Selhurst to have the current cut off from the conductor rails; this was initially done on all the 'Brighton' lines through Battersea Park but later, in liaison with the site, the Slow lines were re-energised to enable a train to be run from Battersea Park to Victoria to convey passengers from the damaged trains, and subsequently to run some service trains past the site.

10. As to the general functioning of the signalling, Stoney said it was working normally until at 09.22 a driver had reported that signal VC554 on the Up Slow line had changed from green to red and back to green; Stoney had requested the Signal and Telecommunications (S&T) staff to investigate this report. The attention to the end-post on the Up Fast line had apparently not affected the signalling at all. Stoney also confirmed Thompson's evidence regarding the indications on the panel after the accident.

11. *Assistant Traffic Regulator D Morgan* was in overall charge of Panels 1 to 4 in the signalbox. He knew of the problem at VC554 signal to which the S&T staff had been called, and of Stoney's proposal to cross 2L51 to the Up Slow line because of attention to an end-post; he was content that suitable action was being taken in each case. When Stoney told him of the accident Morgan contacted the Emergency services via the railway telephone system; he experienced some difficulty in making himself heard but not such as to cause any excessive delay. He noted that Rubie had requested the electrical power off and then checked the panel indications, reporting them to be as the previous witnesses had described. He was satisfied that the site was safe from the approach of other trains and free from danger from the conductor rails. He soon learned that the site was attended by the Area Manager Mr Daughton, and the Area Operations Manager Mr Barrett; it was on Barrett's authority that re-energisation of the Slow lines was arranged later.

12. *Signal Technician B Harvey* was one of two men who investigated the aspect change which had been reported on VC554 signal. They were both at the SPT for that signal, at the London end of Battersea Park station, when the DEMU (2L51) stopped at VC552 on the Up Fast line opposite to him. Owing to the noise of its diesel engine Harvey decided to delay making a call to the signalbox until the train had left. It was stationary for a few minutes, during which time a Down train passed, and then Harvey saw VC552 change from red to green with the junction indicator lunar lights on. The diesel train accelerated slowly, and Harvey thought it was about 2 coach lengths past the signal, travelling at walking pace, when there was a bang as the Up Gatwick Express (1D91) struck the rear of it. Harvey only glimpsed the Gatwick train before the impact but he thought its speed may have been about 35–40 mile/h. He believed that signal VC552 had reverted to danger, owing to the movement of the DEMU past it, moments before the collision occurred.

13. After telling his colleague Jamieson to report the collision Harvey went to see the driver of the Gatwick train who was leaning from the cab window looking shaken; he told Harvey that he had not been concentrating. Harvey then sought other ways to help by placing on the Down Fast line a pair of Track-Circuit Clips given to him by the guard, and thereafter by assisting and reassuring passengers.

14. *Railman P Jamieson,* also employed in the signal maintenance department, was working with Harvey on the morning of the accident. Jamieson told me he was standing beside Harvey at signal VC554 when the DEMU stopped at VC552, which changed from red to green with a junction indicator after a delay of about two minutes. As the DEMU moved off Jamieson happened to look round towards the country end of the station and to his horror saw a Gatwick Express coming round the curve on the same line as the DEMU. When it first came into his view Jamieson thought its speed could have been

40–45 mile/h but as it approached he heard a rush of air, which he thought was a heavy brake application. He thought that the speed at impact was reduced to 30 mile/h or less.

15. After the accident Harvey gave Jamieson the telephone handset and told him to report the collision to the signalbox. When he did so he was told that everything was under control and emergency services had been sent for. Jamieson then rejoined Harvey to give him this assurance and to generally assist at the scene.

