DEPARTMENT OF TRANSPORT

RAILWAY ACCIDENT

Report on the Derailment that occurred on 30th July 1984 near Polmont

IN THE SCOTTISH REGION BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE

£3.70 net

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RAILWAY INSPECTORATE
DEPARTMENT OF TRANSPORT
2 MARSHAM STREET
LONDON SW1P 3EB
7th February 1985.

SIR,

I have the honour to report for the information of the Secretary of State for Transport, in accordance with the Direction dated 7th August 1984, the result of my Inquiry into the derailment, on Monday 30th July 1984, of the 17.30 Edinburgh – Glasgow express passenger train near Polmont in the Scottish Region of British Railways.

The train consisted of a Class 47/7 diesel-electric locomotive pushing 5 Mark III coaches with a Mark II DBSO coach leading. This latter vehicle has a driving cab at the outer end from which the locomotive and train can be remotely controlled and it also has guard's, parcels and passenger seating accomodation. The train was one of a number of similar fixed formation push-pull trains operating between Edinburgh and Glasgow. The locomotives are normally at the Edinburgh end.

At 17.55, whilst travelling at about 85 mile/h, the DBSO collided with a cow that had gained access to the line. The leading bogie of the coach became derailed towards the cess, ran up the slope of a small cutting, and was followed into derailment by the rest of the train. The DBSO came to rest without its bogies, badly damaged, and on its side with the roof towards the top of the cutting and the cab facing Edinburgh. The second coach was turned end for end, badly damaged, and came to rest diagonally across the adjacent track but upright. The remainder of the train was derailed but remained upright although some coaches were badly damaged.

The driver of a similar train approaching in the opposite direction on the other line saw a coach 'somersaulting' from a distance and was able to bring his train to a stand 165m short of the wreckage. The first of the emergency services were on the scene at 18.15, some 12 minutes after being called, but I regret to have to report that 13 passengers lost their lives and a further 14 passengers and 3 Railway Staff were taken seriously injured to hospital. Treatment for minor injuries was given to 44 others.

Both lines were blocked and Edinburgh – Glasgow trains were diverted by an alternative route while some of the damaged vehicles were rerailed and others were cut up on site and removed. Both lines were returned to traffic at 18.55 on Wednesday 1st August 1984. At the time of the accident it was light and a fine clear evening.

DESCRIPTION

The Site and Signalling

1. Descriptions using the words 'left' and 'right' are as if facing Glasgow. The line between Edinburgh and Glasgow runs approximately east to west and at the scene of the accident, at the 23½ milepost, there are two tracks with the northern one being used by trains to Edinburgh and designated the Up line. There are stations at Linlithgow, Polmont and Falkirk High. From a point 3.2 km to the west of Linlithgow the line rises gently towards Falkirk High at gradients of 1 in 880, 1 in 600, and 1 in 757.

2. From Polmont Station, travelling towards Glasgow, there is a left hand curve of 179 chains radius through Polmont Junction, where the lines to Stirling diverge to the right and where there is a signal box, followed by a right hand curve of 83 chains radius. The scene of the accident is on the following section of line which runs straight for about 1.2km. The track consists of 110A section CWR on concrete sleepers with Pandrol fastenings and 350mm depth of ballast. The line is categorized Class A with a maximum permitted speed of 100 mile/h at the point of derailment although lower limits apply at other points.

3. To the north of the railway line in the area of the collision there are open fields used for grazing separated from the railway by a 1.22m high stone wall. The wall is some 5.4m from the cess rail of the Up line and in some fields there is a 7-strand post and wire fence reinforced with Rylock (large mesh chain link) placed on the field side. Towards Edinburgh, from a point opposite the point of impact with the cow, the stone wall is broken down but the post and wire fence is in good condition.

4. To the south of the railway there is waste land and a canal running parallel to the railway. The waste land is overgrown and criss-crossed by paths and tracks. It was formerly the site of a factory, now demolished, and there are well established trees alongside a stone wall and ditch which act as the railway boundary some 4.2m from the Down Line cess rail. Both stone walls lie at the top of cutting slopes rising some 2m above rail level.

5. In the area of the accident trains are signalled under the Track Circuit Block Regulations using 4-aspect colour-light signals controlled from Polmont Signal Box (P).

6. At the 23¼ milepost, on the Glasgow side of the site of the accident, is a former Accommodation and Footpath Level Crossing known as West Quarter Level Crossing. The crossings were closed in 1981 and fencing erected in place of the gates on both sides of the line. However, the existence of housing on the north side of the line and the recreational area afforded by the wooded factory site and canal to the south of the line have led to constant trespass over the line at the site of the crossing and damage to the fencing there which has frequently had to be repaired. Alongside the closed crossing is a culvert carrying a stream beneath the line.

The Train

7. The 17.30 Edinburgh – Glasgow express passenger push-pull train (1052) was marshalled as follows with the locomotive at the Edinburgh end and the DBSO leading: –

Class	*Coach No*	*Type, length, and weight*
Mark II	9706	Driving Brake Second Open (DBSO) 20.7m long 33.5 tonnes
Mark III	11004	First Open (FO) 23m long 33.0 tonnes
Mark III	12006	Tourist Second Open (TSO) 23m long 33.0 tonnes
Mark III	12004	Tourist Second Open (TSO) 23m long 33.0 tonnes
Mark III	12021	Tourist Second Open (TSO) 23m long 33.0 tonnes
Mark III	12013	Tourist Second Open (TSO) 23m long 33.0 tonnes
Class 47/7	47707	1925 Kw diesel-electric locomotive 19.4m long 117 tonnes

The axle-load of a DBSO is 8.4 tonnes. The locomotive is of Co-Co type with axle-loads between 19 and 20 tonnes.

8. The length of the train was 155m and its total weight was 315.5 tonnes. The air brake was in operation and the available brake force was 158 tonnes. The locomotive was coupled to the train by the locomotive screw coupling and the coaches were coupled using the standard BR automatic coupler, that at the leading end of the DBSO was in the lowered position. The DBSO was one of 13 converted in 1978 from Mark II Brake Second Open coaches when part of the brake van accommodation was used to provide a driving cab and the controller, instruments and electronic equipment were fitted. The locomotive was one of 12 modified specially for this service in the same year and designated Class 47/7.

9. From Glasgow to Edinburgh the driver occupies the leading locomotive cab and operates the controls there. In the opposite direction he shuts down the controllers in the locomotive cab and occupies the cab of the DBSO which is at the leading end of the train for the journey to Glasgow. The driving cab of the DBSO is equipped with a standard brake valve and a power controller as is the locomotive. Most of the guages and indications provided in the locomotive cabs are duplicated in the driving cab of the DBSO which is similar to that of some Electric Multiple-Units (EMU).

10. The brake valve of the DBSO operates the brakes in exactly the same way as the valve on the locomotive by opening the brake pipe to atmosphere. The power controller of the DBSO however, provides an electronic signal to the locomotive power equipment which is transmitted using the train lighting wires. These wires are also used to transmit the indications from the locomotive to the cab of the DBSO.

The Course of the Derailment and Damage Caused

11. After a scheduled stop at Linlithgow it is calculated that the train would have accelerated to about 85 mile/h after passing Polmont Station and Signal Box on the Down Line. Coming round a gentle right hand curve the drivers view to the point of impact would have been about 469m which allowed a maximum of 12½ seconds in which to see and react to any hazard. It has not been possible to obtain any information from Driver Tennant, the driver of the derailed train, who suffered major injuries and has no recollection of the accident. It appears however, that he must have realised the hazard some 5 – 6 seconds before the collision and made an emergency brake application.

