RAIB

Rail Accident Investigation Branch

Rail Accident Report

Runaway of a trolley and subsequent collision at North Rode, Cheshire 26 May 2024

Report 07/2025
May 2025

This investigation was carried out in accordance with:

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

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

Cover images courtesy of Network Rail (left) and RSRG (right).

Preface

The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

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Where RAIB has described a factor as being linked to cause and the term is unqualified, this means that RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident or incident that is being investigated. However, where RAIB is less confident about the existence of a factor, or its role in the causation of the accident or incident, RAIB will qualify its findings by use of words such as 'probable' or 'possible', as appropriate. Where there is more than one potential explanation RAIB may describe one factor as being 'more' or 'less' likely than the other.

In some cases factors are described as 'underlying'. Such factors are also relevant to the causation of the accident or incident but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, words such as 'probable' or 'possible' can also be used to qualify 'underlying factor'.

Use of the word 'probable' means that, although it is considered highly likely that the factor applied, some small element of uncertainty remains. Use of the word 'possible' means that, although there is some evidence that supports this factor, there remains a more significant degree of uncertainty.

An 'observation' is a safety issue discovered as part of the investigation that is not considered to be causal or underlying to the accident or incident being investigated, but does deserve scrutiny because of a perceived potential for safety learning.

The above terms are intended to assist readers' interpretation of the report, and to provide suitable explanations where uncertainty remains. The report should therefore be interpreted as the view of RAIB, expressed with the sole purpose of improving railway safety.

Any information about casualties is based on figures provided to RAIB from various sources. Considerations of personal privacy may mean that not all of the actual effects of the event are recorded in the report. RAIB recognises that sudden unexpected events can have both short- and long-term consequences for the physical and/or mental health of people who were involved, both directly and indirectly, in what happened.

RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of any inquest or fatal accident inquiry, and all other investigations, including those carried out by the safety authority, police or railway industry.

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Runaway of a trolley and subsequent collision at North Rode, Cheshire, 26 May 2024

Contents

Summary

At around 05:00 on Sunday 26 May 2024, a track trolley ran away downhill towards a group of track workers at North Rode, Cheshire. A site supervisor and a controller of site safety saw the trolley approaching at around 20 mph (32 km/h) and shouted a warning which provided enough time for staff in the site of work to get clear of the track. The trolley then collided with a piece of equipment within the site of work. No one was hurt in the accident, but the trolley and work equipment were damaged.

The trolley was being used within a possession to transport equipment from a railway access point to the site of work. This section of track is on an average downhill gradient of 1 in 176.

The runaway was caused by the trolley becoming unbraked while it was on a downhill gradient after the operator had intentionally defeated the ‘failsafe’ function of the trolley’s braking system. The design of the trolley made it possible to do this and the operator was aware that it was possible to do so. The ergonomics of the trolley brake system made it tiring to use, potentially encouraging the operator to defeat the brakes. The operator was also unaware that there was a risk of the trolley running away at this location.

RAIB identified two underlying factors to the accident. These were that the product acceptance process employed by Network Rail did not manage the risks incurred by this design of trolley. A lack of clarity in site leadership roles also led to risks not being effectively managed. A further probable underlying factor was that the defeating of the braking system on this type of trolley is a known issue, but no effective action had been taken to eliminate the practice.

As a result of its investigation, RAIB has made two recommendations, both addressed to Network Rail. The first recommends that Network Rail, in conjunction with the Rail Safety and Standards Board and the M&EE Networking Group, reduces the likelihood of the failsafe brakes on trolleys of the type involved in this accident being modified by operators and rendered ineffective. With consideration of modern ergonomic practices and the product acceptance process, they should identify and implement control measures to prevent trolley misuse. The second recommendation aims to improve the implementation of safety learning resulting from accident and incident investigations.

Two learning points have been identified. The first reinforces the importance of staff not rendering the braking system ineffective when working with trolleys of this type. The second concerns the importance of controllers of site safety accompanying work groups to personally observe and advise them.

Introduction

Definitions

1 Metric units are used in this report, except when it is normal railway practice to give speeds and locations in imperial units. Where appropriate, the equivalent metric value is also given.

2 The report contains abbreviations and acronyms, which are explained in appendix A. Sources of evidence used in the investigation are listed in appendix B.

The accident

Summary of the accident

3 At around 05:00 on Sunday 26 May 2024, a manual track trolley ran away downhill towards a site of work at North Rode, Cheshire (figure 1). The trolley was being used within a possession to transport equipment from a railway access point to a site of work. The trolley came to a halt when it collided with a rail-carrying trolley (known as an 'ironman') that was being used to hold a piece of rail.

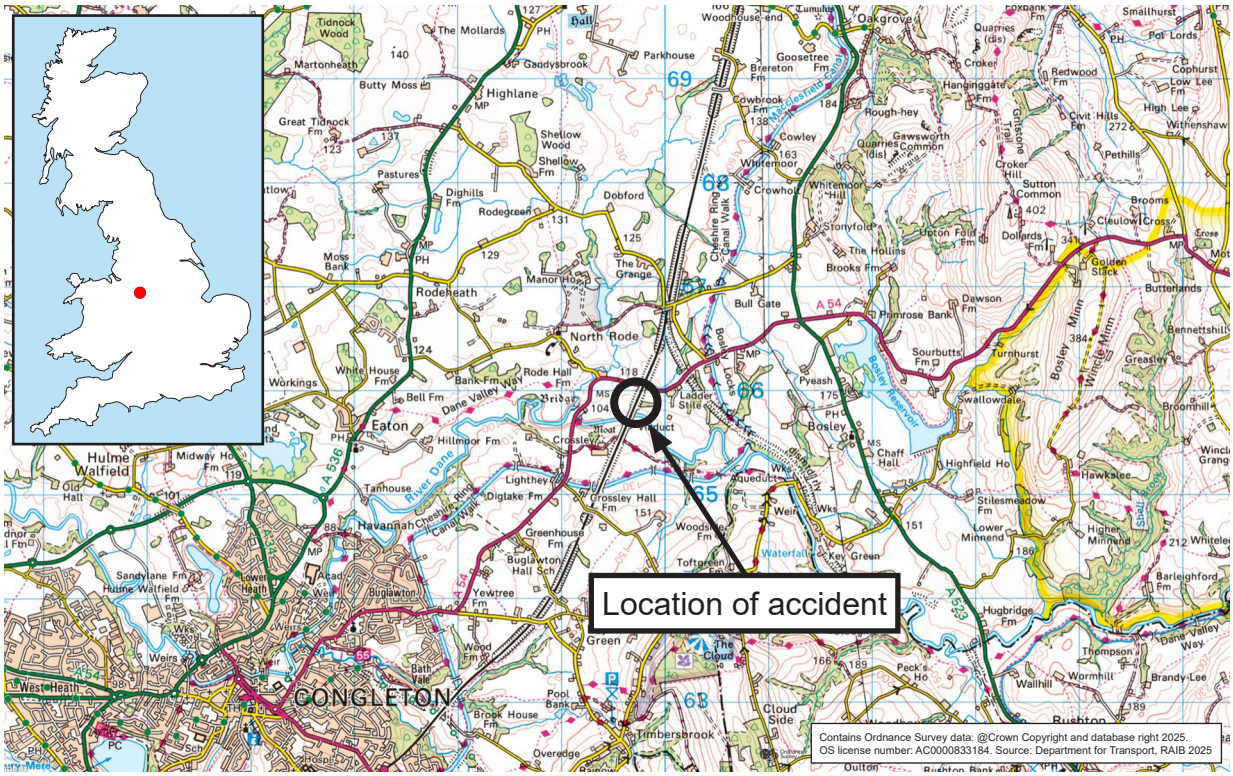

Figure 1: Extract from Ordnance Survey map showing the location of the accident at North Rode.

4 The site supervisor and the controller of site safety (COSS) saw the runaway trolley approaching at around 20 mph (32 km/h) and shouted a warning which provided enough time for their colleagues to get clear. No one was hurt in the accident, but the ironman, the trolley and the equipment it was carrying were damaged (figure 2).

5 The trolley had previously been pushed uphill from the site of work to the access point to collect a piece of equipment. The runaway began while the trolley was returning to the site of work. Evidence suggests that the trolley ran uncontrolled, downhill, for approximately 1100 metres before colliding with the ironman.

Figure 2: Final position of the runaway trolley having collided with the ironman (courtesy of Rhomberg Sersa Rail Group Ltd).

Context

Location

6 The work on 26 May 2024 was being carried out within an engineering possession of both lines of the railway between Macclesfield (from the north end of Prestbury Tunnel) and Congleton station in Cheshire. This possession was scheduled to run from 00:10 to 08:30 and contained a number of work sites; the one in which the accident took place contained a number of sites of work (figure 3).

7 The railway at this location consists of two running lines, the Up Stoke and the Down Stoke, both electrified using overhead line electrification equipment energised at 25 kV. The trolley was placed on the Down Stoke line at an access point known as North Rode. This access point is at 4 miles 1113 yards from a reference point to the north of Macclesfield station, and the site of work where the accident occurred was at 5 miles and 627 yards from the same reference point. The site of work was therefore 1165 metres from the access point. The Down Stoke line railway between the access point and the site of work is on a slight left-hand curve with a downhill gradient of 1 in 176.

8 A second access point, adjacent to an underbridge, was used by a number of the workers involved in the activities on the night of the accident. This access point, identified as ‘UB27’, is located at 5 miles 565 yards, 57 metres north of the site of work.

Organisations involved

9 Network Rail is the owner and maintainer of the railway infrastructure at North Rode. It employed the person in charge of the possession during the accident.

10 Rhomberg Sersa Rail Group Ltd (RSRG) was the principal contractor for the work taking place at the accident site. It planned and carried out the work, owned the trolley involved in the accident and supplied all other tools and equipment used on the RSRG sites of work within the possession. RSRG directly employed the senior supervisor and supervisor, and managed the subcontracted staff on site.

