Rail Accident Investigation Branch

RAIB Bulletin 01/2010

Passenger train collision at Darlington 3 October 2009

Description of the accident

1. At around 10:54 hrs on 3 October 2009, a passenger train arriving in platform 4 at Darlington station collided with the rear of another passenger train which had just started to depart from the same platform (see figure 1). The collision caused a small number of minor injuries and two passengers were taken to hospital for treatment. Both trains suffered minor damage.

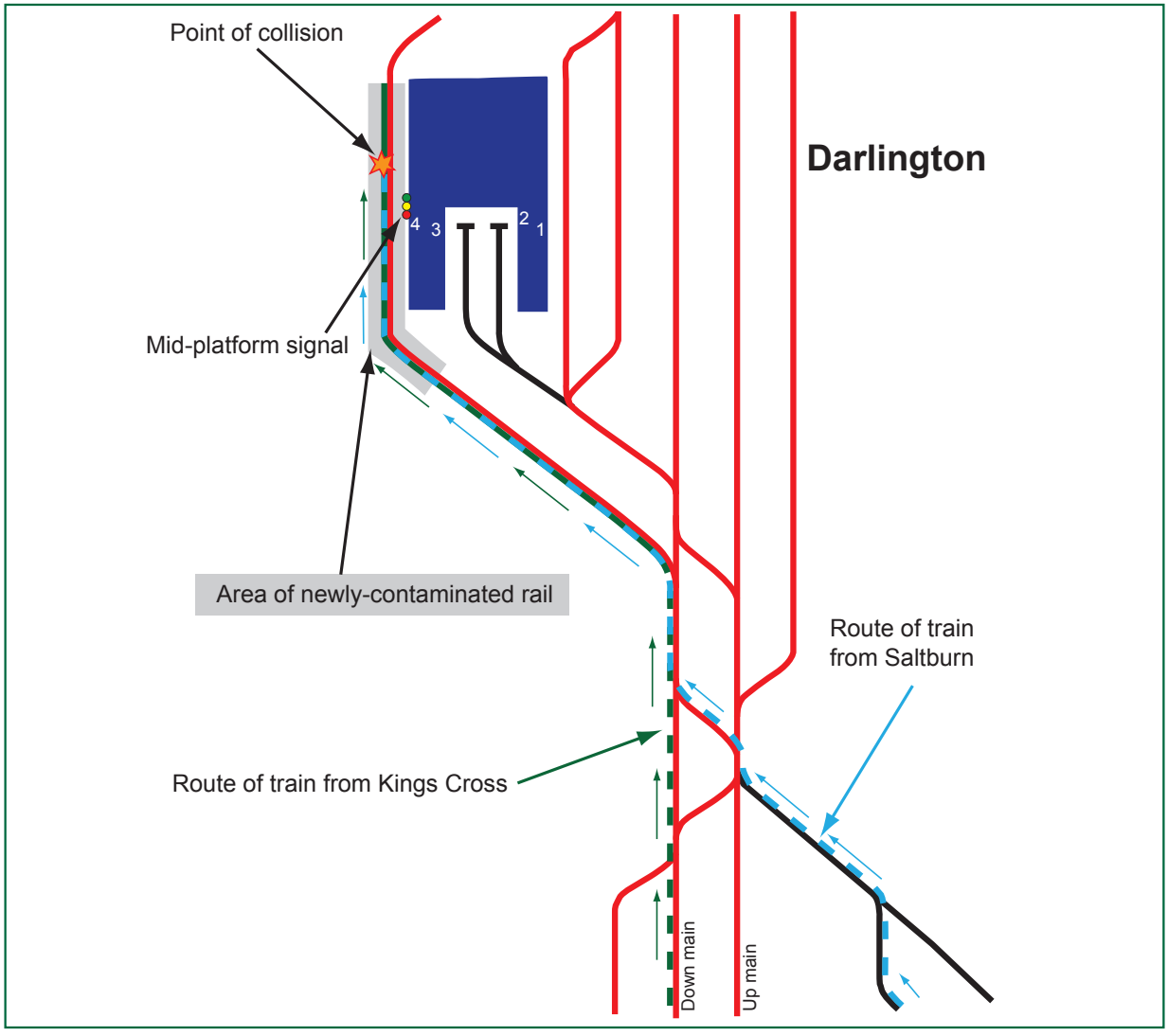

Figure 1: Layout of track and path of trains involved

2. The signalling arrangements at platform 4 permit two trains to be present at the same time. A mid-platform signal effectively divides the platform into two sections (north and south). An overlap of 72 metres beyond the mid-platform signal means that a train standing at the north end must be at least this distance beyond the mid-platform signal for a train to be allowed to enter the south end of the platform.