12. After it was struck by the DBSO, part of the animal was dragged along the left hand (cess) rail. About 3.6m beyond the point of impact the leading left hand wheel was lifted, so that its flange ran on top of the rail and finally dropped off to the cess side. At the same time the leading right hand tyres ran across the '6-foot' side rail. This took place over a distance of about 5.5m. The leading vehicle then ran derailed with the right hand wheels in the '4-foot' until they struck the cess rail about 98m from the point of impact turning it on its side. The rail was fractured but whether by the leading wheels or others running derailed is impossible to

say. Part of the animal carcass that had been carried along by the train then fell into the '4-foot' some 14.6m further on and 128m from the point of impact both rails were fractured, probably by other derailed vehicles of the train.

13. The DBSO then veered to the left and ran up the inclined cutting slope, through the wall at the top and into the trees where the leading end appears to have run up against a tree. It then turned on its right side, the bogies becoming detached, as the rear end was dragged round by the rest of the train and separated from it, pushing the leading end of the second vehicle up the opposite cutting slope. The rear end of the second coach was pushed forward by the coaches behind, dividing it from the train and turning it end for end although it remained upright, coming to rest at an angle across the adjacent track. The DBSO fell on its side on the cutting slope with the underside towards the track and it then slid or was pushed a further 105m before it came to rest on the cutting slope, impacted into the side of the third coach which had run past it. The remainder of the train ran past the second coach and came to a stand roughly in line but derailed, with the leading end of the second coach, which had originally been at the Glasgow end, now facing Edinburgh and impacted into the side of the 5th coach. The diagram at the back of the report shows the details of the site and the position of the coaches when they came to rest.

14. Both body and underframe of the DBSO were very severely damaged and the coach had to be cut up on site. All the below-floor modules containing air conditioning units, batteries, motor alternators etc. were ripped off the second coach 11004, the body and body pillars were bent, and the body was twisted off true by 35°. The buffers, gangway, and headstocks were badly bent and the underfloor panelling was badly torn and pushed up. The vehicle was removed on its bogies and later cut up. The third vehicle, No.12006, also had very heavy body and frame damage caused by striking the DBSO and coach No.11004, and the bogie centre castings had been ripped off. The leading Buckeye coupler and drawbar had been sheared through and ripped off. The vehicle was cut up on site. The headstock of coach No.12004 was bent and there was considerable under-floor damage but the coach can probably be repaired. There was considerable body damage to coach No.12021 because one end of 11004 was embedded in its side but the vehicle can probably be repaired. Both centre casting top plates of the last vehicle No.12013 were bent by running derailed but otherwise there was not a large amount of damage and the vehicle can be repaired. Although the locomotive was derailed it suffered only minor damage and after a thorough examination and testing was returned to service.

EVIDENCE

Events Leading Up to the Accident

15. *Driver N. McColl* was driving the 17.15 Up express passenger train from Glasgow to Edinburgh with the locomotive leading. After leaving Falkirk 5 minutes late and whilst travelling at about 30 mile/h, because of restrictive signal aspects, he caught a glimpse of a cow on the other side of the line, up on the bank. He decided to report this during the booked stop at Polmont Station because he did not see any actual danger at that moment as the cow was clear of the line. Two or 3 minutes after passing the animal he stopped the train at Polmont Station at about 17.52 and told his assistant to tell the staff there that care must be taken as there was a cow on the Down line.

16. While the train was stationary at Polmont, the 17.30 Edinburgh – Glasgow passed through, but he did not consider giving any warning about the animal to the driver of that train. He explained that had there been a herd of cattle or if the cow had actually been on the line he would have acted differently. He would have stopped his train at the nearest signal, put down detonators and track-circuit operating clips and informed the signalman by telephone.

17. *Signalman L. Martin* was in Polmont Signal Box at 17.55 when all the track-circuit indications became illuminated and the telephones began to ring. His immediate reaction was that this had been caused by vandalism and he replaced all the signal switches to Danger. A minute or so later he received a message from the porter at Polmont Station that there was a cow or cattle on the line between signals P503 and P505. He realised something was seriously wrong and informed the signalman in the adjacent signal box.

18. At 18.02 he received a telephone message saying that there had been a derailment and that there might be fatalities. He called for the emergency services and then received a second telephone message at 18.10 saying that there were definitely fatalities. As a result he called for a full turnout of all emergency services together with buses.

19. The 17.30 Glasgow – Edinburgh Up express passenger train with the locomotive leading was driven by *Driver H. Kilpatrick* who recalled that, after departing from Falkirk Station, Signal P502 was displaying a double yellow aspect and his train was travelling at about 65 mile/h. Just after passing the signal he saw a tremendous cloud of dust ahead of him and a coach which he described as "somersaulting in the air with a twisting movement". He closed the controller and instantaneously made an emergency brake application.

20. When his train came to a stand he went to Signal P503 on the Down line but there was no light in the signal and the telephone did not work. He spoke to his guard who went to protect the train and he asked a passenger to use a telephone in a nearby housing estate to alert the emergency services. Driver Kilpatrick then went with railway officials travelling on his train to see if they could assist those in the derailed train. He thought he caught his first glimpse of the derailment as he came onto the straight track just after passing West Quarter Level Crossing.

21. It was his opinion that if Driver Tennant driving the derailed train had seen a single cow on the line he might not have made an immediate emergency brake application. Driver Kilpatrick had been on a steam locomotive which had run into a herd of cattle and had also been on locomotives which had run into flocks of sheep on the line but he had never been on a locomotive that had been derailed by them. He said it was quite common to be stopped at a signal and cautioned about cattle or sheep on the line. Since West Quarter Level Crossing had been fenced off with high wire he had not seen people crossing the line there, although before that he had seen them on the crossing.

From Passengers on the Train

22. Some 5 months after the accident, when they were partially recovered, I was able to interview *Guard D. Blackburn* of the derailed train and *Mr W. S. Hutchison* the *Project Engineer* of the *Regional Mechanical and Electrical Engineer's Department*. The former could only tell me that he had been checking tickets and that as he returned to his compartment in the DBSO he became aware that the vehicle was derailed, reached for the brake valve and then realised that an emergency brake application had already been made. Mr Hutchison however estimated that after Polmont the train was travelling at at speed slightly in excess of 80 mile/h. He was travelling in the DBSO with companions and talking to them when he realised that an emergency brake application had been made and he stopped talking. About 2 seconds later he heard or felt what he described as a "soft thud" and almost at once the vehicle became derailed and began to swing from side to side, a movement which became progressively worse. He then described the sensation as if "the vehicle was running up the leading bogie" and it turned on its right side, the rear end was carried round and the vehicle slid on and came to a stand. At the first sign of derailment he had tucked his feet beneath the seat and sat back; this saved him from being ejected through the windows although he suffered major injuries.

Inspection of the Track and Fencing

23. *Leading Trackman C. Whittet* patrolled the length of track on which the accident occurred on the morning of the derailment. He walked on the Down line facing oncoming trains but looked at both tracks checking the state of the line, fences, tunnels, and bridges. He left the Edinburgh end of Falkirk Tunnel at 11.10 or 11.15 and finished at the 24 milepost at about 11.50. He found nothing untoward about the condition of the track, the fences were in order, and there were no cattle on the line at that time. If there was anything wrong with the fencing he reported it at the end of his patrol and men were sent out to effect repairs. He had carried out the patrol about 20 times over the past 3½ years and could only recall one occasion when he had found a wall damaged by vandals. He had reported it and it was repaired the same day.

