



Rail Accident Investigation Branch

TRAIN DERAILMENT AT
GRAYRIGG, CUMBRIA
23 FEBRUARY 2007

RAIB INTERIM REPORT

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Rail Accident Investigation Branch

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Summary

1. At approximately 20:15 hrs on 23 February 2007 the 17:15 hrs Virgin Pendolino train from London to Glasgow derailed near Grayrigg in Cumbria (figure 1). Following its derailment the train travelled a further 600 metres and came to rest on the side of the railway embankment.
2. One passenger suffered fatal injuries; 22 further persons on board the train, including the driver, were taken to hospital with injuries. At the time of publication of this report, five of those persons remain in hospital and three are in critical condition. A significant number of others were walking wounded and received first aid on site.
3. The current focus of the RAIB's investigation relates to the condition of the Lambrigg 2B points at the site of the derailment. Indications are that these points were the immediate cause of the derailment. No evidence has been found to date that indicates the driving of the train, the condition of the train or the signalling control system contributed to the accident.

Figure 1: Location of accident



Introduction

The Rail Accident Investigation Branch (RAIB) investigation and the context of this interim report

4. The RAIB¹ is responsible for conducting independent investigations into rail accidents in the UK. The purpose of its investigations is to improve safety by establishing the causes of the accident and making recommendations to reduce the likelihood of similar occurrences in the future.
5. The RAIB is not a prosecuting body; its investigations are focused solely on safety improvement and do not apportion blame or liability. The police and safety authorities still deal with breaches of legislation and none of their statutory duties are changed by the RAIB investigation.
6. The scope of the RAIB investigation into the accident at Grayrigg on 23 February includes:
 - the design, performance, inspection and maintenance of points at Lambrigg;
 - the behaviour of the vehicles, including interior fittings, after they derailed until they came to rest.
7. The RAIB investigation is running independently and in parallel with the investigations of those of the British Transport Police (BTP), Her Majesty's Railway Inspectorate (HMRI), and the industry parties.
8. All investigating agencies, and the industry, are co-operating fully with each other.
9. This interim report sets out the RAIB's initial findings from the first two days of its investigation. As the full investigation progresses beyond this point the RAIB may publish further interim reports particularly if significant findings come to light. A final report will be published on completion of the investigation. All RAIB investigation reports are put in the public domain on the RAIB web-site.
10. At any stage in its investigations the RAIB may issue urgent safety advice and make recommendations to such persons as appropriate in the circumstances.

Background

The track

11. The accident on 23 February occurred near Grayrigg at the crossover known as Lambrigg on the West Coast Main Line (WCML) – between Oxenholme and Tebay, 24 miles 20 chains from Lancaster. The crossover is locally operated by a ground frame, driven by point motors. The ground frame can only be operated by a person on site once its control has been released by the signaller at Carlisle Signal Box.
12. The line speed in the area of the derailment is 95mph and the plain line track consists of continuously welded rail laid on concrete sleepers. Lambrigg crossover consists of 113lb vertical rail, and it was laid in 1986. It is of a design commonly installed between the 1970s and early 2000s.
13. At the time of this report, the RAIB has not been able to locate evidence of the last use of the Lambrigg 2B points.
14. Network Rail report there are no outstanding faults logged for the points at Lambrigg on Network Rail's fault management system – the record system into which inspection staff enter information. The RAIB have yet to examine the related records.

¹ www.raib.gov.uk

The train

15. The train involved in the accident was a Class 390 Pendolino operated by West Coast Trains Ltd (Virgin Trains), one of 53 such trains in use in UK. The class 390s were introduced in July 2002. The fleet has not previously been involved in any serious accidents, although there were two occasions early in their operation when a Pendolino train hit the buffer stops in Liverpool Lime Street station. This led to a modification to the trains' braking software, since then there has been no further problem.
16. The train, which consisted of 9 carriages, was the 17:15 hrs Euston – Glasgow. There is no evidence available to indicate that the journey prior to the derailment had been other than normal.
17. There were 111 passengers and 4 staff on the train.

The derailment

18. At 20:15 hrs, all carriages of the train derailed at the Lambrigg crossover. The leading carriage fell down the embankment to the west of the track turning through 180 degrees from its previous direction of travel. The second carriage ended up lying near perpendicular to the track on the side of embankment and the following carriages came to rest at various positions along the embankment. Carriages three to five ended up on their sides at the base of the embankment and the remaining carriages were at various positions either sloping or vertical on the side of the embankment. See photograph at Figure 3.

