



DEPARTMENT OF TRANSPORT

RAILWAY ACCIDENT

Report on the Collision that occurred on 22nd October 1979 at Invergowrie

IN THE
SCOTTISH REGION
BRITISH RAILWAYS

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RAILWAY INSPECTORATE,
DEPARTMENT OF TRANSPORT,
2 MARSHAM STREET,
LONDON SW1P 3EB
16th January 1981.

SIR,

I have the honour to report, for the information of the Secretary of State, in accordance with the Direction dated 24th October 1979, the result of my Inquiry into the collision between two passenger trains that occurred on 22nd October 1979 at Invergowrie, near Dundee, in the Scottish Region of British Railways.

At approximately 10.56 on Monday, 22nd October 1979, the 08.44 Glasgow to Dundee passenger train passed Longforgan Signal Box, about 6 miles west of Dundee, and was correctly signalled into the section leading to the next signal box ahead, Buckingham Junction. It was running some 25 minutes late, having lost time on the journey from Glasgow due to mechanical difficulties with its diesel locomotive. After making its booked stop at Invergowrie Station, the locomotive was unable to develop adequate power and, after travelling slowly some 540 yards beyond the station, the train came to a stand. The driver applied the train brake and sent his assistant back to inform the guard that the locomotive was a failure.

Meanwhile the following train, the 09.35 Glasgow to Aberdeen express, had arrived at Longforgan at 11.09. It was brought nearly to a stand at the Down Home signal in accordance with the rules and the signalman then cleared this signal with the intention of allowing the train forward towards the Down Section signal to await clearance of the section by the train ahead. The Section signal had been replaced to Danger by the signalman after the passage of the 08.44 train and the interlocking was such that it could not be cleared again until the next train had been accepted by Buckingham Junction. The signal was visible from Longforgan Signal Box and appeared to the signalman to be correctly at Danger. The 09.35 train, however, did not stop at the Section signal but continued forward into the occupied section. The Longforgan signalman immediately telephoned to Buckingham Junction and sent the emergency bell signals but there was nothing that either signalman could do to prevent a collision.

The 09.35 train passed through Invergowrie Station at about 70 mile/h, at which point the 08.44 train would have come into the driver's view, only a few hundred yards ahead. A last-second brake application reduced the train's speed to around 60 mile/h before it struck the train ahead. The force of the collision threw the two rearmost coaches of the 08.44 train across the sea wall and onto the muddy foreshore of the Tay estuary. Of the other three coaches in this train, the first was derailed and drawn towards the river and the second and third were projected onto the sea wall but remained coupled to the first coach. The locomotive was not derailed. The locomotive of the 09.35 train was very severely damaged and derailed all wheels. Its leading cab was totally crushed. The first coach was impacted into the rear of the locomotive and derailed all wheels, and the leading bogie of the second coach was also derailed. The remaining five coaches were not derailed and the complete train remained coupled together.

I regret to have to report that the driver and driver's assistant of the 09.35 train together with two passengers travelling in the rearmost coach of the 08.44 train were killed, and an elderly lady received injuries from which she subsequently died.

The accident was witnessed by local residents who alerted the emergency services at 11.12. The response was immediate and the first unit arrived at 11.20. Fifty-one persons, including five railway employees, were taken by ambulance to Dundee Royal Infirmary, where 13 were detained including four with serious injuries. During the rescue operations the tide was on the flood, with High Water due at 16.40. Difficulty was experienced in righting the rearmost coach of the 08.44 train, which had become partially submerged, and the Tay Bridge rescue craft assisted the Fire Services to recover the last body from this coach. The uninjured passengers were taken from the site to Dundee by bus.

Clearance of the wreckage and repairs to the damaged track continued until 09.30 on Tuesday, 23rd October, when both lines were reopened, subject to a 5 mile/h speed restriction.

At the time of the accident the weather was fair with generally good visibility.

DESCRIPTION

The Line

1. The double line railway between Perth and Dundee runs along the north side of the Firth of Tay, the general alignment being west to east. The Down direction is from Perth to Dundee. Between Perth and Dundee there are unstaffed passenger stations at Errol (10 miles 858 yards from Dundee) and Invergowrie (3 miles 1100 yards). Approaching Invergowrie Station from the Perth direction the line is

in cutting but beyond the station it runs slightly above the level of waste land to the north and with the Tay estuary on the south side. The Down line is on a right hand curve of 30 chains radius with gradients varying between level and 1 in 318 rising. The collision occurred at 3 miles 560 yards, at which point the line is retained on the south side by a masonry sea wall sloping down at 45 degrees to the estuary, where the high water mark is about 13 ft below the level of the railway. The general layout of the line, together with the position of signals, is shown on the diagrams at the back of the report (Figures 1 to 5).

The Signalling

2. The double line between Longforgan and Buckingham Junction is worked in accordance with the Absolute Block Regulations. Longforgan Signal Box is situated on the Down side of the line adjacent to and on the Perth side of a public level crossing. British Railways standard 3-position block instruments are provided. The Longforgan Down Distant signal is a colour-light capable of showing a single-yellow or green aspect. It is situated 1,751 yards from the signal box and is equipped with standard B.R. Automatic Warning System (AWS) equipment. The Down Home signal is a semaphore, situated 71 yards on the approach side of the signal box and 1,680 yards from the Distant signal. The Down Section signal is also a semaphore, situated 522 yards in advance of the signal box. Its signal arm is positioned 27 ft 6 ins above rail level and the centre of the lattice signal post is 5 ft 6 ins from the outside edge of rail. All the signals are to the left of the line to which they refer, and the semaphore signals are upper quadrant and oil lit. The Up and Down Distant signals were renewed as colour-lights in April 1979 and the Down Home 2 signal removed, otherwise the signalling at Longforgan had remained substantially unchanged during the 30 years that preceded the accident.

3. At the time of the accident, the following block controls were provided on the Down line at Longforgan:

Down Section Signal

This is provided with a Line Clear release which prevents the signal lever being pulled unless the Buckingham Junction signalman has placed his Down line block commutator, and hence the block needles in both Buckingham Junction and Longforgan, to Line Clear. Once a Line Clear release has been obtained, and the signal lever pulled to clear the signal and then replaced to return the signal to Danger, the lever cannot be pulled again until the normal block signalling procedures have been carried out and a new Line Clear release has been given by Buckingham Junction. In order to ensure that the signal lever in Longforgan is replaced, and therefore locked electrically awaiting a further Line Clear release, a mechanical interlock (known as a sequential lock) is provided such that, unless the section signal lever has been properly replaced, the signalman cannot clear the Down Home signal.

Down Home Signal

This is provided with a Home Normal Contact (HNC) which prevents the Longforgan signalman from giving Line Clear to the signal box on the approach side, Inchtute, unless the Down Home signal has been replaced to Danger and the lever has been properly replaced in the frame.

Down Distant Signal

The electrical controls on this signal are such that the Longforgan signalman cannot accept a train from Inchtute unless the signal lamp is lit and showing a yellow (Caution) aspect.

The combination of a Line Clear release on the section signal, sequential interlocking, HNC on the Home signal, and proving of the Distant signal thus requires that the Section, Home, and Distant signals are replaced to Danger and Caution respectively after the passage of a train and a fresh Line Clear release obtained from Buckingham Junction before a second train can be signalled into the section.

4. There are no electric track circuits at Longforgan on the Down line but there is a berth track circuit at the Buckingham Junction Down Home signal. Once the Down line block instrument at Buckingham Junction has been placed to 'Train on Line' (after Longforgan has sent 'Train Entering Section'), the block between Longforgan and Buckingham Junction cannot normally be released until a train has passed through the section and over this track circuit. The only alternative is to obtain a release by using a hand-operated screw release at Buckingham Junction. Operation of this hand release takes about two minutes and can only be done while the track circuit is clear; its use is covered by special instructions.

5. The Longforgan Down Section signal is operated to the OFF (clear) position by a single signal wire and returns to Danger under its own weight, assisted by a weighted balance lever at the foot of the signal post. At the time of the accident, no apparatus was provided by which the signalman could adjust the tension of the signal wire, although adjustment could be made, by Signal and Telecommunications technicians, using a hook and chain arrangement located beneath the operating floor of the signal box. The signal arm, or light, is normally visible from the signal box against a distant background of trees and buildings. At the time of the accident, there was no arm or light repeater for the signal in the signal box.

