RAIB

Rail Accident Investigation Branch

Rail Accident Report

Runaway of a maintenance train near Markinch, Fife
17 October 2017

Report 01/2018
January 2018

This investigation was carried out in accordance with:

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

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

* Centre and right-hand cover photos courtesy of Network Rail

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.

The RAIB's findings are based on its own evaluation of the evidence that was available at the time of the investigation and are intended to explain what happened, and why, in a fair and unbiased manner.

Where the RAIB has described a factor as being linked to cause and the term is unqualified, this means that the RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident. However, where the RAIB is less confident about the existence of a factor, or its role in the causation of the accident, the RAIB will qualify its findings by use of the words 'probable' or 'possible', as appropriate. Where there is more than one potential explanation the 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 but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, the words '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 event 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 the RAIB, expressed with the sole purpose of improving railway safety.

The 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 maintenance train near Markinch, Fife, 17 October 2017

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Summary

At about 04:25 hrs on Tuesday 17 October 2017, a maintenance train that was clearing leaf debris from the track, hit a tree just north of Markinch station, Fife. The debris from the tree disabled the train's braking system. The train came to a stop before running away backwards for a distance of about 4.7 miles (7.5 km). The train crew on board made an emergency call to the signaller before jumping off the train, suffering minor injuries.

The train eventually came to a stop at Thornton North junction after running backwards and forwards between two adjacent gradients a total of nine times.

The brakes were fully released when debris from the tree operated the release mechanisms on the brake system distributors underneath both of the vehicles in the train.

The driver was unable to reapply the brakes because the debris from the tree had also separated all three of the brake pipes between the two vehicles in the train.

The RAIB has made two recommendations to Network Rail. The first addresses the risk of a runaway being initiated by debris on the track causing multiple disruptions to the braking system on this type of train. The second recommendation addresses the possibility that similar risks might be present for other short formation trains that operate on its infrastructure.

Introduction

Key definitions

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

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

The accident

Summary of the accident

3 Around 04:25 hrs on 17 October 2017, a maintenance train ran away for a distance of about 4.7 miles (7.5 km), from a location north of Markinch station in Fife (figure 1). The train had struck a tree that had fallen across the track. The resulting damage to the underside of the train had caused the brakes to be irreversibly released.

