Rail Accident Investigation Branch

RAIB Bulletin 11/2010

Derailment at Dingwall, Scotland
22 January 2010

Description of the Accident

1 At 17:40 hrs on 22 January 2010 the 17:15 hrs passenger train from Inverness to Ardgay, reporting number 2H75, derailed on the points[1] to the south of Dingwall station. The train comprised a two-car class 158 Diesel Multiple Unit and was operated by First ScotRail.

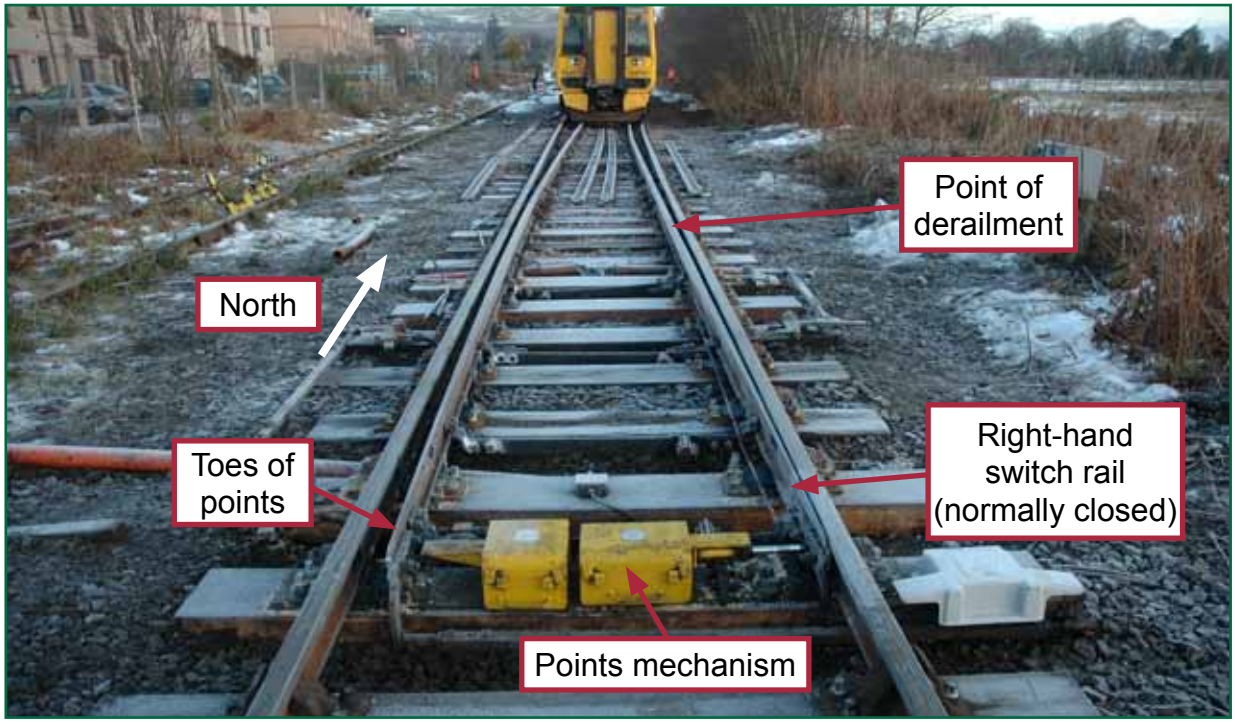

Figure 1: View showing the location of the derailment and the rear of the derailed train

2 All wheels of the train became derailed and the train came to a stand with the leading cab 69 metres north of the toes[2] of the points (figure 1). The driver informed the signaller at Inverness and the Fire and Rescue Service were called. The 75 passengers on board were taken to Dingwall station for their onward journeys. One person was taken to hospital with minor injuries.

3 The line was closed for three days while the infrastructure was repaired.

[1] Points - a set of switches whose purpose is to divert rail vehicles from one line to diverging routes or vice versa.

[2] Toes – the free ends of switch rails.