6. The British Railways Rule Book states that a semaphore signal at Danger has the arm in a horizontal position and a clear signal has the arm raised or lowered at 45 degrees. For a signal to be regarded as a proper clear one, the tolerances accepted by the Board are a minimum inclination of 37½ degrees and a maximum of 65 degrees. Any inclination outside these limits is regarded as a defective signal. Where an electric arm repeater is provided in the signal box a tolerance of plus or minus 5 degrees is allowed on the Danger aspect; this means that provided the arm is not more than 5 degrees above or below the horizontal it will be indicated as a proper ON signal. These tolerances are for signalling maintenance purposes; they are not quoted in the Rule Book.

The Trains

7. Train 2L31, the 08.44 Glasgow to Dundee, was formed of diesel locomotive 25 083 and five vacuum-braked coaches: 4 Tourist Second Open coaches and a Brake First Corridor at the rear. The total weight of the train was 236 tonnes, the total available brake force was 196 tonnes, and the overall length of the train was 382 ft.

8. Train 1A25, the 09.35 Glasgow to Aberdeen, was formed of diesel locomotive 47 208 and seven vacuum-braked coaches. From the front these were marshalled as follows: a Brake Second Open, a First Corridor, a Miniature Buffet car, three Tourist Second Opens, and a Brake Second Open. The total weight of the train was 346 tonnes, the total available brake force was 282 tonnes, and the overall length of the train was 528 ft.

Rules and Regulations

9. Extracts from the British Railways Rules and Regulations that are relevant to the Inquiry are given in Appendix 1.

EVIDENCE

10. The 08.44 Glasgow to Dundee train was driven by *Driver R. Croll* of Eastfield Depot. He was accompanied by *Driver's Assistant I. Forsyth*, also of Eastfield. Driver Croll had been a railwayman for 34 years and had driven trains over the Perth to Dundee line since the days of steam. On joining locomotive 25 083 at Eastfield they found that the train heating boiler was not working and that there did not appear to be a repair book on the locomotive. Croll made enquiries about the repair book but it could not be found and a new one was made out. The fault in the boiler was rectified and they left for Queen Street Station with the locomotive apparently in satisfactory working order. Having coupled to the train, they left Queen Street, on time, at 08.44.

11. The gradients between Queen Street and Cowairs are severe and required the locomotive to be on full power. At two points power was momentarily lost but was regained when Croll closed the throttle and then reopened it. After Cowairs the run as far as Gleneagles was normal, apart from a short delay at a level crossing. Approaching Hilton Junction, Perth, power was again lost and the train came to a stand. There was no blue light on the cab panel, which would have indicated an earth fault, but on going into the engine room Croll found the earth fault light illuminated. After resetting and then isolating the earth fault switch, he found he could obtain power and continued to Perth, where a fitter was awaiting their arrival. Croll told the fitter that there had been an earth fault on the locomotive and that he had isolated the fault switch and the fitter said that it would be in order for them to continue to Dundee.

12. On leaving Perth the locomotive appeared to be working normally. After a station stop at Errol they approached Longforgan. The colour-light Distant signal was at Caution when it first came into view but cleared to green as they approached, travelling at about 60 mile/h. The Home and Section signals were both off when they came into view. Both signal arms were fully off, at something like 45 degrees above the horizontal. They continued to Invergowrie, where they stopped normally, but on restarting something seemed to be holding the train. After travelling slowly until the rear of the train was just clear of the station, Croll stopped and examined the locomotive. The brakes appeared to be binding on the leading bogie and he could not free them so he restarted the train, hoping to be able to complete the short distance to Dundee. Having travelled a few hundred yards, Forsyth called out that a traction motor was on fire so Croll stopped the train, applied the brakes, and stopped the engine. After again inspecting the locomotive from the ground he told Forsyth to go back and tell the guard that the locomotive was a failure and that they would need assistance. Forsyth left and Croll climbed back into the cab but he was then suddenly thrown heavily into the engine room by the force of the collision. As far as he could remember, it was only two or three minutes after leaving Invergowrie that he had sent Forsyth back to report the failure. Forsyth confirmed his driver's evidence. On going back, he had reached the fourth coach from the locomotive when the collision occurred. In reply to my questions, Driver Croll said that in all his experience he could not recall any occasion when a semaphore signal had been other than properly on or off.

13. The guard of the 08.44 train was *Guard J. Barrie* of Glasgow, Queen Street. He had been a guard for over 5 years. He had not observed any of the signals as the train passed Longforgan. After the station stop at Invergowrie he joined the last coach and as the train set off it was clear that the locomotive was again in trouble. The train moved slowly and stopped with the rear coach just clear of the platform. After several attempts the driver got the train going and they moved some distance away from the station. At this point Barrie started to go forward through the train, switching off the lights in the coaches. However, the train then stopped again and he sensed that this time the locomotive must have failed completely, so he went towards the rear of the train to prepare for carrying out protection. He had reached the junction between the fourth and the last coach when he heard the sound of an approaching train. He immediately looked out of an off-side window and saw a train approaching at high speed round the curve at Invergowrie. He shouted a warning to the passengers and had reached the middle of the fourth coach when the collision occurred. only 4 or 5 seconds after he had seen the other train. After the collision, the coach was laying on its side. He gave what assistance he could to injured passengers before being taken away by ambulance to have his own injuries attended to. He remembered that there had been only two passengers in the rear coach and about 15 in the fourth coach.

14. The guard of the 09.35 Glasgow to Aberdeen train was *Guard G. McRitchie* of Dundee. He had been a guard for 19 years and knew the line between Perth and Dundee extremely well. On the day of the accident he worked the 06.48 train from Dundee to Glasgow Queen Street together with Driver Robert Duncan and Driver's Assistant William Hume. This train was stopped by signals at Longforgan because the tail lamp had been reported out by the signalman at Buckingham Junction. McRitchie replaced the tail lamp and shortly afterwards was told by a passenger that a coach window had been broken by a stone thrown from the line side near Kinwoodie housing estate, on the Perth side of Invergowrie Station. Passengers were transferred from the affected coach at Stirling. On arrival at Queen Street all three went to the mess room where he and Hume had some tea. Driver Duncan stood talking to them and seemed to be his normal self. They then joined the train which was to form the 09.35 to Aberdeen.

15. There were several slight delays between Queen Street and Perth and they left Perth about 8 minutes late. Approaching Longforgan, McRitchie was travelling in the guard's compartment in the rear coach of the train. The train slowed down to a walking pace and he looked out of the near-side window. He saw the locomotive just approaching the Longforgan Home signal and saw this signal move from a full ON to a full OFF position. The train continued slowly past the signal and over the level crossing, and as his coach came opposite to the signal box he shook his fist at the signalman in mock indignation at being slowed down. The signalman, who was inside the cabin and standing by the frame, raised his arm in acknowledgement. As the train continued moving slowly forward he went to the off-side window so as to be in position to look at the area of the earlier stone throwing incident. The train then started to accelerate and he re-crossed the compartment and looked out of the near-side window towards the Section signal which was then about one and a half coach lengths away. The signal arm appeared to be "half-cocked", that is to say it was not horizontal but was not giving a proper OFF indication. He described it as a "poor off". The signal arm was quite stationary and there was no indication that it had just finished moving. McRitchie said that, at the time, he had not really thought about whether the signal was clear or not; he knew Driver Duncan as a most experienced and competent driver and felt that he would not have passed the signal if it had not been properly off. In retrospect, he realised that the signal was certainly not giving a proper OFF indication and he thought that he must have assumed that the signal had been cleared and returned to Danger by the signalman and that the arm had not returned properly to the horizontal position.

16. At this point, Guard McRitchie was asked to indicate his impression of the degree that the signal arm was above the horizontal, as he saw it, using a full-size model of the signal arm. He placed it at an angle of 7.4 degrees.

17. Continuing, McRitchie said that the train accelerated normally, reaching something like its normal running speed of 50-55 mile/h by the time it reached Invergowrie. He was looking out of the off-side window and, looking ahead, he saw a train standing on the curve beyond Invergowrie. He thought at first that it was on the Up line but then realised that it was on the Down. He dashed for the brake lever but there was a sharp deceleration, followed almost at once by the violent shock of the collision. Before reaching the brake he had seen that the gauge was reading zero, which indicated that the brakes were already fully applied. The gauge had previously shown a full vacuum reading. He was thrown forward, injuring his arm, but was able to collect his detonators and set out to protect the train. He met other railwaymen who said that they would look after the protection and he went forward where he found the bodies of his driver and driver's assistant.