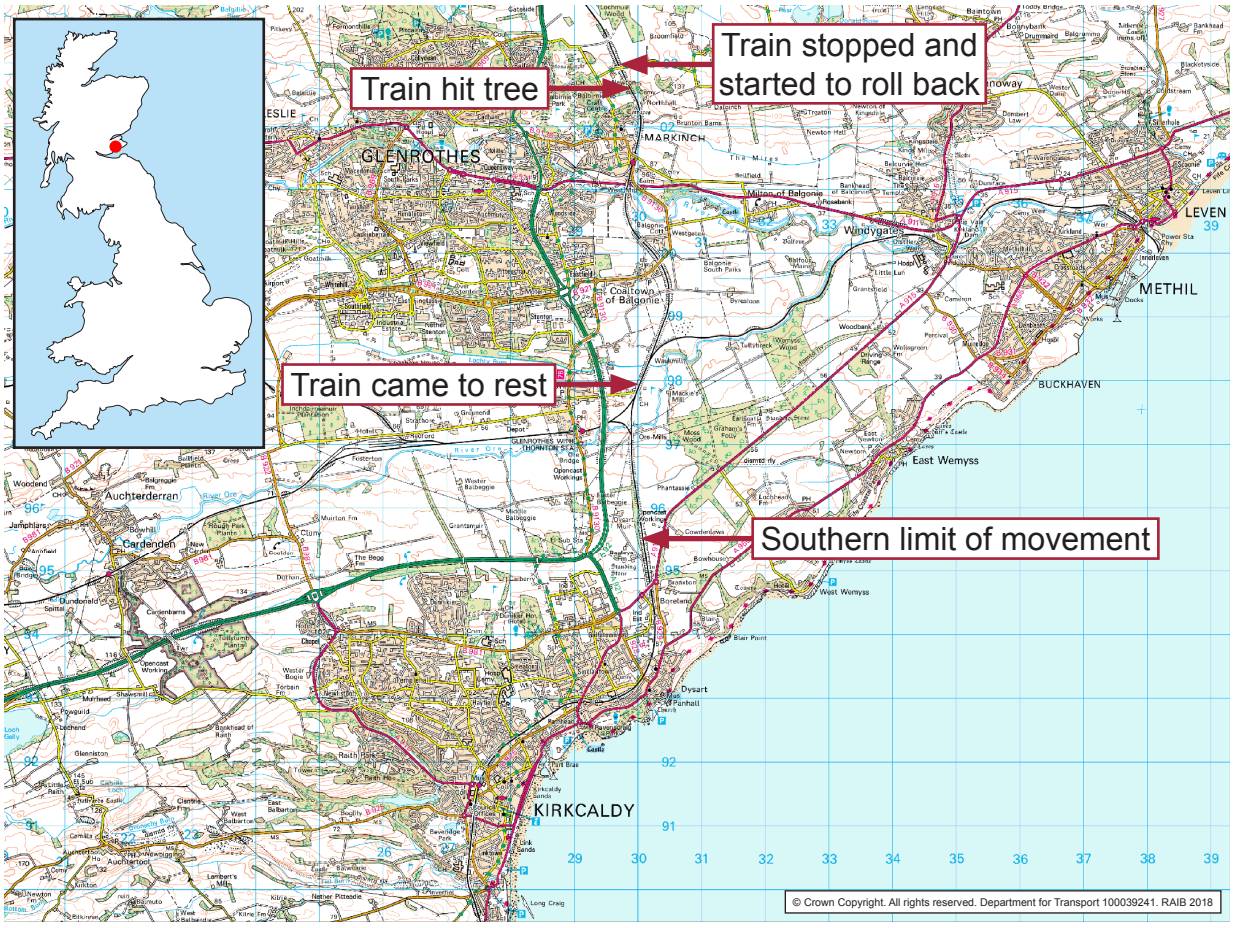

Figure 1: Location of the runaway

4 The train came to a rest on the uphill gradient, but then started to roll backwards. Having made an emergency call on the train radio, the two train crew jumped from the train onto the trackside and suffered minor injuries.

5 The train eventually came to a stop at a low point near to Thornton North junction, after having run up and down the adjacent track gradients several times.

Train involved

6 The train was a *Multi-Purpose Vehicle* (MPV) that was carrying out *Rail Head Treatment Train* (RHTT) duties. It consisted of slave vehicle DR98957, which was leading at the time, and master vehicle DR98907. This type of MPV entered service between 1999 and 2001 and consists of two flat-decked vehicles coupled together, each of which has a driving cab at the outer end (figure 2). The master vehicle is powered in each MPV, while the slave is unpowered.

7 The MPVs can be fitted with a variety of modules to undertake different duties, such as weed spraying and de-icing. At the time of the accident, the MPV was fitted with water jetting and *adhesion modifier* spreading equipment. This is intended to clear leaf debris from the tracks and to improve the friction between train wheels and the rails.

Figure 2: The Multi-Purpose Vehicle involved (photographed at Slateford depot)

Organisations involved

8 The MPVs were built for Railtrack by Windhoff, and are now owned by Network Rail. At the time of the runaway, the MPV involved was being operated and maintained by DB Cargo Ltd, on behalf of Network Rail. DB Cargo Ltd subcontracted operation of the RHTT functions of the train to Weedfree Ltd. At the time of the runaway, there was a DB Cargo driver and a Weedfree rail head treatment operator on board the MPV, both of whom were in the leading cab.

9 Network Rail, DB Cargo Ltd and Weedfree Ltd all freely co-operated with the investigation.

The sequence of events

10 The MPV had left Slateford depot in Edinburgh just before midnight, with the driver and treatment operator on board, and had treated the lines to Tweedbank, Dunfermline and Kirkcaldy before passing through Markinch en-route to Ladybank. At approximately 04:25 hrs, when approximately 0.8 miles (1.3 km) north of Markinch station, the driver saw the outline of the top of a tree across the track ahead. At this moment the MPV was travelling at about 43 mph (70 km/h) (figure 3).