16. *Driver R Fox,* who was driving train 2L51, told me that the journey was uneventful up to the stop at signal VC552 at Danger. He stopped the train just a few feet back from the signal and waited about two minutes, when it changed to green with a junction indicator showing that the route was to cross over to the Up Slow line. Fox could not recall exactly how he drove the DEMU forward, but based on his usual practice thought he probably used notch 4 of 7 on the power controller. The train had not travelled far when Fox heard a very loud bang and suffered a severe jolt which hit his head against the cab bulkhead and dislodged all the loose equipment in the cab. As he collected his senses Fox found that he had involuntarily made an emergency brake application and released the deadman's device. He first thought that the diesel engine behind him had blown up, so he put on his high visibility vest to go to the telephone at VC552. Before he got there he found that many passengers were distressed and complaining of injury, he saw the Gatwick express behind his own train on the same line, and thus realised there had been a collision. He telephoned the signalbox to ask for emergency services and electric current isolation and then found his guard in a state of shock and pain in the rear guard's compartment. After comforting the guard, Fox went to the Gatwick Express to find its driver who was in a distressed state with his guard in the brake van of that train: the driver told Fox that he had lost his concentration.

17. In spite of his head injury, which made him dazed, Fox then assisted by opening emergency boxes and distributing first-aid requisites, tools and equipment where they were most needed. BR Officers told me that Fox stayed at the site long after he need have done, as he was anxious to do all that he could to assist in the emergency.

18. *Guard P Scott* was in charge of train 2L51 and was travelling in the brake compartment in the rear power car. He told me that the journey was uneventful before the collision; the train was detained for one or two minutes at signal VC552 but it cleared very quickly after a Down train had passed. As his train moved off Scott looked out and saw the lunar lights and a proceed aspect at VC552, which he thought was a single yellow. He returned to the interior of the van to prepare for the arrival at Victoria, but next found himself on the floor and bleeding from a head wound; he had been knocked unconscious in the collision. After he had picked himself up Driver Fox came to reassure him that everything was safe and in order, and in due course Scott was conveyed to hospital where he was found to have four broken ribs in addition to his head wound.

19. As to the loading of his train, Scott thought it was virtually full of passengers, although he could not comment in detail as it was a non-gangwayed train and he could not walk through it from the brake compartment.

20. *Guard P Cox* who was in charge of train 1D91, told me that on the morning of the accident he first spoke to Driver Short on the train 'loudaphone' in order to carry out a brake test before working down to Gatwick on the 08.30 from Victoria. Cox first saw Short in person at Gatwick Airport station when he joined in a conversation between Short and the guard of another Gatwick express at the adjacent platform; he considered that Short was his usual relaxed and cheerful self, adding "*John* (Short) *is always cheerful*".

21. The two men then re-joined the same stock to return to Victoria as train 1D91. Cox considered that the running of the train was perfectly normal and uneventful. He went through the train to check the passengers' tickets and noted that it was quite full, especially the leading two coaches. It was not until the train was passing Clapham Junction that Cox had finished his commercial duties and he sat down in the brake compartment in the leading vehicle. From there to the time of the accident he believed the speed of the train was fairly steady at around 25–30 mile/h. Suddenly he was thrown from his seat by the shock of the collision, temporarily lost his glasses and was dazed.

20. Cox could not remember whether there had been a brake application before the collision nor could he remember the order in which he attempted to control the confused situation afterwards, but he did recall separate events, namely that: He passed a pair of track-circuit clips out of the brake-van window (the door was jammed) and asked a railwayman outside to apply them. He called to the driver of a train stationary on the Atlantic lines to have the power taken off the live rails, and was assured that was done.

He attempted to reassure his passengers by means of the public address system, but finding that it no longer worked, walked through the first two coaches. He found a number of passengers apparently seriously injured and others attempting to leave the train; he persuaded the latter to stay where they were, and by another call to a driver outside satisfied himself that the emergency services had been summoned. He gave the First-Aid appliances to passengers who had offered assistance, one of whom was a doctor, and went to the cab where he expected to find Short dead. As he was not, but was badly shaken and apparently injured, Cox helped him back to the brake-van seat and comforted him.