18. *Signalman C. Dand* was on duty in Buckingham Junction Signal Box. He accepted the 08.44 Glasgow to Dundee train from Longforgan under Regulation 4 at 10.55 and received 'Train entering

section' at 10.58, at which time he offered the train to Dundee. It was accepted and he cleared his signals. At 11.10, with the train still in section and not shown as having occupied the Home signal track circuit, he received two bells from Longforgan and went to the telephone where the Longforgan signalman told him that the Aberdeen train had gone past the Section signal at Danger. This was followed by receipt of bell signal 4.5.5.—train or vehicles running away in right direction. There was no train approaching on the Up line, but Dand carried out Block Regulation 23 and then waited, hoping against hope that the Dundee train would appear so that he could replace the Home signal to Danger and perhaps slow or stop the express. A supervisor, who had come into the box shortly before 11.00, left by road for Invergowrie as soon as the message came from Longforgan and telephoned at about 11.48 with details of the accident. Dand confirmed that he had not received a cancelling signal from Longforgan before the collision and that he had not used or attempted to use the Welwyn manual release.

19. *Relief Signalman R. Mennie* was on duty in Longforgan Signal Box. He had been resident signalman at Longforgan from 1968 until May 1971 and had occasionally relieved in this signal box since then; he was nevertheless fully competent to be in charge. He had started his duty at 07.13 and the work had proceeded perfectly normally. At 10.45 he was offered the 08.44 train by Inchtute and accepted it under Regulation 4 and received 'Train entering section' at 10.54. He offered the train on to Buckingham Junction and it was accepted and he cleared his signals. He could see from the box that the Section signal was properly off. The train passed at 10.56 and he replaced his signals sequentially—Distant, Home, and Section signal. From experience he knew that the Section signal, 522 yards from the box, needed a firm replacement of the lever in the frame and this is what he gave. The visibility was good and he could see the Section signal quite clearly and it appeared to have gone correctly back to Danger. At 11.00, Inchtute offered him the 09.35 train and he accepted it under Regulation 4 and received 'Train entering section' at 11.05. At this stage he could not offer the train on to Buckingham Junction since he had not yet received the 'Train out of section' signal for the previous train, the 08.44. He therefore maintained his Home signal at Danger and observed the express come almost to a stand at it. At this point he cleared the Home signal to allow the train to pass over the level crossing and go towards the Section signal. As the locomotive passed the box, moving at a walking pace, he caught a glimpse of the driver and his assistant and he thought that he might have given them a wave, although he could not be sure. The train was still going slowly when the rear coach passed the box and he gave a friendly wave when the guard shook his fist at him—he knew Guard McRitchie. As the train approached the Section signal it started to pick up speed and went past the signal, which as far as he could see was still at Danger. He immediately informed Signalman Dand at Buckingham Junction and then went down on to the track near the level crossing gates. From there it appeared that the signal arm was slightly raised. Using the full-size model of the signal arm, Mennie set it at between 2.8 degrees minimum and 5.6 degrees maximum to show the degree of rise as it appeared to him from the track.

20. *Leading Trackman W. Bluckley* carried out regular patrolling of the section of line that included Longforgan, walking both Up and Down lines three times each week. On previous occasions—he remembered one about five months before the accident—he had noticed that the arm of the Down Section signal was not quite horizontal and he had pushed down on the weighted lever arm at the base of the signal until the arm was properly horizontal. On these occasions he had reported what he had done to the signalman. Using the model signal arm, he indicated that on these occasions the arm had been just over 2 degrees above the horizontal. On the day of the accident he commenced his patrol, walking from Dundee towards Longforgan in the Down line four-foot space. He noticed nothing unusual about the Longforgan Down Section signal and it was only after the accident that he learned that the bracket at the base of the signal was badly bent and had apparently been bent for some time. Arriving at the signal box he went inside to use the lavatory and on coming out he saw the express train slowly approaching the Home signal. As it passed the box he was standing, wearing his high visibility jacket, in the front corner of the box nearest to Dundee, and as the locomotive passed he gave a wave towards the driver. He did not see whether the driver made any response. As far as he could remember the windows in the signal box were closed. Neither he nor the signalman had shouted anything as the locomotive passed. He did not look towards the Section signal and did not see the train go past it because he left the box as soon as the locomotive had passed and continued his patrol towards Inchtute.

21. *Signalman W. Paton*, although not on duty at the time of the accident, had been a regular signalman at Longforgan for about three years. During that period there had been a number of occasions, during very cold or very warm weather, when the Down Section signal had not gone to the fully OFF or fully ON position due to tension or slackness in the signal wire. On one occasion, soon after he had started at the box, the signal was showing a proper red light during the night but when daylight came he could see that the signal arm was not truly horizontal. Using the model arm, he estimated the inclination on this occasion to have been about 5.4 degrees. Thereafter, on cold nights, he would bang the lever back in the frame rather than replacing it normally. On some occasions he had gone down outside the box and lifted the wire until the signal arm became slightly raised and then dropped the wire thus causing the signal to drop to the fully horizontal position. He would then go below the operating

floor and adjust the wire, using the hook and chain. He made these adjustments, both to tighten and to slacken the wire, whenever he considered it necessary, often judging by the 'feel' of the lever that the wire was slightly tight or loose. Some 12-18 months before the accident he had suggested to a supervisor that wire adjusters should be provided but nothing had come of this. During his time at Longforgran he had never known a driver question any of his signals.

22. *Senior Technician J. M. Stewart*, based at Perth, had been responsible for the maintenance of the signals at Longforgran during the five years preceding the accident. He had carried out an inspection and maintenance of the signals on 9th October. In the case of the Down Section signal, he had examined the running wire between the signal box and the signal, oiled and greased the moving parts at the signal, and checked that everything was secure and in proper working order. He was quite sure that on 9th October the bracket at the base of the signal was not damaged or bent. After carrying out his maintenance work, which he did at least once every month, he would go to the signal box and have a word with the signalman. At no time during the past five years had he received any complaint about the Section signal, nor was he aware that the signalman was in the habit of adjusting the signal wire. He himself adjusted the wires, usually before the commencement of the warm or cold weather. In the normal course of events he would have adjusted the wires during his next visit to Longforgran, in November.

23. *Mr. I. K. Samson*, the Assistant (Maintenance) at the Divisional Signal and Telecommunications Engineer's office, Perth, was responsible for the maintenance of all signalling equipment on the line between Perth and Dundee. He was informed of the accident at about 11.55 and went to Invergowrie, where he set about providing communication to the site. While there he was told by a Traffic Inspector that he should go to Longforgran and look at the Section signal. Approaching Longforgran by road, he could see that the signal arm was slightly 'cocked'. At the signal, he scribed the position of the balance lever against the signal post and then climbed to the signal arm and scribed its position, marking the boss plate across to the signal spindle. The time was then between 13.00 and 13.15. He went to Perth to collect a gauge and returned to the signal at about 14.30. The position of the balance lever and the signal arm had not altered in relation to the scribe marks. He measured the inclination of the signal arm above the horizontal and found it to be 6 degrees. Later that afternoon Mr. Samson was involved in the testing of all the block controls at Longforgran and Buckingham Junction. These are the controls described in paragraphs 3 and 4. The tests established that all the controls were in order and were functioning correctly.

24. After the accident, Mr. Samson examined the signalman's reports for Longforgran back to 1977. There had been no reports of failure or of difficulty with any of the signals. He had not been aware, before the accident, that Signalman Paton and possibly others had been in the habit of adjusting the signal wire at Longforgran; he was firmly of the view that, without an arm repeater, the signalmen should not have attempted to make adjustments on a signal so far from the box. Neither had he been aware, before the accident, that the Longforgran signalman had made verbal requests for the provision of a wire adjuster.

25. Various other people visited, or saw, the Down Section signal between the time of the accident and Mr. Samson's arrival at about 13.00. The first of these was probably *Mr. J. B. Heatlie*, the Area Manager at Dundee, who arrived at Longforgran Signal Box shortly before 12.00. From the level crossing he could not be sure whether the signal was fully horizontal, so he walked down the line towards it. The closer he got, the more the signal arm appeared to be raised above the horizontal. At the signal, he saw that the wire between the balance weight lever at the foot of the post and the signal arm was tight and that both the balance lever and the arm were slightly raised. He used a small piece of stone as a gauge to measure how far the balance lever was raised. He then climbed the signal post ladder and verified that the signal would have been showing a full red light had it been dark. He was positive that the signal arm did not move at all during his ascent and descent of the ladder. The following day he revisited the signal, where members of the C.S. & T.E.'s staff showed him the scribe marks made by Mr. Samson. Using the same piece of stone, he verified that the scribe marks indicated the same inclination of the balance lever as he had found.