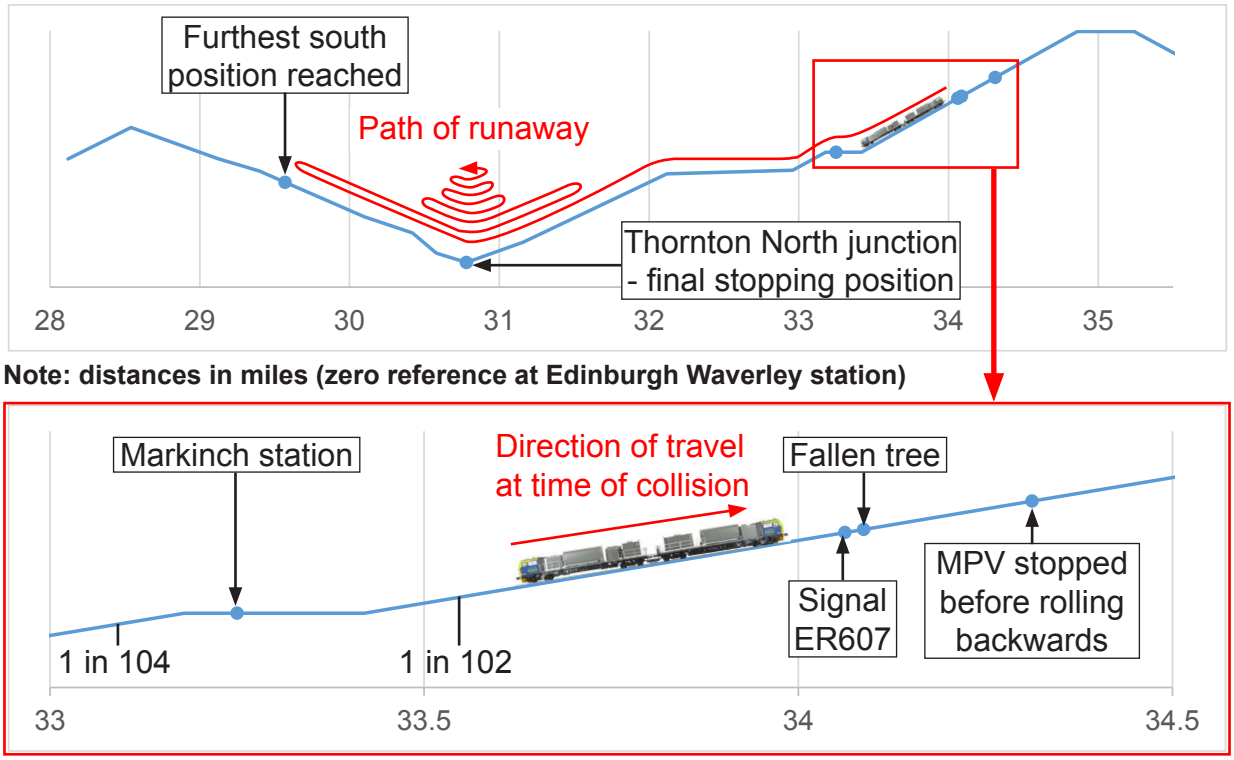

Figure 3: Diagram showing approximate locations of events (Not to scale)

11 The driver immediately pushed the *emergency brake plunger*, and both the driver and the rail head treatment operator dived to the floor under the control console. It is unlikely that the brakes had time to significantly reduce the train's speed before it hit the tree. As soon as the train came to a stop, it started to roll backwards, at which point the driver unsuccessfully tried to use the desk controls to stop the train, despite the emergency brake having already been applied.

12 The treatment operator then left the cab and hurried along the MPV's walkway to operate the emergency brake plunger in the other cab. However, this had no effect and he returned to what had been the leading cab at the time of the collision. While this was happening, the driver operated the emergency alarm button on the *GSM-R radio*, which made an emergency call to the signaller in Edinburgh. During this call, the driver stated that the train had hit a tree and that it had lost all braking and was rolling backwards out of control.

13 The signaller checked that there were no other trains in the path of the runaway and immediately took steps to prevent any northbound trains from passing Inverkeithing. The next train in the path of the runaway was northbound empty coaching stock that had previously formed the southbound Aberdeen sleeper, which was still south of the Forth Bridge. The signaller held this train at Dalmeny junction, which is 24 miles (39 km) away from Markinch.

14 Having contacted the signaller, and recognising that he was unable to stop the train as it gathered speed, the driver decided that he and the treatment operator needed to get off as soon as possible. He feared that the train could either collide with another train, or derail. The two crew left the cab and jumped from the train onto the side of the track, which was in complete darkness at the time. Both the driver and the treatment operator sustained minor injuries, including cuts, bruises and cracked ribs.

15 The RAIB has calculated that the train had been rolling backwards for about 100 seconds, over a distance of approximately 0.28 miles (450 metres), and had reached about 20 mph (32 km/h) when the crew jumped off. This is based on information from the *On-Train Data Recorder* (OTDR), and the crew's account of where they jumped.

