RAIB
Rail Accident Investigation Branch

Rail Accident Report

Incident involving a runaway track maintenance trolley near Haslemere, Surrey 10 September 2011

Department for Transport

Report 14/2012
July 2012

This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC;
- the Railways and Transport Safety Act 2003; and
- the Railways (Accident Investigation and Reporting) Regulations 2005.

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Incident involving a runaway track maintenance trolley near Haslemere, Surrey, 10 September 2011

Contents

Summary

At approximately 03:00 hrs on Saturday 10 September 2011, a hand trolley ran unattended for a distance of 2.9 miles (4.6 km) along the Portsmouth main line near Haslemere. The incident occurred within an overnight engineering possession and there were no casualties.

The trolley operator did not know he was on a long falling gradient when he let go of the trolley and the brakes on the trolley failed to apply automatically. The brake mechanism probably jammed with the brakes in the 'off' position due to a combination of factors including inadequacies in the design, risk assessment and acceptance processes, and in the subsequent maintenance of the trolley.

The RAIB has made five recommendations to Network Rail. These relate to the training and competence of trolley operators, the product acceptance process, reviewing the actions it has taken since the incident, alternative means of communication in areas of poor mobile phone reception and the process for reviewing RAIB recommendations made to other operators. One recommendation is made to Torrent Trackside, the maintainer of the trolley, to improve the competence of its staff to maintain equipment.

As a learning point from this incident, the RAIB has also identified that duty holders should have effective processes for making sure their staff are made aware of changes in the Rule Book which are relevant to the work they perform.

Introduction

Preface

1 The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway incidents or by mitigating their consequences.

2 The RAIB does not establish blame or liability and does not carry out prosecutions.

Key definitions

3 All dimensions and speeds in this report are given in metric units, except speed and locations which are given in imperial units, in accordance with normal railway practice. Where appropriate the equivalent metric value is also given.

4 Mileages are measured from London Waterloo station.

5 The terms 'up' and 'down' in this report are relative to the direction of travel; the Down Main line runs from London Waterloo towards Portsmouth via Guildford.

6 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B.

The incident

Summary of the incident

7 At about 03:00 hrs on Saturday 10 September 2011 a *hand trolley*, which was being used by a track maintenance gang to transport small tools, ran unattended downhill for a distance of 2.9 miles (4.6 km) along the Portsmouth main line near Haslemere. The incident occurred within an overnight *engineering possession* and the trolley remained within the limits of the *work site*.

8 The trolley reached an estimated maximum speed of 10.5 mph (16.8 km/h) and ran past a site where a gang had just finished rail grinding work in the path of the runaway trolley, before it stopped on an uphill gradient (figures 1 and 2). There were no casualties.

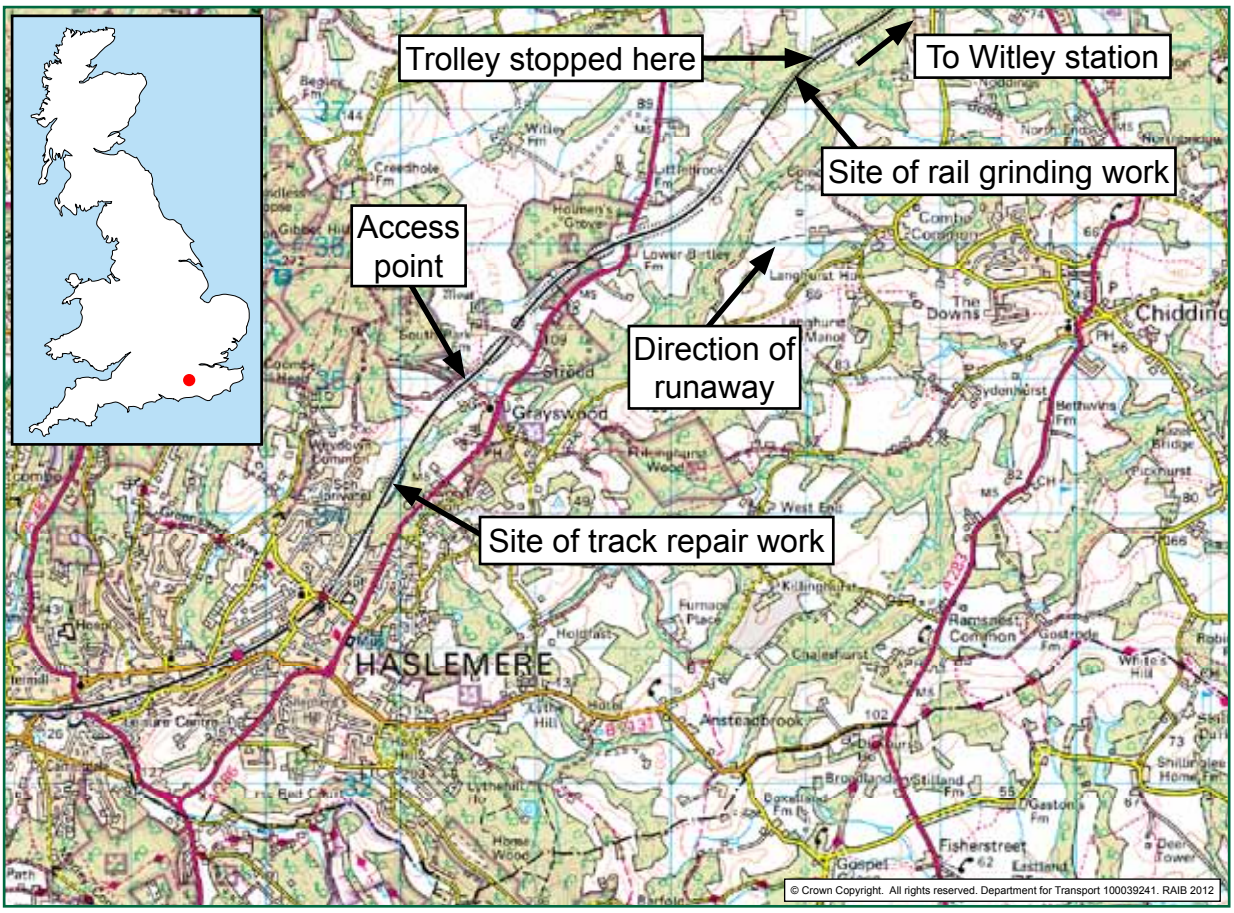

Figure 1: Extract from Ordnance Survey map showing location of incident

9 The incident was not reported by those involved; Network Rail received a letter from a 'whistleblower' about ten days later and the incident was subsequently reported to the RAIB.

Location

10 Between Witley and Haslemere, the Portsmouth main line consists of two running lines: the Up and Down Main. The work on 10 September 2011 was being carried out within an engineering possession of both lines between Milford and Haslemere (36 miles 44 chains to 42 miles 50 chains). This was scheduled to apply from 00:55 hrs to 05:15 hrs; details were published in a supplement to the *Weekly Operating Notice*, Ref. P2011/1536860. There was one work site within the possession; this extended from 37 miles 11 chains to 42 miles 20 chains.

11 The trolley had initially been placed on the Down Main line at an access point known as 'Damson Cottage' (41 miles 23 chains), and was used to transport tools to the site of a track fault on the Up Main line at 41 miles 70 chains, see figure 2.

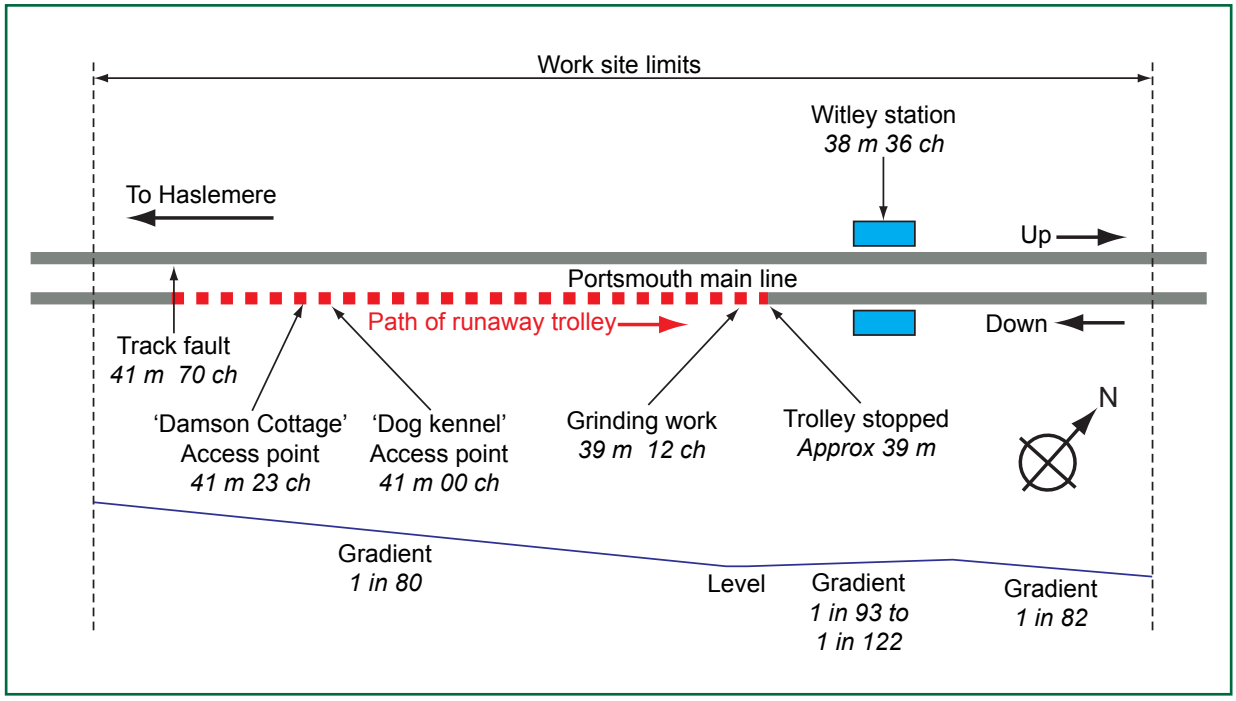

Figure 2: Track layout showing Portsmouth main line between Haslemere and Witley

12 The runaway began while the trolley was being pushed from the site of work back to the access point, after the repair to the track fault had been completed. Both the site of work and the access point were on a section of track known as Witley Bank, which has a gradient of 1 in 80 extending for 3.4 miles (5.5 km), between Witley and Haslemere stations.

13 The gradient levels out at 39 miles 14 chains, in the direction the trolley travelled, and it stopped close to the 39 milepost on a rising gradient of 1 in 93. It was then pushed to Witley station (38 miles 36 chains), where it was taken off the track.

Organisations involved

14 Network Rail owns and maintains the track and infrastructure; it also employs the track maintenance staff involved in the incident. It owned the trolley involved in the incident and had approved trolleys of this type for use on its infrastructure.