24. *Leading Trackman R. Alston* had carried out some 100 patrols over the length of track concerned in a year and for most of the time he had been Acting Track Chargeman. He could not recall any occasion when he had found fencing damaged between the east end of Falkirk Tunnel and the 24 milepost. However, he had complained about people knocking down the fencing to get across the line at the former West Quarter Level Crossing. He had reported the damage and it had been repaired the same day. He said that sometimes there were cattle in the field to the north of the line but not always.

25. *Mr A. J. Smith* has been the *Permanent Way Maintenance Engineer* responsible for track safety and maintenance of the stretch of line from Glasgow (Queen Street) to the 28 mile post for 5 years. He said that the state of the track was monitored by the High Speed Track Recording Car 3 times each year. The most recent recording was on 16th May 1984 and the trace showed that in all respects the section of track was well above the standard for a Class A line.

26. The rail profile had been checked both on the curve and on the straight portion where the derailment occurred. There was no side cutting and the rail depth was within 1mm of new. The rail was ultrasonically tested for defects manually in March 1984 and by the test train in April 1984. Before that it had been checked manually in November 1983; no defects were found in the rails on the curve or straight.

27. Mr Smith arrived at the site of the accident at about 19.15 and carried out a thorough inspection. At 38.010 km (23 miles 1088 yards) there were signs of an impact with an animal and some 4m further on, wheel marks commenced on top of the rails and continued for about 5m going across the top of both rails from the '6-foot' side towards the cess. Where the wheel marks ended there was a broken sleeper which had been struck

in the '4-foot' by the '6-foot' wheel. Thereafter there were signs of the coach having travelled derailed towards the banking.

28. At 37.912 km (23 miles 981 yards) the cess-side rail was broken and turned over towards the cess. At 37.897 km (23 miles 965 yards) were the remains of the beast and at 37.881 km (23 miles 948 yards) both rails were broken. The broken ends were clean with no dark patches which might have indicated a previous crack and he was satisfied that the rails had been broken as the result of the derailment and being struck by derailed vehicles. After that point there were signs on the cutting where the leading coach had run up the slope on the Down side. The wall at the top of the bank was broken down and a swathe was cut through the vegetation; some of the substantial trees outside the wall, or parts of them, had been felled by the DBSO.

29. Mr Smith confirmed that the whole of the train would have been on straight track at the time of impact. The end of the transition was at 38.167 (23 miles 1260 yards). There was no cant on the straight and the curve was correctly designed, according to the recording trace, for a balancing speed of 71 mile/h. The CWR had been destressed on 23rd October 1978 to a temperature of 80°F and there was no sign of a buckle in the area of the derailment so far as could be seen.

30. He explained the job of the patrolman and the frequency with which he and other staff patrolled or rode over the line. He said that vandalism in the Falkirk area could be difficult to keep up with. Between the tunnel and West Quarter Level Crossing the fencing was difficult to keep intact. This fencing belonged to the District Council but the railway's staff reported damage to the Council and patched the fence until they were able to carry out repairs. Temporary repairs would be done the same day as damage was reported. After the accident he looked at the fencing on the Up side of the line. Between the end of the curve and the level crossing going westwards, adjacent to the site of the accident, the fencing was intact and stockproof. However, there were gaps at the level crossing and the fencing had been damaged between the level crossing and the tunnel at 3 points. He thought an animal might have been able to get onto the line through the damaged level crossing fencing. He was satisfied that none of the damage to the fencing to which he referred had been caused in the accident or by the emergency services gaining access.

31. On the section from Glasgow (Queen Street) to the 28 milepost there had been a total of 7 occasions in the past 5 years when cattle had gained access to the line and been struck by trains, two of them between Falkirk and Polmont. He was certain he would have been told of every occasion when there had been delay to trains or beasts had been struck. On 3 of the occasions the leading coach of a push-pull train struck the animal and on the other occasions either a locomotive or a coach of a DMU was leading. There had been no derailments. He gave details of the accidents and said that when the cattle got on the section between Falkirk and Polmont previously there was no real evidence that they had come on at the site of the former level crossing.

32. The fencing at the level crossing and the stone walls demolished in the accident were all repaired and made stock proof by the time of the re-opening to traffic on the Wednesday evening 1st August 1984. Since then, fencing in the area of the crossing and towards the tunnel had again been vandalised and repaired on a number of occasions. He was considering with his superiors ways in which the system for reporting and repairing could be improved. Persistent vandalism was reported to the British Transport Police but there was so much that they were unable to attend to all reports.

33. In summary Mr Smith was quite satisfied that the track was fit for 100 mile/h running and he could find nothing in its condition that might have made derailment more likely or have caused derailment to the left rather than to the right.

34. *Mr M. Farmer* the *Civil Engineer (Permanent Way)* of the Scottish Region said that he was satisfied from all the enquiries that the stretch of railway line involved was well up to the standards for a 100 mile/h line and that the Board's statutory responsibilities for fencing appeared to have been complied with.

The Rolling Stock and Manner of Derailment

35. *Mr J. Bryceland* the *Regional Technical Support Engineer* explained the significance of the marks and damage that he found at the site of the accident. He described what he thought was the sequence of events and how the two leading coaches had both, in effect, turned end for end. The remainder of the train, derailed, was coming to a stand as its leading end passed between them. The speed of the train at the point of impact with the animal had been calculated at 85 mile/h and the sighting distance that the driver would have had of the cow was about 469 m. At the best this could have given the Driver a 12½ seconds view of the animal.

36. Mr Bryceland commented that on both sides of the cess rail he found animal fat and tissue in the web for about 8 m, whereas on the '6-foot' rail there was only rumenal rubbish such as grass. The flange mark suddenly appeared on top of the cess rail as though the wheel had been lifted up and dropped down on the rail.

He conjectured that, as the wheel marks on the rail head commenced 3.7 m after the point of impact and most of the animal was covering the cess rail, the bones might have formed the ramp up which the wheel flange rode.

37. He described the wheel guards, which were able to knock small objects off the rail. After the accident those on the leading bogie, which was left at the top of the bank behind a tree, were bent in towards the wheel by about 75 mm. There was no evidence of their having hit the animal and he concluded that they had been bent after the derailment. There were no animal remains on the coach although there was a little blood on the tyre surface of the two leading left hand wheels. He was as sure as he could be that the wheel had been lifted by the action of some part of the animal. He agreed that from his experience a locomotive could possibly have been derailed in a similar manner and he had knowledge of this happening.

38. *Mr B. Balfour*, the *Regional Brake Engineer*, described the brake and power control systems of the push-pull trains used on the Edinburgh – Glasgow services. The brake valve in the driving cab of the DBSO was the standard valve used on the locomotive and operated the brakes in exactly the same way. Trials showed that the reduction in brake-pipe pressure caused by an emergency brake application at the DBSO took 1.8 seconds to reach the locomotive. This reduction in pressure acts as a signal to apply the brakes. The brakes on the DBSO would be fully applied within a further 1.2 seconds and on the locomotive within 6.5 seconds from the initiation of the brake application.

39. The operation of the power controller in the DBSO cab is similar to that in the locomotive cab although the signal has to be transmitted to the locomotive. This is done electrically and consequently without measurable delay, thus closure of the controller in the DBSO results in almost instantaneous removal of power from the locomotive. If the driver makes an emergency brake application at the DBSO but fails to close the controller, the control governor in the brake-pipe automatically shuts off power at the locomotive 4.6 seconds after the initiation of the brake application, when the brake-pipe pressure falls to a certain pre-set figure.