26. *Operating Inspector C. Murray* and *Assistant Outdoor Superintendent W. Gordon* were at Stanley Junction Signal Box at about 11.40 when they learned of the accident. They left by car and turned off the main Perth-Dundee road at Longforgran. The road between the village and the signal box is fairly open and they were able to see the Down Section signal from a distance of about half a mile. Murray, who was in the passenger seat, thought that the signal was off. They reached the signal box at about 12.20 and saw that the signal lever was normal in the frame. From the operating floor the signal arm appeared to be horizontal. After about ten minutes they left the box and drove towards Invergowrie by way of the coast road. They saw the signal, this time from the south side of the line and at a distance of about 400 yards, and again it gave the appearance of being raised. Using the model arm, Inspector Murray estimated the inclination as 12 degrees when first seen from the north side of the line, as virtually

horizontal when seen from the signal box, and as 17 degrees when seen from the coast road. After visiting the site of the accident, Murray returned to Longforgan where he witnessed Mr. Samson scribe the position of the signal arm. Again on this occasion, the signal gave the impression of being raised when seen from the road, but horizontal when seen from the signal box.

27. *B.R. Divisional Fire Inspector I. Gray* left Perth by car at about 12.00 in company with other railwaymen. They called at Longforgan Signal Box at about 12.20 and asked where the accident had occurred. They did not go into the signal box, nor did they look towards the Section signal. From the coast road, Gray got a view of the signal across the fields and it appeared to him to be off. Using the model arm, he assessed the angle as 12 degrees. On arrival at Invergowrie he reported what he had seen to Mr. Sherratt and Inspector Liddle.

28. *Mr. N. Sherratt*, B.R. Safety Officer (East) based at Dundee, arrived at the scene of the accident at 12.00. At about 12.25 he was told by Mr. Gray that the Longforgan Down Section signal appeared to be off, so he left by car for Longforgan, accompanied by *Traction Inspector J. Liddle*. Approaching Longforgan along the coast road, Mr. Sherratt, who was driving, saw the signal from a point where the road was somewhat lower than the railway. The arm appeared to be raised, at an angle which he estimated (using the model signal arm) to be between 18 degrees and 20 degrees. He looked at the signal from the level crossing and thought that the arm was showing about the same angle of inclination as was seen from the road. Inspector Liddle did not get a clear view of the signal from the coast road, but as seen from the level crossing he thought that the arm was inclined at about 6 degrees with a possible maximum of 10 degrees. Both Mr. Sherratt and Mr. Liddle were experienced footplate men. Sherratt said that as a driver he would have had doubts about whether the signal was off or not, unless he had seen it move from the ON position or had received a clear Distant signal. Liddle said that, as seen from the signal box, the signal was definitely not a clear one.

29. Other witnesses claimed that the Longforgan Section signals had been 'cocked' on other occasions before the day of the accident. *Mrs. Sinclair* had been the resident Crossing Keeper at Templehall, about 600 yards to the west of Longforgan, for the past five years. The crossing is situated close to the Longforgan Up Section signal and Mrs. Sinclair said that on a number of occasions she had reported to the Longforgan signalman that the signal was not fully on. It was usually noticeable in very cold weather. She had never reported the matter officially, beyond speaking to the signalman. On the day of the accident, she had been in her garden when the 09.35 train had passed. It was travelling slowly and she had clearly seen the young driver's assistant in the seat nearest to her cottage, that is in the driver's assistant's seat.

30. *Signalman A. Merralls*, of Errol, lived in the station house at Longforgan. There had been occasions in the early morning when he had noticed from his garden that the Longforgan Down Section signal was slightly 'cocked' and not in the fully ON position. He thought that there had been times when it could have been as much as 20 degrees above the horizontal. He had also seen the Up Section signal raised by a similar amount when it was supposed to be on.

31. Estimates of the likely inclination of the Down Section signal arm at the time the 09.35 train passed the signal were given by *Mr. D. S. Jewell*, Chief Signal and Telecommunications Engineer, Scottish Region. When examined after the accident, the signal wire was found to be slightly on the tight side, this being aggravated by the deformation of the bracket at the base of the signal. Mr. Jewell considered that the deformed bracket accounted for four out of the six degrees measured by Mr. Samson. He had established that the air temperature in the area had been 9.2°C at 10.00 on the morning of the accident, followed by a maximum for the day of 12°C. There had been intermittent weak sunshine during the morning but none during the afternoon. Assuming that the maximum temperature was reached at about 13.00, the temperature at the time of the accident could have been about 10°C. Between that time and the time the position of the signal was scribed, the arm could have eased back due to expansion of the signal wire. The theoretical maximum change in inclination due to temperature was 4 degrees but, having studied the physical conditions, Mr. Jewell considered that 2 degrees was a more likely figure. Thus, allowing for temperature changes, the signal arm was most probably 8 degrees above horizontal when the 09.35 train passed, with a theoretical maximum of 10 degrees.

32. *Mr. F. C. Walmsley*, Chief Operating Manager of Scottish Region, reported that enquiries had failed to establish the cause of the deformation of the signal post bracket. Rough calculations showed that the force used must have been about a ton, and this seemed to rule out vandalism. The bracket may have been struck by a chain hanging from a wagon, or perhaps by engineers' machinery working on the lineside.

33. *Mr. G. H. Passey*, Chief Mechanical and Electrical Engineer, Scottish Region, first described the tests that had been carried out on the defective locomotive of the 08.44 train. Soon after the accident the locomotive was driven under its own power to Dundee Motive Power Depot, where it was examined.

The reason for the final failure of the locomotive beyond Invergowrie was found to be the burning through of two internal copper conductors on one of the traction motors. This had put two of the locomotive's four traction motors out of action and had led to the whole of the generator output being fed to the remaining two motors. This had given rise to severe wheel spin when the driver attempted to start the train, and to overheating of the motors. From the evidence available, it had not been possible to determine the exact sequence of events which culminated in the burning through of the conductors, nor the reasons for the incorrect fault light indications observed by Driver Croll. Mr. Passey confirmed that the action taken by Driver Croll was correct in the circumstances.

34. Mr. Passey then described tests and calculations made into sighting and braking distances at Invergowrie. He had determined that, if the 09.35 train had been approaching the Longforgan Down Section signal at 5 mile/h and had then accelerated normally, it would have achieved a speed of 70 mile/h by the time it reached Invergowrie. From the driver's cab, the point at which the stationary 08.44 train first came into view was 520 yards from the rear of the 08.44 train. Had a full brake application been made at the instant the other train came into view, the 09.35 would still have been travelling at over 40 mile/h when it collided with the train in front. However, Mr. Passey pointed out that owing to the curvature of the line it is highly probable that Driver Duncan would have assumed that the train ahead was on the Up line and that he would have travelled nearly half the distance of 520 yards before realising that the train was in fact on the Down line. An emergency brake application made from this point would have reduced the speed to between 55 and 65 mile/h. Such a speed would accord with the damage done in the collision, and the timing of the brake application would agree with Guard McRitchie's evidence. The results of these tests and calculations are shown in Figures 6 and 7 at the back of the report.

35. Finally, Mr. Passey described the tests that had been carried out on the brakes of the locomotive and train forming the 09.35 express. These showed that the brakes would have been in proper working order before the accident and that the braking performance would have been as designed.

36. During the course of the Inquiry, I viewed the Longforgan Down Section signal, which had been set at 6 degrees above the horizontal, from the signal box, from the level crossing, and from various points on the roads around Longforgan, and also from the footplate of a class 47 locomotive which followed as far as possible the movements of the 09.35 train on the day of the accident. I was struck by the apparent differences in inclination of the signal arm when viewed from different places. From the signal box, the arm was visible against a background of dark trees which sloped upwards to the left and this may have helped to disguise the inclination of the signal, which it was almost impossible to detect. The inclination was more readily visible from the level crossing, with the arm silhouetted against the sky. From the footplate, the arm looked horizontal when seen from opposite the Home signal or opposite the signal box. However, when closely approaching the Section signal, it became quite apparent that the arm was not horizontal, although the apparent inclination was certainly not such as to constitute a proper clear signal. An indication of what a signal arm looks like at various angles of inclination is given on the drawing at the back of the report (Figure 8).

*of the
"electric
brake".*

CONCLUSIONS

37. The direct cause of the accident was the passing of the Longforgan Down Section signal at Danger by the 09.35 Glasgow to Aberdeen express. The evidence suggests strongly that at the material time the semaphore arm of this upper quadrant signal was raised above the horizontal by at least 6 degrees but by not more than 10 degrees; in such a position it should have been taken to be an imperfectly exhibited signal and thus treated as at Danger, but for some reason the train driver passed the signal and continued into the occupied section.