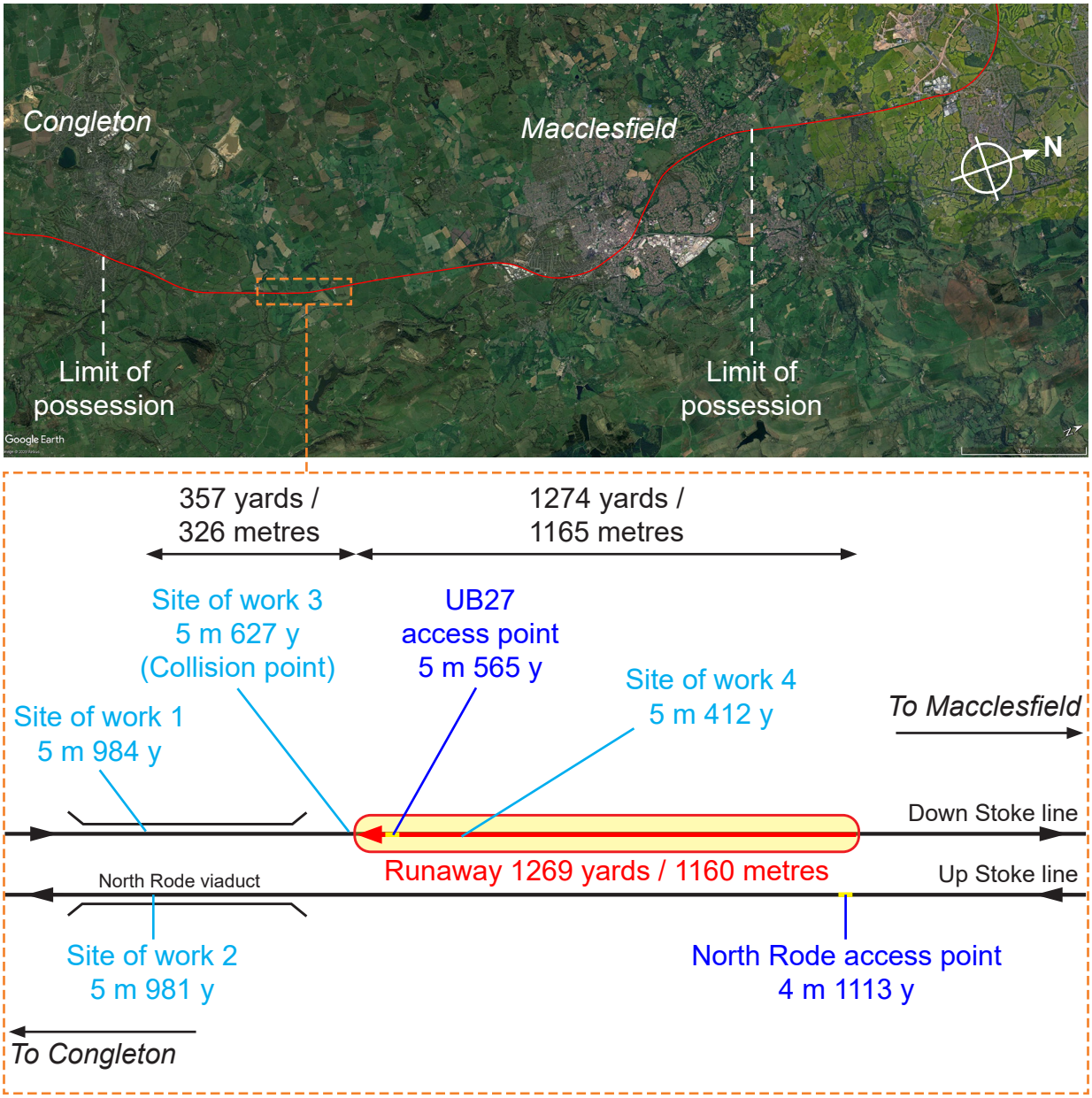

Figure 3: Schematic showing the possession between Macclesfield and Congleton, and the accident site of work track layout, including access and related sites of work (top image courtesy of Google with RAIB annotations).

11 OnPoint Trac Ltd employed the trolley operator involved in the accident and all the track workers involved, including the team leader and COSS.

12 Specialist Tools & Equipment Ltd (STEL) is the designer and manufacturer of the trolley involved.

13 Sunbelt Rentals Ltd was employed by RSRG to service the brakes on the trolley involved in the accident.

14 All the organisations involved freely co-operated with the investigation.

Rail equipment involved

15 The manual hand trolley which ran away (figure 4) was manufactured by STEL. RSRG bought the trolley new in October 2023. It is described in more detail in paragraph 58.

Figure 4: The trolley involved in the accident.

16 Ironman trolleys are used for lifting and transporting rails and other track components. A pair of ironman trolleys were being used at the accident site. At the time of the accident, the ironman that the runaway trolley collided with was carrying a replacement section of rail. The rail being held by the ironman was abutting one end of a fixed rail.

Staff involved

17 The senior site supervisor for RSRG was responsible for planning the work, arranging the staffing with OnPoint Trac and preparing the equipment and tools for the work. The senior site supervisor directly supervised two of the four planned sites of work on the night of the accident. Witness evidence indicates that they were perceived to be the overall person in charge for RSRG. The senior site supervisor had over 17 years working on the railway, 8 of those in a supervisory role.

18 The work group on the site of work where the accident took place consisted of a site supervisor, a COSS, a team leader and a team of four track workers.

19 The site supervisor was the person identified by the track workers as being in charge of the work group. The site supervisor is a machine operator and had worked on the railway for approximately 18 years. They had been building up their experience as a supervisor with RSRG over the previous 4 years.

20 A COSS is the person responsible for ensuring that a safe system of work is set up to protect staff from the movement of trains. The COSS in this work group had been working on the railway since 2001. During the working week, the COSS delivered railway-related training (including use of tools) for their primary employer, while maintaining track-based competencies through weekend shift work with OnPoint Trac. The COSS was responsible for signing off the safe work pack (see paragraph 116) as both the COSS and the person in charge (PIC). Under Network Rail standards, a PIC has overall accountability of supervising and overseeing works and managing operational, site and task risks (see paragraph 116).

21 The Team Leader directed the track workers activities while on site. They had worked on the railway doing weekend shifts for OnPoint Trac since gaining the required competences in 2022. The team leader had completed other weekend shifts with OnPoint Trac for RSRG as part of the wider project to replace insulated rail joints (IRJs)[1] in the Macclesfield area, which started in July 2023.

22 Of the team of four track workers, three were newly qualified and inexperienced on the railway and, as required by railway rules, wore blue safety helmets to signify this. They are referred to as ‘blue hat’ track workers in the report. The fourth track worker, who was the trolley operator, was more experienced, and hence wore a standard white safety helmet.

23 Although the trolley operator had gained their personal track safety (PTS)[2] in a previous job (see paragraph 90), they had completed their competence training and assessment for railway tools and use of trolleys in September 2023, transitioning to white hat status in February 2024. At the time of the accident, this was their second shift for OnPoint Trac and their first time working with RSRG.

24 One of the blue hat track workers accompanied the trolley operator at the time of the accident. That night was their first shift with OnPoint Trac and their first ever shift working on the railway.

25 Other members of staff, including two welding teams, were part of the wider RSRG work site and were not directly involved in the events which led to the accident occurring.

External circumstances

26 The accident happened around 1 hour after sunrise, at around 05:00. A weather station at Congleton (approximately 5 km from the accident location) recorded light drizzle, with a temperature of around 12°C. There was no significant ambient noise present at this time. RAIB has concluded that external circumstances did not affect the accident.

[1] An IRJ is a joint in a rail where one section of rail is electrically insulated from another for signalling or electrification purposes.

[2] A qualification enabling a member of staff to be on or near the line.

The sequence of events

Events preceding the accident

27 The work being undertaken was part of a project to remove IRJs from the track in the area and replace them with lengths of continuous rail. Network Rail procurement awarded RSRG the role of principal contractor for this work as part of the wider Macclesfield re-signalling scheme. The work was scheduled to be completed between July 2023 and September 2024 during a series of weekend possessions.

28 As part of the planning process, RSRG distributed the sections of rail that were going to be used to replace the IRJs along the track. These sections were numbered to link to a specific weekend of work. During a site visit on 27 February 2024, RSRG identified that two of the rails were missing and raised the issue with Network Rail. After investigating, Network Rail identified that a maintenance team had probably used the sections of rail by mistake, and that it would leave two replacement sections of rail on site. However, one of the replacements left by Network Rail was high performance (HP) rail, which is constructed from hypereutectoid steel and has a different chemical composition to standard rail. Although HP rail has been engineered to have high wear resistance and hardness, elements of its composition become hard and brittle when exposed to heat. In practical terms, this means that a flame cutting tool cannot be used when reducing the length of an HP rail (see paragraph 47).

29 The senior supervisor from RSRG sent a staffing request for the night of 25 to 26 May to OnPoint Trac on 2 May. To fulfil these requirements, OnPoint Trac sent a WhatsApp[3] message to a number of track workers, team leaders and COSSs, stating the start time and location for the shift. The shift's start time and location was the only information shared.

30 On Monday 20 May, 5 days before the shift, RSRG produced the task briefing sheet (TBS).[4] Two days later, on 22 May, RSRG received the safe work pack (SWP)[5] which had been produced by an external provider. The SWP was issued to the COSS who was due to be with the work group, who signed and verified the document as both COSS and PIC.

31 The following day, Thursday 23 May, the senior supervisor and supervisor met at the Macclesfield compound and prepared the tools and equipment for the weekend's work. They loaded four vans with the required materials, one for each work group.

[3] WhatsApp is an internet based social media application that allows messages and other media to be sent between users.

[4] A document issued to a work group detailing the health and safety information relevant to the task they are doing.

[5] The collection of information issued to a COSS for them to brief to the work group, providing details of the site of work, the work to be done and the suggested safe system of work.

32 A ‘whiteboard session’ was held on Friday 24 May, the day before the shift, to brief and discuss the health and safety arrangements for the forthcoming weekend’s work to critical staff. The whiteboard session was led by the senior supervisor and attended by safety-critical work site personnel including the engineering supervisor (ES). An ES is the person nominated to manage the safe execution of works within an engineering work site, including managing access to site through a COSS.

33 The planned work for the night of Saturday 25 May was to remove four IRJs (numbered 77-80) and replace them each with a section of rail, over four separate sites of work (figure 3). The senior supervisor was responsible for IRJ 80, at site of work 1, and IRJ 79, at site of work 2. The supervisor was allocated site of work 3, where IRJ 78 was being replaced and where the accident occurred. IRJ 77, within site of work 4, was assigned to an agency supervisor.

34 On the night of the accident, at approximately 22:00, the senior supervisor and supervisor arrived at the Macclesfield compound. They unlocked the compound, prepared the paperwork for the shift, and waited for the contracted labour and the ES to arrive. RSRG were sharing the compound with the contractors who were responsible for supervising the engineering possession that RSRG were working within. Although the contractors were designated to use different ends of the compound, there was some confusion at the start of the shift with workers not knowing which section of the compound to report to.

35 Twelve track workers, three team leaders, three COSSs, an agency supervisor from OnPoint Trac, and three welding teams arrived at the compound between 23:00 and 23:30. On arrival, the COSSs received a briefing from the ES. During this time, the senior supervisor and supervisor moved vans loaded with tools and equipment to the North Rode access point, parking them ready for the start of the possession.

36 The senior supervisor returned to the compound at around 23:30, identified who was present and tasked one of the team leaders to create four work groups, one for each site of work. The COSSs for each site of work then delivered the task briefing to their individual groups and checked their PTS cards. This included the person responsible for operating the trolley at the time of the accident.

37 Soon after, the senior supervisor took another van from the compound and drove to the UB27 access point, accompanied by two track workers, a team leader, a COSS, and a person from a welding team. Meanwhile, the supervisor drove to the North Rode access point, followed by the agency supervisor, 10 track workers (including the trolley operator), two team leaders, two COSSs and three welding teams.