Consequences

19. One passenger suffered fatal injuries. Twenty two other people were taken to hospital; five were seriously injured. Many others were treated on site but the exact number is not known to RAIB.
20. There was substantial damage to the train. However, all carriages retained their structural integrity of the passenger compartment. The RAIB has yet to carry out its inspection of any of the carriage interiors.
21. The derailed train caused considerable damage to the track and infrastructure. Other points in the vicinity also suffered damage and will need to be renewed, whilst the plain line on both the Up and Down lines from the Lambrigg crossover to the point where the train stopped was destroyed. The overhead electrification masts were brought down on the Down line by the derailed carriages, and also severely damaged on the Up line.

Parties involved

22. The railway infrastructure is owned and maintained by Network Rail.
23. The train was operated by West Coast Trains Ltd (Virgin Trains).

Progress to date

24. The RAIB was notified of the incident at 20:45 hrs, arrived at the site of the accident at 23:35 hrs and has continued to work on site since.

25. To date, the RAIB:

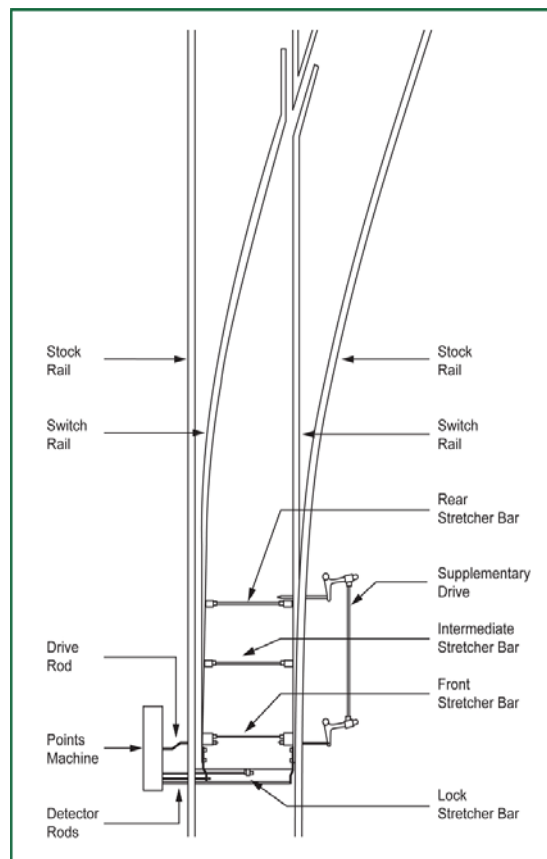
- is carrying out a detailed survey of the crossover points and all other track in the vicinity of the derailment;
- is obtaining details of the most recent operation of the points at Lambrigg for review and will be reviewing the signal box tapes relating to operation up to the time of the accident;
- has examined the train for damage, in so far as its condition presently permits, and recovered the On Train Data Recorder for analysis; and
- is collecting records of the inspection and maintenance of the track, signalling, and train for further review.

Findings to date

Track

26. The design of the facing points² at Lambrigg had one lock bar and three stretcher bars.

Figure 2: Diagram of switch and stock rails and stretcher bar



² Points are used to enable trains to divert or join between two routes. The diversion is carried out by having two rails that move from one side of the track to the other, and select the route. These moving rails are known as the switch rails and are designed to abut against specially modified rails known as stock rails – see diagram. The two switch rails are maintained the correct distance apart by a series of bars known as stretcher bars. In addition, a bar at the toes of the switches (i.e. the moveable end) carries detection equipment to show that the switches are correctly positioned – this is known as a locking bar. Facing points are where two routes diverge in the direction of travel.

27. Investigation of the lock and stretcher bars in the facing points at Lambrigg crossover showed that one of three stretcher bars was missing, and bolts that secured the lock bar and another stretcher bar were not in place – some of these bolts and the associated nuts and washers were found in the ballast, but others were not. However, the RAIB search of the area has not been completed. There is no evidence that the bolts had been wrenched free. Two of the stretcher bars were fractured; in one case the nature of the fracture surface indicates that it may have been consequential to the derailment. In the other case, the fracture surface indicates that it may have predated the derailment. The latter will be confirmed by further analysis.
28. There was therefore no complete stretcher bar in place between the switch rails immediately before the derailment. The left hand switch rail was free to move across close to the left hand stock rail whilst the right hand switch rail remained, correctly, against the right hand stock rail.
29. The marks on the crossover at Lambrigg indicate that at the time of the derailment both switch blades were in contact or very close to their respective stock rail. The train wheels were thus set on a course where the gauge was narrowing as the train moved forward. The train wheels, (which are rigidly mounted on an axle a fixed distance apart), could not follow the narrowing route and climbed over both switch rails, and then ran in a derailed state.
30. All the remaining wheels of the train derailed at the points. At least five sets of the wheels crossed over to the southbound (up) line during the course of the derailment.