38. I am satisfied that the Section signal had not been cleared irregularly by the signalman. The interlocking was such as to preclude this, unless a release had been given by the signalman at Buckingham Junction. There are no grounds for believing that such a release was in fact given.

39. The mechanical problems that led to the late running and subsequent failure of the 08.44 Glasgow to Dundee train were unfortunate, but should not in themselves have led to any danger: the signalling should have afforded the necessary protection to the failed train. Had the train been at a stand for longer, additional protection would no doubt have been provided by the train crew, but in the event there was insufficient time for them to do anything.

40. The Longforgan signalman acted correctly in bringing the 09.35 train almost to a stand before he cleared his Home signal. Thereafter, the Rules required the driver to move slowly forward, being prepared to stop at the signal box, and this he did. With no hand danger signal being given by the signalman, the train should then have been drawn forward so as to be clear of the level crossing and then stopped so that a trainman could go back to the signal box. In the event, the train continued slowly forward until the locomotive was approaching the Section signal at which point it started to accelerate and continued past the signal. This suggests that the driver must have been aware, when passing the

Home signal and the signal box, that the Section signal was at Danger, otherwise he would have started to accelerate as soon as he had passed the signal box. It follows that, at some point between the signal box and the Section signal, he must have become convinced that the Section signal had cleared. I believe that, after the clearance of the Home signal and having observed that the Section signal was on, the driver moved forward, looking towards the signal box until he passed it, and did not again look towards the Section signal until he was quite close to it. He may well have been looking back towards the signal box, or checking that the train was clear of the level crossing. As he then looked up towards the signal he might have concluded that it had moved since he had last seen it and that it had, therefore, been cleared by the signalman. This is the only explanation that seems to accord with the known facts. It is most unlikely that a driver of Driver Duncan's long experience and competence would have passed the signal unless he was sure that it had been cleared, and had he kept the signal constantly in view I cannot believe that he would have taken it to be clear. Nevertheless, even allowing for the optical effect, as seen from the cab, of an inclination of as much as 10 degrees on the signal arm, the signal should not have been taken as a clear signal but should have been treated as an imperfect one and thus as at Danger.

41. I rule out the possibility that the raising of their arms or waving by the signalman or the patrolman, or both, might have been taken by the driver as a sign that he could pass the Section signal at Danger. From all that I have learned of Driver Duncan, I am sure that he would never have accepted such a vague indication as authority to pass a signal at Danger.

42. There must remain a remote possibility that, at the time the train approached the Section signal, the signal arm was raised by more than 6 to 10 degrees and that it subsequently eased back to 6 degrees, perhaps when Mr. Heatlie climbed the signal post ladder. It is quite clear from the evidence that no reliance can be placed on purely subjective estimates since these varied widely depending on the individual and the point from which the signal was observed. Nevertheless, the evidence is very strong that there was no significant movement of the arm between the time that the train passed the signal and the time its inclination was scribed. I believe, therefore, that the scribing can be regarded as a reliable guide to the position of the arm at the time the train passed the signal. This was also the view of Sheriff J. B. W. Christie, who conducted the Fatal Accident Inquiry into the deaths of those killed or fatally injured in the accident. After hearing substantially the same evidence as was presented at my Inquiry, he concluded that "The deviation from horizontal which existed when the 09.35 train passed the signal was of the order of 6 degrees." He also thought it "inconceivable" that the angle could have been more than 8 degrees.

REMARKS

43. Accidents caused by a driver passing an imperfectly exhibited semaphore signal are, fortunately, very rare. One must go back 12 years, to the collision at Winwick Junction on 11th July 1967, to find a comparable accident. On that occasion a driver accepted a semaphore signal arm that was raised about 17 degrees above the horizontal as a clear signal and ran into the train ahead.

44. The signalman has the prime responsibility for seeing that a signal is displaying its correct aspect. As stated in the Signalmen's General Instructions (quoted in Appendix 1), he must "after operating a lever, switch or button, ascertain either by observation, if practicable, or by indicator where provided that the signal . . . concerned is working correctly". The evidence has shown that at Longforgan it was all but impossible for the signalman to detect, by observation, small differences in the inclination of the Down Section signal, over 500 yards away from the box, and that he was not provided with arm or light repeaters. I am glad to report that the signal box was equipped with the necessary indicators and wire adjusters soon after the accident.

45. It is, of course, unfortunate that it took a major accident to bring the potentially serious nature of the deficiencies at Longforgan to the attention of management. The evidence shows that it was common knowledge amongst the signalmen that signals could not always be relied upon to display a correct ON aspect, yet the local supervisory staff do not seem to have been aware of this nor of the fact that some signalmen were attempting to adjust the signal wires without reference to the technicians. Local management had, however, appreciated the need for wire adjusters and had proposed in June 1979 that adjusters made surplus to requirements as a result of the April 1979 signalling alterations should be fitted to the Longforgan section signals. In the absence of any complaint from drivers or signalmen, and in view of the very long time that the signals had existed without adjusters, it is understandable that, before the accident, the fitting of these adjusters should not have been regarded as a matter of high priority.

46. In addition to providing indicators and adjusters at Longforgan, Scottish Region also reviewed the need for the Down section signal to be in its present position. Retention of the signal had been discussed some time ago when the trailing crossover had been renewed. It had been decided to keep it in order to permit a train which had not been accepted by Buckingham Junction to draw clear of the level

crossing and also because no signal is provided at the trailing crossover for a movement from the Up to the Down line requiring to proceed into the section ahead. These reasons are still valid and it is not, therefore, practicable to dispense with the signal. Its position was examined by the Region's main Signal Sighting Committee. They established that the longest train regularly using the line was one of some 500 yards in overall length and that to enable this train to stand clear of the level crossing would require the Down Section signal to be repositioned some 50 yards further from the box. Detaining such a train at the Home signal was not practicable, since standing at this signal it would obstruct Templehall Level Crossing which is 440 yards on the approach side of the Home signal. The Committee therefore recommended repositioning the Down Section signal 50 yards further from the box, lowering the signal arm to approximately driver's eye level, and the provision of a track circuit and telephone at the signal for the purposes of Section K of the Rule Book. I fully endorse these recommendations.

47. Scottish Region also reviewed all the semaphore section signals in the Region that were 400 yards or more from the signal box, listing whether or not they were equipped with arm repeaters, light repeaters and wire adjusters. The review showed that a total of 50 of these signals were without one or more of these items. Some of the signals were due for replacement or renewal under existing signalling schemes; the remainder are to be provided with arm and light repeaters and wire adjusters as necessary under a programme which has already started and which it is anticipated will be completed by the end of 1981.

48. In the light of what has been done in Scottish Region, I discussed the question of similar signals in other Regions with the Board's Chief Signal and Telecommunications Engineer. He is conducting a similar review to assess the current position and is widening its scope to include an examination of the need to retain each of the signals concerned. He has undertaken to keep the Inspectorate informed of progress.

49. I also discussed the question of the tolerances in the indication of a proper Danger signal where electric arm repeaters are provided. As stated in paragraph 6, the present tolerance is plus or minus 5 degrees and the circumstances of the Invergowrie collision show that it is possible that a signal arm as little as 6 degrees above the horizontal might have been taken by a driver to be a clear signal. I questioned whether a reduction in the tolerance might not help to reduce the chance of a similar accident ever happening again. It was the view of the Railway Officers that a reduction from 5 degrees to, say, 3 degrees would be insignificant in terms of the probability of a driver accepting such an inclination as a clear signal, and that any reduction below 5 degrees would entail excessive recourse to wire adjustment in order to cater for relatively small changes in ambient temperature. I agreed that there was no point in reducing the present tolerances.

I have the honour to be,

Sir,

Your obedient Servant,

C. F. ROSE,
Major

The Permanent Secretary,
Department of Transport.

APPENDIX I

EXTRACTS FROM THE BRITISH RAILWAYS RULE BOOK, REGULATIONS FOR TRAIN SIGNALLING ON DOUBLE LINES BY THE ABSOLUTE BLOCK SYSTEM, AND SIGNALMENS GENERAL INSTRUCTIONS

British Railways Board Rule Book

Section C.3.2.1. includes the following under the heading "Semaphore Signals. Distant and Stop Signals":
 "Stop signals, consisting of a red arm, with a square end and a vertical white stripe; the day and night indications being:—

	Day	Night
Danger (Stop) position	Arm in horizontal position	Red Light
Clear position	Arm raised or lowered 45 degrees	Green Light

Section C.4.6.