15 Torrent Trackside was contracted by Network Rail to maintain *small plant*, including hand trolleys. It employs the fitters who maintained the trolley before and after the incident.

16 Wolfe Designs designed and manufactured the trolley, and certificated its conformance with the European Machinery Directive (98/37/EC). Wolfe Designs Limited was liquidated prior to the incident, and the design rights for the type of trolley involved subsequently passed to Norlec Sheet Metal; the tooling to make the plastic deck, which is held by a specialist supplier, is reported to be unusable and is due to be scrapped.

17 Network Rail, Torrent Trackside and the former directors of Wolfe Designs all freely co-operated with the investigation.

The trolley involved in the incident

18 The trolley was a Wolfe Designs 'trakrat'[1] LT1000P (figure 3). Two of these trolleys were based at Havant track maintenance depot; it is likely that the trolley involved in the incident was No. E0007515 (refer to paragraph 46) although it has not been possible to confirm this as trolley use is not recorded. Network Rail had taken delivery of thirteen LT1000P trolleys in August 2009, following product acceptance of the 'trakrat' family of trolleys by Network Rail during 2008. The LT1000P was the smallest product in the range, which included the LT1250A, LT1500A and LT1500A welders' trolleys.

Figure 3: LT1000P 'trakrat' trolley

19 The trolleys in the 'trakrat' range are equipped with a braking system using disc brakes. The wheels and braking mechanism were contained within two demountable assemblies known as wheel skates or bogies (refer to appendix D); this reduced the weight which had to be carried and made the trolleys easier to transport to and from railway access points. The larger trolleys were made from aluminium, but the LT1000P had a plastic deck.

[1] 'trakrat' is a registered trademark of Norlec Sheet Metal and previously belonged to Wolfe Designs.

20 London Underground had also approved and acquired 'trakrat' trolleys, although not the LT1000P as the plastic material used for the deck did not comply with its fire regulations.

21 Network Rail guidance note NR/L2/RMVP/0200/P018, 'Rail mounted manually propelled equipment (formerly M&EE CoP0018)',[2] recommended that hand trolleys should have a maintenance brake test every three months. Both of the LT1000P trolleys at Havant depot had been serviced by a fitter from Torrent Trackside[3] on 27 June 2011; this was 11 weeks before the incident. The trolleys were serviced again on 20 September 2011 by a different fitter; this was after the runaway incident had occurred, but before Network Rail had received the whistleblower's letter about the incident.

22 After the incident came to light, Network Rail's Wessex maintenance team withdrew its six LT1000P 'trakrat' trolleys from use, and also arranged through Torrent Trackside for the seven remaining trolleys in use elsewhere in Network Rail to be withdrawn (refer to paragraph 105). Seven of the trolleys, including the two from Havant depot, were subsequently examined by the RAIB and Network Rail (refer to paragraph 45).

Staff involved

23 The *controller of site safety* (COSS) was responsible for establishing a safe system of work for the track maintenance gang; he was also in charge of the trolley and had taken the role of *hand trolley controller*. By 10 September 2011 the COSS had been working for Network Rail on track maintenance duties for six and a half years. He had been at Havant depot for five months, and was a *technician*. Before joining Network Rail, he had been an apprentice traction & rolling stock fitter for a train operating company. He was deemed competent by Network Rail to act as a hand trolley controller when this competence was introduced to the *Sentinel* scheme. Like others who were certificated as hand trolley controllers when the competence was introduced during 2009, this was done on the basis of *grandfather rights* and he had received no formal training in the competence.

24 The *engineering supervisor* had worked for Network Rail for ten and a half years, carrying out track maintenance. He had been a team leader at Havant depot for six years prior to the incident, and was working only night shifts.

25 Both of the Havant 'trakrat' trolleys were serviced on 27 June 2011 by a mobile fitter who was employed by Torrent Trackside. He had been maintaining small plant since 1989 for a variety of employers: he was transferred to Torrent Trackside when it took over the maintenance of Network Rail's small plant on 12 December 2010. He had not been trained to maintain 'trakrat' trolleys and had no experience of doing so prior to 2011.

[2] This guidance note converted the *M&EE Networking Group* 'Code of Practice for Rail Mounted Manually Propelled Equipment', CoP0018 Issue 3, April 2010, into a Network Rail document.

[3] Torrent Trackside's trolley Maintenance Schedule includes the required brake test as part of the routine three-monthly service.

26 The second mobile fitter, who serviced the Havant trolleys on 20 September 2011, had also worked for a number of employers before transferring to Torrent Trackside in December 2010. He had been trained by a previous employer to maintain small plant, although this did not include 'trakrat' trolleys, which he too had no experience of maintaining until 2011. He had been a mobile fitter since Torrent Trackside took over the Network Rail contract.

External circumstances

27 The overnight temperature on 9/10 September 2011 was recorded as about 17°C and 94% relative humidity. The incident occurred during the hours of darkness.

28 The external circumstances did not affect the causes of the runaway incident.

Events preceding the incident

29 The work on the morning of 10 September 2011 to correct the track fault was to be carried out by a four-man team, including a COSS. This work had been pre-planned, and was taking place within an engineering possession which was granted at 01:13 hrs. The worksite was subsequently granted at 01:31 hrs and the engineering supervisor issued the *conductor rail permit* to the COSS at 01:47 hrs. The COSS had been applying *short-circuiting straps* at the London end of the worksite (37 miles 11 chains) with another gang member; they then drove to the Damson Cottage access point, where they probably arrived shortly after 02:00 hrs.

30 Meanwhile, the two remaining members of the COSS's gang had arrived at the access point, carried the trolley up a flight of steps to track level, reassembled it (paragraph 19) and placed it on the Down Main line at 01:41 hrs; they then partially loaded it with tools and waited for the COSS.

31 When the COSS arrived with the other gang member, he gave a safety briefing to the other gang members in accordance with Network Rail procedures. They carried the remaining tools up the steps and finished loading the trolley; the RAIB estimates that the total weight of the loaded trolley was 150 - 200 kg. The COSS assumed the role of hand trolley controller, although he did not make sure that the trolley's brake had been tested (refer to paragraph 57). He pushed the trolley approximately 950 metres to the site of the track fault on the adjacent Up Main line, where he and his gang arrived at about 02:22 hrs.

Events during the incident

32 On completion of the work to repair the track fault, the gang loaded the tools they had been using back onto the trolley. The COSS started to push the trolley back towards the access point at 02:52 hrs.

33 According to witness evidence, the COSS let go of the trolley to roll his sleeves up; as he did so, the trolley continued to roll. One of the gang members shouted a warning to the COSS, who was distracted from his responsibility for controlling the trolley and turned round. When he turned back again, the trolley had run away from him. The RAIB estimates that, if the trolley was already moving when the COSS stopped to listen to his colleague, it would have taken about 5 - 7 seconds for it to have picked up sufficient speed for him to have been unable to catch it.

34 Witnesses reported that the COSS ran after the trolley as far as the Damson Cottage access point, but failed to catch it; he then stopped to wait for the rest of the gang. When the others reached the access point, one of them incorrectly told the COSS that the gradient flattened out at the next access point, known as 'Dog Kennel', which was 500 yds (460 m) further on (at 41 miles 0 chains), so he resumed his pursuit of the trolley.

Events following the incident

35 The trolley ran at an average speed of 10.4 mph (16.7 km/h) and came to rest near the 39 milepost, approximately 2.9 miles (4.6 km) from where the COSS had let go of it, shortly after the gradient started to rise[4].

36 A two-man team had been working on the Down Main line at 39 miles 12 - 12½ chains, carrying out grinding repairs to two welded rail joints. They had returned to Witley station and were clear of the line by 03:15 hrs. At the time that the COSS for this team contacted the engineering supervisor to advise him that they had finished work, the engineering supervisor was unaware that the trolley had run away.

37 The COSS, who was still pursuing the trolley, phoned the engineering supervisor to report the runaway at 03:22 hrs. The engineering supervisor was engaged on another call using his personal mobile phone and he passed his work phone to a colleague who was in the van with him. The COSS was able to report that his trolley had run away, but communication was lost before he could pass on the details and contact could not be effectively re-established. By this time, the only gang remaining within the worksite was the one for which the COSS was responsible.

38 The COSS sent a text message to the engineering supervisor's company phone at about 03:38 hrs, to say he had found the trolley. The engineering supervisor phoned him back and told him to push the trolley to Witley station, where his colleagues would be waiting. The trolley was unloaded at Witley station and removed from the line at 03:56 hrs.

[4] The gradient levels out at 39 miles 14 chains in the direction of travel, and starts to rise again at 39 miles 8 chains.

The investigation

Sources of evidence

39 The following sources of evidence were used:

- examination and testing of withdrawn 'trakrat' trolleys;
- witness interviews;
- signal logging[5] and *Control Centre of the Future* (CCF) data;
- closed circuit television (CCTV) recordings from Witley station;
- trolley maintenance records;
- Wolfe Designs' 'trakrat' Instruction Manual;
- Network Rail's product acceptance history file;
- Network Rail's internal management investigation report[6]; and
- previous RAIB investigations that have relevance to this incident.

[5] The recorded time of the *signalling data logger* has been adjusted to align with both CCF data and the Witley platform clock, which was captured on CCTV.

[6] This was compiled by the infrastructure maintenance delivery manager, Eastleigh, following receipt of the whistle-blower letter (paragraph 9). It concluded that an unreported incident had occurred.

Key facts and analysis

Identification of the immediate cause[7]

40 **The trolley did not stop when the COSS let go of the brake handle.**

41 When the COSS let go of the brake handle to roll his sleeves up, it did not spring up and the brakes did not apply. He stated that he let the trolley roll, expecting the brake handle to jump back and the trolley to stop.

Identification of causal factors[8]

The runaway of the trolley

The brake did not apply after the handle was released by the COSS

42 **The COSS did not intervene when the brake handle did not spring back to the 'on' position after he let go of it. This was a causal factor.**

43 The trolley was designed with a brake handle that needed to be held down in the 'off' position by the operator in order to allow the trolley to move. When the brake handle was released, it was designed to return to the 'on' position and the brakes to apply. This did not happen and the trolley continued rolling in front of the COSS; within a few seconds it would have been too far from him for him to have been able to catch up with it (paragraph 33). There are two possible explanations why the COSS did not immediately intervene when the handle did not spring back to the 'on' position after he let go of it, which are considered below.