38 At 00:58 on Sunday 26 May, with the line now under possession, the ES contacted the COSSs and senior supervisor to grant track access (figure 5). The work group with the senior supervisor put a track trolley on the Up Stoke line at the UB27 access point, loaded it with rail burning equipment and pushed it to site of work 1. Meanwhile, at the North Rode access point, work started to unload tools and equipment onto trolleys. The supervisor drove each of the four vans previously taken to North Rode access point down to the track for the workers to unload equipment (including the trolleys and a pair of ironman trolleys) as the supervisor was the only person insured to drive the vans. The trolleys and welding equipment were placed onto the Down Stoke line in the order of the furthest site of work first – site of work 1 to site of work 4 (figure 3). While this was happening, work had started at site of work 1 to cut out IRJ 80 ahead of the welding team's arrival to insert the new rail sections.

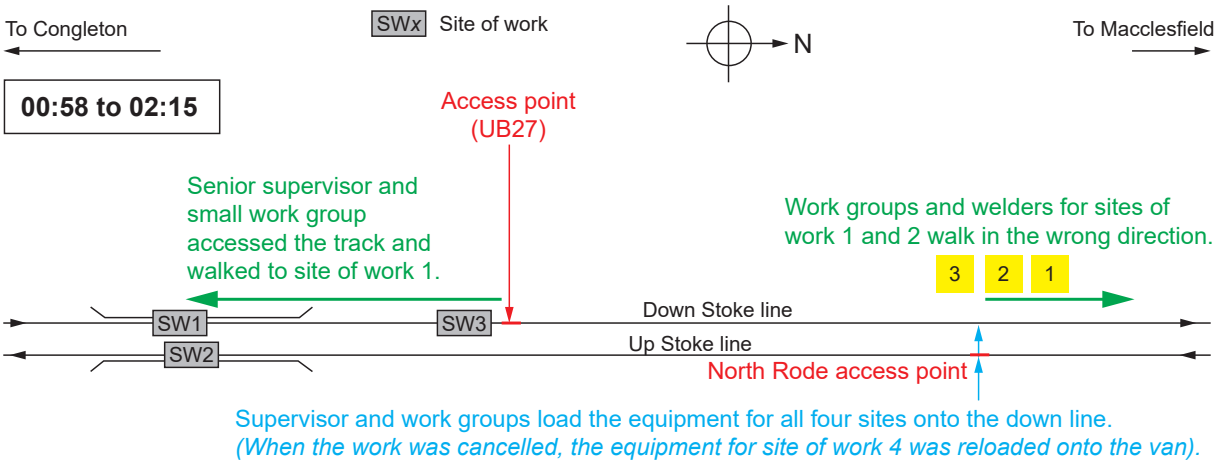

Figure 5: Illustration of the movement of work groups and trolleys/equipment between sites of work on the night of the accident from 00:58 to 02:15 (all timings are approximate).

39 At around 01:45, the senior supervisor cancelled the replacement of IRJ 77 (site of work 4) due to a personal issue affecting one of the welding teams.

40 The work group for the cancelled site of work 4 (consisting of a COSS, agency supervisor and track workers) loaded the equipment that was no longer required back into one of the vans at North Rode access point. The RSRG supervisor directed the remaining two welding teams, the work groups for sites of work 1 and 2 and two loaded trolleys to go to site of work 1 (figure 5) using the Down Stoke line. However, in doing this, the supervisor unintentionally sent the teams in the opposite direction (north) to that needed to reach to site of work 1 (south).

41 At approximately 02:15, the senior supervisor called the supervisor to check where the resources were as IRJ 80 (site of work 1) had been cut out and the new rail was ready for welding (figure 6). The phone call made the supervisor realise that they had sent the groups in the wrong direction from North Rode access point. The supervisor called the groups to turn them around, after they had walked an estimated 1370 metres in the wrong direction.

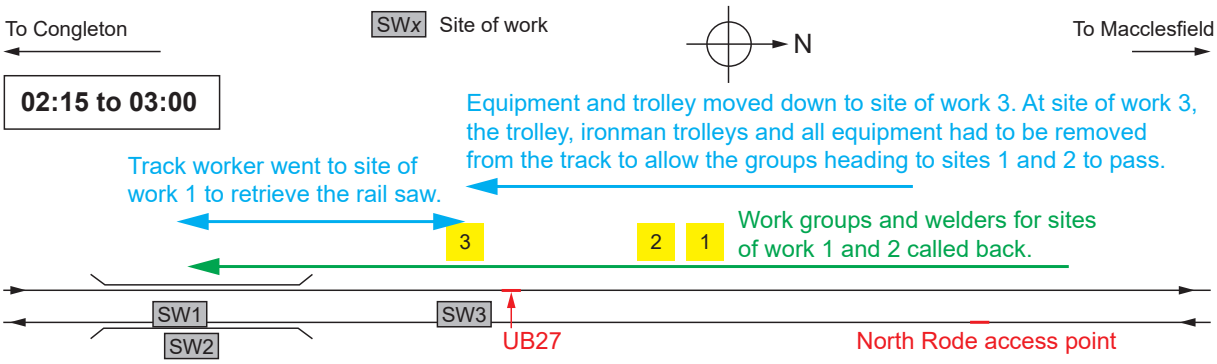

Figure 6: Illustration of the movement of work groups and trolleys/equipment between sites of work on the night of the accident from 02:15 to 03:00 (all timings are approximate).

42 Meanwhile, the work group for site of work 3 (consisting of the supervisor, COSS, team leader, trolley operator and three blue hat track workers) and the trolley with their associated equipment left North Rode access point and arrived at their site of work at around 02:45. The trolley operator who was later involved in the accident operated the trolley from the access point to the site of work.

43 When the delayed work groups and welding teams for sites of work 1 and 2 arrived at site of work 3, the trolleys for site of work 3 had to be unloaded and moved off the track to enable the other trolleys to pass up the line. This created further delay.

44 With both welding teams now being at other sites of work, the supervisor of site of work 3 decided to use a rail saw to cut the existing rail and remove IRJ 78. There were two rail saws assigned to the shift. One had been returned to the van (at North Rode access point) when the work on IRJ 77 was cancelled and the other was at site of work 1, from where it was collected.

45 One of the welding teams, having completed their first weld, left site of work 1 soon after 03:15, to relocate to site of work 3 (figure 7). At this point, IRJ 78 at site of work 3 had been removed and the replacement rail had been moved into position, abutting the existing rail using the ironman trolleys. The replacement rail needed to be cut to size. However, at approximately 03:45, the trigger of the rail saw that was being used to cut the rail broke.

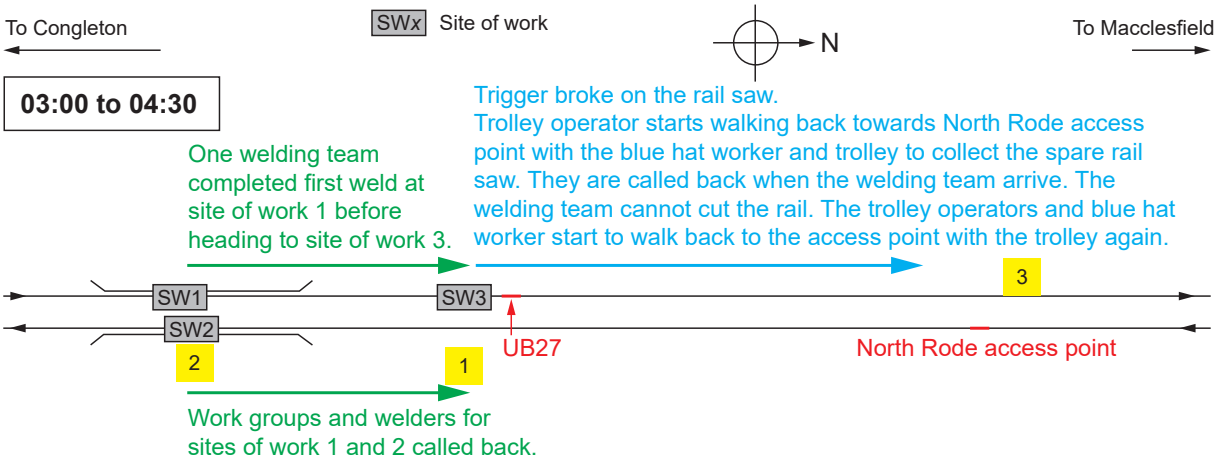

Figure 7: Illustration of the movement of work groups and trolleys/equipment between sites of work on the night of the accident from 03:00 to 04:30 (all timings are approximate).

46 A discussion was held between the supervisor and COSS about sending the trolley operator and a blue hat worker to the access point to collect the replacement rail saw. A further discussion took place with the trolley operator about unloading the trolley before taking it back as it was loaded with 241 kg of tools and equipment, including a rail stressing kit and hydraulic power packs. Following these discussions, it was decided to leave the trolley loaded. At this point, the COSS checked that the trolley operator held a valid trolley operator competency.

47 The trolley operator and the blue hat worker started to push the loaded trolley back to North Rode access point, only to be called back soon afterwards when the welding team arrived at site of work 3. The welders were asked to flame cut the rail, to negate the need for the rail saw. However, at approximately 04:15, the welders identified that the replacement rail was HP rail, which could not be flame cut (paragraph 28). The trolley operator and the blue hat worker were again tasked with pushing the loaded trolley to North Rode access point to collect the replacement rail saw. The trolley operator remained in control of the trolley's brake handle while the blue hat worker helped push the trolley. The journey along the Down Stoke line from site of work 3 back to the access point is estimated by witnesses to have taken 20 to 25 minutes.

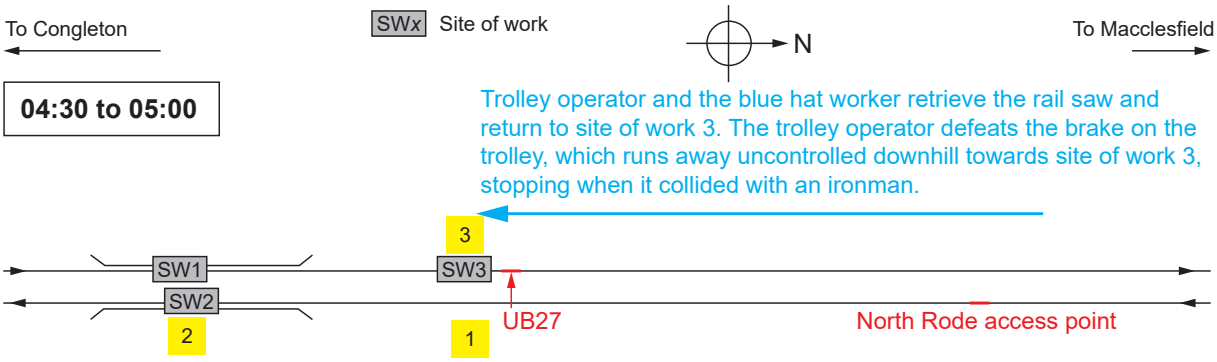

Figure 8: Illustration of the movement of work groups and trolleys/equipment between sites of work on the night of the accident from 04:30 to 05:00 (all timings are approximate).

48 At approximately 04:30, the team at site of work 1 (including a COSS) loaded their equipment onto a trolley located on the Up Stoke line and walked towards the North Rode access point, stopping at site of work 3 as they did so (figure 8). The senior supervisor remained with one work group and one welding team to complete the work on site of work 2.