4.6 Clearing of stop signals

When the Signalman is not in a position to clear a stop signal, he must not clear the stop signal in rear of it until the train has been stopped or brought nearly to a stand at such signal.

Note: The above paragraph will not apply where the stop signal in rear of the signal at Danger is:—

- (a) a colour light signal capable of exhibiting a yellow aspect and the exhibition of that yellow aspect—
 - (i) is controlled by the occupation of the berth track circuit, or
 - (ii) requires the line to be clear up to and including the terminating point of the overlap track circuit of the signal at Danger,
- (b) the signal controlling the entrance to an intermediate block section.

Where, however, the Signalman is unable to satisfy himself that the section signal is at Danger, he must not clear the stop signal next in rear for a train to draw towards the section signal unless the Driver can be advised of the circumstances.

Section C.5.9.

5.9 Clearing of stop signal when signal next ahead is at Danger

When a stop signal is at Danger, the stop signal next in rear of it and worked from the same signal box will not be cleared for an approaching train until the train is close to such signal and has been stopped or brought nearly to a stand. When the signal is cleared, the Driver must proceed cautiously to the next stop signal, being prepared to stop at the signal box if necessary.

Note: The above paragraph will not apply where the stop signal in rear of the signal at Danger is:—

- (a) a colour light signal capable of exhibiting a yellow aspect and the exhibition of that yellow aspect—
 - (i) is controlled by the occupation of the berth track circuit, or
 - (ii) requires the line to be clear up to and including the terminating point of the overlap track circuit of the signal at Danger,
- (b) the signal controlling the entrance to an intermediate block section.

Section C.5.10.

5.10 Stopping of train when signal ahead at Danger

5.10.1 When proceeding towards a section signal at Danger, the Driver must (except for station duties or shunting purposes, or as shown in clause 5.10.3 of this Section) only proceed as far as is necessary to leave the last vehicle well clear of junction points and junction crossings and, as far as practicable, within sight of the Signalman.

5.10.2 Where there are no junction points or junction crossings, the Driver must bring his train to a stand in a convenient position to enable the Trainman to go to the signal box to remind the Signalman of the presence of the train.

5.10.3 Where track circuit or other apparatus is provided in connection with the section signal, to avoid the necessity for Trainmen having to go to the signal box to remind the Signalman of the presence of the train, the Driver must draw forward to such signal.

Section C.5.11.

5.11 Signalman communicating with Drivers

When a Signalman wishes to communicate verbally with a Driver and telephone communication is not available, he will bring the train to a stand at the stop signal in rear of the signal box, after which the signal will be cleared and the train again stopped by the exhibition of a hand Danger signal at the signal box.

The Driver must not proceed until he clearly understands the verbal message and the Signalman exhibits a green handsignal held steadily.

Section E.8.

8. Duties of Drivers

8.1 Passing signal at Danger

In every case when a train is required to pass a signal at Danger, the Driver must give one long blast on the horn and proceed cautiously in accordance with the Signalman's instructions, or handsignal and instructions given by the Handsignalman. The Driver must not exceed a speed of 10 m.p.h. when passing over any facing points, switch diamonds or swing nose crossings and, where practicable, must satisfy himself that they are correctly set in position for the route over which the train is to run.

If, however, a train is detained at a defective stop signal in rear of the signal box and a green handsignal, held steadily, is exhibited by the Signalman, the Driver must accept this as an authority to pass the signal at Danger and proceed as far as the signal box for instructions.

8.2 Signal not shown or imperfectly shown

8.2.1 The absence of a signal where one is ordinarily shown, or a signal imperfectly exhibited, or the exhibition of a white light where a red, yellow or green light ought to be shown, must be treated as a Danger signal.

After the train has been brought to a stand, the Driver must immediately advise the Signalman either by going to the signal box or, where necessary, by telephone.

Regulations for train signalling on double lines by the absolute block system.

Regulation 4 (extract)

4. LINE CLEAR OR GIVING PERMISSION FOR A TRAIN TO APPROACH

(a) Except where instructions are issued to the contrary, the line must not be considered clear, nor must a train be allowed to approach from the box in rear in accordance with Regulation 1, unless the line, or at a junction the line for which the facing points are set, is clear for at least $\frac{1}{4}$ mile ahead of the home signal, and all the necessary points within this distance have been placed in their proper position for the safety of the approaching train subject to the provisions of clause (f) of this Regulation.

Where the outermost home signal is situated at least $\frac{1}{4}$ mile in rear of the next home signal a train must not be allowed to approach from the box in the rear unless the line is clear to the latter signal and any points between these signals have been placed in their proper position for the safety of the approaching train.