The COSS did not know the brake linkage had jammed

44 **The COSS was expecting the brakes to apply automatically but they did not, because the brake linkage mechanism had jammed in the 'off' position.**

45 Although the brake handle was designed to return to the 'on' position when released, the brake linkage mechanism (refer to appendix D) may have jammed so that the handle remained in the 'off' position. Seven 'trakrat' LT1000P trolleys from four different track maintenance depots were examined after the incident, see table 1. Both of the trolleys from Havant track maintenance depot were found to have bent brake pushrods. The condition of the brake linkage was consistent with the brake handles having been forced in the wrong direction, which had probably been causing incremental damage over a period of many months (refer to appendix D, paragraph D5). All of the trolleys examined, except one, had brake pushrods which were sufficiently bent to allow the linkage to jam on occasion and prevent the handle from fully springing back. The exception, from Reading depot, was in good condition and appeared to have received little use.

[7] The condition, event or behaviour that directly resulted in the occurrence.

[8] Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

Trolley No.	Depot	Condition of brakes when tested (with linkage jammed)
E0007510	Guildford	Both wheels partially or fully braked
E0007513	Woking	Both wheels free to rotate
E0007514	Woking	One wheel partially or fully braked and one wheel free to rotate
E0007515	Havant	Both wheels free to rotate
E0007516	Reading	Straight pushrods – linkage did not jam
E0007520	Havant	One wheel partially or fully braked and one wheel free to rotate
E0007521	Guildford	One wheel partially or fully braked and one wheel free to rotate

Table 1: Results of trolley examination

46 Based on the subsequent examination, trolley No. E0007515 was probably the one involved in the incident as both of its braked wheels were found to be free to rotate when the handle jammed. The brake on one of the wheels on the other trolley from Havant depot, No. E0007520, was found to be at least partially functioning when the handle jammed, and this would probably have been sufficient to prevent the trolley from running away. The average speed of the runaway trolley (paragraph 35) was consistent with the trolley having been unbraked but subject to rolling resistance[9].

47 The most likely reason that the brake handle did not return to the 'on' position on the trolley involved in the incident, and that the brakes did not apply, was that the brake linkage had jammed.

The COSS was unaware of the gradient

48 **The COSS was aware the brakes would not apply automatically (either because he knew that the brake handle could stick in the 'off' position or because he had interfered with the mechanism), but was not aware that he was on a long falling gradient when he let go of the trolley.**

49 The bending of the pushrods altered the position of the brake handle and made it harder to push the trolley. Measurements made by the RAIB established that the brake handle of trolley No. E0007515 had to be moved through 157° to release the brakes, to only 11° from the horizontal. This compared with 72° measured on trolley No. E0007516, and the manufacturer's designed rotation of 55° (refer to appendix D, paragraph D6). It is probable that this made it uncomfortable to push the trolley, as it meant that the handle had to be pushed lower.

50 Witness evidence indicates that some staff at Havant depot knew that the brake pushrods were prone to bending, and that this could make it difficult to release the brakes. The RAIB has been unable to establish whether the COSS was aware that it could also cause the handle to stick in the 'off' position and prevent the brakes from applying automatically. It is possible that the COSS was expecting that he would have to move the handle to the 'on' position himself in order to make the brakes apply.

[9] This would include friction in the wheel bearings and drag from the rolling contact between the trolley wheels and the rails.

51 The abnormal angle of the brake handle (paragraph 49) may have encouraged the COSS to wedge the handle down. There is conflicting witness evidence concerning whether the COSS interfered with the brake handle to prevent the brakes from applying. Witnesses reported that they believed he had, because, although they did not see him do so, the brakes had held the trolley on the gradient during the work; they also knew the COSS had said the brakes were working when he subsequently found the trolley. They suggested that it might be possible to hold the brake handle on a trolley down by wedging it under part of the trolley's load. However, the COSS stated he did nothing to disable the brake. There is no further evidence to resolve this conflict.

52 The COSS had been at Havant track maintenance depot for only five months before the incident occurred, and was unfamiliar with the area; he stated that he did not know he was on a long falling gradient when he let go of the trolley. His colleagues, some of whom had been based at Havant depot for many years, were also unaware of the topography of the line. If the COSS had been aware of the gradient, it is likely that he would have ensured that the brake on the trolley had engaged before stopping to roll up his sleeves. Since much of the railway is constructed on gradients, the principal mitigation for the risk arising from trolleys running away is for them to be equipped with an effective automatic brake (see below), rather than to make staff aware of specific gradients.

There was no second person with the trolley

53 **Had there been a second person with the trolley while it was being moved they might have prevented the trolley from accelerating away from the COSS. This was a probable causal factor.**

54 The rules for a person in charge of a trolley are given in Handbook 10 of the *Rule Book*, 'Duties of the COSS and person in charge when using a hand trolley' (GE/RT8000/HB10), which came into force in December 2010. The requirements include the presence of two people with a trolley when moving and that one of them should be in charge of the brake. This requirement had previously been contained in Module T2 of the Rule Book (GE/RT8000/T2), which set out the arrangements for work on lines not under possession and for which no engineering trains would be involved. In practice, staff who had worked predominantly in third rail electrified areas would have had little or no experience of the controls on the use of trolleys which were specified in Module T2. This is because Network Rail's instructions governing work on electrified lines (NR/WI/ELP/3091) do not permit trolleys to be placed on the track with *third rail electrification* without an *isolation*, which would normally require a possession.

55 Network Rail briefed the changes to the Rule Book to its maintenance staff before they came into force in December 2010. However, the briefing material did not mention the requirement for a second person to be with a trolley while it was being moved. In addition, although the briefing material contained a list of those Sentinel competencies affected by the modules which were being withdrawn from the Rule Book, it did not identify the competencies which were affected by the handbooks which were being introduced, and the hand trolley controller competence was not included in the list. The COSS has stated that he was unaware that there should have been a second person with the trolley while it was being moved within the possession.

The automatic function of the brake was not tested prior to use

56 Network Rail does not explicitly require a hand trolley controller to test the automatic brake mechanism as part of the pre-use brake check. This was a possible causal factor.

57 The duties of a person in charge of a trolley given in Handbook 10 of the Rule Book (paragraph 54) also include the requirement to make sure that a trolley's braking system has been tested and is in good order. All trolleys on Network Rail infrastructure should be equipped with an automatic ('dead man's') brake mechanism, which is a requirement of both European Standard BS EN13977 and Railway Group Standard GM/RT1310 'Design requirements and acceptance of portable / transportable infrastructure plant and work equipment' (now replaced by RIS-1701-PLT).

58 Network Rail documents which contain requirements for the duties of a hand trolley controller include the following:

a. Maintenance risk control sheet NR/L3/MTC/RCS0216/SP08 'Use of Manual Trolleys / Rail Skate / Scooter'. The required pre-use checks include:

- checking the equipment is in date and is fitted with a 'CoP0018' brake test label;
- checking the brake cables underneath the trolley for damage;
- checking the link box housing for damage; and
- testing the brakes.

b. The 'Keypoints' booklet for hand trolley controllers, which forms the basis for the set of questions used as part of the competence assessment of hand trolley controllers. This document states that pre-use checks must be carried out by a competent person to ensure the trolley is in good working order; they include:

- a check that the trolley has the correct labelling;
- a check that the maintenance brake test date has not expired; and
- a visual check of the brakes before placing the trolley on the line, and a test of the brakes by a push test before the trolley is loaded or used.

The document contains a simplified version of the requirements of CoP0018 (refer to paragraph 58c); it includes a photograph showing a trolley operator carrying out a pre-use 'brake function test': the trolley is inverted and the operator is attempting to turn a wheel of the trolley by hand.

c. Guidance note NR/L2/RMVP/0200/P018 'Rail mounted manually propelled equipment (formerly M&EE CoP0018)'. The pre-use checks include:

- checking the labelling, including making sure that the maintenance brake test date has not expired;
- assembly of the trolley by a competent person in accordance with the manufacturer's instructions, ensuring that it is in good working order; and
- ensuring that the brakes are in full working order by gaining access to the wheels and turning the braked wheels using one hand; the wheels must resist movement.

In addition, CoP0018 states that a push test should be conducted as soon as the trolley is placed onto the track 'to ensure that the braked wheels do not rotate when pushed without activating the brake lever'.

59 Another Network Rail standard, NR/L2/RMVP/0206, 'Safe Use of Plant for Infrastructure Work', referred to the automatic brake. However, it also stated that 'an acceptable method for checking and maintaining brakes on trolleys is set out in M&EE Code of Practice COP0018' (which did not include checking that the brakes will apply automatically). Furthermore, the content of this standard was not briefed to Network Rail maintenance staff, including hand trolley controllers.

60 The RAIB has not seen any information which is provided to hand trolley controllers to make them aware that they should check the automatic function of the brake. The pre-use brake checks defined in the Network Rail documents will establish that the brakes are effective when applied but not whether they will apply automatically, although the requirement in Handbook 10 of the Rule Book (paragraph 54) can be interpreted as including the automatic function. The information provided to a hand trolley controller does not provide clear and concise guidance on the way in which the pre-use brake test should be conducted.

61 The trolley had already been put on the track and partially loaded with equipment by the time the COSS arrived on site (paragraph 31). Neither he, nor the gang members who had assembled the trolley and placed it on the line, carried out a pre-use check or a push test.

The condition of the trolley

The brake mechanism was damaged

62 **The brake linkage was susceptible to damage if the handle was forced in the wrong direction. This was a causal factor.**

63 The brake handle operates in opposite directions on either end of the trolley. Due to leverage, movement of the handle in the wrong direction results in a force on the end of each of the pushrods of about twelve times the force applied to the brake handle. Forcing the brake handle in the wrong direction can cause bending of the pushrods, which are hollow steel tubes. The indication to the operator of which direction to push the brake handle is provided by a label on the end of the trolley (refer to appendix D, paragraph D4).

64 The aluminium 'trakrat' trolleys were equipped with a stop to prevent the brake handle from being pushed the wrong way. London Underground reported to the RAIB that this stop was an addition to the original design, following the identification of the potential for damage to the brake mechanism during testing of the prototype trolleys. The RAIB has been unable to establish when this design feature was introduced, although it has found evidence of other modifications to the design. The plastic LT1000P trolley did not have an equivalent stop.

65 The damage to the brake mechanism had two effects. Firstly, the bent pushrods could rub on the trolley frame (refer to appendix D, paragraphs D5 to D7) and jam in the 'off' position (paragraph 45). Secondly, it probably made the trolley more difficult to push because of the angle of the brake handle when the brakes were in the 'off' position (paragraph 49).

The knowledge and understanding of the fitters who maintained the trolley

66 **The maintainer did not take action to withdraw the trolleys or repair the bent pushrods. This was a causal factor.**

67 It is probable that the damage to the pushrods on the trolleys which were examined by the RAIB and Network Rail after the incident (paragraph 45) had been occurring progressively during their 18 months in service. If the pushrods had been straight when the trolleys had last been serviced, this would imply that they had all simultaneously become damaged within the few weeks prior to their examination on 4 October 2011. A representative of Norlec Sheet Metal (see paragraph 16) stated that no new pushrods had ever been requested as spares or replacement items for any 'trakrat' trolley.