3. At the south end of the station, the line from Saltburn (via Middlesbrough) joins the main line from the east. Trains approaching the station from the Saltburn line can be routed into platform 4.

4. On the day of the accident, a northbound main-line train from Kings Cross to Edinburgh (comprising a Class 91 locomotive, a rake of Mark IV coaches and a Driving Van Trailer at the rear) ran into platform 4 at Darlington and stopped normally at the north end, with the rear of the train more than 72 metres beyond the mid-platform signal.

5. Shortly afterwards, a train (comprising a Class 142 'Pacer' unit) approached from the Saltburn line and was routed into platform 4, with the intention that it would stop in the south end at the mid-platform signal. The driver received a correct sequence of signal aspects approaching the mid-platform signal, which was correctly set at danger.

6. The driver of the Saltburn train approached the station at around 30 mph (48 km/h), which was below the permitted line speed of 35 mph (56 km/h). Approximately 170 metres from the mid-platform signal, the driver applied the brake momentarily in steps one and two and then into step three[1] (only one second elapsed between initial application of the brake and the driver's selection of step three). Within two seconds of the brake being applied in step three, the wheels locked and the train started to slide.

7. The driver released the brakes in an attempt to get the wheels turning again, but with the train still running at around 27 mph (43 km/h), re-applied them within three seconds into brake step two. The brake pressure did not fall to zero in this short period and the train continued to slide.

8. When the Saltburn train was 75 metres from the mid-platform signal it ran over the Train Protection and Warning System (TPWS) overspeed sensor for the signal, which is set to detect trains running at over 22 mph (35 km/h). The speed of the train was above this limit, so the the train's emergency brakes were applied. The train wheels remained locked and the train continued to slide, passing the mid-platform signal at danger, and running into the rear of the main-line train, which had just started to depart from the north end of the platform.

9. When the driver of the Saltburn train realised that a collision was likely, he alerted the passengers via the Public Address system to brace themselves. This action gave passengers enough time to prepare for the impact.

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[1] On the Class 142 unit, there are three 'normal' braking positions designated steps one, two and three and an emergency braking position. Step one braking results in the lowest rate of retardation; step three braking is equivalent to a maximum brake demand. See paragraph 24 for an explanation of the link between braking rate and available levels of adhesion.

Findings of the Rail Accident Investigation Branch (RAIB)

10. The primary cause of the accident was contamination of the rail head at the south end of the station. Samples were taken from the rail head (see figure 2) and the wheels of the main-line train, which was equipped with disc brakes (see figure 3). The swabs from both sources showed high levels of leaf/vegetation material.

Figure 2: Contamination on the rail-head at the south end of the station

Figure 3: Contamination on one of the wheels of the main-line train

11. It is likely that the contaminant had been carried into the area from a location approximately two miles south of the station, on the main line, by earlier trains. The driver of an earlier northbound main-line train had reported problems in braking at this location and the driver of the main-line train involved in the accident recalls passing through leaves being thrown up by a southbound passing train in roughly the same area. Platform 4 at Darlington is covered and would not have been vulnerable to contamination by any vegetation in the vicinity of the station.

12. There were high wind speeds in the area at the time. A speed restriction was in force in order to protect against damage to the overhead line equipment. It is likely that the high winds resulted in leaves and other vegetation being blown onto the line, from where it could be picked up by the wheels of passing trains and transported short distances. This material, having been deposited from trees during the early part of autumn, is likely to have had a high moisture content, which would have made a significant contribution to the low level of adhesion available. The colour of the contaminant (see figures 2 and 3) also suggests that the material was moist.

13. Both main-line trains were equipped with disc brakes, which meant that when they braked on the approach to Darlington station, the wheels were not rapidly cleaned by the action of tread brakes on the wheel rims. Instead, the train(s) continued to deposit vegetation on the rail head.

14. This part of the main line is not identified by the industry as a known area of low adhesion and the rail head is not treated during the leaf-fall season. In any case, this accident occurred approximately two weeks before the introduction of the rail industry's annual arrangements for mitigating the effects of low adhesion in autumn.

15. The analysis of the rail head samples also showed the presence of hydrocarbons. A rail greaser is located approximately 160 metres south of the mid-platform signal, shortly after the location where the driver of the branch-line train started to brake. It is likely that the rail greaser was the source of the hydrocarbons. A subsequent examination of the equipment by the infrastructure owner showed that the rate at which grease was being dispensed was within permissible parameters. It may, however, have provided a rail-based medium to which the contaminant could adhere.

16. The Class 142 unit was equipped with tread brakes, which act directly on the wheels of the train rather than on discs. Although tread brakes can help to clean the surface of the wheel, this was of negligible benefit initially because the contamination was being continually re-applied as the wheels turned and later because the wheels were locked. The unit was subsequently examined by the train operator and a special brake test was undertaken, which did not reveal any anomalies that could have contributed to the accident.