Signalmen's General Instructions

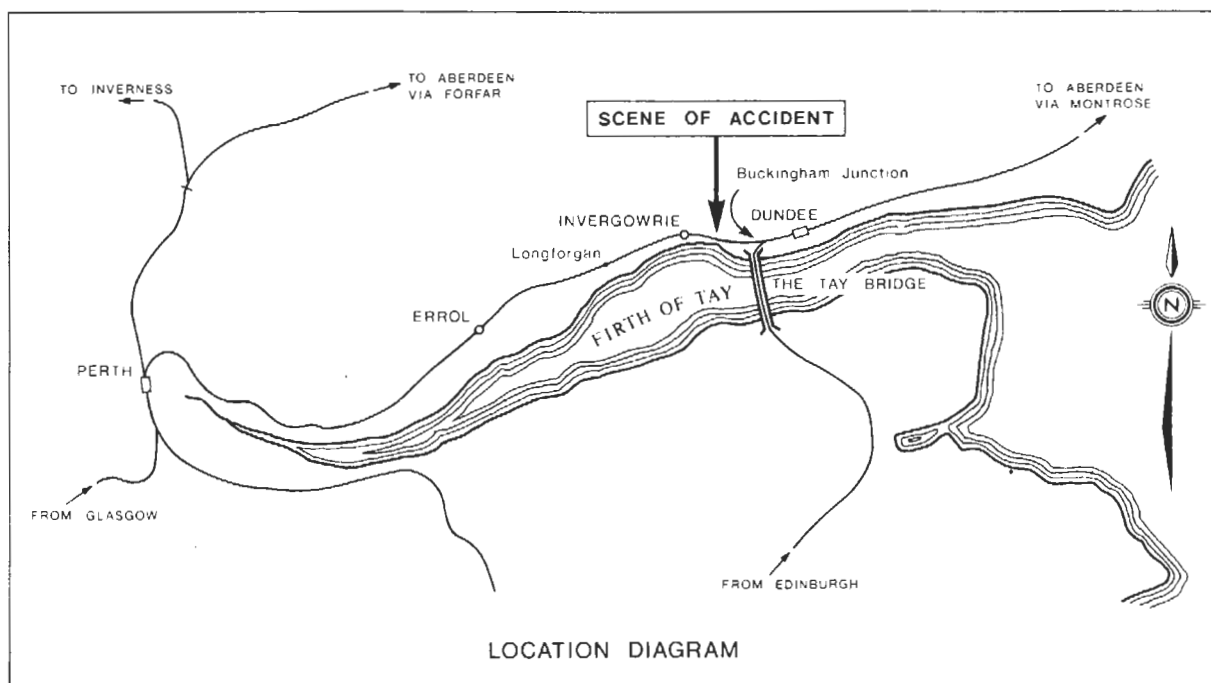
OBSERVATION OF SIGNALS

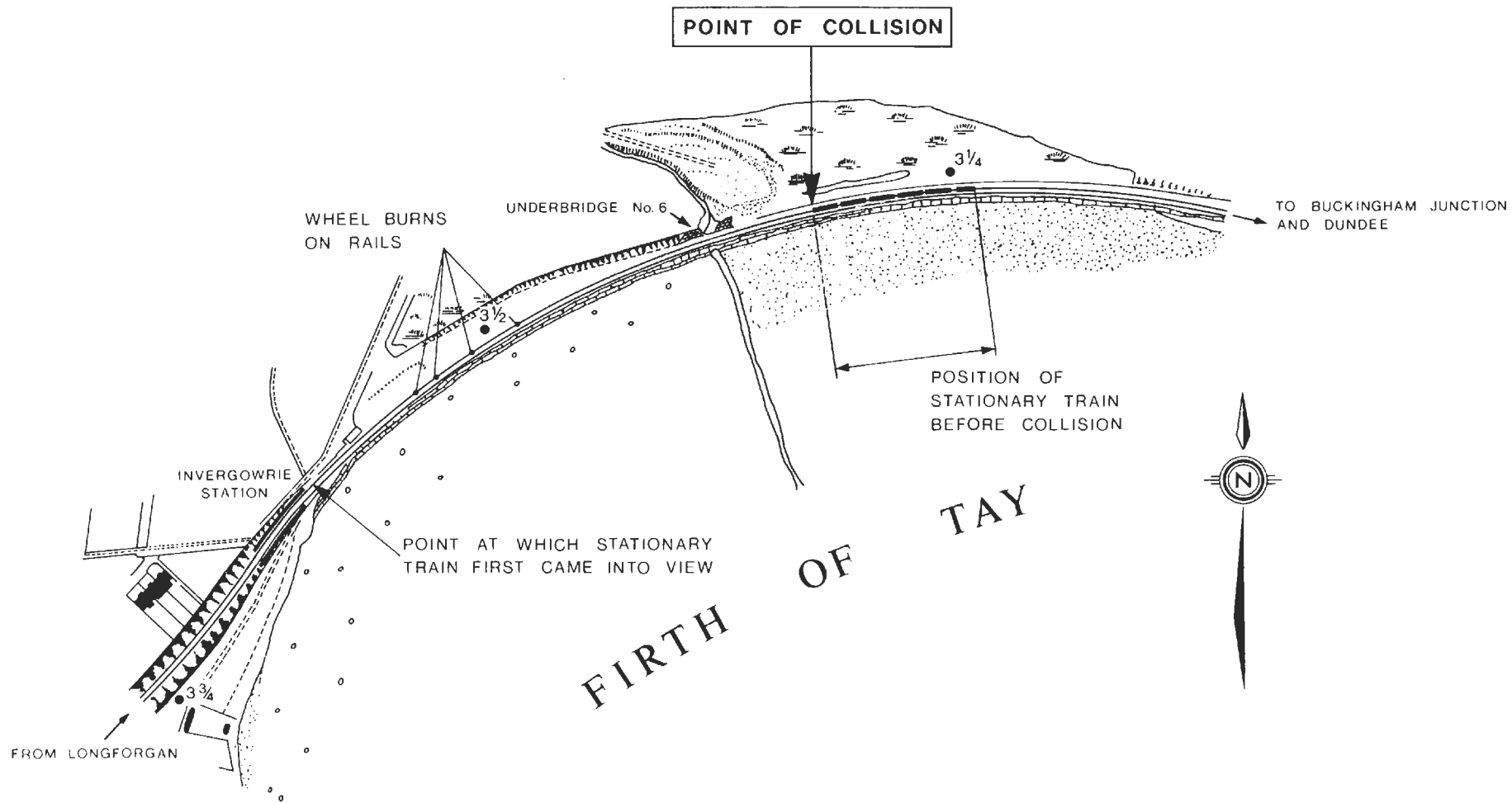
The Signalman must, after operating a lever, switch or button, ascertain either by observation if practicable or by indicator where provided that the signal (and/or points where appropriate) concerned is working correctly.

Where the distant signal for one box is fixed near another box, the Signalman at the latter box is responsible for seeing that the signal is working correctly and that the light is burning when necessary. This does not, however, relieve the Signalman from whose box the distant signal is worked from satisfying himself that the signal is working correctly.

Signalmen must keep the signal wires adjusted by means of the regulating appliances, to compensate for expansion and contraction caused by variations of temperature.

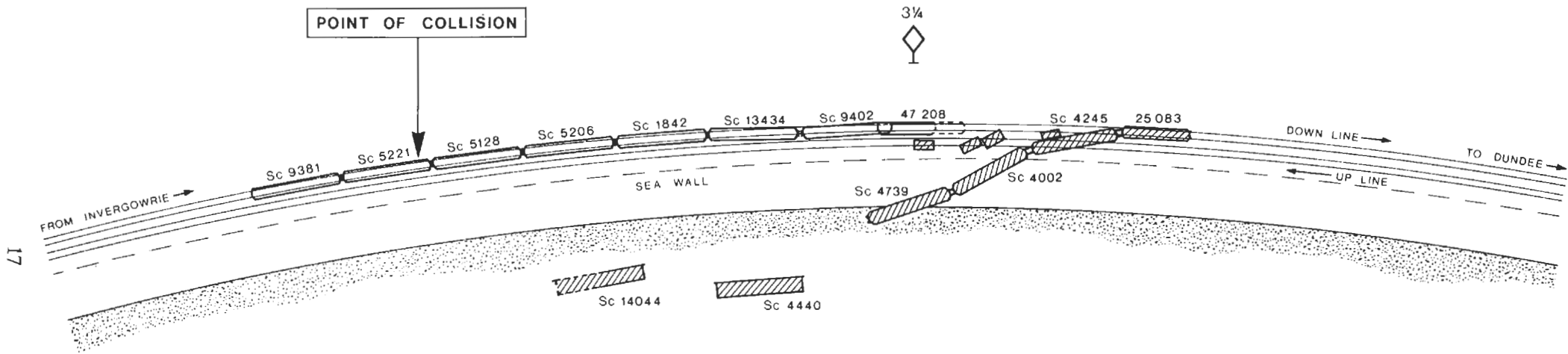
Figure 1





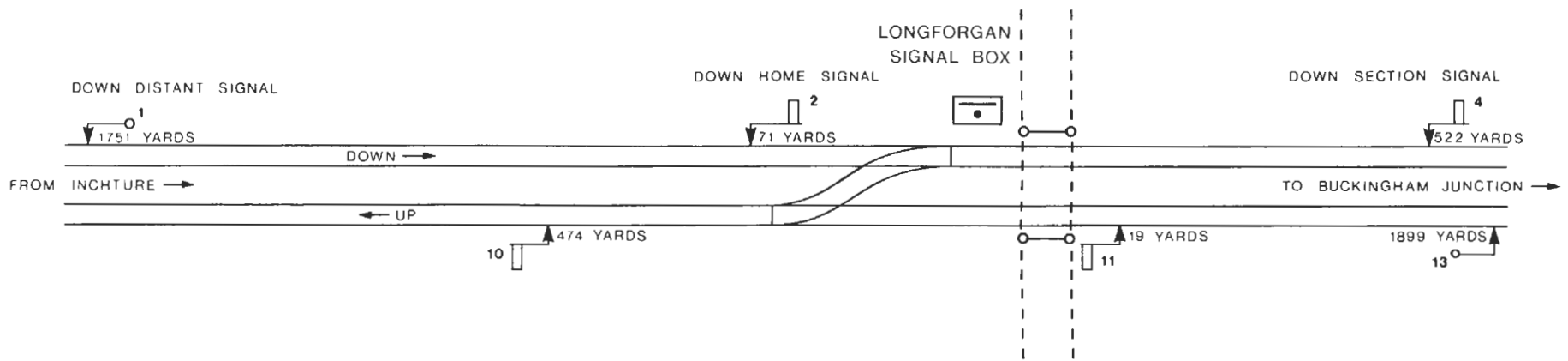
LOCATION PLAN OF SITE OF ACCIDENT

Figure 2



VEHICLE DISPOSITION AFTER COLLISION

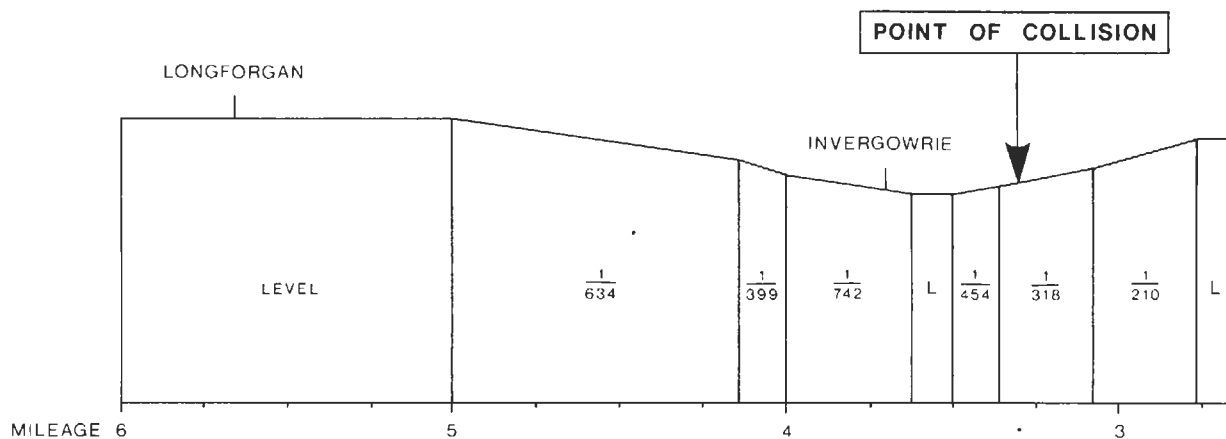
(Vehicles and separated bogies of 0844 Glasgow to Dundee train shown shaded)