68 The two 'trakrat' trolleys at Havant track maintenance depot were serviced on 27 June 2011 by a mobile fitter who worked for Torrent Trackside and on 20 September 2011 by a different fitter working for the same company. At the time that they serviced the trolleys, neither fitter had been given any training or issued with any documentation covering 'trakrat' trolleys. Neither of them had maintained 'trakrat' trolleys until they were transferred to Torrent Trackside in December 2010.

69 The fitter who had serviced the trolleys on 27 June 2011 had spoken to his line manager about the lack of documentation for 'trakrat' trolleys. He was sent the manufacturer's instruction manual at the beginning of July 2011. Torrent Trackside also revised its trolley maintenance schedule, MS029, in July 2011, to include 'trakrat' trolleys. The second fitter had not received either of these documents when he serviced the trolleys on 20 September 2011, ten days after the incident. The RAIB considers that there are two possible reasons why the maintainer did not take action to withdraw the trolleys.

70 **The maintainer did not recognise that the brake pushrods were bent.**

71 It is possible that neither fitter was aware that the brake pushrods on the trolleys should have been straight. The first fitter had serviced the trolleys at Havant depot on two previous occasions earlier in 2011. He normally serviced each of the six 'trakrat' trolleys which were found with bent pushrods after the incident (paragraph 45), and he stated that he would have placed any trolley that he had seen with bent pushrods into *quarantine*.

72 **The maintainer noticed that the brake pushrods were bent but did not think that it mattered.**

73 It is possible that one or both of the fitters who had maintained the trolleys at Havant depot noticed that the brake pushrods were bent, and realised that they were designed to be straight, but did not think that it mattered.

74 Torrent Trackside's maintenance schedule did not include any specific reference to checking the release mechanism of the brake or any requirement for the fitter to turn a trolley the right way up in order to carry out a full functional test of the brake[10]. The July 2011 version of the maintenance schedule included the statement 'operate and inspect brake linkage tubes are serviceable (Trakrat only)'. However, as mentioned at paragraph 69, neither fitter had seen this document when they serviced the trolleys at Havant depot, on 27 June and 20 September 2011 respectively.

[10] Trolleys are serviced upside down, and mobile fitters cannot rely on there being anyone else to help them turn a trolley the right way up.

Identification of underlying factors[11]

Design and acceptance of the trolley

Risk assessment of the design

75 **The manufacturer did not identify the risk from bent brake pushrods. This was an underlying factor.**

76 Wolfe Designs issued a declaration of conformity which stated that the 'trakrat' LT1000P complied with all of the applicable Essential Requirements of the European Machinery Directive (98/37/EC). Annex I to this directive states that 'The manufacturer is under an obligation to assess the hazards in order to identify all of those which apply to his machine; he must then design and construct it taking account of his assessment'. The RAIB has been unable to find any evidence that the manufacturer carried out a formal review of potential hazards or a risk assessment of the design.

77 Witness evidence indicates that Wolfe Designs used its experience of designing industrial equipment to design a product for the railway which it believed to be safe. Wolfe Designs knew that the brake pushrods could bend; plastic trolley(s) with bent pushrods had been returned from the trials carried out with Network Rail track maintenance teams in April 2008. It believed that the pushrods had been bent by misuse, such as people using the pushrods to pick the trolleys up or throwing other equipment on top of them, and it believed that the worst consequence would be difficulties in releasing the brake (in other words that the wheels would remain locked). The RAIB has eliminated the possibility that the bending of the pushrods had been caused by such misuse. The manufacturer did not identify the risk that the brake pushrods could jam when bent and prevent the brakes from applying automatically (appendix D, paragraph D7).

78 Directive 98/37/EC requires that '… machinery must be designed to prevent abnormal use if such use would engender a risk'. Although the aluminium trolleys, which were developed in parallel with the plastic ones, were equipped with a stop to prevent damage to the pushrods from incorrect operation of the brake handle (paragraph 64), the RAIB has been unable to establish why Wolfe Designs did not include an equivalent feature in the design of the plastic trolley. Furthermore, it did not refer specifically to possible bending of the pushrods in the instruction manual; the only relevant references were a weekly requirement to 'operate and inspect brake linkage tubes' and a quarterly one to 'inspect all linkages, ensure they are free from damage and operate easily'. There is no evidence that the requirement for a weekly inspection was recognised by Network Rail or that anyone had been carrying out the inspections.

The acceptance process

79 **The product acceptance process did not identify either the causes or consequences of possible wrong-direction operation of the brake handle. This was an underlying factor.**

[11] Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

80 Before a new product can be used on Network Rail's infrastructure it must be formally accepted for use. At the time that the 'trakrat' trolleys were being assessed, the process was defined in Network Rail company standard NR/CS/ACC/029, 'Product and Plant Acceptance' (the arrangements have since changed). The responsibilities for product acceptance of the trolleys were fragmented and involved the following Network Rail departments:

a. A 'national specialist team' within the Maintenance organisation in York, who acted as *Sponsor* and provided the point of contact for the companies which were hiring plant & equipment to Network Rail. The Sponsor arranged and reported on the user trials of the 'trakrat' trolley.

b. Rail Vehicle Engineering in Derby, representing Network Rail's Professional Head for rail vehicles, which was responsible for reviewing new products against the requirements of current standards[12].

c. Acceptance Services in London, which administered the process of product acceptance.

d. End users in Network Rail's maintenance function, at various locations. Maintenance staff were involved in discussions with the manufacturer about their requirements and methods of working. Some track maintenance depots also used the pre-production trolleys during the trial period and provided their feedback to the Sponsor.

81 Although Network Rail's acceptance process considered compliance of the trolleys with the requirements of standards, there was no risk assessment of the novel features of the design or any consideration of the effects of wear and tear or abnormal use. The RAIB has previously found no evidence that formal safety management techniques were being employed as part of the design process of road-rail vehicles (RRV), and recommended that Network Rail should implement a systems engineering process for such plant (RAIB report 27/2009 'Investigation into runaways of road-rail vehicles and their trailers on Network Rail').

82 Network Rail carried out a limited ergonomics assessment of the forces and movements involved in operating the brake handle; this followed Recommendation 4 of RAIB report 12/2007 'Runaway permanent way trolley at Notting Hill Gate, 24 May 2006' (refer to paragraph 110). The RAIB has seen no evidence that a broader ergonomics assessment of the final design was carried out prior to product acceptance.

83 As a result of the limited scope of assessment in the product acceptance process, Network Rail did not identify:

a. the possibility that the brake handle might be forced in the wrong direction due to the opposite handing of the brake on opposite ends of the trolley (refer to appendix D, paragraph D4);

[12] Principally this was Railway Group Standard GM/RT1310, 'Design Requirements and Acceptance of Portable / Transportable Infrastructure Plant and Work Equipment'. Towards the end of the acceptance process, GM/RT1310 was superseded by Railway Industry Standard RIS-1701-PLT, 'Portable and Transportable Plant Used for Infrastructure Work', and some work was carried out to confirm that the braking performance of 'trakrat' trolleys complied with the new requirements. Consideration was also given to the code of practice CoP0018 'Rail mounted manually propelled equipment', which stated that any new trolley should comply with the stopping distances given at section 5.4 of BS EN 13977:2005 'Safety requirements for portable machines and trolleys for construction and maintenance'.

b. that the brake pushrods were prone to bending if the handle was forced in the wrong direction; or

c. that bending of the pushrods could cause the brakes to remain off when the handle was released by the operator.

Previous RAIB recommendations

Network Rail's application of relevant recommendations made to other operators

84 Network Rail had a process for reviewing RAIB recommendations made to other operators, but had not implemented changes which might have prevented the incident on 10 September 2011 from occurring. This was an underlying factor.

85 The RAIB has previously made recommendations which had relevance to the incident on 10 September 2011. These included the recording of pre-use brake checks for trolleys, the provision of gradient information to trolley operators and management of the specification, design, operation and maintenance of road-rail vehicles (refer to paragraph 110).

86 Following the publication of RAIB report 24/2008 'Minor collision between an engineering unit and two manual trolleys near St. John's Wood, 25 October 2007' (refer to paragraph 110), Network Rail's National Recommendations Review Panel agreed that the Safe Plant Working Group would review the recommendations to determine if there were any transferable lessons for the company. The action was closed out following the publication of the final report of the On-track Safety Project on 24 April 2009. This report made 21 recommendations, although these did not directly address any of the recommendations in the RAIB's report, which had included the provision of gradient information to trolley operators.

Discounted factors

Reduction in brake force

87 The condition of the brake discs on one of the 'trakrat' trolleys in use at Havant track maintenance depot was unsatisfactory when they were inspected on 4 October 2011 (refer to appendix D, paragraph D8). However, this had not significantly reduced the effectiveness of the brakes when they were serviced by Torrent Trackside after the incident. The worst-case torque readings[13] obtained for the brakes of both trolleys on 20 September 2011 were 106% and 87% of the minimum values required by NR/L2/RMVP/0200/P018. Although the average torque reading for trolley E0007520 was less than the minimum required value, this value is based on the requirement to stop a fully-laden trolley (1000 kg) on a 1 in 27 gradient. The RAIB has calculated that the minimum brake force was about 15 times higher than that required to stop the trolley involved in the incident, which was not fully laden (paragraph 31) and was on a 1 in 80 gradient.

[13] The torque values for the maintenance brake test on 20 September 2011 were recorded as 'LB' (foot pounds) but the values were probably in fact measured as Nm (Newton metres).

88 Witness evidence indicates that the brakes on the trolley involved were effective on the night of the incident. The brakes were reported to have held the trolley on the gradient on Witley Bank, both when it was placed on the line and at the site of the work to repair the track faults. The RAIB has therefore concluded that the brakes would have prevented the trolley from running away if they had applied.

Factors affecting the severity of consequences

Other staff working in the path of the runaway trolley

89 **The welding gang which had been working in the path of the runaway trolley had finished work and were clear of the line before the trolley passed their site of work.**

90 It is unlikely that the welding gang (paragraph 36) would have heard or seen the runaway trolley approaching them if they had still been working. The nature of their work was noisy and the trolley was not equipped with lights (refer to paragraph 92c). If the gang had still been working when the trolley reached their site of work, it is likely that it would have caused them injury[14]. On completion of their work, the gang walked back to Witley station in the same direction as the trolley was running. The RAIB has estimated that the gang was a minimum of five minutes ahead of the trolley at all times. The trolley passed their site of work by approximately 12 chains (240 metres) before it stopped.

Observations[15]

The safety culture at Havant depot

91 There were a number of non-compliances and examples of deficient safety behaviours which, when taken together, may constitute evidence of a weak safety culture at Havant depot.