23. *Driver J Short,* aged 24, entered railway service at the age of 17 and had been a driver since October 1983 when he was 22. He told me that his duty roster was arranged to include a mixture of slow suburban trains and non-stopping trains like the Gatwick Express. He had worked the same turn of duty as the Friday morning of the accident on both Tuesday and Thursday of that week. He assured me that on the Friday morning he was well rested, feeling well, and had not taken any drugs or alcohol; he had no particular health problems, though he admitted he was overweight.

24. He booked on duty at 08.09 at Victoria, to work the 08.30 Victoria to Gatwick train. He carried out a brake test in co-operation with Guard Cox and then drove the train to Gatwick without incident. After exchanging pleasantries with Guard Cox and other staff on the platform at Gatwick, Short entered the cab of the GLV and drove the same stock back towards Victoria as train 1D91 departing at 09.20. Short said that he was alone in the cab throughout the journey, the cab heating was off, the side window was slightly open, and although it was a bright sunny day the sun visor was up as he was driving mainly northwards. He confirmed that the AWS was operating correctly and there were no distractions in the cab.

25. The journey was free from undue delay, until when approaching Clapham Junction station restrictive signal aspects were encountered causing Short to reduce speed. He cancelled the AWS warnings at at least 3 successive signals approaching Clapham Junction station; as the train proceeded towards VC594 at the London end of the platform Short saw it change from red to yellow so he cancelled the AWS warning and passed it at between 25 and 30 mile/h. The same thing happened at signals VC584 and VC572, that is Short first saw them displaying a red aspect which changed to one yellow as he approached. He also distantly saw VC564 at red, and as he approached the flyover bridges shut-off the power he had applied to climb to that point. Between the two bowed-girder bridges a down Gatwick Express passed Short's train (this would be the 09.45 from Victoria, which 2L51 was waiting to cross). Short glanced at the down train, and recognised its driver as the son of Guard Scott (the guard of 2L51); he waved at Driver Scott, and thought that Scott waved back. At about this time the AWS in Short's driving cab sounded a warning for signal VC564, and he recalled cancelling it. He also had a distant recollection of looking across at a train approaching Battersea Park on the South London lines.

26. As a result of these distractions Short coasted past signal VC564 without consciously observing its aspect at all. As he proceeded he saw signal VC522 in the distance showing a proceed aspect with the junction 'feather' illuminated; he estimated the speed of his train at about 30 mile/h at this point. On rounding the curve to Battersea Park station he saw the DEMU; at first he concluded it was on the down line but a few seconds later he realised it was on the same line in front of him. Short admitted that he froze momentarily, unable to believe what he saw, before making a brake application by which he thought he reduced his speed to a closing speed of 15–20 mile/h relative to the DEMU at the moment of impact. He thought that he made the brake application only 4 or 5 seconds before the collision.

27. To summarise the AWS indications prior to the accident, Short recalled at least 3 successive warnings before Clapham Junction station, 3 more afterwards at each of which the signal changed from red to yellow before him, and finally he recalled cancelling the warning at VC564 but failed to see whether the signal had changed from red to a proceed aspect. After the accident he realised what he had done and freely admitted to me that he must have passed VC564 at Danger, having allowed himself to become distracted as he approached it. In the collision he was not seriously injured and was lucky to escape with a leg injury sustained against the driving desk.

After the Accident

28. *Mr C Daughton, the Area Manager, Victoria,* attended the site of the accident as Mishap Controller. As such, he told me, he first of all satisfied himself that the site was safe from other train movements and from electrical hazard. He then liaised with the emergency services regarding the evacuation of the injured by ambulance, and then of the uninjured by train. He did not consider there was any particular pattern to the distribution of injuries in the two trains, except that most of the injured were in the last two coaches of the East Grinstead train and the first two of the Gatwick. As for means of egress, whilst some external doors did not open freely, sufficient of them could be forced open so that this did not cause any delay; no external windows had to be broken by rescue workers to facilitate evacuation,

and only one each side had been broken in the collision. Certain internal vestibule sliding doors were jammed, and glass panels had been broken in some of these to aid egress.