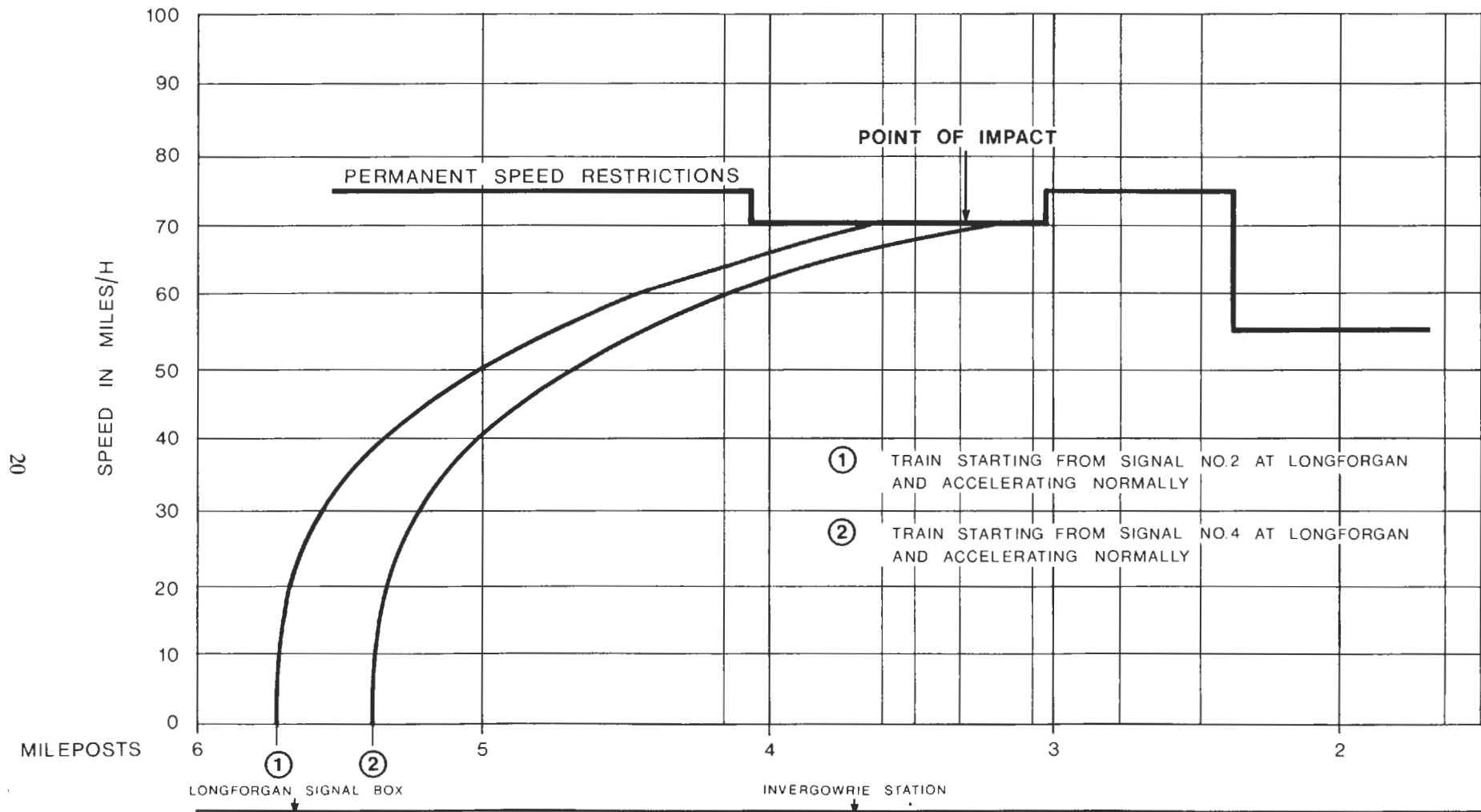
NOT TO SCALE

DIAGRAM SHOWING SIGNALS CONTROLLED BY LONGFORGHAN SIGNAL BOX
(Distances of signals are from signal box)

Figure 5



GRADIENT DIAGRAM



ACCELERATION CURVES FOR CLASS 47 LOCOMOTIVE HAULING 7 COACHES

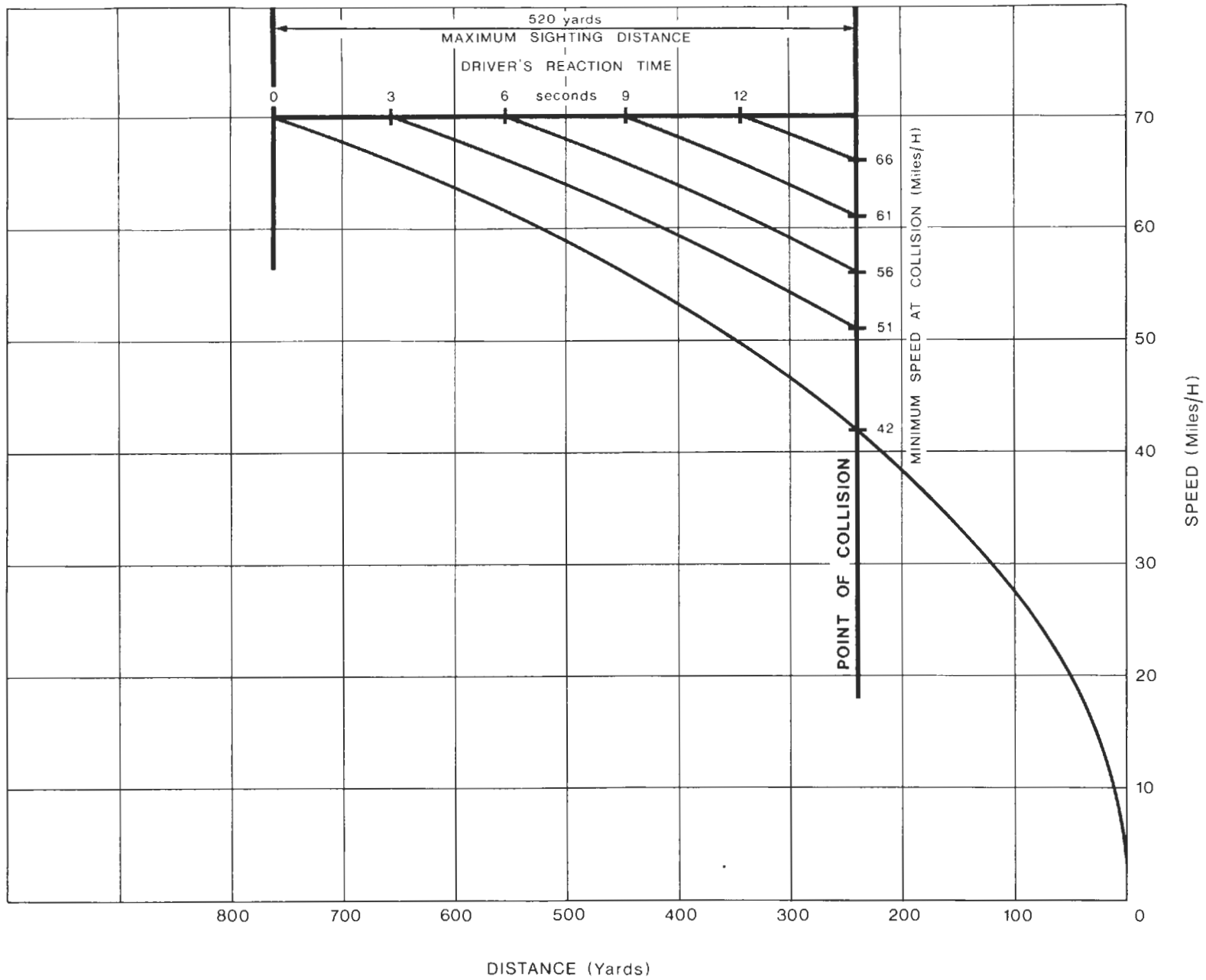


Figure 7

EMERGENCY BRAKING CURVES (LEVEL GRADIENT) FOR 0935 GLASGOW/ABERDEEN TRAIN
COMPRISING CLASS 47 LOCOMOTIVE AND 7 COACHES

Figure 8