Description of the infrastructure

4 The line between Inverness and Ardgay is single track with passing loops, one of which is at Dingwall station. The maximum speed permitted on the route is 75 mph (120 km/h). The permitted speed over the points at passing loops is 15 mph (24 km/h).

5 The signalling system is Radio Electronic Token Block (RETB) and is controlled by the signaller at Inverness. A driver is granted an electronic token[3], via a radio system, which authorises the train to travel over the single line section between the loops.

6 At Dingwall there are points to the north and the south of the station forming the ends of the loop. The train was travelling north; its derailed position is shown in figure 2.

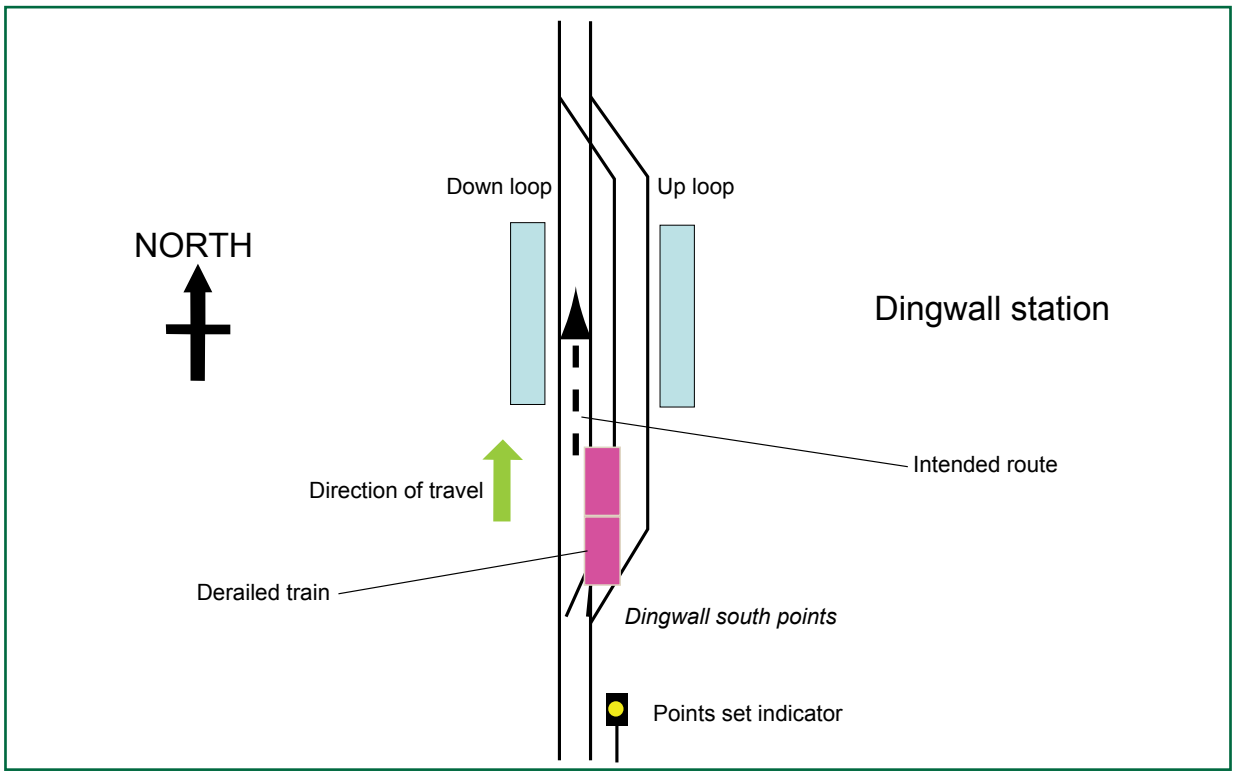

Figure 2: Layout at Dingwall showing the location of the derailed train

7 The points at Dingwall are of a type known as train operated points (TOPs). The points mechanism[4] (figure 1) allows the switch rails to be pushed over by a southbound train passing over the points in a trailing[5] direction when leaving the up loop. The mechanism returns the switch rails to the normal, straight on position once the train has passed. This allows the next northbound train approaching the points, in a facing[6] direction, to be directed to the down loop.