29. Mr Daughton told me he was assisted by his Operations Manager, Mr Barrett, who was particularly involved in organising the relief trains and the restoration of services. As to the partial restoration of current, it was found that the current isolation had been taken by and in the name of Signalman Rubie on No 1 Panel, not in the name of Driver Fox, as Fox had believed. Therefore both the electrical and movements aspects of restoring services could be co-ordinated at the signalbox on the instructions of Barrett at the site.

30. *Mr J Hailstone, Area Maintenance Engineer (Traction and Rolling Stock)* also attended the scene of the accident. He established the point of collision quite accurately from the patches of glass crumbs from one broken window on each side of train 1D91, which were trapped where they fell in the ballast. 1D91 had come to rest 23m beyond the point of collision, and 2L51 had separated and run further, stopping with its rear 43m forward from the point of collision, which was itself 100m before signal VC552.

31. Mr Hailstone also noted, and had photographed, the state of the cab which Short had occupied. The brake handle was in the emergency position, the power and master control handles locked 'off', the cab heater at 'minimum' and the AWS indicator showing 'all black' ie that the last indication received was 'clear'. Calculations had shown however that the receiver had already passed over the inductor for VC552 before the collision; if VC552 was showing 'clear' at this time, that was the valid AWS indication showing in the Gatwick train.

32. Subsequent tests on the stock of train 1D91 revealed no pre-accident fault on the brake system, the AWS was working correctly, and the speedometer was reading about 3% higher than actual speed.

33. From Driver Fox's evidence at the British Railways' own inquiry, and using performance data for the type of train involved, it had been calculated that 2L51 probably reached a speed of 8 mile/h in the distance it had travelled before it was struck by 1D91.

34. Mr Hailstone also summarised the damage to the rolling stock, the most significant points of which were: On the DEMU train both diesel power units had been displaced from their mountings, there was buffing gear damage throughout and slight body structure and interior damage to some vehicles. The Gatwick Express vehicles suffered worse; all of them sustained some end damage and minor internal damage, but the first passenger coach sustained vertical bending of its body structure, consequent upon telescoping at floor level. The distortion passed through the rearmost windows of the passenger saloon, which broke in consequence, and caused the passenger saloon floor to buckle upwards by about 600mm. Some seats were displaced from their mountings, particularly those which were in solitary pairs i.e. not being braced against either a bulkhead, another pair of seats, or a luggage stand. A number of sliding vestibule doors had become immovable by being displaced from their runners. There was also some damage to the electro-diesel locomotive at the rear, including displacement of the diesel engine from its mountings.

35. Mr Hailstone had consulted technical experts within British Railways regarding the coach body distortion described above. He remarked that some of the energy of colliding trains is often absorbed in causing derailment, and vertical or sideways displacement of whole vehicles. This did not occur; the trains stayed coupled in their original formations and on the rails. Some energy would be absorbed and released elastically; above a certain limit it would cause permanent deformation. It could be demonstrated that the vehicle which did deform was the one most likely to do so and the extent and nature of the damage was to be expected in the circumstances.

36. *Mr P Hunter, a Signal and Telecommunications Maintenance Assistant,* organised the testing of the signalling after the accident. He told me that firstly the positions of the relays associated with VC564 signal were noted very soon after the accident, before any change had taken place. Tests and examinations were then carried out on VC564, 572 and 584 signals to ensure they were clean, properly aligned and properly illuminated; the corresponding AWS inductors were also tested. Insulation tests between all relevant cables and from the cables to earth showed a minimum resistance of 20 megohms, a very satisfactory value.