Events during the accident

49 By approximately 04:45, the trolley operator and the blue hat worker had retrieved the rail saw from the van at North Rode access point and loaded it onto the trolley. This increased the load on the trolley to around 271 kg. They then started the return journey to site of work 3. Shortly after this, the trolley operator forced the brake handle under the trolley's push barrier, defeating the 'failsafe' function of the trolley's brake (see paragraph 69). The trolley operator then pushed the trolley to propel it forward a short distance, but when pushing the trolley a second time realised that the trolley had moved a distance greater than expected. The trolley then started to accelerate and ran away at a speed high enough that the trolley operator and blue hat worker could not catch up with it. They had no means of warning their colleagues at work site 3 that the runaway trolley was approaching (see paragraph 136).

50 The runaway trolley moved southwards on the Down Stoke line, running uncontrolled towards site of work 3. At around 04:55, the supervisor at the site of work looked up and saw the trolley's lights approaching. The COSS and supervisor realised that no one was with the trolley, and they shouted a warning to the rest of the group. The supervisor and the team leader ran towards the runaway trolley to attempt to stop it but realised that any attempt to do so would be dangerous. It is estimated that the runaway trolley was travelling at 20 mph (32 km/h) when it collided with the stationary ironman, at around 05:00.

Events following the accident

51 All the work group were clear of the track at the time of the collision and no injuries were sustained. However, the ironman, the trolley and the equipment it was carrying were all damaged. Approximately 10 minutes after the collision, the trolley operator and blue hat worker returned to the site of work. The supervisor immediately checked that the trolley operator held the necessary competence to operate a trolley.

52 The supervisor phoned the senior supervisor (located at site of work 2) to report the accident. There was some confusion initially as the senior supervisor was unaware that the two workers had taken a trolley back to North Rode access point, and instead thought the supervisor was referring to the work group that had recently left site of work 1 (paragraph 48).

53 The senior supervisor stopped all work across sites of work 2 and 3 and walked to site of work 3. After checking that the site was safe and that no one was injured, the senior supervisor reported the accident to the ES, to Network Rail, and to RSRG. The senior supervisor arranged for drugs and alcohol screening[6] to be conducted at the end of the shift at the Macclesfield compound.

54 When the ES arrived on site at approximately 05:50, the work group was in the process of clearing the accident site. The ES consulted with the supervisors and those directly involved before leaving site of work 3, enabling work to restart.

[6] Rail Industry Standard RIS-8070-TOM, 'Testing Railway Safety Critical Workers for Drugs and Alcohol', issue 1 dated December 2016, states that a test result for drugs is positive if it shows 'the presence of drugs for which there is no legitimate medical need for either their use or the quantity of their use.' Available from www.rssb.co.uk.

55 The senior supervisor returned to site of work 2, where the welders completed work on replacing IRJ 79 around 06:00. At approximately 07:15, the welders completed work at site of work 3.

56 The work group at site of work 3 helped the other work groups to remove some tools from site at the UB27 access point. All other tools and equipment were pushed back to the North Rode access point. After all the welds were inspected, the supervisor walked to North Rode while the senior supervisor left site from the UB27 access point. The track was handed back to the ES at 07:47.

57 The trolley operator, the blue hat worker, the supervisor and the COSS were all subsequently tested for the presence of drugs or alcohol. All tests were negative for the presence of drugs and alcohol.

Background information

The trolley

58 The STEL split trolley is a manually operated trolley that comes in two parts for ease of transportation. It weighs 138 kg (69 kg per half) unloaded and has a maximum safe working load of 1000 kg (figure 9). The two parts are assembled on site using interlocking pins.

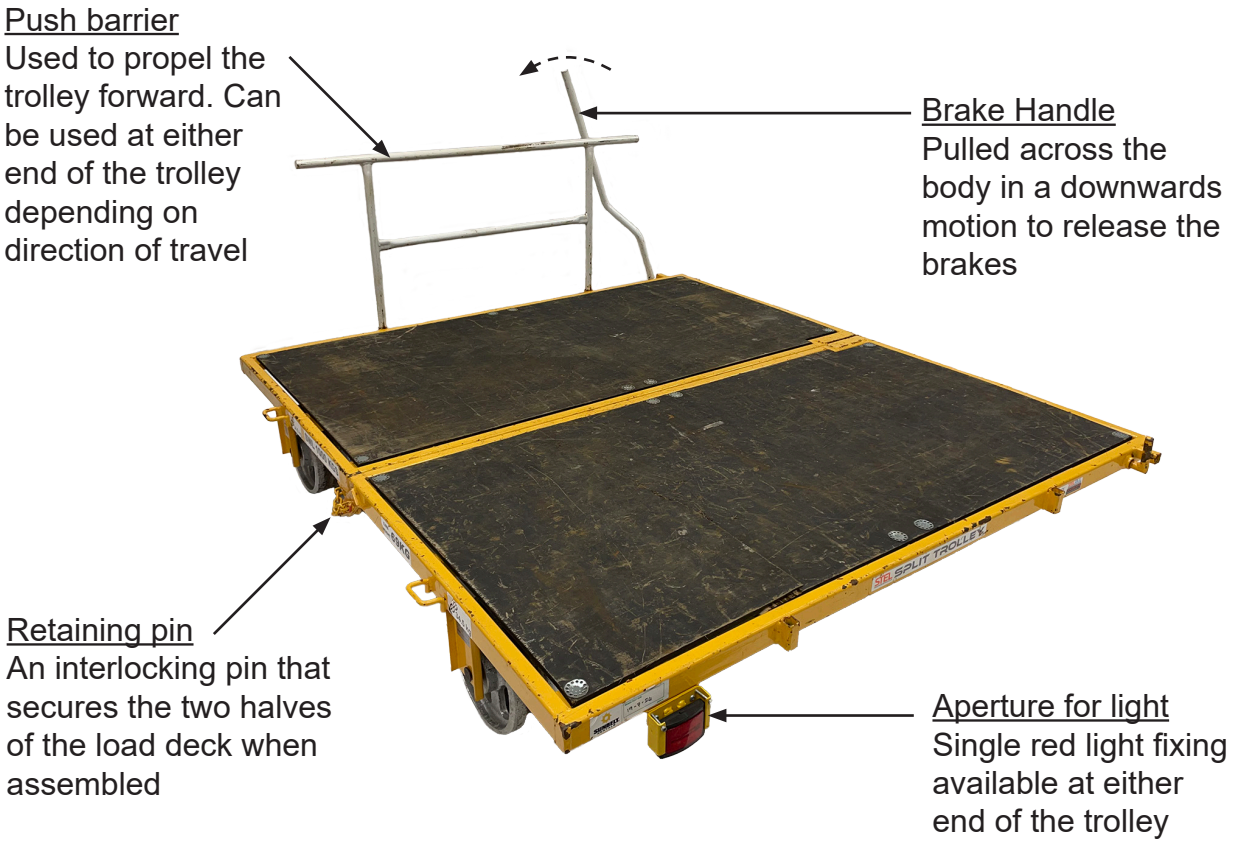

Figure 9: Schematic of the trolley and how it is operated.

59 The push barrier is used by an operator to push the trolley forward. It can be attached to either end of the trolley within fixings (the base of the push barrier inserts into hollow brackets) depending on the direction the trolley is required to travel.

60 The brake handle has a hollow base that is attached to the trolley with a single bayonet pin mount (a radial pin that is locked into an L-shaped slot). To release the brakes, the handle is rotated and held. The brake handle is located to either the operator's left or right, depending on the direction of travel. How the brakes on the trolley function is discussed in more detail in paragraph 67.

61 At the time of the accident, the trolley had a red light at the front and back as required by the Rule Book, Handbook 10 (GERT8000-HB10, 'Duties of the COSS and person in charge when using a hand trolley', issue 5 dated December 2023).

Analysis

Identification of the immediate cause

62 The trolley ran away on a downhill gradient because the operator had rendered its brake ineffective.

63 The brakes of the trolley are released by the trolley operator depressing the brake handle (see paragraph 67). Immediately before the accident, the trolley operator had forced the brake handle under the push barrier (figure 10) to keep the brake handle in a depressed state without them having to apply pressure to it. The trolley was found in that state immediately after impact and the trolley operator stated that is what had happened. This meant that the trolley had no effective brakes when operating on a downhill gradient of 1 in 176, allowing the trolley to run away from the operator.

Figure 10: The brake handle, shown wedged under the push barrier, immediately after the collision (courtesy of RSRG).

64 Before the journey which resulted in the accident, the trolley had been safely used twice, firstly downhill from North Rode access point to site of work 3, and later returning uphill to North Rode to collect the rail saw (paragraph 47). No problems with the trolley brakes were reported during these journeys and no brake faults were identified during post-accident testing.

Identification of causal factors

65 The accident occurred due to a combination of the following causal factors:

a. The design of the trolley meant that the brakes could be rendered ineffective relatively easily (paragraph 66).

b. The ergonomics of the trolley brake system made it tiring to use, potentially encouraging users to defeat the brake (paragraph 77).

c. The operator was unaware that there was a risk of the trolley running away at this location (paragraph 89).

d. The operator was aware that it was possible to render the braking system ineffective on this trolley (paragraph 97).

Each of these factors is now considered in turn.

The susceptibility of the trolley design to misuse

66 The design of the trolley meant that the brakes could be rendered ineffective relatively easily.

67 The STEL split trolley has one wheel on each half of the trolley that is directly braked via a spring-applied friction shoe (figure 11). The brake is released when the trolley operator depresses the brake handle at the end of the trolley, which rotates a longitudinal shaft to pull the brake release cables. This overcomes the springs and pulls the friction shoes away from being in contact with the wheels.

68 The two half-trolley brake shafts are automatically linked when the halves are joined, enabling the handle to release the brakes on both halves simultaneously. This allows the brake handle to be fitted and used at either end of the assembled trolley. A separate push barrier is inserted into sockets at either end of the trolley to assist operators to manually push the trolley.

69 In its normal state, the trolley brake is always engaged, with the friction shoes applied to the rail wheels by means of the springs. As such, the brakes are considered to be failsafe, as a positive action (depressing the brake handle) is required to release the brakes.

70 The current requirements for the performance of a manual rail trolley's braking system are contained in Railway Industry Standard RIS-1530-PLT, 'On-Track Plant, Trolleys and Associated Equipment', issue 7.1 dated March 2024. This states that the design of the trolley should assume that the brakes are being used dynamically on a downward slope and therefore should be capable of stopping and holding the trolley on a gradient. The self-application of the brakes to prevent runaway and the brake stopping distances is a requirement of British Standard BS EN 13977:2011, 'Railway applications – Track – Safety requirements for portable machines and trolleys for construction and maintenance'.