40. In the unlikely event of a driver making an emergency brake application but not closing the controller, the brakes at the front of the train would be fully applied after 3 seconds, the brake application progressing down the train, and power would be shut off after 4.6 seconds with a full brake application on the locomotive being achieved after a further 1.9 seconds. This could lead to $\frac{3}{4}$ of the effective brakes (all the coaches) being applied before power was shut off. If this is done the emergency stopping distance is increased from 941 m to 1116 m.

41. Mr Balfour said that after the accident the controls in the DBSO were reported as being undamaged and that the power controller was in the 'Off' position with the brake valve in 'Emergency'. The coaching stock was so badly damaged that no meaningful tests could be conducted. The locomotive had minimum damage and had satisfactorily passed the mandatory special brake test carried out after an accident. He pointed out, in addition, that the train had run 400 miles already that day including 4 return push-pull journeys. There had been no complaints from drivers, he had checked all the repair books carefully and there were no entries in them for that day or for several days previously. All previous entries were signed off as completed. The DBSO had a maintenance examination on 28th July, the coaches in the train formation underwent a periodic examination on 24th July and the locomotive had undergone a 'B' examination on 22nd July. He was satisfied that the rolling stock was fit for the duty in which it was used.

42. *Mr G. H. Passey* the *Regional Mechanical and Electrical Engineer* confirmed that the tyre profiles of the DBSO were virtually as new, that the rolling stock was correctly maintained, and that no defect had been found which might have contributed to the accident.

In Respect of the Animal

43. *Dr H. Thompson BVMS, PhD, MRCVS,* the *Senior Lecturer in the Department of Veterinary Pathology, University of Glasgow,* was asked by British Railways to examine the coach and some of the remains of the animal that was struck. This was about a week after the accident. He estimated that the animal was a $2\frac{1}{2}$-3 year-old adult Ayrshire weighing between 320-450 kg (700-1000lbs) and about 1.25 m to the shoulder. He had looked at the site and had photographs and samples from the rails. He would expect that if the train collided with the animal at 85 mile/h it would not pass over it but the animal would virtually disintegrate and the largest part left would probably be a hind leg complete with muscle, fat, and bone.

44. He considered that the larger parts of the animal would be surprisingly tough and that what had to be considered was the possibility that some part of the animal could get between a wheel and the rail or beneath a flange, and lift the wheel. He thought that a part of the animal might be sufficiently tough to lift a wheel load of 4.5 tonnes some 45 mm i.e sufficient to lift the flange onto the rail table. The fact that the cess

rail appeared to have more animal matter on it than the other, implied that some part of the animal had been dragged along it. He was somewhat surprised to find so little animal tissue on the wheels but felt that this might be due to the speed at which the wheels passed over the carcass. There were no visible animal remains on the bogie or on the coach which supported his theory that the animal would have disintegrated. There was however a strong smell of rumenal contents which had spattered over the bogie.

Push-Pull Operations and Rolling Stock Features

45. *Dr R. Illingworth, Head of the Vehicle/Track Interaction Unit* at the *British Railways Research and Development Division* at Derby, said he had studied vehicle dynamics, the way in which vehicles ride and curve, and the forces induced in the track, for 15 years. He had been closely involved with the investigation of the derailment. He was satisfied that the track was to a good main line standard and agreed with the description of the initial stages of the derailment. He considered that any lateral motion of the bogie induced by movement round the curve would have been virtually damped out in the 4 seconds after the DBSO left the curve. There might have been random minor track irregularities but he thought that the initial collision with the animal and the events immediately after would have been much more likely to have produced the lateral forces which, combined with a vertical component caused the derailment. He could think of no other reason why the derailment was to the left. After the initial derailment, the bogie appeared to deviate gradually to the left but then, possibly when the cess-side wheels dug into the ballast, the drag caused the bogie to slew to the left and the '6-foot' side wheels struck the cess-side rail with a lateral velocity of about 6-8 mile/h. He felt that the impact of the wheelset, which weighed 1 tonne, would have been sufficient to fracture the extremely stiff rail or to turn it on its side.

46. After that the route of the derailed vehicle would have been determined by the amount of energy to be expended and the topography of the site. He explained that the initial impact with the animal would have had little effect on the velocity of the train whether it was braking or under power. Even if the locomotive were under power after the impact, the maximum force exerted by it on the train at 85 mile/h would be about 4 tonnes and most of that would be expended in overcoming the atmospheric and rolling resistance of the remainder of the train and its inertia such that the compressive force between the DBSO and the adjacent vehicle would be little affected. Thus, because the amount of energy already stored in the train was so great, the braking or powering for a few seconds after the collision was not a major factor. The angle of the cutting had been insufficient to contain the leading coach and its course could be plainly seen. A much steeper-sided cutting would almost certainly have contained the coach, especially if the initial derailment had not occurred at about the start of the cutting.

47. Dr Illingworth explained that in 1964, when it became the intention to operate trains between London, Bournemouth, and Weymouth with the power unit at one end only, an investigation was conducted to determine whether the propelling force could buckle the train, overcoming the lateral resistance of the suspension. It was found that the forces were insufficient to cause buckling and that although the effective lateral spring stiffness was reduced by the propelling force, there was no significant difference in the way the vehicles rode. This was confirmed by practical tests. The curving performance was also examined, as were the effect of traction and braking surges, but these were not found to cause any untoward effect. He considered that the results were applicable equally to the Edinburgh – Glasgow operation. Subsequently, tests were carried out with the Edinburgh – Glasgow formation which confirmed that there was no detectable difference in the ride.

48. He said that no specific investigation was carried out at that time into the effeet of a shock load at the front of the train such as might arise in a collision or derailment. It was felt that the situation would involve no more risk than had been involved in DMU/EMU operations, which are a form of push-pull, and which had been going on for many years. He did not think that there would have been any difference in the result of the derailment if a 4-car Bournemouth unit had been pushing, rather than a locomotive where the weight and power were concentrated. Nor would the shorter DBSO Mark II coach, compared with Mark III coaches, have any bearing on the initial derailment potential or on the likelihood of the bogie breaking free of the '4-foot'.

49. He commented that the attitude of the bogie in relation to the track, and the speed of the train, were all factors affecting the likelihood of derailed wheels leaving the '4-foot'. There might be a minor advantage in having the locomotive brake applied first, but if this were possible it would equally be possible to apply all the brakes simultaneously. Thus to apply the locomotive brakes first implied a delay in braking which would destroy less energy in a given time and this must be disadvantageous. He described the amount of energy stored in the train when moving at 85 mile/h as sufficient to raise the two leading coaches to the top of the Eiffel Tower. Dr Illingworth agreed that with a locomotive at the leading end of the train there must be less likelihood of the train being derailed by a cow but he could not say if the situation in this accident would have been changed had this been the case.

50. Over 10 years, of the total number of collisions with animals, about $\frac{2}{3}$rds had involved locomotives and the remainder multiple-units. He knew of one locomotive being derailed and some 13 lower axle-load leading vehicles of multiple units. Although the detailed mechanism of the derailments resulting from animal strikes was not known, the factors involved included axle load, detail design of the bogie, the ease with which the carcass could get beneath the wheels, an axle box or a gear case, the speed of the train, and the geometry of the bogie and track.

51. He felt that damage to the wheel guards, which might have been indicative of impact with part of the animal, might have been obscured by damage caused after the derailment. He believed that Dr Thompson's evidence, that the animal probably disintegrated in the collision, meant that it was unlikely that the carcase of the animal lifted the bogie frame or the axle.