16 The train crew checked that each of them was not seriously injured and walked a short distance to the nearest signal (signal ER607). The driver called the signaller from the *signal post telephone* and told him that they had jumped from the train and that both lines needed to be blocked. The signaller did this and made arrangements for an ambulance to meet them at Markinch station after checking that they were able to walk the mile or so there. The signaller subsequently called the driver to let him know that the train had changed direction and could come back to towards them, and that they would need to keep clear of the track. The train crew were met at Markinch station by an ambulance crew and taken to hospital.

17 The train ran south for a total of about 4.7 miles (7.5 km), reaching a maximum speed of 43 mph (69 km/h), before coming to a stop about 1.1 miles (1.8 km) along the 2.2 mile (3.5 km) long uphill gradient south of Thornton North junction. The train then ran forwards and backwards for a total of eight further movements before coming to a stop at the lowest point at Thornton North junction. The train ran backwards and forwards for a total of 39 minutes from its first stop after hitting the tree.

18 The accident caused disruption to services through Fife, and on the Fife circle line, until mid-morning, after the MPV was recovered to a siding and the tree was cut back. The MPV was subsequently moved to Slateford depot, in Edinburgh, for investigation and repair.

Key facts and analysis

Background

19 Figure 4 shows a simplified diagram of the *air brake system* on the MPV. It operates very similarly to that of a modern *two pipe freight wagon*. A main reservoir pipe and a brake pipe run the length of the MPV, with hose couplings in each between the two vehicles. The main reservoir pipe keeps the auxiliary reservoirs topped up from the main reservoir and compressor. The driver's brake control modulates the air pressure in the brake pipe. Each vehicle has a *brake distributor* that controls the air from its own auxiliary reservoir to apply the *brake cylinders* on that vehicle.

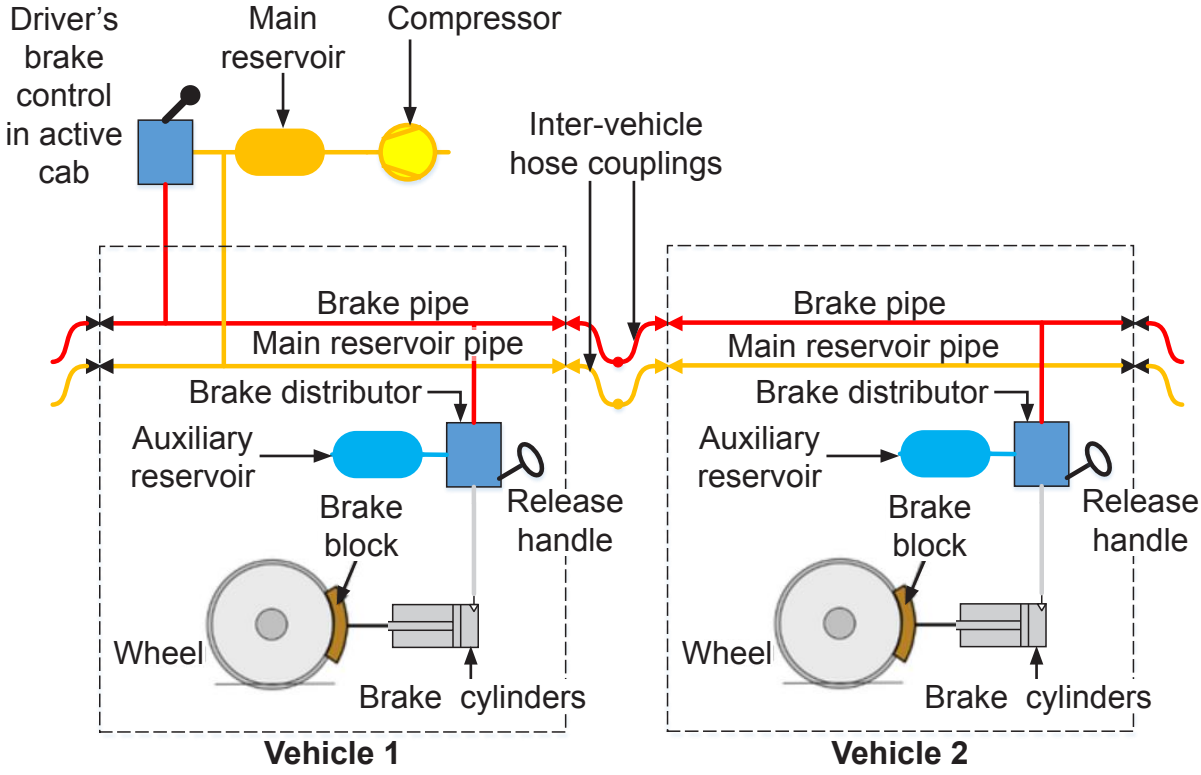

Figure 4: Simplified diagram of MPV braking system (direct brake omitted – see paragraph 22)