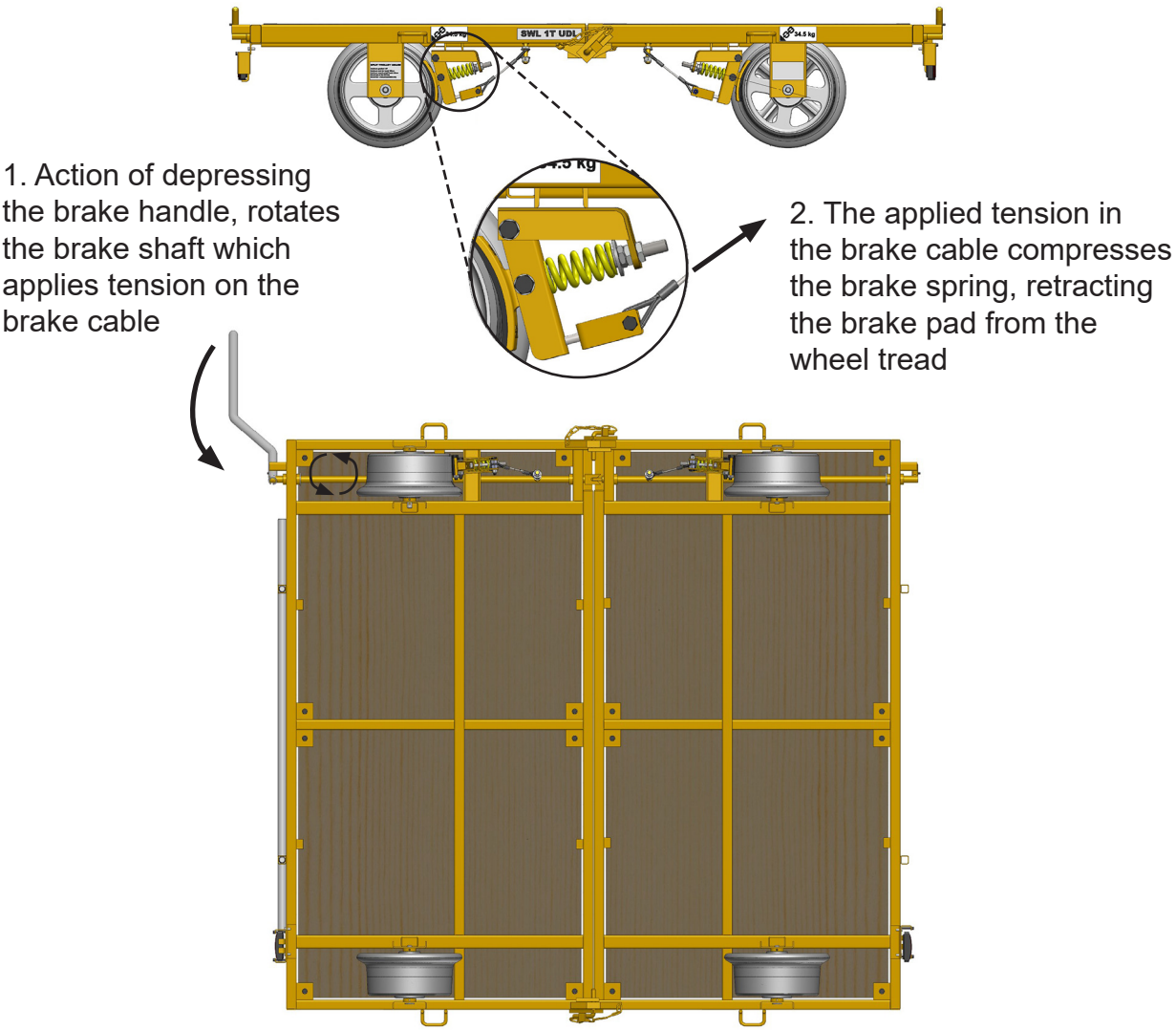

Figure 11: Schematic of the trolley braking system (courtesy of STEL with RAIB annotations).

71 Although the trolley was introduced before the current standards (see paragraph 106), RAIB post-accident testing results show that the braking system of the trolley could meet current requirements when the brake handle was positioned as designed.

72 RIS-1530-PLT also states that the dynamic torque for each braked rail wheel should be measurable. This dynamic torque is the force applied externally to the wheel that would overcome the brakes and make the wheel turn with them applied. The method of testing brakes for maintenance and use of trolleys is set out in the Mechanical and Electrical Engineering (M&EE) Networking Group's code of practice COP0018, 'Code of Practice: For Rail Mounted Manually Propelled Equipment', issue 7 dated May 2023.

73 Since the brake shoes are applied to the wheels of the trolley by springs, and the springs are overcome by using the brake handle to release the brakes, there is a direct relationship between the dynamic torque measurement and the force which an operator has to apply to the brake handle to release the brakes. The greater the dynamic torque when the brakes are applied, the greater the force that needs to be applied to the brake handle to release the brakes (see paragraph 84).

74 Sunbelt Rentals performed a routine brake test on the trolley on 19 April 2024 following the 'User and Maintenance Guide' from STEL which required a minimum dynamic torque of 80 Nm. The trolley was recertified with torque readings of 123.9 Nm and 121.3 Nm for the two brakes wheels. However, the test paperwork supplied by STEL is more specific, requiring the torque to be in the range of 80 Nm to 100 Nm. The consequences of an increased dynamic torque would be an increase in brake force and therefore a slight decrease in stopping distance, but also a greater force needed from the operator to release the brake.

75 Using a calibrated torque wrench for the STEL split trolley, RAIB tested the brake torque after the accident. The readings recorded by RAIB were within the 80 Nm to 100 Nm torque range specified on the test paperwork.

76 RAIB also tested the functionality of the trolley brakes following the accident. To replicate the site conditions during the accident, the trolley was loaded with around 275 kg of mass and was used on a gradient averaging 1 in 135. This is steeper than the gradient at the accident site (paragraph 7). While the trolley was in motion, the brake handle sprang back towards the vertical if released by the operator. This automatically applied the brakes and stopped the trolley. The trolley remained static on the incline when under test. This shows that the brakes would have applied and stopped the trolley on 26 May 2024 had the operator not rendered them ineffective.

77 The trolley operator had rendered the brake ineffective before the runaway by forcing the brake handle under the push barrier. This caused the brake handle to be fixed in a depressed state, defeating the failsafe trolley brake. Although the base of the trolley handle used at the time of the accident had some deformation, RAIB identified that a brake handle could also be positioned under the push barrier even on a new trolley of the same model, which did not have a brake handle with this deformation. This was achieved without undue difficulty.

Ergonomic considerations in the trolley design

78 The design of the trolley brake system made it tiring to use, potentially encouraging users to defeat the brake.

Ergonomics and design

79 Ergonomics is the scientific discipline concerned with understanding the interactions between humans and the physical aspects of the environment, such as equipment, machinery and interfaces with technology. Ergonomic design focuses on ensuring a good fit between people and equipment, aiming to make work safer, healthier and more productive.

80 The Health and Safety Executive ('Reducing error and influencing behaviour', HSG48, 1999) states that, when a piece of equipment is hard to use from an ergonomic perspective, such as '*excessively awkward, tiring or slow controls or equipment*', the operator is more likely to find an easier way of using the equipment. Seeking these easier alternatives can result in 'situational violations' which occur due to circumstances in the workplace that make rule compliance difficult. The trolley operator forcing the brake handle under the push barrier so that they no longer need to maintain downward force on the handle is an example of a situational violation.

81 Good ergonomic design helps to reduce the risk of situational violations occurring and hence eliminates the risks that such violations import. Chengalur, Rodgers & Bernard state '*the goal of ergonomically designed tasks is to get the work done with the least amount of effort so that unnecessary fatigue does not accumulate in the active muscles during a shift*'.[7] In the context of moving a load on a trolley, a good ergonomic design therefore needs to consider how the operator interacts with the trolley in addition to the intended use. Chengalur, Rodgers & Bernard also suggest that, when trolleys are used over a long distance, this is better done with powered equipment to reduce muscle fatigue.

82 The Rail Safety and Standards Board (RSSB)[8] has included ergonomic requirements within RIS-1530-PLT (paragraph 70). To ensure that a trolley can be safely used, the standard includes the need for trolleys to be designed '*taking into account the capabilities of the people required to propel them*'. Guidance is provided to designers regarding the maximum weight of the trolley and the permitted load in consideration of the end user, thus focusing on the manual handling side of ergonomics. Related to this, the standard refers to COP0018 (paragraph 71) for advice on the number of people required to propel a trolley (based on weight, load and gradient). RIS-1530-PLT recommends consulting Network Rail's Ergonomics & Human Factors Specialist Team for '*additional advice on design considerations regarding the handling and operation of* [a] *trolley*'. Requirements for both ergonomic design and manual handling are also included within the Network Rail product acceptance process (see paragraph 101).

Force required by the trolley operator

83 The trolley operator was required to apply two different forces to move the trolley. To release the brakes, the brake handle must be pushed across the body in a downward motion using lateral force from the shoulder. To propel the trolley, the operator must apply longitudinal force to press the push barrier forward from the waist. Although intended as an action requiring the operator to use both hands, it is possible to extend the hand gripping the top of the brake handle to also hold the push barrier. Most ergonomic guidance assumes that the design permits the operator to exert force from around the waist. There are no specific guidelines for this type of dual manoeuvre.

84 The lateral force across the body applied to the brake handle is exerted from the weaker shoulder muscles rather than from the waist. RAIB measured the applied force required to initially depress the handle and release the brakes as 61.3 N (6.3 kg(f)) to 63.8 N (6.5 kg(f)). This is reduced to 44.1 N (4.5 kg(f)) to maintain the release of the brakes. These measurements are within the limits of 7 kg(f) suggested by Chengalur, Rodgers & Bernards, but these limits do not refer to a sustained movement or to one that is combined with the motion of pushing the trolley forward. In addition, it is possible that the force required would have been greater at the time of the accident because a higher brake torque was recorded before the accident, which would have increased the force required to depress the brake handle (paragraph 72).

[7] Chengalur, Rodgers & Bernard (2004). 'Kodak's Ergonomic Design for People at Work' (second edition), Wiley & Sons.

[8] A not-for-profit body whose members are the companies making up the railway industry.

85 RAIB also tested the force required to push the trolley up a 1 in 135 gradient, a steeper gradient than at the site of work (1 in 176). Between 4.9 N (0.5 kg(f)) and 9.8 N (1 kg(f)) was needed to propel the trolley in an unloaded state, which increased to between 39.2 N (4 kg(f)) and 58.9 N (6 kg(f)) when loaded with approximately a 275 kg mass to reflect the loading at the time of the accident. Although this horizonal force on its own is not challenging to an average operator, RAIB testing showed that the combined body positioning and movement required to apply both the lateral and longitudinal forces together is awkward, uncomfortable and difficult for operators to sustain over a long period.

Operator guidance

86 The TBS produced by RSRG (paragraph 30) stated that '*any personnel pushing any trolley is restricted to do so for a maximum of 20 minutes or 1 mile in distance, (whichever comes first), they then must relinquish this task and safely handover to allow another person to takeover*'. The trolley operator at the time of the accident was unaware of this requirement. They had just pushed the trolley uphill to the North Rode access point for approximately 20 to 25 minutes and loaded a rail saw, before starting to push the trolley back to the site of work. There was no other competent person with the trolley operator who could have taken over the task.