52. *Mr J. A. Higton* the *Inter-City Design Engineer* of the Department of Mechanical and Electrical Engineering of the British Railways Board had held his post for only 2 months at the time of my Inquiry but had worked for the Board since 1971 and had dealt with bogie and suspension design in the past. He described the information that he had obtained verbally from the French and West German railways. In France, Inter-City push-pull trains are operated at speeds up to 100 mile/h on unfenced railways because Continental and British law on railway fencing and animals differ. They claim to have overall, and not just in push-pull operations, very few animal strikes (8 in 1984) but about 250 collisions with road vehicles per year on level crossings. They had recently decided to fit all locomotives and driving trailers that operated at speeds greater than 100 mile/h with a deflector which was designed to minimise the risks from level-crossing accidents.

53. The West German railways have some 600 locomotive-propelled push-pull units operating at speeds up to 87 mile/h with driving trailer axle loads of 7-10 tonnes. These driving trailers are not fitted with deflectors. They have, overall and not just in push-pull operations, a history of an increasing number of animal strikes ranging from 89 in 1979 to 131 in 1983 but only one derailment had resulted. They are planning to build a large number of push-pull units for Inter-City operation at speeds of up to 110 mile/h. These new driving trailers will be fitted with snow ploughs, as are now fitted to their locomotive bogies, but the snow ploughs are designed for snow clearance and not to deflect animals in collisions. Mr Higton confirmed that as a result of this accident the Board was considering the practicality of designing a deflector with the objective of clearing obstacles from the line.

54. His Department had done some research into accidents involving animals and had been unable to find any record of such a collision on BR causing loss of life before the Polmont accident. He described the purpose of the wheel guards or lifeguards as to remove small objects out of the path of the wheel. They were fixed to the bogie directly over the rail and could therefore come within 50 mm of it. It was not until recently that a design standard had been produced for them by British Railways. He thought it possible that the provision of cow catchers or deflectors had been considered in the past although he could find no correspondence showing it had been considered and discounted; deflectors might not have been adopted because it was felt that they were only required where the railway was unfenced.

55. Mr Higton described the design criteria for a deflector. If it was assumed that the object most likely to be encountered was an animal of the size involved in this accident at a similar train speed, then the force required to accelerate the animal to the same speed as the train would be 100-150 tons. However if the object was of greater mass or the train speed greater, then there was a danger that the deflector itself, which would have to be massive to withstand the force, might be distorted or broken off and go beneath the train causing damage or derailment. To withstand a force of that order it would have to be fixed to the body of the vehicle and not the bogie, otherwise an impact might shear the bogie king-pin. The deflector could not be fitted to come closer to the rail surface than about 135 mm to allow for static deflection and wear. An additional 50 mm would have to be allowed for dynamic deflection, thus the gap between the lower edge of the deflector and the top of the sleepers would be of the order of 300-350 mm. The shape of the deflector, to make it as effective as possible, would probably be similar to that of a snow plough or arrowhead. This might create a projection which could be a hazard to those coupling or working at the front of a fitted vehicle or locomotive.

56. Mr Higton felt that he could not agree that a deflector would probably have prevented this accident because knowledge of the precise mechanism of the derailment was so slight. The animal might have fallen between the rails or the deflector might not have been strong enough. A standard British Railways miniature locomotive-fitted snow plough would almost certainly have broken off because it would have failed at about $\frac{1}{4}$ of the load calculated to have been exerted on the train in this case. Obviously the load depended on how the animal was struck by the snow plough but even if one assumed the position which exerted the least force, it was his opinion that the snow plough would have failed and might have added to the hazard by going beneath the wheels.

57. He described the design of the Mark III vehicles as being to the full UIC standards whereas 20-25 years ago, when the Mark II vehicle was designed, some loading standards were rather lower for points above floor level. For instance at cantrail level the UIC standard required the design to meet a compressive load of 30 tonnes without deformation. When the Mark II coach was designed the British Railway's standard used was 10 tonnes. He understood that a Mark II vehicle had been used to form the DBSO because the end design of the Mark III had chamfered-in sides which would not have allowed room for a cab of acceptable size and because there were no Mark III vehicles with a brake compartment which had to be partly used to form the cab.

58. He did not think that any need had been seen to increase the axle load of the driving trailer because it was similar to that of the DMU fleet and of most EMUs on British Railways. Indeed it is similar to that found on push-pull trains on the Continent. He was unable to say how the cab of the DBSO compared with that of a Class 47 locomotive in terms of resistance to collision and deformation. He pointed out that new locomotive and multiple-unit cabs would comply with the UIC regulations and felt that the DBSO cab, which had remained substantially intact in the accident, did not fall far short of the multiple-unit requirement.

59. Mr Higton confirmed that the Board's engineers are satisfied that the principle of propelling at high speed is safe. However the accident had raised a number of questions that were now being studied. Over the past 12 months there had been studies of propelling at higher speeds and with higher tractive efforts than had previously been the case. Tests were to be conducted, with the higher tractive effort, of the possibility of the train buckling, of the ride, and of derailment potential on sharper curves at lower speeds.

60. Mr Higton had analysed the braking of the train making an assumption that all seats were occupied, that power was off, and that all brakes were fully on before the derailment. He pointed out that the braking effort as a proportion of weight was greater for the Mark III coaches than for the locomotive or DBSO. At 80 mile/h he was satisfied that the coupling between the DBSO and leading Mark III coach would have been in tension by about 0.5 tons, the second drawbar would also have been in tension of about 0.2 tons. The remainder of the drawbars would have had a compressive force increasing to 1.25 tons between the locomotive and the rear Mark III vehicles. Mr Higton pointed out that although in similar circumstances a locomotive at the front of a train would have been less likely to become derailed, there was a large number of trains with equivalent axle loads of 6-10 tonnes for the leading vehicle, which had been operated by British Railways for many years in safety.

61. He pointed out that similar operations are carried out on continental railways and that he was endeavouring to obtain information and statistics that could be comparable. The tests and calculations of propelling dynamics had been carried out since 1964 when 2 locomotives propelled a 12-coach train at speed. In 1965, two locomotives propelled 8 coaches at up to 100 mile/h. Other tests at about this time involved the propulsion of test trains at low speeds on sharp curves. In 1968, tests were carried out related to the Edinburgh – Glasgow service propelling 9 coaches at up to 90 mile/h and there were further tests in 1979 with a Class 47 locomotive propelling 3 Mark III coaches, a test car, and a non-working Class 27 locomotive to provide an increased rolling resistance. All the tests were related to stability, coupling forces and lateral track forces and they were to confirm theoretical work. The initial tests were concerned with the Bournemouth line operation, which was introduced in 1968. The experience with that operation, which had been successful, was drawn on for the later tests and design for the Edinburgh – Glasgow services, which were introduced in their present form in 1979. There did not appear to have been any question of the need to fit some form of deflector because the risk of collision from animals had not arisen. He could certainly find no record of deflectors having been considered and this was confirmed by others involved in the tests.

62. *Mr V. Chadwick, The Regional Operations Manager* of the *Scottish Region* described the current arrangements for radio communication with trains. Several types of radio telephones were available or under development, but some had limitations. The ideal was direct communication between Driver and Signalman or other Driver and this was already available on the Dingwall/Kyle line and parts of the Inverness/Wick, West Highland and Aberdeen/Inverness lines. A feature of some equipment is the ability in emergency to interrupt any communication already in progress and this is included where practical. Since the accident, the issue of radio telephones to Drivers on the Edinburgh/Glasgow route was being considered under BR's National Radio Plan and this would allow direct communication between Driver and Signalman. Mr Chadwick also mentioned that the radio system operating on the St. Pancras/Bedford scheme had been authorised for the Glasgow/Ayr line and would directly link the Driver with the Signalman. The provision of radio was subject to constraints such as the availability of frequencies, the design of suitable equipment and investment priorities.