Signalling

31. The track in the Lambrigg area is signalled by multiple aspect colour light signalling; this is controlled from a power signal box at Carlisle. The operation of the crossover at Lambrigg is described above in paragraph 11. To operate the crossover requires a positive action by both the signaller at Carlisle and an operator at the crossover.
32. The RAIB has no evidence of anyone operating the crossover on 23 February. The derailment mechanism, evident from the site examination, requires that the switches are against both stock rails, which is not possible when the stretcher bars are present. There is no evidence to indicate that the signalling systems contributed to the accident.

Train operation

33. Whilst the On Train Data Recorder is yet to be downloaded to confirm the train speed etc, and interviews are yet to be completed, the RAIB has no evidence that the train was being driven in any other way than it should have been.

The train

34. The rolling stock suffered damage in the collision, but maintained the basic structural integrity of the passenger compartments. Due to safety issues related to the stability of the carriages in their current position, it has not yet been possible to carry out detailed inspection of either the carriage interiors or the running gear and further investigation is still to be conducted. However, no evidence has been found to date that shows that the train itself contributed to the derailment.



Figure 3: Photograph of derailed train with carriages numbered.

35. Key aspects of the damage are:

- The trailing bogie of the first carriage and the trailing bogie of the fifth carriage separated from the carriage bodies. There was no further consequential damage from this.
- The front end of the leading carriage suffered damage, but the crashworthy structure appears to have performed as designed, and the windscreen was not broken.
- The leading carriage was separated from the second carriage, and out of line as described above.
- The second carriage was separated from the third carriage, and out of line, lying on the embankment slope almost perpendicular to the track.
- All other carriages remained in line, but the gangways were separated. At this stage it has not been possible to establish whether the couplings held in all cases.
- The leading end of the second carriage hit an overhead line stanchion, causing damage to the vestibule area, but not affecting the passenger compartment.
- The overhead line pantographs on the third and seventh carriages remained intact.
- There are broken windows on the left hand side of the second carriage, and probably on other carriages, but these have not yet been examined as the carriages are on their sides.

- There are isolated broken windows on the right hand side of the train, but this may be a result of emergency service recovery of the passengers.

Maintenance

36. The RAIB has carried out a preliminary review of the recent maintenance of the points at Lambrigg based upon documents provided by Network Rail.
37. This review indicates that all recently scheduled tests of the points took place on the Network Rail scheduled dates. The RAIB will further review when visual inspections were carried out. There is evidence that the last scheduled visual inspection on Sunday 18 February did not take place. The RAIB will carry out further investigation into the content of these tests and inspections.
38. Network Rail's New Measurement Train ran over the site on Wednesday 21 February. This train records the geometry of the track and also takes a video record of the track. The RAIB is currently in the process of reviewing these records.

Emergency response

39. The emergency services were summoned immediately after the accident; the arrangements worked well and they recovered the injured and other travellers from the train in a very efficient way especially considering the remoteness of the accident site, and the extremely trying conditions, with heavy rain and access only possible over very muddy ground.
40. In the immediate aftermath of the accident and prior to the arrival of staff from Network Rail and Virgin Trains, members of the public resident in the area near the accident site assisted in the immediate recovery and welfare of the injured, and of other passengers.
41. The RAIB will as part of its investigation further review the response with the emergency services and others involved in the accident.

Actions already taken by industry relevant to the investigation

42. Network Rail commissioned an immediate survey of at least 15% of its high speed facing switches of the same design for loose and missing components. By 18:00 hrs Sunday, 938, more than 15%, examinations had been completed. Network Rail has confirmed that no problems sufficient to present a risk to safety have been found.
43. Network Rail's routine patrolling inspections take place weekly on this line.

Restoration of site

44. Network Rail's current estimate, at the time of this report, is that it will take a minimum of 14 days to restore the line to permit services to resume. RAIB is conducting its investigations in a manner that will facilitate this restoration work.

Conclusions

45. The immediate cause of the accident was the condition of the stretcher bar arrangement at points 2B at Lambrigg crossover which resulted in the loss of gauge separation of the point switch blades.

RAIB's future action in the investigation

46. RAIB's investigation will continue to investigate:

- the immediate and underlying reasons for the condition of the stretcher bars; and
- the behaviour of the rolling stock in the extreme conditions of a high speed derailment.

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