[3] An electronic data message giving the driver authority to enter a section of line.

[4] The points are Hydro-Pneumatic Self Restoring points. The mechanism employs a gas filled accumulator which is connected to a hydraulic actuator. The energy stored within the accumulator allows the points to be restored to their normal position following the passage of a train leaving the loop.

[5] The direction of travel over the points where two tracks converge into one.

[6] The direction of travel over the points where one track diverges into two.

8 There is a 'points set indicator' (PSI) 50 metres to the south of the points (figures 2 and 3). The PSI is controlled by a points position detector unit. This permits the PSI to display a steady yellow lamp to approaching drivers if the points are in the correct position for the train. If the points are in an incorrect position the PSI cannot illuminate. The setting of the point detector ensures that the PSI lamp is illuminated when the right-hand switch rail is within 3.5 mm of its adjacent stock rail, i.e. the route is proven to direct northbound trains into the down loop.

9 On the approach to the PSI there is a reflective warning board and an associated AWS magnet to warn drivers that the train is approaching a set of points.

10 If the PSI is not illuminated the instructions state that the driver must stop the train at the PSI, inform the signaller and manually secure the points in position. Before proceeding the driver must then check that the PSI is illuminated.

Figure 3: View towards the north showing the illuminated points set indicator

Findings of the Rail Accident Investigation Branch

Events preceding the derailment

The points

11 On 16 January 2010 the local track maintenance team undertook planned maintenance work on the points. The task was to replace all rails of the points, three timber bearers (sleepers) and the points position detector unit. The rails were replaced but the bearers and detector unit were not. The bearers were not replaced because the temperature was close to 0 °C and the team were aware of the requirement to limit the disturbance of ballast at low temperatures (this is to avoid the risk of frost making the ballast difficult to move and reinstate). Signalling technicians were not present during this work so the existing detection unit remained in place. The points detection test was not undertaken until 19 January 2010 despite the rails having been replaced and trains having run over them for two days.

12 On 20 January 2010 the replacement bearers and the detector unit were fitted. This involved removing the ballast from around the three existing bearers, removing them and replacing with new items. There is no evidence that the detection test, which involves checking the detection settings (paragraph 8) was undertaken prior to the points being put back into service.

Other train passages before the derailment

13 On 22 January 2010, prior to the accident, there were three points failures reported to Fault Control. The first two failures, at 05:12 hrs and 08:46 hrs, resulted in the trains having to stop on the southern approach to the points as the PSI was unlit. The train drivers reported this condition to the signaller. Between these two events four trains had passed over the points without incident; the first train was entering the loop and the subsequent three trains were leaving the loop.

14 Signalling technicians attended the points between 09:00 hrs and 09:50 hrs at the request of the signaller. They found that the points were not fully returning to their normal position (i.e. set to direct northbound trains into the down loop). The log sheet records that there was 'rubbing' between sliding parts, and suggested that the maintainer should attend. An adjustment was made to the mechanism and the operation of the PSI was checked and found to be working. The reported fault was cleared at 09:50 hrs.

15 Eight trains in each direction subsequently passed over the points without any reported problems until 17:03 hrs when the third reported failure occurred.

16 At 17:03 hrs the driver of a train leaving the loop, reported to the signaller that the points were not correctly positioned. This was the last train to pass over the points before the accident.

17 The signaller neither recorded this as a fault nor informed the driver of 2H75 that the points may be incorrectly set because:

- the signaller thought that the points would fully reset as per design following this move, and
- the RETB Train Signalling Regulations do not specifically require signallers to inform drivers of subsequent trains of this possibility unless they have been informed by a driver of a train approaching an unlit PSI during a facing move.

The incident train and the driver

18 Train 2H75 left Inverness at 17:15 hrs. The journey was uneventful. The driver had made an earlier journey that afternoon to Invergordon and back, passing over the points at Dingwall twice without incident. On both journeys he was not aware of any problems relating to the points south of Dingwall.