63. *Mr A. M. McKenzie* the *Assistant Chief Constable* for Scotland of the British Transport Police, with Mr Chadwick, explained what was done to counter trespass and vandalism by education and by patrols

including special trains in the worst affected areas. He explained that most of the effort went in the urban areas and that the Falkirk area had few reports, but that this might be because there was no British Transport policeman permanently posted there.

The Emergency Services

64. In addition to the testimony of witnesses I have received assistance from the Emergency Services and from the Hospital Authority. The Central Region Fire Brigade have commented on the importance of being able to describe access points to the railway accurately either in terms of grid references or by relation to other items of local geography. They also stressed the importance of having a senior railway officer at the site of the accident as early as possible. In this case the Assistant Chief Constable of the BT Police for Scotland was travelling on the train and was of considerable assistance. The Fire Brigade also commented that the ladder carried in the DBSO was of great use in gaining access to the vehicle on its side and for evacuating passengers from it.

65. The Unit Medical Manager commented that, in the first and second coaches, the majority of the fatalities occurred when passengers were ejected through the windows. Injuries and fatalities inside the carriages were caused either by head injuries or chest or abdominal injuries caused through impact with the tables, compounded by people or items falling on top of them. Further back along the train injuries were caused when the leading two coaches struck other coaches as they fell back on to them. It was the injuries and fatalities suffered when people were ejected through the windows or were injured by other passengers being thrown about the coaches, that led to the comment that rolling stock equipped with passenger seat belts would reduce casualties. Although seat belts are very effective in private cars I consider that this would be completely at variance with the freedom given to passengers on railway trains to stand if they wish or to move about, and the use of the belts would be unenforceable. Railway travel is fundamentally a very safe form of travel and it is only the rare serious accidents, such as this one, which bring it to attention.

Appendix

66. An extract from the Rule Book Section H.3.8 concerning the action to be taken by train drivers when an irregularity or obstruction is seen is attached with an extract from S.68 of the Railways Clauses Consolidation Act 1845 concerning fencing which in this respect is identical to Scottish legislation.

STATISTICS

67. A study of the accident statistics obtained from the reports made to the Department by British Railways shows that for the period 1st January 1974 to 31st December 1984 there were 1,096 collisions between animals and trains, an average of about 100 per year. About two-thirds of the accidents involved cows, bulls, heifers, bullocks etc., the remainder being smaller animals such as sheep, goats, deer, etc., or horses, none of which are known to have derailed a train although they have caused damage and delay. Although the leading vehicle in every collision is not known, a study of the Class of train involved indicates that rather more than 50 per cent of collisions probably involved locomotives and the remainder multiple-units, on-track machinery etc. The collisions resulted in 24 derailments of which one was of a locomotive, 17 involved at least the leading vehicle of multiple-units with a much lower axle load than locomotives; and one was the Polmont accident.

68. Thus, out of some 730 collisions which could have led to a derailment, more than half were with locomotives and the rest with the equivalent of coaching stock. They led to one derailment of a locomotive and 18 of coaching stock. It has not been possible to determine the speed at which the collisions occurred nor the position of the animals relative to the vehicle in the collision or in every case the number of animals struck. It is difficult to compare BR with European experience because of differences in accident reporting requirements. For the years 1981 – 83 on BR, 250 collisions with animals were reported; 20 – 30% of them involved small animals. In about 50% of the accidents it was reported that cattle had gained access to the line through defective or inadequate fences or gates. In the 3 years there were 3 diesel multiple unit derailments, one locomotive derailment, and one coach in a locomotive hauled passenger train was derailed. Only collisions are reportable, there are many more occasions when animals get on the line but trains are cautioned, or the animals rounded up, before a collision occurs.

DISCUSSION

Before the Accident

69. Driver McColl, who "caught a glimpse of" the animal at the side of the line before the collision, made a decision that it did not constitute actual danger at that time. Accordingly he reported it at Polmont Station, presumably in accordance with the Rule Book Section H.3.8.3. He was quite clear about what he would have done if the cow had actually been on the line or if there had been a herd and this would have been the action laid down in the Rule Book as being required when cattle *on the line* were seen. His decision was

based upon the Rule Book, which I feel is not as clearly laid out in terms of priorities as it might be, and his knowledge and experience of the threat posed by the animal. It would be wrong to criticise him after the event because of what is now known can be the outcome of a collision such as this. The Porter and Signalman acted promptly and correctly as did Driver Kilpatrick who is to be complimented. Sadly Driver Tennant was too ill for me to interview and I have still not been able to talk to him but his reaction to the animal by applying the brakes was clearly the correct one and he was keeping a proper look out.

70. The fencing appears to have been constructed and inspected to meet the Board's responsibilities, although it is clear from events after the accident that the fencing at the closed West Quarter Level crossing was subject to persistent vandalism. There was no damage found during the patrol on the morning of the accident and there was clearly a proper system for patrolling, reporting damage to fencing, and repairing it. The track and rolling stock were properly maintained and fit for the operation of the train. They do not appear to have contributed to the severity of the accident.

Fencing

71. The legal requirement for railway fencing in Scotland is identical to that stated in S.68 of the Railways Clauses Consolidation Act 1845. Simply put, whatever is provided by the railway to separate railway lands from others must keep cattle off the line. Where there is an additional hazard such as 3rd/4th rail electrification in an urban area, higher standards of fencing are maintained. From the records it is clear that the problem is not confined to secondary and branch lines and although few collisions result in a derailment the train is usually damaged and delayed.

72. Although the patrolman is required to check the hedges and fences, his first priorities must be his own safety and to detect track defects, and the railway boundary may well be out of sight from the track upon which he has to walk. If the Board is to continue and extend push-pull operations using driving trailers with an axle load considerably lower than that of a locomotive, then clearly a reduction in the amount of animal trespass must be achieved. Therefore, greater efforts must be made to ensure that the fencing is adequate for the task and is so maintained. This will help to remove the hazard at source.

Radio

73. At present, except on a few routes on British Railways, communication between Driver and Signalman is only possible by the use of a telephone after the train has been stopped. However, there is little doubt in my mind that had the Edinburgh – Glasgow sets been equipped with radio, Driver McColl would have used it to report the animal and Driver Tennant could have been alerted either by radio message or by the action of the Signalman replacing the signals to Danger to warn trains. As well as a reduction in the time taken to pass urgent messages to or from trains, the trains can be kept moving if that is permissible.

74. Since the accident, experiments on the Edinburgh – Glasgow line have been carried out with currently available portable radio equipment which is not only awkward but requires the routing of a call via a Telephone Operator thus introducing a delay in the passing of urgent messages. A difficulty also exists in that the equipment only operates over half the route. The experiments are continuing with newer equipment but, if successful, can only be regarded as an interim measure as a more satisfactory alternative is available which, subject to the Board authorising the investment, will be available early in 1986 over the whole route. I refer to this later.

Push-Pull Operations

75. In addition to the Scottish Region push-pull trains and although not classified as push-pull working, many DMUs and EMUs have driving trailers at the outer ends and incorporate trailer and motor cars in the formations. Thus one or two cars may be propelled. In the Waterloo – Bournemouth – Weymouth services, one or two 4-car un-motored EMUs are propelled to Bournemouth and drawn to Waterloo at speeds of up to 90 mile/h by a 4-car powered EMU. Between Bournemouth and Weymouth the un-motored EMUs are drawn to Weymouth and propelled to Bournemouth by a Class 33 diesel-electric locomotive. A similar system is sometimes used on the Waterloo – Exeter line.