92 The following non-compliances and deficient safety behaviour were exhibited by members of Havant track maintenance depot:

a. the trolley involved in the incident was put on the track before the COSS arrived and even before he had received the conductor rail permit authorising him to start work (paragraphs 29-30);

b. neither the staff who placed the trolley on the track nor the COSS, who assumed the role of hand trolley controller when he arrived, carried out a pre-use test of the trolley brakes (paragraph 31);

c. the trolley was not equipped with a red light, which is a requirement of Handbook 10 of the Rule Book and was included in the briefing material issued by Network Rail prior to the Rule Book change in December 2010 (paragraph 55);

[14] However, the consequences would probably have been much less severe than the accident which occurred at Tebay in Cumbria on 15 February 2004, in which four track workers were killed and five were injured, as the speed and weight of the trolley were significantly lower.

[15] An element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the incident but does deserve scrutiny.

d. the runaway was not reported to the *person in charge of possession* or signaller by any of the staff who were aware of it, and the engineering supervisor was not informed until approximately 30 minutes after it had occurred (paragraph 37)[16];

e. none of the staff involved reported the incident within Network Rail prior to receipt of the whistleblower's letter (paragraph 9);

f. the engineering supervisor did not formally report the incident, as he decided that it was sufficient for him to have discussed it with the COSS on their return to Havant depot; and

g. the COSS assumed the trolley would be examined or quarantined after the incident; however none of the other members of staff believed that it was necessary and, consequently, it was still available for use by others.

93 Network Rail has advised the RAIB that it has been working to understand the system failures which led to the incident occurring, and to appreciate the cultural elements that prevented it from being reported. This work is being led by the Woking infrastructure maintenance delivery manager, with support from the Wessex route safety improvement manager as well as the national safety leadership and culture change team. The individuals involved in the incident agreed to assist managers in exploring why it occurred and why it was not reported. The company has identified that the system failings included the poor ergonomic design of the trolleys, the poor provision of communications in the area, the tensions that were allowed to exist in the depot and the prevailing culture. It believes that its response to the incident demonstrates that it is prepared to listen and to act positively when things go wrong. Network Rail expects that this will encourage people to report accidents, near misses and close calls more openly. The learning from the incident has been incorporated into its safety culture and leadership change programme, and has influenced its forthcoming national 'life saving rules' and 'close call reporting system' initiatives.

Mobile phone reception

94 **The engineering supervisor was unable to establish details of the incident due to the poor mobile phone reception in the area of the work site.**

95 The engineering supervisor could not immediately make contact with the members of the gang who had been repairing the track fault. The network coverage for Network Rail company mobile phones is poor in the area of the work site. Some staff, including the engineering supervisor, used their personal mobile phones as an alternative to the company ones.

96 The engineering supervisor later spoke in person with some members of the gang, although he was unable to contact the COSS by telephone until about 20 minutes after he was first made aware of the incident (paragraph 38).

[16] This could have had more serious consequences if the grinding team had not already finished work by the time the trolley reached their site of work (paragraph 90).

Summary of conclusions

Immediate cause

97 The trolley did not stop when the COSS let go of the brake handle (**paragraph 40**).

Causal factors

98 The COSS did not intervene when the brake handle did not spring back to the 'on' position after he let go of it. This arose for one of the following reasons:

a. the COSS was expecting the brakes to apply automatically but they did not, because the brake linkage mechanism had jammed in the 'off' position (**paragraph 44, Recommendation 1**); or

b. the COSS was aware the brakes would not apply automatically (either because he knew that the brake handle could stick in the 'off' position or because he had interfered with the mechanism), but was not aware that he was on a long falling gradient when he let go of the trolley (**paragraph 48, Recommendation 1**).

99 Had there been a second person with the trolley while it was being moved they might have prevented the trolley from accelerating away from the COSS. This was a probable causal factor (**paragraph 53, Learning point 1**).

100 Network Rail does not explicitly require a hand trolley controller to test the automatic brake mechanism as part of the pre-use brake check. This was a possible causal factor (**paragraph 56, Recommendation 1**).

101 The brake linkage was susceptible to damage if the handle was forced in the wrong direction (**paragraph 62, Recommendation 2**).

102 The maintainer did not take action to withdraw the trolleys or repair the bent pushrods (**paragraph 66, Recommendation 3**). This was due to one of the following reasons:

a. the maintainer did not recognise that the brake pushrods were bent (**paragraph 70**); or

b. the maintainer noticed that the brake pushrods were bent, but did not think that it mattered (**paragraph 72**).

Underlying factors

103 The underlying factors were:

a. The manufacturer did not identify the risk from bent brake pushrods (**paragraph 75, Recommendation 2**).

b. The product acceptance process did not identify either the causes or consequences of possible wrong-direction operation of the brake handle (**paragraph 79, Recommendation 2**).

c. Network Rail had a process for reviewing RAIB recommendations made to other operators, but had not implemented changes which might have prevented the incident on 10 September 2011 from occurring (**paragraph 84, Recommendation 4**).

Additional observations

104 Although not linked to the incident on 10 September 2011, the RAIB observes that:

a. There were a number of non-compliances and examples of deficient safety behaviours which, when taken together, may constitute evidence of a weak safety culture at Havant depot (**paragraph 91 Recommendation 5**).

b. The engineering supervisor was unable to establish details of the incident due to the poor Network Rail mobile phone reception in the area of the work site (**paragraph 94, Recommendation 6**).

Actions reported as already taken or in progress relevant to this report

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

105 Network Rail has withdrawn all of the 'trakrat' LT1000P trolleys from use on its infrastructure.

106 Since the acceptance of 'trakrat' trolleys, Network Rail has issued company standard module 'Product introduction and change', NR/L2/RSE/100/05, which clarifies the sponsor's accountabilities, including the responsibility for the successful introduction of new products (paragraph 80)[17].

107 Network Rail has installed and commissioned a number of strategic lineside telephones in the areas of poor reception for its company mobile phones in the Witley area (paragraph 104b).

108 Network Rail is using the incident as an opportunity to promote change in its safety culture. The Woking maintenance delivery unit is participating in a range of national initiatives to improve safety culture within the organisation. The leadership team of the maintenance delivery unit, as well as those directly involved in the incident, have shared their experiences within Network Rail through a campaign of articles in the internal press, on the company's intranet and through safety briefings (paragraph 93). More detail on the implementation of the national initiatives is due to be contained in the forthcoming RAIB report 'Track worker struck by a train at Stoats Nest Junction, 12 June 2011'.

109 Torrent Trackside has enhanced its competence assessment process to include a minimum requirement for the mentoring of candidates, a minimum duration for which a mentor should hold the relevant competence, the completion of a fault finding assessment and the production of action plans for any fitter that either fails an assessment or shows a degree of weakness. It has also created the roles of plant standards advisor and workshop supervisor (for each depot), with the objective of making sure that all fitters are properly supported and appropriately supervised (paragraph 102).

[17] This document refers to 'Sponsorship of Product Introduction Projects – Generic Sponsor's Remit', NR/L3/EBM/029/SPONS1 (the version which was supplied to the RAIB as the current version is numbered NR/L2/AMG/029/SPONS1).

Previous RAIB reports and recommendations relevant to this investigation

110 The following RAIB reports are relevant to issues identified in this report. Recommendations which address factors identified in this investigation are listed, and are not remade so as to avoid duplication:

Runaway manually propelled trolley between Larkhall and Barncluith Tunnel, 2 November 2005, RAIB report 20/2006

A manually propelled trolley being used within a T3 engineering possession on the partially built Larkhall branch in the Hamilton area in Scotland ran away from the trolley operator. The trolley travelled over three miles down hill, passing over steep gradients of up to 1 in 48 and reaching speeds above 20 mph (32.1 km/h), eventually leaving the limits of the possession and running onto a railway line open to traffic.

Recommendation 5

Torrent Trackside should ensure that:

- Their maintenance procedures take account of the guidance issued by [the trolley manufacturer].
- Instruction is available to identify the operational checks required and risks associated with trolley operation … This should be issued to those using the trolley (for inclusion in method statements and risk assessments).

The ORR reported on 6 March 2008 that the recommendation was closed following advice from Torrent Trackside that, with effect from 6 November 2006:

- *'…our Maintenance Policy (MS029) has been redrafted in accordance with [the trolley manufacturer's] revised maintenance procedure and in conjunction with COP018.*
- *'Operator Instructions are now supplied with the Rail Trolleys (OP004 - Type B Trolley and OP005 Link Trolley).'*

Runaway permanent way trolley at Notting Hill Gate, 24 May 2006, RAIB report 12/2007

A manually propelled track trolley being used in connection with engineering works on the London Underground Circle line ran away down a gradient of 1 in 70 and collided with a stationary trolley of a similar type.

Recommendation 1

London Underground Ltd should amend site management procedures to record the satisfactory completion of pre-use brake checks. This should consider pre-delivery and on-site physical inspections recognising that the current tests are only partially effective.

The ORR advised that London Underground had made the following response:

'The issue was reviewed at Safety and Standards Partnership Group (SSPG) on 21st September 2007, where it was agreed that use of Site Person in Charge log books was impractical and likely to result in a tick box exercise. It was proposed that verification of the track trolley pre–use checks would be by better site management and site manager's checks.'

The ORR reported on 9 November 2009 that it was satisfied all that could be done (so far as is reasonably practicable) had been done at that time for the above recommendation.

Recommendation 4

London Underground Ltd and Network Rail should conduct studies into trolley design with an objective of improving the ergonomic issues connected with propelling and braking hand trolleys.

The ORR reported that the following action was taken in response to the above recommendation:

'Network Rail conducted trials in co-operation with LUL and trolley manufacturer using two trolley types. They identified the key issues as being the force required to operate the brakes and as a result all new trolleys have a requirement on them to ensure brakes can be operated by reasonable force.'

This recommendation was reported as closed on 14 January 2009 by ORR.

Minor collision between an engineering unit and two manual trolleys near St. John's Wood, 25 October 2007, RAIB report 24/2008

An engineering unit on the London Underground Jubilee line (consisting of a motorised electric track trolley carrying four persons and two loaded trailers) failed to slow down at the rate the driver expected and collided at slow speed with two manual trolleys.

Recommendation 8

Tube Lines should put in place a process to ensure that gradient data (obtained from either a database or the relevant method statement) is made available to Track Trolley Operators for each site.

The ORR advised that the following action had been taken in response to the above recommendation:

'Tube Lines will introduce gradients into the reviewed track Trolley Operators training. This will be further supported by gradient information in the proposed track trolley operators' handbook. As it is proposed that the "handbook" will be counter signed by the site person in charge then a declaration of site discussion including discussion around site gradients will be evident.'

The ORR reported on 9 November 2009 that it was satisfied all that could be done (so far as is reasonably practicable) had been done at that time for the above recommendation.

Investigation into runaways of road-rail vehicles and their trailers on Network Rail, RAIB report 27/2009

The RAIB carried out a class investigation to determine whether there were sufficient systems and controls in place to prevent runaways and collisions involving road-rail vehicles (RRVs), and trailers that couple to them, and to determine whether these had been properly implemented. The RAIB did not find any evidence that formal safety management techniques were employed as part of the design process of RRVs (paragraph 81).