87 The 20-minute threshold is taken from Network Rail's task risk control sheet NR/L3/MTC/RCS0216/SP08, 'Task Risk Control Sheet Use of Manual Trolleys/ Rail Skate/Scooter', issue 3. The sheet states that the limits of use are up to a maximum of 1 mile, or for a maximum of 20 minutes (whichever is the lesser). It goes on to detail that this is based on the same two handlers (a trolley operator on the brake handle and a person to assist in pushing) in a single operation (for example, when moving from an access point to the site of work). A period of 20 minutes completing physically different activities is required if the same handler is to operate the trolley more than once per shift. The only details from this sheet included in RSRG's TBS was the 20-minute or 1 mile limits.

88 The task risk control sheet includes a reference to Rule Book Module GERT8000/HB10, 'Duties of the COSS and person in charge when using a hand trolley', issue 5 dated 2023. Section 3 of this module states that a trolley has to have at least two people with it when moving and one of them must be in charge of the brake. Although the blue hat worker assisted in pushing the trolley, the trolley operator was responsible for the operation of the trolley and its brake. This was in excess of the time limits recommended by industry guidance and detailed within the TBS.

Risk awareness

89 The operator was unaware that there was a risk of the trolley running away at this location.

Operator's training and experience

90 The trolley operator had previously worked in the construction industry. They first gained their PTS in 2005 when working on railway station roofs, but not working directly on the track. Eighteen years later, seeking a career change, they started a course to gain further railway competencies, including that for operating trolleys. The 8-week course, concluding in September 2023, was based at a training college with practical elements covered on track within a depot.

91 The training for a hand trolley operator takes place over half a day, concluding with an assessment. Core elements of the standardised course include:

i. pre-use checks, assembling the hand trolley safely

ii. completing the appropriate visual checks (including braking system and manual tests)

iii. identifying wear/defects

iv. safe use, control and operation according to manufacturer's instructions

v. correct loading techniques including consideration of weight and gradient

vi. understanding the safe method of working before the trolley is placed on the track.

92 Having been offered only one shift on the railway since gaining these additional railway competencies, the trolley operator temporarily returned to non-railway work. In January and February 2024, they changed employers and completed 8 weeks of track work. It was during this period that their employer progressed them from blue hat to white hat status (paragraph 22).

93 After another period without railway work, the trolley operator joined OnPoint Trac in April 2024. The first shift for this company was on 11 May 2024. This work was not IRJ replacement, was not undertaken for RSRG, and did not involve them using a trolley. The shift which started on 25 May, the night of the accident, was the trolley operator's second shift for OnPoint Trac and the first time they had been solely responsible for a trolley. This meant that it was the first time they had been entrusted with a trolley for a shift and the first time they had to complete a pre-use trolley check outside of a training environment (see paragraph 113).

Gradient

94 For managing the ironman trolleys, the RSRG TBS detailed the gradients within the possession (ranging from 1 in 535 up to 1 in 102). The general risks of gradients and managing other rail-based equipment were not covered within the assessment of risk within the document.

95 The SWP (paragraph 30) contained a section entitled '*runaway risk analysis*'. It explicitly states that there is no runaway risk at this location, both within the work site mileage and within 5 miles of the area. This was because the gradient was not steeper than 1 in 100, which is the threshold taken from Network Rail company standard NR/L2/OHS/019, 'Safety of people at work on or near the line, Module 05 – Management of runaway risk', issue 12 dated 2023 (this document was withdrawn pending review at the time of the accident). Module 05 was written to manage the risk of rail-mounted plant and equipment running away within a possession and importing risk onto the operational railway, as had been seen during a number of previous incidents and accidents (see paragraph 143). The trolley did not leave the possession during the runaway and collision at North Rode.

96 With no risk being identified for the gradient between North Rode access point and the site of work, there was no requirement for the COSS to brief the work group on the gradient. No other operational risks specific to that location, the gradient or the use of the trolley had been shared with the trolley operator. Without this knowledge, the trolley operator did not know there was a risk of the trolley running away due to the gradient, as such a gradient was not readily perceived in darkness.

The operator's knowledge of how to render the brake ineffective

97 The operator was aware that it was possible to render the braking system ineffective on this trolley.

98 The training that the trolley operator received included the safe use, control and operation according to the manufacturer's instructions (paragraph 91).

99 Although relatively inexperienced with trolley use (paragraph 93), the operator nevertheless knew how to render the brakes ineffective by forcing the brake handle under the push barrier. The trolley operator stated that they had never done this before and was aware that it should not be done. However, the trolley operator stated they had seen other staff using trolleys in this manner when working on previous work sites and had observed the trolleys moving a couple of metres and then coming to a natural stop, enabling operators to rest their arms.

Identification of underlying factors

Product acceptance

100 The product acceptance process employed by Network Rail did not manage the risks associated with this design of trolley.

Current product acceptance process

101 The product acceptance process was introduced to the rail network in 1994 and exists to provide assurance that tools, equipment and plant do not present a significant risk, are safe, compatible, reliable and fit for purpose. Network Rail's current product acceptance process is described in NR/LS/RSE/100, Module 05, 'Product acceptance and change to Network Rail operational infrastructure', issue 4 dated 2021. This requires that, before products are permitted on the railway, the manufacturer or supplier must gain a certificate of acceptance from Network Rail. This involves the manufacturer or supplier of the product working with a sponsor from within Network Rail to submit a product acceptance application.

102 A lead reviewer from Network Rail will then assess the information supplied in the application and review any operational trials for compliance against the product acceptance requirements. The verification process includes each design requirement from national, international and railway industry specific standards. For a trolley, the lead reviewer would be allocated by the Network Technical Head of Plant. The lead reviewer is required to consult with other relevant asset and function areas within Network Rail such as the ergonomics and human factors team to ensure effective integration of the product. Should it be identified that the application does not comply with the ergonomic design principles defined within the plant product acceptance process, the design becomes subject to an ergonomics approval within Network Rail.

103 A separate Network Rail standard, NR/L2/ERG/24020, 'Engineering assurance arrangements for Ergonomics within design and development Projects', issue 3 dated 2011, provides engineering assurance that ergonomics and human factors requirements have been considered within the product design and development phase. Supporting the standard are project classification tables which categorise equipment, systems and projects based on the type of changes that may be introduced, which are more likely to have ergonomic implications. Portable and transportable mobile plant, such as a new trolley, would be classified as a 'category 1' project, which NR/L2/ERG/24020 states would be *'deemed unlikely to require specialist ergonomic input or assessment and exemption may be sought from the Professional Head (Ergonomics) from any further assurance deliverable requirements of this standard'*.

104 Whether its design is new, updated or otherwise modified, an additional assessment of risk is completed for plant, which includes trolleys. The lead reviewer completes the assessment of risk laid out in Network Rail standard, NR/L3/RMVP/27702, 'Plant Product Acceptance Process', issue 1 dated 2023. The plant product acceptance checklist in this standard also includes a requirement for an ergonomic review.

105 The lead reviewer produces a final report stating if they are recommending the item of plant for acceptance and use on infrastructure managed by Network Rail. The report will be submitted alongside all documentation collated during the assessment process to the Network Rail product acceptance team. The team shares its recommendation with the appropriate Network Rail technical head (in the case of a trolley, this would be the Technical Head of Plant), who is responsible for signing off the product and issuing the product acceptance certificate.

Process followed for the type of trolley involved in the accident

106 For designs that pre-date the product acceptance process, much of the information needed for verification does not exist. A process known as 'historic rights' applies where continued acceptance is based on the premise that the design has performed without concern over many years and hence continued use will be acceptable. This process can also be applied where the design of a new product is judged to be similar enough to an existing product.

107 Similar trolleys receiving product acceptance under historic rights were introduced by other manufacturers in 2005 and 2010. STEL submitted its design for the split trolley in 2013. The Network Rail product acceptance team was able to assess it against previous submissions for a similar trolley design, and historic rights were applied to process the application. The Network Rail Technical Head of Plant was able to grant historic rights to the STEL trolley as the basic design was already widely implemented on the UK railway before the 1994 requirement for product acceptance. Furthermore, there had not been any significant or substantial change to the design, standards, manufacturer or its intended use.

108 As a consequence of the application of historic rights, the split trolley design has never been ergonomically assessed. This meant that the ergonomic issues associated with the trolley (paragraph 77), and the ability for the operator to relatively easily alter the state of the failsafe brakes to leave them ineffective (paragraph 97) remained an inherent risk of its design.

109 A second product acceptance certificate was issued in 2023. Network Rail stated that this was issued following a change in the manufacturer's name and that the approval followed the relevant process in module 05 of NR/LS/RSE/100 for such a change. This required no change to have occurred to the trolley, including its design, manufacturing site, fitness for purpose and safety integrity.

110 Module 5 of NR/L2/RSE/100 states that all products, including those that have been granted historic rights, '*shall be assessed every five years or fewer by the Network Rail Technical Head or delegate to determine whether they are still compliant with current legislation and standards, meet safety expectations and have a proven history of reliability*'. There is no evidence of this ever having taken place for the STEL trolley.

Site management

111 Lack of clarity of site leadership roles led to the trolley runaway risk not being effectively managed.

112 The senior supervisor requested the number of staff required to complete the shift on the night of the accident (paragraph 29). Usually, in addition to the numbers and roles of staff that were needed (such as team leader) the request would contain the details of specific competency requirements which the allocated staff would be required to hold. This information was provided by the TBS (paragraph 30) which listed the required resources for the shift, including staff competencies. For the 15 track workers, the TBS required competencies for the use of small tools, site lights and ironman. Three trolley operators were also required. However, the actual staffing request for the work on 25 and 26 May only identified the need for two individuals to hold ironman competencies and did not specifically seek trolley operator competencies.

113 While at the compound on 25 May 2024, the senior supervisor arranged for a team leader to divide the track workers into four work groups (paragraph 36). Although the team leader had completed a number of weekends of IRJ replacement shifts with RSRG and was familiar with the work, they were not informed of the competencies that would be required in each work group. The supervisors from RSRG also did not know what competencies were held within the work groups that they were supervising. While the COSSs checked the PTS cards of their groups (paragraph 36), they did not check specific equipment competencies as they did so. This was a task that RSRG could have completed in advance of the shift had the necessary competencies and roles been known in advance. This in turn could have allowed work groups to be created with an appropriate distribution of staff numbers and the required competencies.

114 The division of track workers and equipment between the access points created a larger number of people for the supervisor to manage and an increased workload at the North Rode access point. Pre-use trolley checks are a requirement of COP0018 (paragraph 71), directing the operator to check the safety of the trolley. However, on the evening of 25 May the supervisor was focused on taking the vans to the North Rode access point for unloading (paragraph 38), resulting in the trolley pre-use checklist not being shared with the trolley operator. This was not raised by the trolley operator as, since their training, they had never had the opportunity to use a pre-use check sheet. The supervisor was also unable to perform supervisory duties and oversee the pre-use checks and assembly of the trolley as they were the only individual able to move the vans to help the unloading.

115 The senior supervisor had overall responsibility for all four planned sites of work for RSRG, with the supervisor overseeing site of work 3. This was detailed in the TBS which refers to tasks being under the supervision or guidance of the RSRG supervisor (paragraph 17).