76. The Victoria – Gatwick service is not a true push-pull system because it uses a Class 73, electro-diesel locomotive of 1192Kw at one end and a 372Kw driving motor car with an outer axle load of about 11 tonnes at the other end. The driver is always at the leading end of the train and operates it using standard controls and indications.

77. For a number of reasons there does not appear to have been any great consideration given to the need for derailment protection for vehicles of lower axle load when leading the train. Firstly, they were found to be just as stable as a locomotive at speed under the normal operating conditions. Secondly, although there

were undoubtedly accidents involving cattle, the perception was of one or two minor derailments each year. Thirdly, the number of strikes was reducing, possibly due to changes in agriculture, or improvement to fencing because of trespass and higher train speeds. Finally, any alteration to the design would have been expensive, have had disadvantages, might not have been fully effective, and would have been difficult to justify. There was some concern that the outcome of the accident might have been made worse because of the mass of the locomotive at the rear of the train, or the slight delay in braking at the locomotive. I am certain that this concern is largely unfounded.

78. I believe that there are three factors which affect the resistance of the leading vehicle of a train to derailment when it strikes an animal. These are the shape and obstruction presented by the bogie combined with axle-mounted equipment such as traction motors, the ability of the front end of the train to cause the animal to disintegrate and to project it to the side of the track and the axle-load of the leading vehicle.

Axle Load

79. I asked British Railways to investigate ways in which the axle-load of the DBSO could be increased and by how much. I suggested that a target might be the axle-load of an HST power car which is about 17 tonnes. I am told that the B4 bogie on which the Mark II coach body is currently mounted is, at 8.4 tonnes axle-load, at about the limit which can be applied. To increase this further would require the use of the B5 bogie which can operate at an axle load of up to 12 tonnes. To achieve this, the body of the DBSO would have to be modified to accommodate about 8 tonnes of ballast at the leading end. At present the total weight of the vehicle is about 33 tonnes. There would also have to be brake modifications. The cost would be considerable and the result would only come part way to achieving the target. The use of a locomotive bogie was also considered but this would require major re-design of the leading end of the coach so that the bogie could be fitted to it as well as the ballast. To achieve an axle-load significantly above 12 tonnes would, I am told, mean designing and building a completely new vehicle, the cost of which would be in excess of £200,000 per vehicle.

Bogie Elevation

80. Consideration was given to ways of making the coach bogie more nearly resemble in elevation a locomotive bogie and to the possibility of providing some form of secondary guidance to operate in the event of a derailment. However the connection between coach and bogie might not have been able to sustain the highest levels of longitudinal force involved in a collision with an animal and, because of loading gauge constraints, secondary guidance might make matters worse in a derailment rather than reduce the danger.

Deflector

81. Several correspondents suggested and sent me details of "cow-catchers" used on various railways, I am most grateful for the interest that was shown and the assistance that was given. The possibilities are mentioned in the evidence of Dr Illingworth and Mr Higton. The Board have now designed a deflector which is mounted on the coach frame and can sustain, without permanent deformation, a load of 30 tons at its lowest point on each side. The centre portion is parallel to the headstock with two wings that are slightly swept back. The 30 tons is calculated as the force exerted on the deflector when a 90kg (200lb) piece of the animal is accelerated to 100 mile/h in a distance of about 300mm (about half the width of the animal).

82. The mounting of the deflector is designed to allow it to collapse in a safe and prescribed manner when overloaded, rather than to break off. This is to reduce the risk of the deflector itself becoming the cause of a derailment. Because allowance must be made for static and dynamic loading causing movement of the coach vertically relative to the rails and for wear including tyre wear, the underside of the deflector has to be set at 230mm above rail level for an empty DBSO with new tyres. An additional safety feature is provided by two robust "lifeguards" mounted on the deflector. These enable the nominal gap between the deflector and each rail to be reduced to 115mm.

Conclusion

83. The derailment was caused when, after a collision with a cow, some part of the animal passed beneath the leading wheels of the train causing them to leave the rails. The outcome then was a matter of chance coupled with the local topography and the speed of the train. Because of the history of damage caused by vandals to the fencing at the closed West Quarter Level Crossing, I believe the animal probably gained access to the line at this point through fencing damaged by trespassers.

Remarks and Recommendations

84. With the knowledge and experience available before the accident, I think that the staff directly involved, and the Board, acted reasonably. However, whilst I consider that the system of push-pull operation currently employed on the Edinburgh to Glasgow line is acceptably safe, I believe that it can and must be made safer. I understand that the Board wish to adopt this form of operation for future main-line trains and

consequently the accident raises important matters of principle. This is especially the case if speeds in excess of 100 mile/h are to be attained. These matters are being considered separately from my Inquiry.

The Rule Book

85. I have asked the Board to amend the Section of the Rule Book dealing with animals on the line. The essential element of the rule must be that any large animal inside the boundary fence must be treated as an immediate danger to trains. I am glad to report that this amendment has been issued.

Fencing

86. I recommend that the Board should consider the most effective ways of reducing the number of times that large animals get onto the line. This is particularly important where animals are kept adjacent to lines where trains with low axle load leading vehicles (16 tonnes or less) run at speeds in excess of 75 mile/h. A special survey should be made of the fencing of such lines and the fencing at any potentially weak points, ie bridges and places where animals or trespassers have broken through in the past, should be made stockproof. I suggest that where push-pull operation is to be introduced, improvements to fencing must be considered as part of the route development.

87. I suggest also that the arrangements for the regular inspection of, and reporting of damage to, fencing between grazing land and high speed lines should be reviewed to find ways to make them more effective, especially where the boundary cannot easily be seen by the patrolman from the track. All railway staff should be reminded of the importance of closing gates and reporting trespass or damaged fencing. Local management must improve liaison with the National Farmers Union over the closing of private level crossing gates and with the British Transport Police over reports of trespass. Finally, consideration should be given to increasing the resources of the British Transport Police, or to a change in priorities, so that more attention can be given to trespass, especially where fencing is regularly damaged in such circumstances that will allow animals onto the line. The Inspectorate will continue to consider the need for cattle-cum-trespass guards at public level crossings.

Radio

88. To reduce the delay in the transmission of urgent messages I recommend that the driving cabs of all traction units capable of operating at speeds of 100 mile/h and over should be equipped with radio so that in an emergency, or if an urgent message needs to be passed, a driver may contact or be contacted by a report centre or signal box capable of initiating or taking action. A facility should be provided so that if necessary a call may be made to, or heard by, a number of drivers collectively. The radio will have, in addition, other operating and staff benefits. I am told by the Board that they are already preparing an investment submission on the above lines for those traction units performing the greatest yearly mileage. It would be Part II of the National Radio Plan and installation could be completed by the end of 1986. I strongly recommend that this investment be agreed and the work carried out with all speed.

Derailment Resistance

89. I have also considered the need to increase the resistance to derailment of EMU and DMU which operate at lower maximum speeds, but which have been involved in 17 derailments out of the 24 that occurred, after collisions with animals, during the past 11 years. Where 3rd/4th rail electrification is employed, it seems that the higher fencing standards and the presence of the conductor rails reduces the amount of trespass both by animals and by human beings who may break down fences and let animals on the line. Accordingly I do not consider that there is any justification for the provision of increased derailment resistance for such DC EMU. For DMU and other EMU, which have much lower axle loads than locomotives, modifications to increase resistance to derailment would be technically extremely difficult if not impossible. Even if such measures were possible they would absorb resources which could well be used elsewhere to greater advantage. Nevertheless, on average, about one in 25 collisions between these vehicles and cattle has resulted in a derailment. Therefore, if the number of collisions with cattle cannot be reduced by other measures, I recommend that the provision of means to increase resistance to derailment be considered by the Board.