Recommendation 1

Network Rail should implement a process that manages the specification, design, operation and maintenance of RRVs on its network throughout their system lifecycle (paragraph 201). The process should include the following elements:

a) a high level requirements specification of the task;

b) a safety requirement specification, including the application of safety analysis techniques such as Hazops, FMEA and FTA;

c) specifications relating to the plant, the relevant personnel and the applicable procedures;

d) RRV configuration management systems;

e) verification and validation requirements;

f) site inspections and audits of the arrangements; and

g) a change control process.

The ORR advised on 26/10/2010 that it had concluded Network Rail had taken the recommendation into consideration and was taking action to implement it, although the action was still 'in progress'.

Learning point

111 The RAIB has identified the following key learning point[18] for the railway industry:

Learning point 1

In order to make sure that staff are made aware of changes in the Rule Book which affect the work that they perform, railway industry *duty holders* should have effective processes for translating changes in the Rule Book into their:

a. definitions of staff competence;

b. requirements for staff training and competence assessment; and

c. staff briefings.

[18] An issue which the RAIB wishes to draw to the attention of industry bodies and railway staff so that they can take appropriate action

Recommendations

112 The following recommendations are made[19]:

1 *The purpose of this recommendation is to improve the effectiveness of the pre-use checks on a trolley and to raise the awareness of hand trolley controllers of the importance of the automatic function of trolley brakes.*

Network Rail should review and revise the material used for training and assessing the competence of hand trolley controllers, such that the required pre-use checks for all trolleys are clearly and concisely stated in a form which is readily accessible to hand trolley controllers. These checks should be consistent with the requirements of Handbook 10 of the Rule Book, and should include a functional brake test using the brake handle to test automatic operation of the brake. The revised material should also incorporate suitable references to the risk arising from the use of trolleys on gradients (paragraphs 98 and 99).

2 *The purpose of this recommendation is to provide assurance that the risk associated with the design of a new product has been assessed and mitigated before it is approved for use by Network Rail.*

Network Rail should clarify the responsibilities for the specification, assessment, approval and introduction to use of each new item of plant that has the capability to import risk to the operational railway. These responsibilities should include confirming that:

a. a design risk assessment has been carried out, taking account of realistic and potential failure modes, the way the equipment is used and the effects of wear and tear (paragraph 101);

b. the supplier has produced operational and maintenance instructions which provide appropriate mitigation for the risks (paragraph 103a); and

c. Network Rail has incorporated the manufacturer's instructions into its own work instructions or assessed the risk of adopting an alternative approach (paragraph 103b).

continued

[19] Those identified in the recommendations, have a general and ongoing obligation to comply with health and safety legislation and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Incident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail Regulation to enable it to carry out its duties under regulation 12(2) to:

(a) ensure that recommendations are duly considered and where appropriate acted upon; and

(b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 200 to 203) can be found on RAIB's website www.raib.gov.uk.

3 *The purpose of this recommendation is for Torrent Trackside to improve the competence of its staff to maintain plant.*

Torrent Trackside should improve its processes for providing suitable maintenance information, documents and training to its personnel for all of the plant which they may be required to service. The information provided to its staff should be sufficient to enable them to discharge their responsibilities competently and safely (paragraph 102).

4 *The purpose of this recommendation is for Network Rail to enhance its process for taking action on RAIB recommendations applicable to other areas, or which are relevant to its own operations but have been addressed to other operators.*

Network Rail should review and, if necessary, revise its processes for taking action on RAIB recommendations, so that suitable actions can be identified, implemented and tracked through to closure. These may have been made for a different system, for example road-rail vehicles instead of trolleys, or may be relevant to its own operations but addressed to other operators (paragraph 103c).

5 *The purpose of this recommendation is for Network Rail to determine whether further action is required to improve the culture at Havant track maintenance depot, pending implementation of its national safety culture initiatives.*

Network Rail should review the actions it has taken at Havant depot since the incident, taking account of the issues identified in this report. If appropriate, it should prepare and implement an action plan for any additional actions necessary to provide an adequate level of safety (paragraph 104a). The review should include (but not necessarily be limited to):

a. compliance with rules and procedures;

b. reporting of safety-related incidents; and

c. management of defective equipment.

6 *The purpose of this recommendation is for Network Rail to take account of known areas of poor mobile phone reception when planning infrastructure work with the potential to affect the safety of the line.*

Network Rail should collate information on known areas of poor mobile phone reception on its infrastructure and, where necessary, make arrangements for alternative means of communication between front-line staff with safety responsibilities (paragraph 104b).

Appendices

Appendix A - Glossary of abbreviations and acronyms

CCF	Control Centre of the Future
CCTV	Closed circuit television
CoP0018	Network Rail document NR/L2/RMVP/0200/P018
COSS	Controller of site safety
RRV	Road-rail vehicle
RSSB	Rail Safety and Standards Board

Appendix B - Glossary of terms

All definitions marked with an asterisk, thus (*), have been taken from Ellis's British Railway Engineering Encyclopaedia © Iain Ellis. www.iainellis.com.

Conductor rail permit	A form of authority signed and issued by an authorised person to a person in charge of a group working on, or near to, conductor rail equipment. The purpose of the form is to make known to the person in charge exactly which equipment has been made electrically safe (isolated) to allow work to commence.*
Controller of site safety (COSS)	A safety critical qualification demonstrating the holder's competency to arrange a safe system of work, ie protecting staff working on the line from approaching trains.*
Control Centre of the Future	A system used by control centre staff and others which provides a visual schematic display of train position, both real-time and historic, and presents information on train running.
Duty holder	An organisation, or person which has a duty imposed on them by the law intended to protect the health and safety of employees and/or other persons.
Engineering possession	The closure of a specific section of line to railway traffic to allow engineering work to take place on the infrastructure in accordance with module T3 of the Rule Book.
Engineering supervisor	The person nominated to manage the safe execution of works within an engineering work site. This includes arranging the marker boards, authorising movements of trains in and out of the work site and managing access to the site by COSSs.*
Grandfather rights	The waiving of the requirement to comply with a new standard or competence on the grounds that the individual or equipment was compliant with its predecessor, or has demonstrated a sufficient level of safety thorough a period of employment in the task. In the context of the incident referred to in this report, COSSs who had prior experience of taking charge of placing of a trolley on the line, its subsequent use and off-tracking were considered to be competent hand trolley controllers, if they and their line manager jointly completed a report to confirm their safe performance.
Hand trolley	A small platform with a rail wheel at each corner used to transport tools, equipment and materials along the railway for maintenance work.*
Hand trolley controller	An individual who is certificated as competent, through the Sentinel scheme, to test and operate a hand trolley safely.
Isolation	The formal procedure of de-energising a section of traction supply equipment, earthing it, verifying its lack of potential and issuing of a certificate to that effect.*

M&EE Networking Group	A non profit making group dedicated to the sharing of professional engineering and railway operations information, and providing a focus to the rail industry relating to operational and technical safety of plant. The professional heads of mechanical and electrical engineering and operations from infrastructure contractors, Network Rail, RSSB[20], the Rail Plant Association and London Underground are represented, as well as other infrastructure renewal companies, plant owners and manufacturers / suppliers of plant & technical services.
Person in charge of possession (also known as PICOP)	The competent person nominated to manage the following: ● Safe and correct establishment of the protection for the possession, complete with detonators, point clips, possession limit boards and signals keyed to danger as required. ● Managing access to the possession area by engineering supervisors. ● Managing the establishment of engineering work sites within the possession. ● Liaising with the signaller regarding the passage of the train into and out of the possession. ● Controlling the movement of the train between the protection and work sites. ● Ensuring that all the foregoing is correctly removed in reverse sequence, the possession is relinquished and the line handed back to the signaller at the due time.*
Quarantine	Withdrawal of an item of equipment from use, pending examination and appropriate testing and / or repair.
Road-rail vehicle	A vehicle that can travel under its own power on the road and also, by virtue of a rail guidance system, on railway track. Such vehicles are not allowed to operate outside possessions.
Rule Book	Railway Group Standard GE/RT8000, which describes the duties and responsibilities of staff and the regulations in force to ensure the safe operation of the railway (see appendix C).
Sentinel	Sentinel is the brand-name for the competency control system based on photographic identity cards. The cards give details of medical fitness and railway related competences.*
Short-circuiting strap	A flexible piece of equipment used specifically for connecting the conductor rail and traction return rail together to prevent the conductor rail becoming energised during a possession.*
Signalling data logger	Equipment used to record the time of operation of electrical contacts within the signalling system.

[20] The company is registered as 'Rail Safety and Standards Board', but trades as 'RSSB'.

Small plant (from RIS-1701-PLT)	Portable or transportable tools and equipment 'used for or in association with the construction, alteration, renovation, repair, maintenance, measurement or inspection of railway infrastructure'.
Sponsor (from NR/CS/ACC/029)	The organisation or person who is independent of the manufacturer and seeks acceptance of the product by Network Rail, and is willing to "champion" and define the business benefits for the introduction, modification, or change in application of a product, and assist with trials.
Technician	A member of staff concerned with the maintenance of the track, with responsibility for leading small gangs of operatives.
Third rail electrification	A general term used to cover the type of electrification that involves the supply of DC current to trains by means of a conductor rail laid along one side of the track (the 'third rail').
Weekly Operating Notice	A document published by Network Rail on a route by route basis, providing information about engineering work, speed restrictions, alterations to the network and other relevant information to train drivers.*
Work site	The area within a possession that is managed by an engineering supervisor. A work site is delimited by marker boards when engineering trains are present. It may contain many work groups, each controlled by a controller of site safety (COSS).* The work site marker boards are erected within the area bounded by the possession limit boards.