19 At around 17:32 hrs, the driver was granted the electronic token by the RETB signaller at Inverness for the section of the line between Muir of Ord and Dingwall.

20 The train reached a maximum speed of 76.3 mph (122 km/h) on this section (slightly in excess of the speed permitted). The driver began braking for Dingwall when the train was travelling at 65 mph (104 km/h), approximately one minute before reaching the points. Under normal circumstances the first application of brakes at this time would have provided sufficient time to slow the train to the permitted speed of 15 mph (24 km/h) before encountering the points at the south end of the loop.

21 The On Train Data Recorder (OTDR) shows that in the minute between the driver's first brake application and the derailment he changed his brake setting on 24 occasions. For most of this time he was alternating between steps 1 (the minimum available brake force) and 2, although for short periods he also selected step 3 (full service brake) and released the brakes. (The OTDR shows that he had adopted a similar style of braking on the approach to previous stations on the route).

22 The speed of the train was reduced from 65 mph (104 km/h) to 28.5 mph (45.6 km/h) by the time it reached the points.

Events during and following the derailment

23 While the train was passing over the points it derailed (the reasons for this are described at paragraph 30).

24 After the derailment the train driver contacted the signaller and reported that the PSI had been lit as his train approached the points. After attending to the train crew and passengers, he walked back to the points and the PSI. He observed that the right-hand switch rail was not fully closed (he estimated the opening to be between 10 and 20 mm). He then discovered that the PSI was illuminated. Once this was reported to the signaller the incident was then recorded as an alleged wrong side, (i.e. unsafe) failure.

The driver

25 The driver was tested for prohibited drugs and alcohol after the accident, in accordance with routine industry practice, and was found to be clear of these substances.

26 The driver had been on prescribed medication since March 2004. The RAIB has explored his medical history and has found no evidence to suggest that this contributed to the accident.

27 His shift patterns do not suggest any evidence of fatigue. The RAIB is aware of no other factors likely to have caused him to be fatigued or to have adversely influenced his performance.

28 The driver had been driving since 1990 and had operated trains over this line for approximately two and a half years and was familiar with the route. Prior to this accident he recalled seeing an unlit PSI on only four occasions in seven years.

Site findings

29 The RAIB attended the site and undertook examination and testing of the points with the support of Network Rail signalling technicians.

30 There was no evidence of the right-hand wheels having flange-climbed the right-hand switch rail or having made contact with the point toes. It is therefore deduced that the right-hand switch rail was wrongly positioned when the train approached. This permitted the right-hand wheels of the train to pass to the right of the switch rail, rather than to the left as intended (figure 4). As a consequence the right-hand wheels travelled towards the up loop and the left-hand wheels towards the down loop. After about 6 metres the divergence of the two rails on which the wheels were now travelling caused the wheels to drop off the rails. This scenario is known in the railway industry as 'splitting the points'.

31 For this to have happened the right-hand switch rail must have been open from its adjacent stock rail by at least approximately 30 mm to allow the leading wheel on the right-hand side to pass through the gap. Once the leading wheel had entered the gap, the wheels kept the switch rail open sufficiently to allow the other wheels through.

32 Since the evidence clearly indicates that the train split the points it can be concluded that the points had not returned to the correct position following the passage of the previous train at 17:03 hrs.