37. After the trains were moved the inter-locking between the signals was thoroughly tested both from the control tables to which it had been designed and on the basis of direct logic from the layout on the signalling panel. No fault was found with the signalling equipment, and Mr Hunter was satisfied that when train 2L51 was standing at signal VC552, it must have been protected at the rear by a red aspect in

signal VC564. The fact that the train description 2D91 had not stepped forward from VC564 on the panel, although the train had entered the section ahead, also confirmed that no route for it had been cleared in advance of VC564.

38. As to the fault which had been reported on signal VC554, this had no bearing whatsoever on the control of VC564. The cause of the momentary failure to safety (red instead of green) was not established but it had not recurred and must have been of a transitory nature. No fault was found with the signalling and no repairs were required before it was returned to service use after the accident.

CONCLUSIONS

39. The accident was entirely due to Driver Short allowing himself to be distracted from his duties for a few seconds, during which time he cancelled the AWS warning for signal VC564, and allowed his train to continue past that signal which was at Danger. I am entirely satisfied that there were no contributory defects on the train or the signalling equipment, both of which performed as designed. It is to Driver Short's credit that he freely admitted his error without claiming any mitigating circumstances whatsoever.

DISCUSSION

As to Safety Aids for Drivers

40. Over many years technical innovations have been introduced to reduce the chance of a signalman's error creating a situation of danger; and experience shows that equipment designed to be 'fail-safe' is more reliable at preventing danger than the human beings operating it. In contrast, since the standardisation of the BR AWS system in 1958, less attention has been paid on BR to enhancing equipment intended to prevent driver's errors. The AWS system was introduced in an era when absolute block signalling predominated, and was provided at distant signals to draw the driver's attention to the lineside signal which he is required to observe. His attention was drawn by two completely unambiguous audible indications: 'Caution – acknowledge and commence or consider brake application' or an audible which indicated the presence of a clear signal with no action required. In extending the application of AWS into four-aspect colour-light signalling schemes the "Caution" indication has acquired additional meanings, as it is given at all aspects of a signal other than green. It is foreseeable that when trains are following each other at close headways (as Driver Short's train was following the DEMU), the repetitive cancelling of the AWS warnings received when a speed reduction is not necessary will sometimes lead to a lack of cognisance when a warning is received which does demand a brake application. When AWS was first applied to closely-spaced four-aspect signals in the Southern Region in 1963 this problem received much thought both by British Railways and the Railway Inspectorate. Various alternatives were proposed and experiments were conducted which delayed the general introduction of AWS on the Southern Region. The inherent complexity and higher costs of more sophisticated systems led to a decision that the BR AWS system should be applied throughout the Southern Region, to bring within a reasonable timescale the safety benefits which would accrue, whilst accepting the small risk from repetitive cancelling of warnings.

41. With rapid advances in semi-conductor technology, systems are now available and in use elsewhere which monitor the movement of a train and reduce its speed, or stop it if necessary, if the driver allows it to proceed into danger. In short, such equipment prevents the driver from committing a potentially dangerous error, just as signalmen in modern signal boxes already have the benefit of equipment which prevents them from committing errors. I am aware that British Railways are currently reviewing the need to provide further assistance in the driving cab, including the enhancement of the AWS to differentiate between different lineside signal warning aspects.

As to the Crash-Worthiness of the Vehicles

42. The Mk II type of coach was the first on British Railways to be designed as an integral structure, that is with the body structure sharing the load-bearing function with the underframe. The design generally followed UIC (International Union of Railways) standards and a prototype test in 1964 applied a longitudinal compressive load of 200 tons without permanent deformation. This was and still is (now defined as 2000kN) the principal end-loading tolerance in UIC recommendations, which have been adopted in full in British Railways' current rolling stock specifications. I am satisfied that the location and nature of the structural damage to one coach was entirely as might be expected in the circumstances, and I have no criticism of the behaviour of the vehicle structures in the collision.