Appendix C - Key standards current at the time

Annex I to 98/37/EC 'Essential Health and Safety Requirements Relating to the Design and Construction of Machinery and Safety Components', June 2008	European Directive, available at: http://eur-lex.europa.eu/en/index.htm
BS EN13977:2005 'Safety requirements for portable machines and trolleys for construction and maintenance', incorporating amendment A1: 2007	European Standard, available at: http://shop.bsigroup.com
GE/RT8000 Rule Book Handbook 10 'Duties of the COSS and person in charge when using a hand trolley', December 2010	The Rule Book – RSSB Railway Group Standard, available at: www.rgsonline.co.uk
GM/RT1310 'Design Requirements and Acceptance of Portable / Transportable Infrastructure Plant and Work Equipment', Issue 2, December 1998	Railway Group Standard
RIS-1701-PLT 'Portable and Transportable Plant Used for Infrastructure Work', Issue 1	RSSB Rail Industry Standard
CoP0018 'Code of Practice for Rail mounted Manually propelled Equipment', Issue 1(a), March 2006	M&E Engineers Networking Group Code of Practice (published by RSSB and later subsumed into Network Rail document NR/L2/RMVP/0200/P018)
NR/L2/RMVP/0200/P018 'Rail mounted manually propelled equipment (formerly M&EE CoP0018)', Issue 1	Network Rail Code of Practice
NR/L2/RMVP/0206, 'Safe Use of Plant for Infrastructure Work', Issue 2, June 2011	Network Rail Company Standard
NR/CS/ACC/029, 'Product and Plant Acceptance', Issue 6, August 2006	Network Rail Company Standard
NR/WI/ELP/3091: *DC Electrified Lines Working Instructions*, Issue E2	Network Rail work instruction
NR/L3/MTC/RCS0216/SP08 'Use of Manual Trolleys / Rail Skate / Scooter', Issue 1, March 2010	Network Rail Task Risk Control Sheet
NR9931 Keypoints booklet, 'Hand Trolley Controller', Issue 1, valid from August 2008	Network Rail Keypoint Card

MS029 ‘Maintenance Schedule – Link & Rail Trolleys (all makes & models)’, Issue 14, 16 February 2010	Torrent Trackside procedure. Later versions of this document, which included ‘trakrat’ trolleys, were identified as: Issue 15 draft A, 19/07/11 Issue 14, 31/07/11 [RAIB note: Issue 15] Issue 15, 30/09/11 [RAIB note: Issue 16]

Appendix D - Description of 'trakrat' brake linkage mechanism

D1 The two 'trakrat' trolleys which had been in use at Havant track maintenance depot on 10 September 2011 were examined at Woking by the RAIB and Network Rail on 4 October 2011. Testing demonstrated that the brake handle could jam with the brakes released, and the trolley could then run un-braked without further intervention from the operator.

D2 The wheels on the 'trakrat' family of trolleys are carried in demountable wheel skates or bogies, figure D1. There are two braked wheels, on diagonally opposite corners of the trolley. The brakes are normally held in the applied position by means of springs, and are released by a brake handle which is attached to either end of the trolley, figure D2.

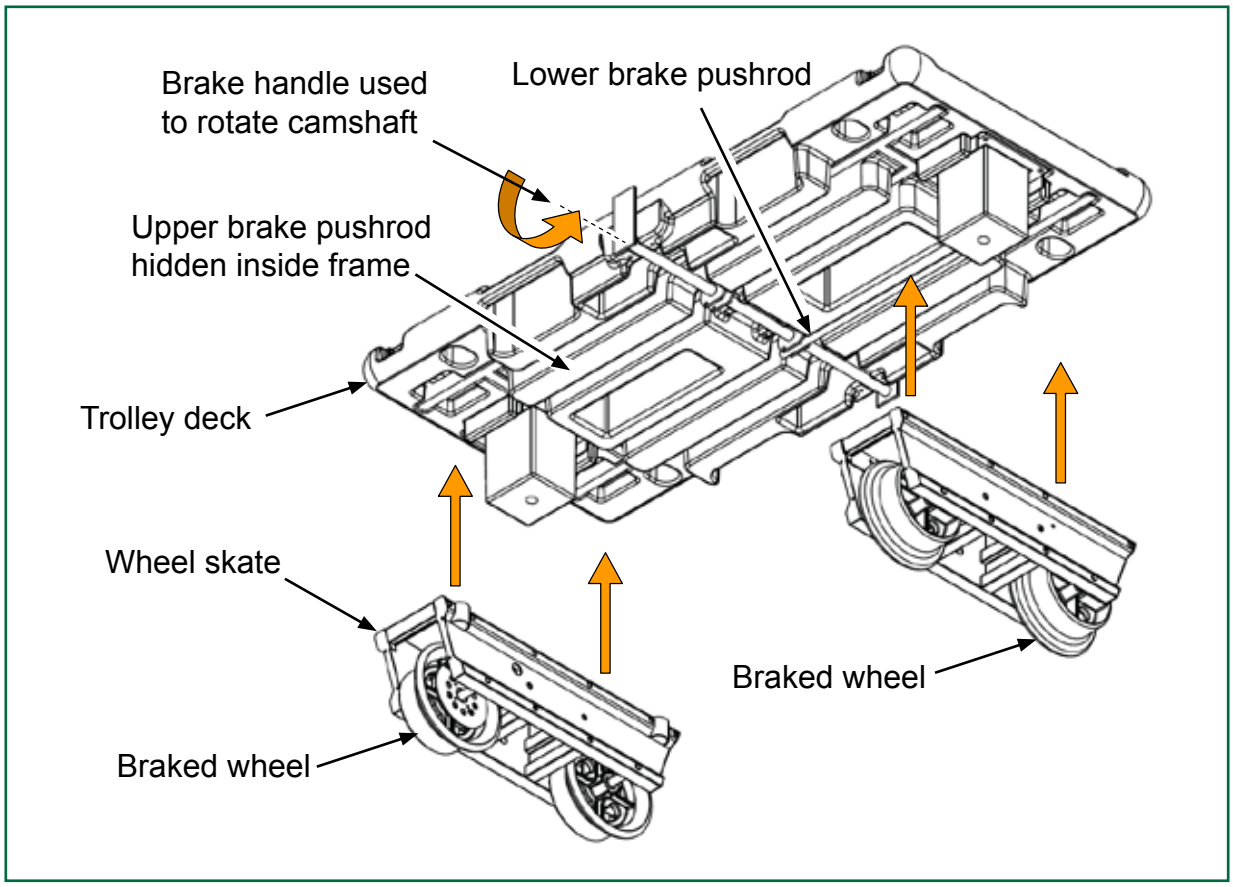

Figure D1: Underside of 'trakrat' LT1000P, showing location of wheel skates and brake linkage (Courtesy of Norlec Sheet Metal)

D3 The brake handle is used to rotate a longitudinal camshaft, which drives one pushrod per braked wheel, figures D3 & D4. When extended, the pushrods overcome the force of the springs holding the brakes on. Because the pushrods are connected eccentrically to the longitudinal shaft, they are offset from each other. The upper pushrod has a return spring to keep the pushrods normally in the retracted position. In this state, the wheel skates can be detached from the trolley deck for transporting to and from site.

Figure D2: One end of 'trakrat' LT1000P, showing use of brake handle to release brakes

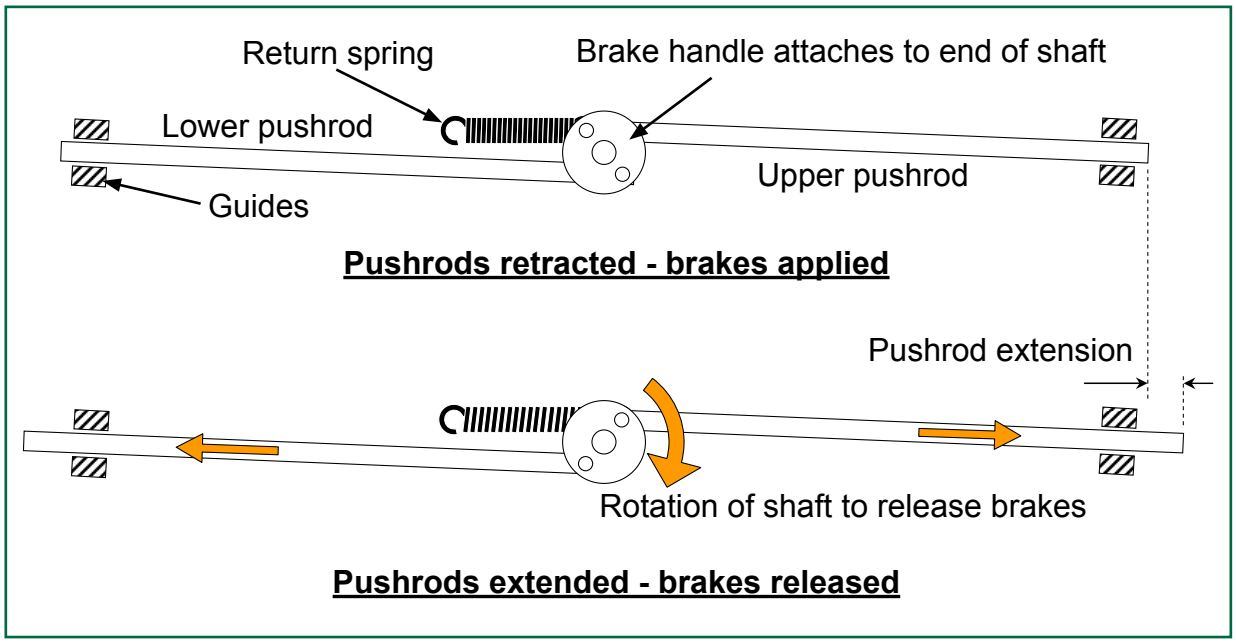

Figure D3: Two views of the brake linkage as designed, showing extension of the pushrods to release the brakes

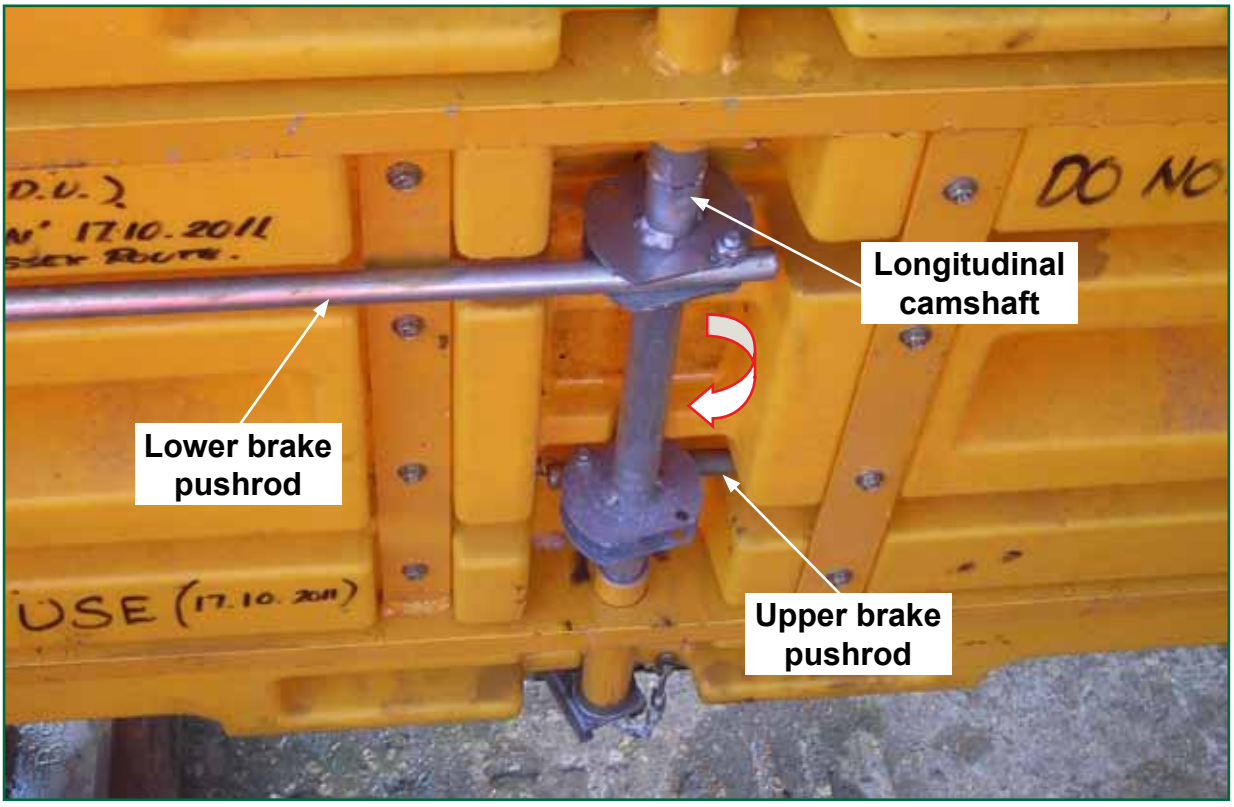

Figure D4: Underside of the trolley from Reading depot, showing brake pushrod linkage as designed