116 Network Rail defines the role of PIC in NR/L2/OHS/019, 'Safety of people at work on or near the line', issue 12 dated 2023, as being '*on site when the work is being undertaken and has overall accountability of supervising and overseeing works*'. Neither of the RSRG supervisors were COSS qualified and could not therefore take on the role of PIC (paragraph 20). There was witness evidence that the RSRG supervisor was directing the tasks on site of work 3, and hence was perceived to be leading and controlling the work being done, while the COSS (who was the designated PIC) was not perceived by anyone as being in charge of the work.

117 The decision to send two track workers back with the trolley for the rail saw resulted in the work group becoming divided. Rule Book handbook GERT8000-HB7, 'General duties of a controller of site safety (COSS)', issue 9 dated 2024, states that the COSS must remain with the work group so that they are able to personally observe and advise everyone. Due to the curvature of the track and the lack of light, the COSS was unable to observe the track workers accompanying the trolley after they departed from site of work 3.

118 The confusion on site between the roles of supervisor and PIC/COSS meant that the COSS lacked confidence that the activity at site of work 3 would cease should they opt to accompany the trolley back to North Rode access point. Perceiving that the site of work held the greater risk, the COSS stayed at the site of work. It is possible that if the COSS had accompanied the track workers with the trolley, the trolley operator would not have misused the brake handle, rendering the trolley's brake ineffective.

119 Due to the cancellation of site of work 4, site of work 1 and 2 had two available COSSs and was only a short distance away (324 m) from site of work 3. It would have been possible for one of these additional COSSs to have been tasked to escort the track workers, with the trolley, back to North Rode access point. However, the RSRG supervisors did not recognise the need for a COSS to accompany the trolley and a redeployment of resources did not take place.

Industry awareness

120 Staff defeating the braking system on this type of trolley is a known issue but actions taken by Network Rail have not been effective in eliminating the practice. This is a probable underlying factor.

Previous RAIB investigations

121 RAIB has previously investigated occurrences of runaway trolleys which have had their brakes made ineffective by the operator (see paragraph 143).

122 The most pertinent RAIB investigation relating to the unauthorised modification of brakes was an incident involving a runaway track maintenance trolley near Haslemere, Surrey, on 10 September 2011 (RAIB report 14/2012). During an overnight engineering possession, a trolley ran away for a distance of 2.9 miles (4.6 km). RAIB found that the runaway occurred because the trolley operator let go of the trolley when they did not know they were on a long downhill gradient and the brake mechanism was probably modified, holding the brakes in the 'off' position. Although there was conflicting witness evidence, it was thought that the abnormal angle of the brake handle may have encouraged the operator to interfere with it, to hold it down and prevent the brakes from applying. Although the trolley in the Haslemere incident was a different model and manufacturer to that involved at North Rode, there are similarities in the design of the braking system and the associated handle.

123 The Haslemere investigation established Network Rail's product acceptance process as an underlying factor, noting that it did not identify the causes or consequences of possible misuse when operating the brake handle. Network Rail carried out a limited ergonomic assessment of the forces and movements involved in operating the brake handle but there was no evidence of a broader ergonomic assessment of the final design being carried out before product acceptance. Network Rail did not identify the possibility that the brake handle might be forced in the wrong direction, as the brake pushrods were prone to bending if the handle was forced in the wrong direction. It also did not identify that bending of the pushrods could cause the brakes to remain off when the handle was released by the operator.

124 RAIB's investigation identified that the runaway was due to a combination of factors including inadequacies in the design, risk assessment and acceptance processes. Of the six recommendations made, two of those directed to Network Rail related to the training and competence of trolley operators and to the product acceptance process.

125 Recommendation 1 of RAIB's report (see paragraph 151) sought the revision and improvement of the training material and competency assessment process for trolley operators, focusing on the importance of pre-use checks and the automatic function of trolley brakes, in addition to incorporating suitable references to the risk arising from the use of trolleys on gradients. The Office of Rail and Road (ORR), the safety authority for railways in Great Britain, advised RAIB in 2013 that this recommendation had been implemented.

126 Despite this recommendation being reported as implemented by 2013, and the trolley operator at North Rode completing their training 10 years later in 2023, the actions of the trolley operator indicate that they were unaware of the risk of gradients in relation to rendering brakes ineffective. Operator misuse of brakes had not been included in their training (paragraph 91), nor had it been included in any briefing they received at North Rode (paragraph 96).

127 Recommendation 2 sought to provide assurance that the risk associated with the design of a new product was assessed and mitigated before it was approved by Network Rail. A design risk assessment should be carried out for each new item of plant that has the capability to import risk to the operational railway, taking account of realistic and potential failure modes, including the way the equipment is used. Although this incorporated the need to assess foreseeable risks such as operator misuse, the recommendation did not apply to items of plant that pass through the product acceptance process through historic rights, such as the trolley involved at North Rode. In 2013, ORR reported to RAIB that this recommendation had been implemented.

128 Three years later, RAIB investigated the runaway of a pair of ironman trolleys and a subsequent near miss at Raven level crossing, Garnant, Carmarthenshire, Wales on 1 November 2014 (RAIB report 13/2015). The pair of ironman trolleys ran out of control for approximately 5.4 miles (8.7 km) when track workers were unable to control their speed on the downhill gradient towards Raven level crossing. The incident occurred due to a combination of the planning of the work, the control of the work, the speed at which the ironman trolleys were travelling and the performance of the brakes. RAIB made six recommendations covering the improvement of manually propelled plant brake design, testing, and maintenance planning work, and measures to mitigate the risk of runaway.

129 Of note is recommendation 4 of RAIB's report (see paragraph 154) where Network Rail, in conjunction with RSSB and the M&EE Networking Group, was tasked to define the required functionality of the braking systems fitted to manually propelled plant used on its infrastructure. This led to the creation of COP0018: Code of Practice: For Rail Mounted Manually Propelled Equipment (paragraph 71). Detailed within this recommendation was the need for a generic risk assessment of such braking systems (including manual trolleys), taking account of all foreseeable failure modes and possible misuse. Based on the findings of this assessment, the recommendation stated that there should be a revision of the requirements and guidance for design, testing and use of the braking systems. The results were intended to lead to improvements in the design of new manually propelled plant, informing any required action with respect to existing equipment. Although misuse is covered within COP0018 (see paragraph 130), the accident at North Rode shows that the impact of this has not reached an operational level.

Existing standards and guidance

130 The risk of rail trolleys being misused by the operator is foreseeable and as such it is reflected in the standards and guidance. Addressing trolley design, RIS-1530-PLT (paragraph 70) states that '*as far as reasonably practicable, trolleys shall be designed to prevent interference and damage to any mechanisms and actuators used in brake operation'.*

131 COP0018 (paragraph 71) requires that '*personnel should not interfere with the braking mechanism. Only authorised competent maintenance staff are permitted to maintain or adjust the braking mechanism*'. This is further reiterated in NR/L2/RMVP/0200/P514 'Infrastructure Plant Manual, Hand controlled trolleys', issue 6 dated 2023, which specifies the requirements for the safe use of trolleys to mitigate risks relating to trolley use. It clearly directs that operators '*do not adjust or interfere with the braking mechanism of a trolley*'. This standard applies to organisations involved with the planning or supply of any trolley, the delivery or control of operations using trolleys, and the maintenance of trolleys used on infrastructure managed by Network Rail and Network Rail projects.

132 From an operational perspective, the STEL split trolley user maintenance guide informs the end user to '*only use the brake and push handles provided. Do not hold the brake handle off using mechanical means'.* This guidance for trolley handle use is also reflected within GERT8000-HB10 (paragraph 61) which states '*each trolley must be fitted with an operational fail-safe braking system. The correct brake handle must be used when operating the trolley'*. Additionally, task risk control sheet NR/L3/MTC/RCS0216/SP08 (paragraph 87) requires that the '*brake handle shall be manually operated at all times. Do not secure the brake in the off position or place load on brake handle'*.

133 Although learning from previous incidents is evidently reflected in these various documents, it is clear from the circumstances of the accident at North Rode that the brakes on some trolleys remain vulnerable to potential misuse. In the absence of engineered safeguards, such as redesigned handles, the remaining barriers to prevent such misuse are effective training and site supervision. Witness evidence indicated that the training for the trolley operator involved in the accident at North Rode (paragraph 91) had not alerted the operator to such risks, and site supervision (paragraph 114) had not provided any mitigations.

Factors affecting the severity of consequences

The presence of the ironman

134 The presence of the ironman on the Down Stoke line mitigated the severity of the consequences of the accident. The two ironman trolleys were attached to a rail on the same railway line as the runaway trolley and the collision caused both of them to move approximately 1.5 m before coming to a stand. If it were not for the ironman arresting the runaway, the trolley would have collided with a welding trolley containing gas canisters before potentially continuing towards to site of work 1, where the workers would have had no warning of its approach.

135 RAIB had access to RSSB's runaway risk assessment tool in advance of its release (see paragraph 161). When used to assess the mile either side of the North Rode access point, the tool identified that the location has a high risk of a runaway. It highlighted that, if the trolley had not been arrested by the collision with the ironman, it would have travelled much further, potentially over 5 miles (8 km).

Inability to warn of the runaway trolley

136 While both the trolley operator and blue hat track worker had mobile phones with them when the trolley ran away, neither had any contact details for the COSS or anyone else within the site of work. This was because they were new to the work group (paragraphs 23 and 24), and the relevant phone numbers had not been shared. This meant that they had no way to contact the site of work to warn them of the approaching trolley before the collision.

Previous occurrences of a similar character

137 RAIB has investigated a number of runaway trolley accidents and incidents of a similar nature to that at North Rode. These are detailed at paragraph 143 onwards. In addition to these incidents, an accident involving a runaway trailer at Tebay, Cumbria, on 15 February 2004 led to the fatalities of four track workers and injuries to five others. This accident occurred before RAIB became operational in 2005.

138 Although not involving a trolley of the type involved in the accident at North Rode, the formal inquiry report issued by RSSB[9] into the Tebay accident found some causes of the accident which are similar to those discussed in this report. These included:

- the disablement of the trailer's brakes resulting from an earlier application of an excessive hydraulic pressure
- an absence of clear, explicit and practical instructions for checking the effectiveness of the parking brakes
- a lack of awareness on the part of the machine controller or operator of the magnitude and length of the gradient.

139 The report made 12 recommendations. Those relevant to the accident at North Rode included:

a. Development of clear instructions for use of trailer parking brakes on the track, coupled with a functional test whenever trailers are first placed on the track.

b. A database or library should store relevant compliance and certification details for all road-rail vehicles and trailers, and other wheeled attachments capable of moving unaided when on the track.

c. Arrangements should be introduced to provide supplementary monitoring and mentoring of newly qualified machine staff.

d. A study should be carried out to identify tools and guidance for managing safety interfaces between companies with a view to producing practical tools and good practice guidance in this area.

e. The Hazard Directory should contain gradient details where the severity and/or length of these merit attention.

[9] https://www.railwaysarchive.co.uk/documents/RSSB_Tebay2004.pdf.

Summary of conclusions

Immediate cause

140 The trolley ran away on a downhill gradient because the operator had rendered its brake ineffective (paragraph 62, **Learning point 1**).