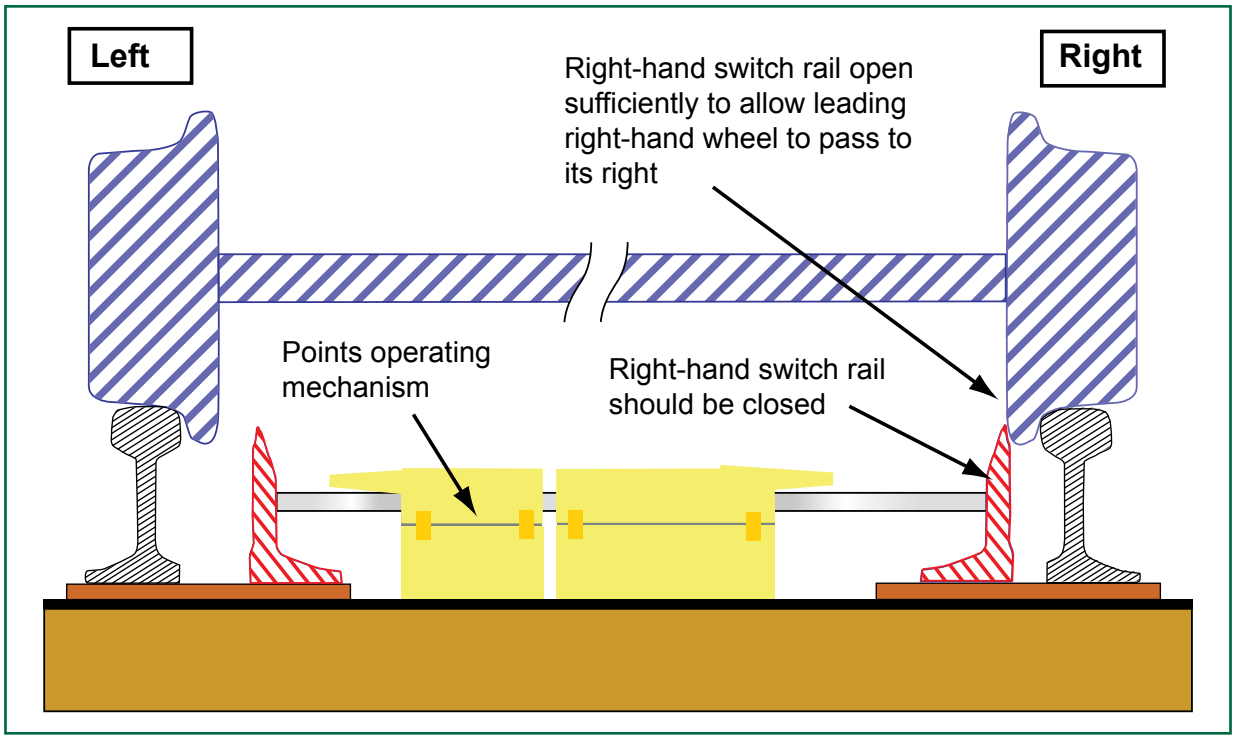

Figure 4: View of the toes of the points, looking north, showing leading wheelset splitting the points

33 After the accident it was discovered that the right-hand switch rail had moved to a more closed position against its stock rail. However damage incurred to the points had caused this switch rail to become twisted. This meant that the toe of the right-hand switch rail was away from its stock rail by 11 mm at rail head level. In this condition the PSI was still illuminated, consistent with the observations of the driver following the accident (paragraph 24).

34 When the damaged stretcher bars were removed the switch rail returned to a vertical position. Subsequent tests on the points position detector unit found that the PSI extinguished when the switch rail moved more than 3.4 mm away from its stock rail. This and other tests showed that there were no faults associated with the detection system and the PSI.

35 There was no visible damage to the points actuator, and its pressure gauge indicated that the actuator's pressure was within its specified limits. Observations made when manually operating the points indicated that the switch rails did not return smoothly to their normal position. Tests undertaken by the RAIB found that this was due to high levels of friction between sliding surfaces, i.e. the rails were 'sticking'.

36 There were two areas of high friction. The first was between the undersides of the switch rails and the slide chairs. This was due to poor support of the switch rail toes because the newly installed bearer at this position was lower than the adjacent bearer.

37 The second area of high friction was between the detector slides (connected to the switch rails) and the newly installed detector unit. There were angular misalignments between these components leading to high forces resisting the actuator returning the points to their normal position.

Previous occurrences of a similar nature

38 The RAIB is aware of three previous derailments relating to train operated points. Two of these occurred on the same type of points on the West Highland line in Scotland on 27 January 1996 and 23 October 2006. The Network Rail report on the latter incident found that the points had not fully returned to their normal position and the driver had only realised that the PSI was not illuminated when it was too late to stop. A third similar incident occurred at Tenby, Wales on 31 January 2007.