D4 One of the features of the linkage arrangement is that the longitudinal camshaft is rotated in opposite directions depending on which end of the trolley the operator is standing. On one end (eg figures D1 & D2) the shaft is rotated anti-clockwise to release the brake, ie the operator must push the handle to the left, and on the other (figures D3 & D4) it is rotated clockwise and the operator must push the handle to the right. The indication to the operator as to which direction he should push the handle is given by a label on the end of the trolley, figure D2.

D5 If the handle is pushed in the wrong direction, the brakes remain applied. If the handle is forced further in this direction, the pushrods, which are made from steel tubing, can start to bend and wrap themselves around the camshaft (figure D5). Damage consistent with this mechanism was observed on six of the seven LT1000P trolleys examined after the incident, figure D6. Bending of the pushrods in this way probably occurred incrementally due to trolley operators mistakenly applying too much force to the brake handle in an initial attempt to release the brakes, before realising that the handle should be pushed in the opposite direction. If the damage had occurred over a short period, it is likely that the operators would have noticed the sudden changes in the positions of the brake handle and put the trolleys into quarantine.

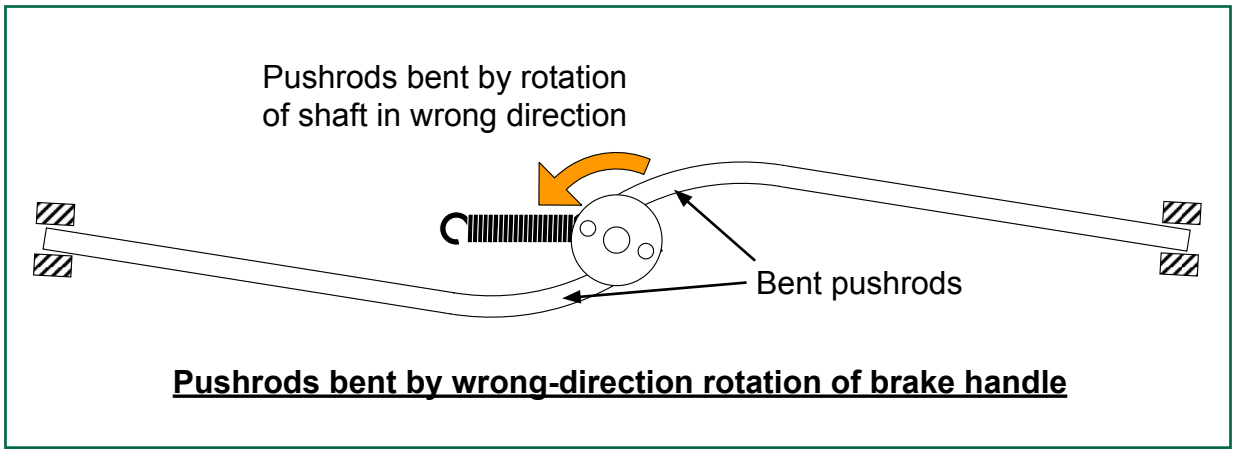

Figure D5: View of the brake linkage showing bending of brake pushrods

Figure D6: Brake linkage of a trolley from Havant depot, as examined after the incident

D6 As the pushrods start to bend around the camshaft, the angle through which the handle must then be turned in the correct direction to release the brakes is increased; this probably makes it harder to use the trolley. Testing by the RAIB established that the total angle through which the brake handle had to be rotated to release the brakes (figure D7), including slack in the mechanism, was approximately:

- 72° for the trolley from Reading depot; and
- 125° and 157° respectively for the two trolleys from Havant depot.

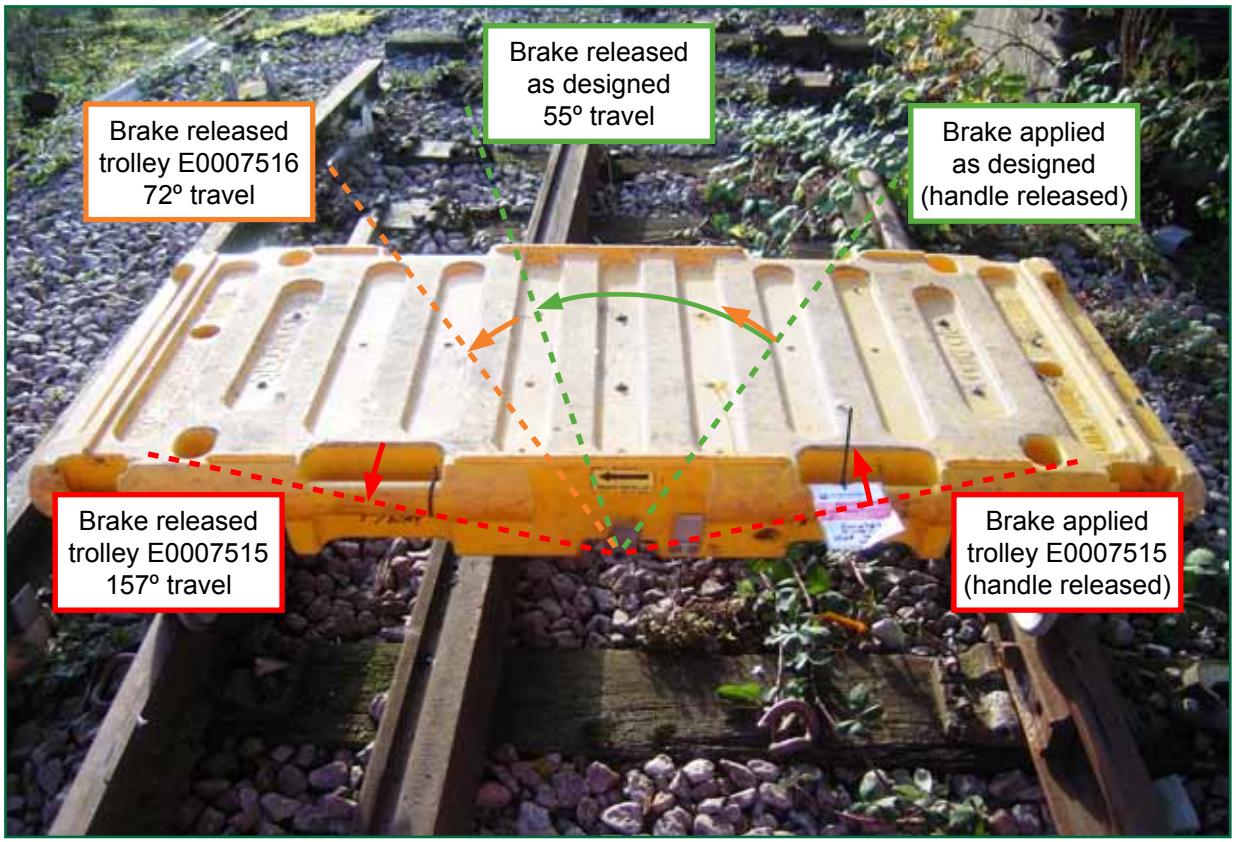

Figure D7: Rotation of brake handle required to release the brake

D7 Where the bending of the pushrods has become extreme, the upper pushrod can rub on the trolley frame. During testing, the RAIB observed that the friction was sometimes sufficient to cause the pushrod to jam and prevent the brakes from applying, figures D8 & D9.

D8 When the trolleys were examined by the RAIB and Network Rail after the incident it was also found that two of the four securing bolts were missing from one of the brake discs on trolley E0007515, and that a lubricant or release agent had been applied to the surface of the discs. Although these conditions each had the potential to prevent the brakes from applying, neither of them was sufficiently advanced to have done so at the time of the incident. The RAIB did not therefore consider them further in this investigation.

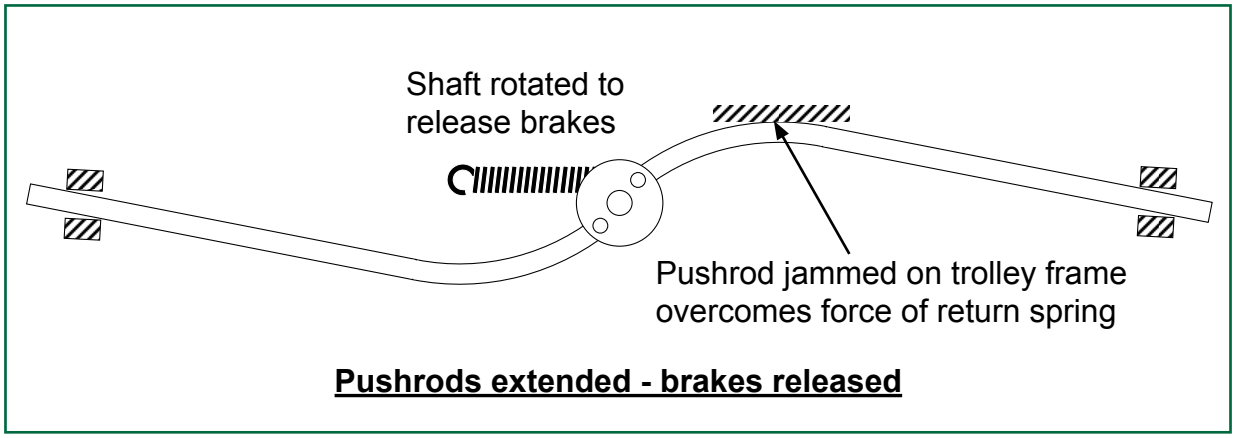

Figure D8: View of the brake linkage showing bent upper pushrod jammed on trolley frame

Figure D9: Close-up of the upper brake pushrod, showing evidence of rubbing on the frame

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