Causal factors

141 The causal factors were:

a. The design of the trolley meant that the brakes could be rendered ineffective relatively easily (paragraph 66, **Recommendation 1**).

b. The ergonomics of the trolley brake system made it tiring to use potentially encouraging users to defeat the brake (paragraph 78, **Recommendation 1**).

c. The operator was unaware that there was a risk of the trolley running away at this location (paragraph 89).

d. The operator was aware that it was possible to render the braking system ineffective on this trolley (paragraph 97, **Recommendation 1**).

Underlying factors

142 The underlying factors were:

a. The product acceptance process employed by Network Rail did not manage the risks associated with this design of trolley (paragraph 100, **Recommendation 1**).

b. Lack of clarity of site leadership roles led to the trolley runaway risk not being effectively managed (paragraph 111, **Learning point 2**).

c. Staff defeating the braking system on this type of trolley is a known issue but actions taken by Network Rail have not been effective in eliminating the practice. This is a probable underlying factor (paragraph 120, **Recommendation 2**).

Factors affecting the severity of consequences

143 Factors that exacerbated the consequences of the event were as follows:

a. The ironman within the site of work arrested the trolley preventing it from travelling further (paragraph 134).

b. The trolley operator and blue hat track worker had no means of warning the site of work of the runaway trolley (paragraph 136, **Learning point 3**).

Previous RAIB recommendations relevant to this investigation

144 The following recommendations, which were made by RAIB as a result of previous investigations, have relevance to this investigation.

145 On 2 November 2005, a manually propelled trolley being used within a engineering possession on the (then) partially-built Larkhall branch in the Hamilton area of Scotland ran away from the trolley operator (RAIB report 20/2006). The trolley travelled over 3 miles downhill, passing over steep gradients of up to 1 in 48 and reaching speeds above 20 mph (32 km/h), eventually leaving the limits of the possession and running onto a railway line open to traffic. A possible collision with a passenger unit was prevented by the activation of a track circuit within Barncluith tunnel by the trolley. The brakes were ineffective due to the use of inappropriate brake lining material on the trolley. The trolley had also been heavily loaded on a gradient steeper than permitted, and there had been little guidance provided to the work group on the safe use of trolleys.

146 Recommendations made by RAIB included the manufacturer changing the design of the brake handle to prevent incorrect usage and to revise its user guidance with particular reference to testing the brakes before use, and the risks and mitigations associated with braking performance on gradients and wet or icy conditions. Recommendation 12 was for Network Rail to review its guidance on product acceptance processes and historical rights, with particular reference to plant, to ensure that there is clarity in the design change approvals criteria and particularly in respect to historical rights. All recommendations have been reported to RAIB as being implemented by ORR.

147 At 01:40 hrs on 24 May 2006, a manually propelled track trolley being used in connection with engineering works on the Circle line of London Underground ran away down a gradient of 1 in 70 and collided with a stationary trolley of a similar type at Notting Hill Gate (RAIB report 12/2007). A warning had been given and all staff were clear of the line before the collision. The trolley was a split trolley of similar design to that used at North Rode.

148 RAIB found that no pre-use checks had been carried out, and the risks arising from not carrying out the pre-use brake tests when operating trolleys on gradients had not been recognised. The investigation also found that the trolley's brakes failed to stop it because its brake system had been modified in a way that reduced its effectiveness, and that the construction of the trolley made it easy to modify.

149 The design of the trolley required the trolley operator to move the brake release handle sideways and downwards, against the brake application spring force, while pushing the trolley forward using the push barrier. By tightening the slack adjusters to the point of brake release, the physical force and degree of movement required to move the brake handle was reduced, thus providing a motive to modify the brakes, reducing the ergonomic difficulties of operation. During its investigation, RAIB found evidence that this type of trolley was often used with modified brakes. The relatively widespread unauthorised modification of brakes allowed and encouraged by this design of trolley was concluded to be the underlying cause of the runaway.

150 Of the eight recommendations made by RAIB to London Underground, two referred to ensuring that standards relating to trolley design and acceptance required the assessment and mitigation of risks associated with unauthorised modification of brake systems, and that existing trolleys were assessed against the same requirements. Recommendation 4 required London Underground to conduct studies into trolley design with an objective of improving the ergonomic issues connected with propelling and braking hand trolleys. All recommendations have been reported as implemented by ORR.

Previous recommendations that had the potential to address one or more factors identified in this report

Accident near Haslemere, Surrey, 10 September 2011, RAIB report 14/2012, Recommendation 1 (paragraph 121)

151 RAIB considers that more effective implementation of recommendation 1 in report RAIB report 14/2012 could have addressed one of the factors that led to this accident.

152 Recommendation 1 from this report (paragraph 121) reads as follows:

> *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.*

153 ORR has recorded this recommendation as implemented, stating that Network Rail has reported that it has taken actions in response to this recommendation.

Accident at Raven Level Crossing, Garnant, 1 November 2014, RAIB report 13/2015, Recommendation 4 (paragraph 127)

154 RAIB considers that more effective implementation of recommendation 4 in RAIB report 13/2015 could have addressed two of the factors that led to this accident.

155 Recommendation 4 from this report (paragraph 127) reads as follows:

> *The intent of this recommendation is to ensure that the design and testing of the brakes of trolleys and ironmen is appropriate for their intended use.*
>
> *Network Rail, in conjunction with RSSB and the M&E Engineers Networking Group, should define the required functionality of the braking systems fitted to manually propelled plant used on its infrastructure. They should then carry out a generic risk assessment of such braking systems, taking account of all foreseeable failure modes and possible misuse. Based on the findings of this assessment, they should revise the requirements and guidance for design, testing and use of the braking systems, and determine what retrospective action is required with respect to existing equipment.*

156 Although recorded by ORR as being implemented by Network Rail, the recommendation has been interpreted as being solely in relation to ironmen trolleys rather than the wider category of manually propelled plant as specified within the recommendation.

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

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

157 RSRG has introduced a frontline supervisors competency assessment process using two updated assessment tools over a period of 13 weeks to ensure supervisors meet the competency standards aimed at supporting a safe work environment. The assessment process covers elements such as forward planning, communication, safety awareness and responsibility.

Other reported actions

158 STEL has updated and reissued the manual for the split trolley to state the correct brake torque figures of 80 to 100 Nm. RSRG raised a National Incident Report through the M&EE Networking Group to inform the industry of the updated manual. In response to this, Sunbelt Rentals has issued a maintenance brief to their staff to reflect the changes in the manufacturer's instructions.

159 Since 2018, STEL updated the material specification of the insulated version of its split trolley brake handle following a request from London Underground Limited which had identified that a number of brake handles were being damaged. After the accident at North Rode, all STEL split trolley brake handles will now be manufactured with the modified design of a strengthened base to reduce the likelihood of deformation through misuse.

160 STEL has now attached a sticker to all of its trolleys before delivery which clearly states to the operator '*DO NOT attempt to override the trolley braking system*'.

161 RSSB is proposing to update Rule Book handbook GERT8000-HB7 (paragraph 117) from December 2025. This is intended to increase the clarity of the role of the COSS and to require that a COSS is always able to clearly see every member of the group. This proposed change, if implemented, would mean that members of a group would not be permitted to leave and work as a separate group unless an additional COSS has been provided to set up a safe system of work for their protection.

162 RSSB has developed a Runaway Risk Assessment Tool with Network Rail, which is expected to be available for use during 2025. The tool identifies the maximum runaway distance based on the recorded gradient of the track at the work site location, the equipment/vehicle being used and its loading. This data can then be used during the Network Rail planning process to inform the distances required for a safe work area by calculating the actual running distance. This will replace the current methodology of applying a blanket 5 miles in either direction (NR/L2/OHS/019 Module 5) (paragraph 95) with a targeted data-driven approach to managing the risk of gradients in work sites.

Recommendations and learning points

Recommendations

163 The following recommendations are made:[10]

1 *The intent of this recommendation is to reduce the likelihood that the failsafe brake on trolleys of the type involved in this accident are modified by operators and rendered ineffective*.

Network Rail, working in conjunction with the Rail Safety and Standards Board and the M&EE Networking Group, should assess the risk of trolley brakes being defeated in the manner seen during this accident and in other foreseeable ways. As part of this assessment of risk, Network Rail should, using current ergonomic design principles and good practice, consider appropriate control measures which will reduce or eliminate the risk of trolley brakes being defeated.

This assessment should include specific consideration of:

- the appropriateness of the present design requirements and guidance for braking systems on trolleys
- determining what retrospective action is required for trolleys already in service, including any ergonomic factors which might increase the likelihood of operators being encouraged to defeat braking systems
- if any changes are required to the product acceptance process (including the management of historic rights) and the way it is implemented in order to ensure that trolleys are being reassessed at appropriate intervals once they have been approved.

Once this assessment is complete, Network Rail should develop a timebound programme to implement any improvements identified (paragraph 139a and 140c).

This recommendation may apply to other types of rail-mounted maintenance equipment.

[10] 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 (Accident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail and Road 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.gov.uk/raib.

2 *The intent of this recommendation is to increase the effectiveness of actions taken in response to incidents involving misuse and consequent runaway of plant.*

Network Rail, working with its contractors and other supply chain organisations, should review the processes by which they identify, share and implement safety learning associated with incidents of plant misuse.

This review should consider legal requirements and good practice, such as that contained in Rail Industry Standard, RIS-3119-TOM, 'Accident and Incident Investigation, and that from other industries. The review should also consider how recommendations are implemented between Network Rail and the different organisations using its infrastructure and whether this results in an effective control of risk of plant runaway as a result of misuse. Following this review, Network Rail should develop a timebound plan to make any appropriate changes identified (paragraph 142c).

Learning points

164 RAIB has identified the following important learning points:[11]

1 This accident demonstrates the importance of staff working with trolleys of this type not rendering the braking system ineffective.

2 This accident demonstrates the importance of controllers of site safety accompanying work groups to personally observe and advise them.

3 This accident demonstrates the importance of ensuring that all individuals involved in work of this nature are provided with an effective means of passing emergency messages or warnings.

[11] 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

Appendices

Appendix A - Glossary of abbreviations and acronyms

Abbreviation / acronym	Full term
COSS	Controller of site safety
ES	Engineering supervisor
HP rail	High performance rail
IRJ	Insulated rail joint
M&EE	Mechanical and Electrical Engineering Networking Group
ORR	Office of Rail and Road
PIC	Person in charge
PTS	Personal Track Safety
RSRG	Rhomberg Sera Rail Group Ltd
RSSB	Rail Safety and Standards Board
STEL	Specialist Tools & Equipment Ltd
SWP	Safe work pack
TBS	Task briefing sheet

Appendix B - Investigation details

RAIB used the following sources of evidence in this investigation:

- information provided by witnesses
- safe work pack, task briefing sheet and work package plan
- RSRG standards and procedures
- OnPoint Trac standards and procedures
- trolley test reports and certificates
- STEL user and maintenance guide for the split trolley
- RAIB analysis from testing the accident trolley
- British Standard, Network Rail, M&EE Networking Group and RSSB industry guidance including Rule Book handbooks
- ergonomic studies relating to propelling activities
- site photographs
- gradient reference information
- weather reports and observations at the site
- a review of previous RAIB investigations that had relevance to this accident.

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

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