90. I have noted that this is the only accident recorded since 1948, and probably for many years before then, in which a collision between an animal and a train has led to passenger fatalities. It is not the only collision recorded between a DBSO and cattle but there is a very limited experience of the outcome of collisions between low axle-load vehicles and cattle at speeds over 70 mile/h. In terms of economics and efficiency, push-pull working, such as on the Edinburgh – Glasgow line, offers considerable advantages. It also reduces the hazard to staff engaged in coupling and uncoupling for locomotive changes.

91. I therefore considered with my other recommendations, which are intended to reduce the number of collisions between trains and animals, what should be done to increase resistance to derailment for the

DBSO in the event of such a collision. I have considered the feasibility of increasing the axle-load of the vehicle but the most that can be achieved without building a completely new vehicle is an increase to 12 tonnes, which in any case will take time and involve considerable modification and expense. I believe that the fitting of a deflector will provide protection commensurate with the maximum speeds involved and I have therefore recommended that a deflector be fitted to the DBSO vehicles in the Scottish Region. This work has been put in hand. However, if speeds in excess of 100 mile/h are to be considered, the consequences of a collision either in terms of damage or derailment become progressively greater and it is for that reason that a separate study is being conducted of the protection required.

I have the honour to be,

Sir,

Your obedient Servant,

A. G. B. KING
Major

The Permanent Under-Secretary of State
Department of Transport

RULE BOOK

Section H. Working of Trains

3. Duties of Drivers and Drivers' Assistants (cont'd)

3.8 Observing any irregularity or obstruction

3.8.1 Should a Driver observe anything abnormal which is likely to endanger trains, he must stop the train at the first station or signal box that is open, or at a lineside telephone, whichever is the nearest, to give the information.

3.8.2 If, however, the Driver sees cattle on the line, or if the safety of trains travelling in the opposite direction is endangered, he must also sound the horn and exhibit a red handsignal to any train approaching on that line and, when practicable, place three detonators, 20 yards apart, on the opposite line(s) at least one mile (at least $1\frac{1}{4}$ miles where permissible speed is 100 m.p.h. or above) from the obstruction. If expedient in the circumstances, a track circuit operating clip must be placed on the opposite line.

3.8.3 If the Driver observes something not of immediate danger to trains he must report it at the first suitable opportunity.

3.8.4 Before leaving duty the Driver must make a full written report of the circumstances.

EXTRACT S68 RAILWAYS CLAUSES CONSOLIDATION ACT 1845

Also sufficient posts, rails, hedges, ditches, mounds, or other fences for separating the land taken for the use of the railway from the adjoining lands not taken, and protecting such lands from trespass, or the cattle of the owners or occupiers thereof from straying there out, by reason of the railway, together with all necessary gates made to open towards such adjoining lands, and not towards the railway, and all necessary stiles: and such posts, rails, and other fences shall be made forthwith after the taking of any such lands, if the owners thereof shall so require, and the said other works as soon as conveniently may be:

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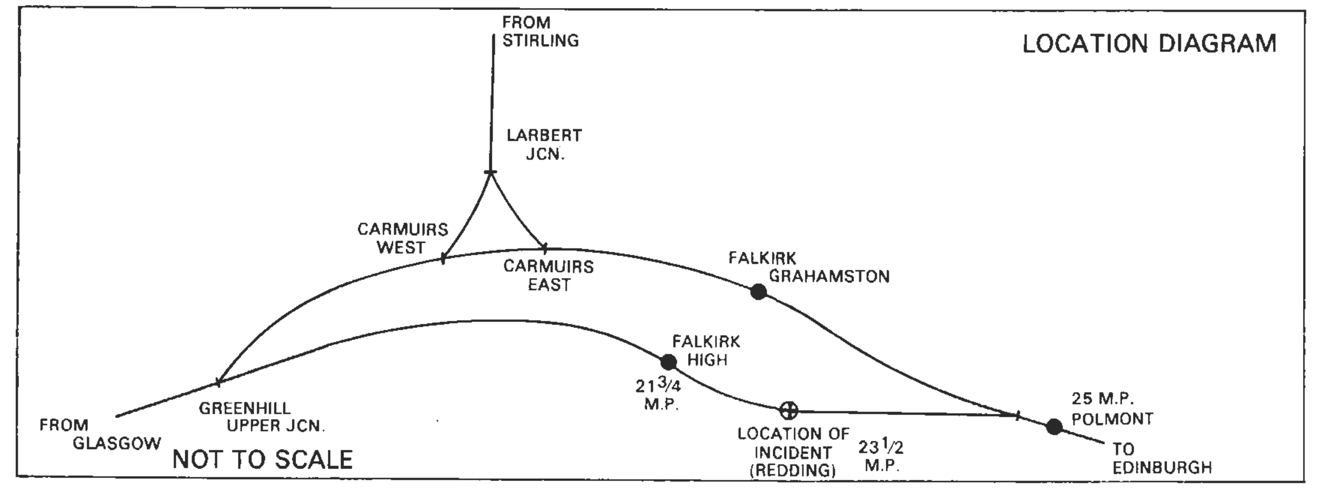
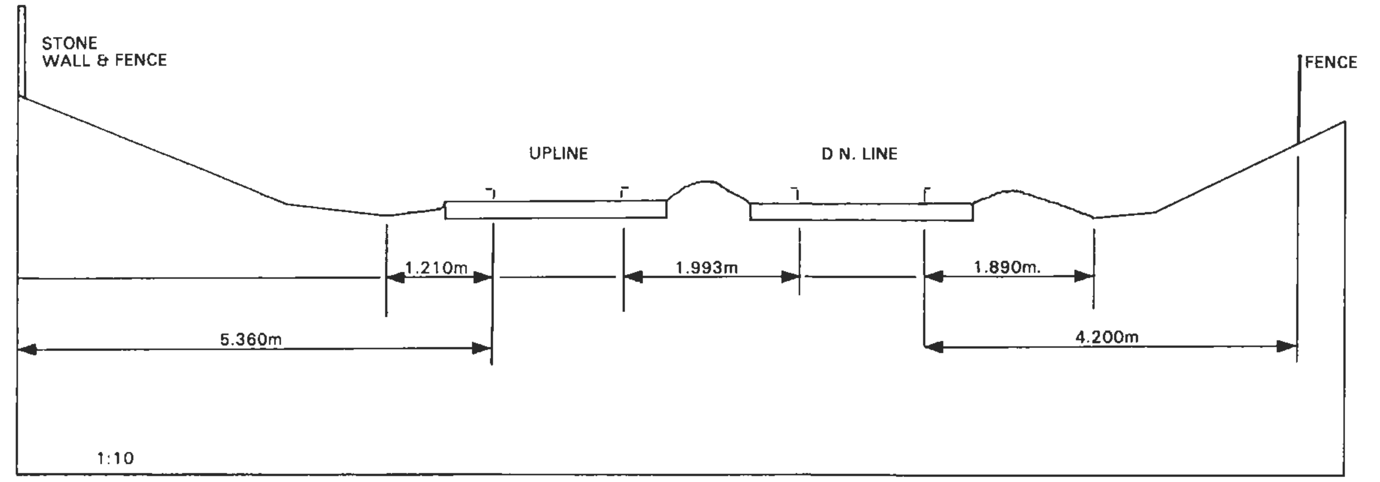
DERAILMENT OF 1730 EDINBURGH–GLASGOW PUSH–PULL EXPRESS PASSENGER TRAIN NEAR POLMONT 30 JULY 1984





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