43. A less satisfactory aspect was the performance of some internal fittings in the Mk IIf coaches, in particular the collapse of some seats and the jamming of vestibule doors. At the time these coaches were

designed the security of such items was not subject to a detailed specification, but relied on the designer's judgement based on previous experiences of normal and abnormal usage. Since then more attention has been paid to the strength of fittings under everyday and crash conditions. For the later Mk III coaches the loads which seats and their fastenings should withstand were specified whilst for the next generation of coaches (Mk IV) loadings for seats, tables and luggage racks have been defined taking into account the likely or foreseeable interactions between those fittings and the passengers. There is also an overall requirement that all fixed equipment and its mountings should withstand 3g deceleration. The current British Railways requirements are compatible with the latest draft UIC specifications, but I believe there may be further scope for improving the crash-safety of vestibule doors to maintain a safe way out after an accident.

As to the electrified line instructions

44. Whilst I have no doubt that the accident site was made safe and kept safe from danger, I gathered there was some doubt in the mind of Driver Fox since Southern Region drivers had been reminded that they must personally authorise the restoration of current after requesting an emergency isolation e.g. to carry out running repairs to a disabled train. There is a difference between that situation and the conditions at this major accident where many personnel are involved and control of the site is taken at a more senior level. This is a reasonable and proper state of affairs, but it is unfortunate that it left some doubt as to who was in charge of the current isolation.

RECOMMENDATIONS

45. In the application of modern technology effort should be directed towards providing additional assistance in the driving cab to avoid drivers receiving repetitive identical warnings with different implications. The ultimate should be to prevent lineside signals being passed at Danger by a system which cannot be over-ridden by the driver.

46, British Railways should ensure that on new passenger coaches all major interior fittings will meet its new standards of crash-resistance. If the current draft UIC standards are published, these would be an acceptable design standard. The crash-resistance of vestibule doors should also be considered. I further recommend that existing rolling stock having a long future life should be reviewed in the light of the new standards to see if improvements are necessary or justifiable.

47. Books of instruction, and practical training, in emergency procedures on electrified railways should attempt to ensure that there need be no doubt in the minds of the participants as to who is in charge of an emergency isolation of the traction current supply.