17. The Class 142 is not equipped with either a wheel slide protection (WSP) system, or with sanding equipment. The application of sand to the rail head might have helped to slow the train and may have prevented the collision. However, the Class 142 is specifically excluded by Railway Group Standard GM/RT 2461 'Sanding Equipment Fitted to Multiple Units and On-Track Machines' from being equipped with sanders. The standard requires that there should be six axles behind the point where sand is delivered and Class 142 units only have four axles in total. The hazard that the standard seeks to mitigate is that the sand might prevent direct contact between the wheels and the rails, which would result in the train failing to operate track circuits, a high risk wrong-side failure.

18. The RAIB conducted an investigation into the high number of adhesion-related incidents that occurred in 2005[2]. The RAIB recommended to the cross-industry safety body that a review be undertaken of the relevant standard to identify ways in which the Class 142 and certain other excluded units could be equipped with sanders. The recommendation was made in January 2007. Relevant research has been planned, but its implementation has recently been deferred pending the outcome from research into the performance of existing sanding systems (delivered in December 2009).

[2] Autumn Adhesion Review, Part 3: Review of adhesion-related incidents, Autumn 2005. RAIB report 25(Part3)/2006. All RAIB reports are available at www.raib.gov.uk

19. The driver of the Saltburn train was experienced and had been driving trains through the area for 16 years. The way that he used the brakes was influenced by a desire to achieve a punctual arrival (the train had earlier been delayed slightly by a door problem) and by his knowledge that use of brake step three had never previously caused a problem in this area.

20. However, this braking technique was not in accordance with the train operator's professional driving policy, in two ways:

    - The policy suggests that drivers should aim to control their speed to between 15 and 20 mph (24 and 32 km/h) when 200 yards (183 metres) from a signal showing a red aspect. On the day of the accident, the branch-line train was travelling at 30 mph (48 km/h) at this point.
    - The policy encourages drivers to think of brake steps one and two as being the normal initial brake, and brake step three to be 'kept up the driver's sleeve'. On the day of the accident, the driver used brake step three almost immediately.

21. Although the train driver had deviated from the professional driving policy, the train operator had also issued braking instructions which were not inconsistent, but differently worded, stating that:

    > 'When rail conditions are good, as a general rule, the normal braking technique should be based on a step one application. If necessary, further adjustments of the brake may be required using step two or step three to enable a controlled stop to be achieved.'

22. While the braking instructions do envisage use of brake step three, they do not imply that initial use of brake step three is the norm.

23. After the accident, the train operator of the Saltburn train engaged the services of specialists to review the circumstances. The specialist concluded that:

    - The train actually achieved a rate of retardation of around 2-2.5%. This low rate was caused by the low levels of adhesion available and by the train sliding with wheels locked.
    - The peak levels of adhesion that were actually available were probably in the range of 4%-7%.

24. It would have been necessary for 9% adhesion to be available to support the step three brake used by the driver. Had the driver braked earlier, and in step one, it is possible that some retardation would have been achieved as only 3% adhesion would have been necessary to support a step one braking rate. However, given:

    - the significant amount of contamination and its impact on adhesion levels; and
    - the intervention of the TPWS which took control of the braking away from the driver,

    it is highly unlikely that a change in braking technique would have prevented the train from passing the mid-platform signal at danger, although it may have prevented the collision.

Conclusions

25. The RAIB has conducted a preliminary examination of the circumstances and key evidence associated with the collision at Darlington on 3 October 2009. On the basis of a review of this information the RAIB has concluded that, in this case, further investigation by the RAIB would be unlikely to result in formal recommendations for the improvement of safety[3]. Nevertheless, the preliminary examination has highlighted two learning points. These are described at paragraph 26.

Learning points

26. The RAIB has identified the following specific learning points:

- the need for advice/instructions given to train drivers on braking techniques to be consistent, and to reflect the requirement for initial braking to be made in step 1 or step 2 (or equivalent for trains with stepless brake control), as this will help to maximise retardation in low adhesion conditions, which can occur at any time of year; and
- the need to review current plans for relevant research in the light of this accident and to identify where that research can now be expedited in order to assist in preventing a recurrence of the circumstances found at Darlington.

27. In addition, the RAIB has held discussions with those conducting the industry investigation and understands that they will consider whether there are any lessons that can be learnt from the presence of rail head contamination in an area where it had never been experienced before.

[3] It should be noted that this does not affect the industry's obligation to comply with health and safety legislation by conducting its own investigation into the accident / incident and implementing appropriate measures to address the risk.

This bulletin is published by the Rail Accident Investigation Branch, Department for Transport.

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