Analysis

39 There are two possible explanations for the derailment of train 2H75:

- the PSI falsely indicated that the points were correctly set; or
- the driver did not notice that the PSI was not illuminated and therefore did not stop to inform the signaller.

40 The first of the above can reasonably be discounted because thorough testing of the points position detector unit and the PSI revealed no defective operation. It is also the case that none of the drivers involved in the previous points failures had reported an incorrectly operating PSI.

41 The second possibility is considered to be highly likely given the outcome of the testing described above. It is also significant that the train reached the points at a speed of 28.5 mph (45.6 km/h); nearly twice the permitted speed. This suggests that the driver had become unaware of his location (it was dark at the time). The absence of an illuminated PSI probably contributed to this.

42 The 15 mph (24 km/h) speed restriction that applied to the points was not related to track geometry but was to minimise the consequences should the points be incorrectly set. It is therefore concluded that the speed of the train on the approach to the points did not contribute to the cause of the derailment. However, the higher speed resulted in the train travelling further after it became derailed than would have been the case at 15 mph (24 km/h).

43 The driver's braking on the approach to Dingwall featured frequent changes of setting. There is no evidence to suggest that the adoption of this unusual style of braking contributed the train's over-speeding on arrival at the points.

44 There is evidence that the incorrect operation of the points had been reported by the driver of the previous train (paragraph 16). Had this problem with the points been reported to the driver of train 2H75 it would have alerted him to the possibility that the PSI may not have been illuminated on his approach to the points. This may have prevented the derailment. It is also observed that the signaller did not report the problem to Fault Control for the reasons explained in paragraph 17, although it is thought that there would have been insufficient time for technicians to attend to the points before the arrival of 2H75.

Actions reported that address factors which otherwise would have resulted in a RAIB recommendation

45 Following the two most recent incidents that were investigated by Network Rail (paragraph 38), recommendations were made that consideration should be given to displaying a signal to drivers to indicate that the points are not in a position for the passage of a train. This would have two important benefits:

- it would provide a positive confirmation that the points were not correctly set so reinforcing the need to take action (by stopping the train); and
- it would prevent the absence of a PSI light causing the driver to become unaware of his/her exact location on the approach to the points.

46 Subsequently Network Rail undertook trials of a PSI that gives a positive illuminated signal to drivers when the points are not in the correct position. The trial is complete and the equipment was accepted for use earlier this year. Its implementation at all train operated points in Scotland began in July 2010 with full completion before August 2012. Plans are also in place for its introduction on other lines with train operated points.

Conclusion

47 The PSI was not displaying an indication due to the non-detection of the points south of Dingwall. This absence was not noticed by the driver, who, expecting to see a yellow light became unaware of his exact location. He therefore encountered the points at nearly twice the speed permitted.

48 The unreliable operation of the points had been noted but not fully rectified.

49 Had the signaller advised the driver of 2H75 that the points may be incorrectly set, the driver is likely to have approached Dingwall station in a more cautious manner and observed that the PSI was not illuminated.

Learning points

50 On the basis of the information collected during its preliminary examination of this accident, the RAIB decided not to conduct a full investigation. This is because further investigation by the RAIB would be unlikely to result in a significant improvement of safety[7]. However, the preliminary examination has highlighted a number of learning points which are described below:

- Network Rail should complete the implementation of the modified PSI that provides a positive indication to drivers when train operated points are not in the correct position (paragraph 46).
- When informed of incorrect operation of train operated points, even during trailing moves, signallers should notify Fault Control and inform subsequent drivers that the points may be incorrectly set. Once the modified PSI has been implemented, Network Rail should assess whether this additional requirement on signallers should remain in place.
- When changing equipment on these points, maintainers should ensure that before their reintroduction into operational service that:
  i. the correct checks are undertaken and recorded (paragraphs 11 and 12), and
  ii. the quality of installation, in particular support of switch rails, is such that points are working in a reliable manner.

[7] 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 and implementing appropriate measures to address this risk.

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

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