I have the honour to be,

Sir

Your obedient servant,

D S HARLAND

The Permanent Under-Secretary of State
Department of Transport

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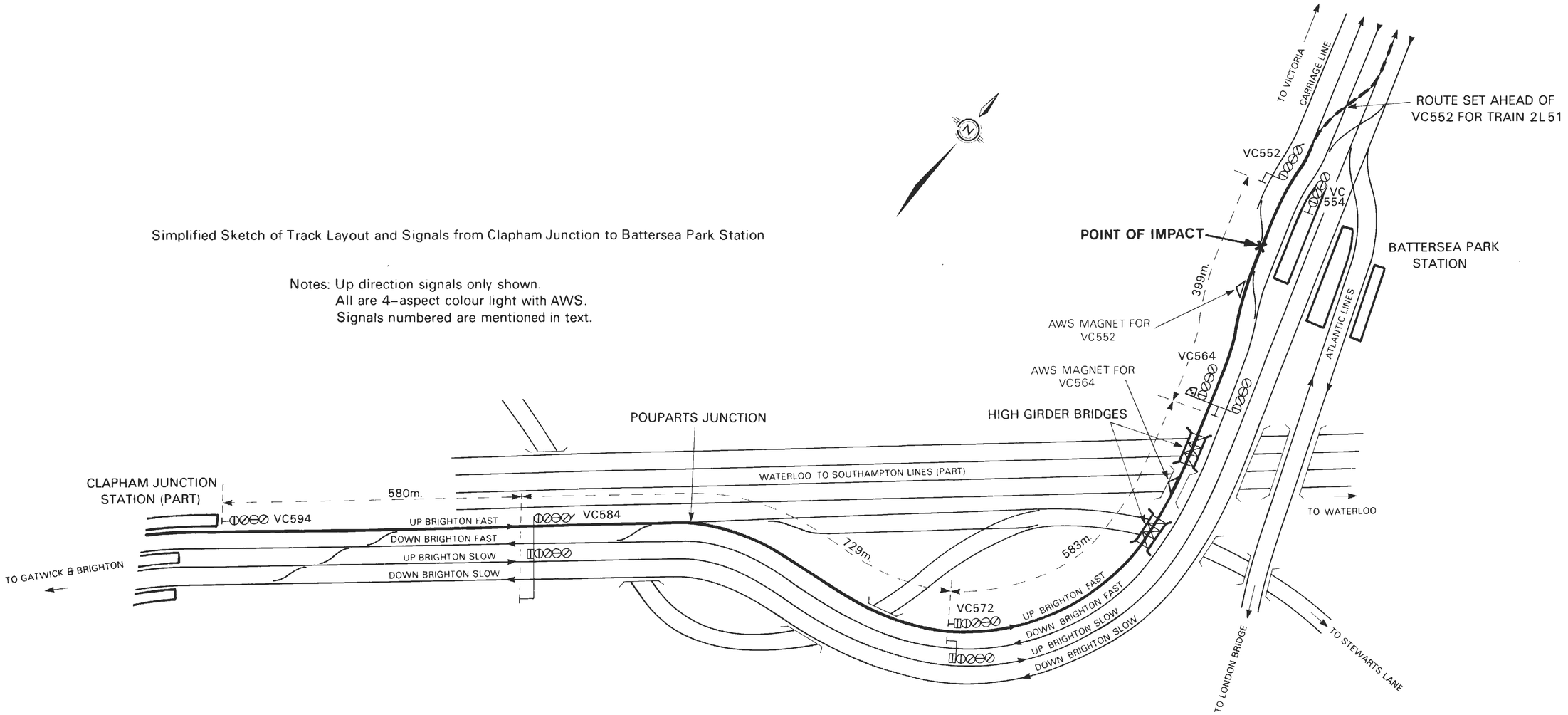
COLLISION AT BATTERSEA PARK 31st MAY 1985

Simplified Sketch of Track Layout and Signals from Clapham Junction to Battersea Park Station

Notes: Up direction signals only shown.
All are 4–aspect colour light with AWS.
Signals numbered are mentioned in text.



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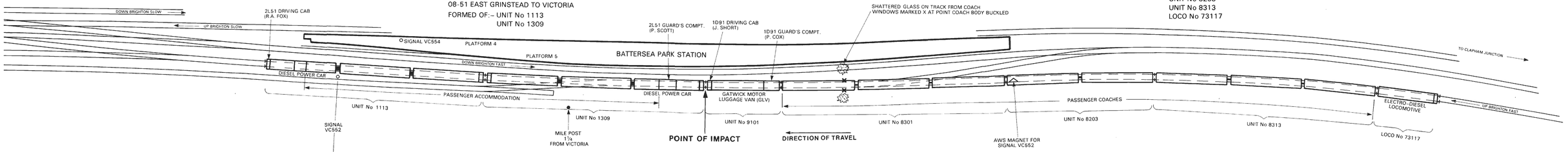
COLLISION AT BATTERSEA PARK ON 31st MAY 1985

Formation of the trains and their positions before and after collision

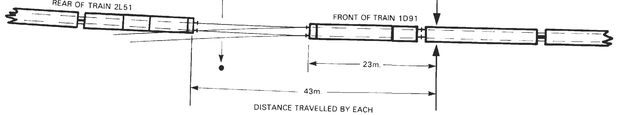
POSITION OF THE TRAINS AT MOMENT OF IMPACT

TRAIN 2L51
08-51 EAST GRINSTEAD TO VICTORIA
FORMED OF:– UNIT No 1113
UNIT No 1309

TRAIN 1D91
09-20 GATWICK TO VICTORIA
FORMED OF:– UNIT No 9101
UNIT No 8301
UNIT No 8203
UNIT No 8313
LOCO No 73117



FINAL POSITION OF TRAINS AFTER COLLISION



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