20 When the brakes are not applied, the brake pipe pressure is at its highest, and this pressure reduces as the driver requests more braking. In an emergency brake application, the brake pipe is vented to atmosphere, so that all the pressure is released.

21 The distributor senses the brake pipe pressure and modulates the air pressure applied to the brake cylinders in response. A reduction in the brake pipe pressure results in an increase in the pressure to the brake cylinders, and thus the amount of braking applied. The manual release handle, when pulled, rotates a spindle on the distributor, which releases a control pressure chamber in the distributor, thus venting the brake cylinder pressure, and releasing the brakes (figure 5). The control pressure chamber is re-pressurised from the brake pipe when the release handle is no longer operated, allowing braking to be re-established.

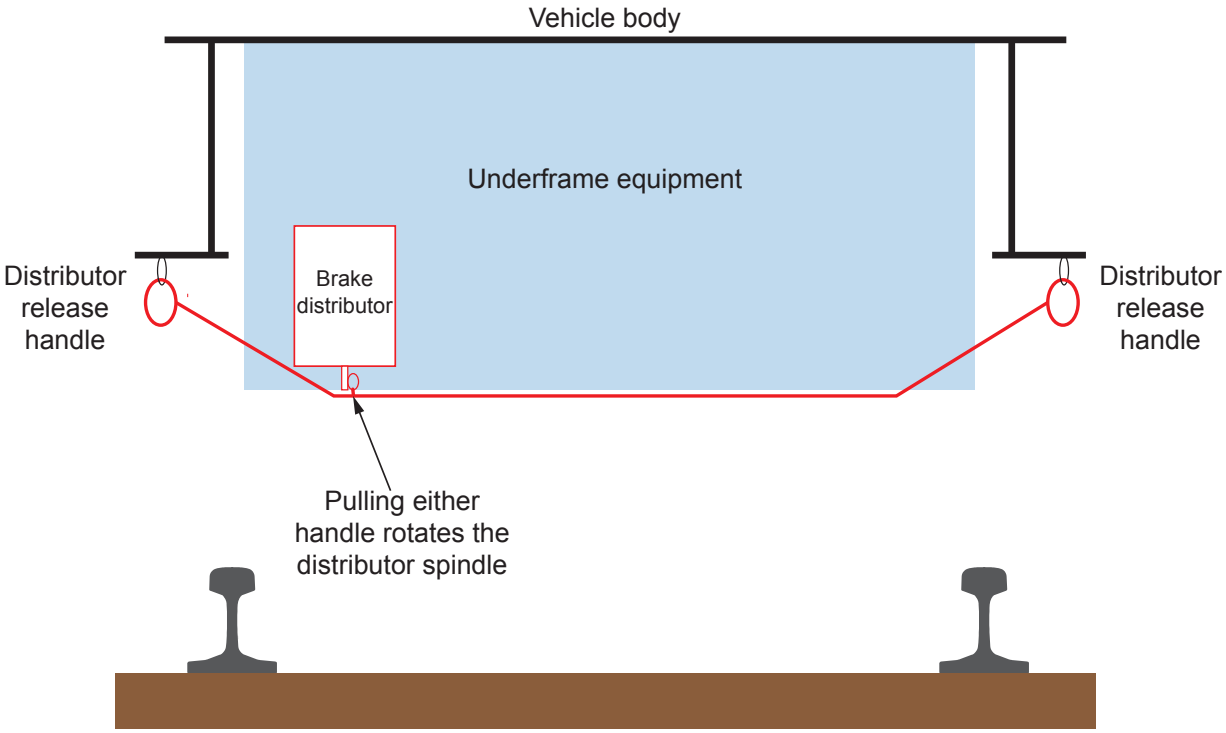

Figure 5: Diagram of brake distributor release mechanism

22 The MPV is also fitted with a direct brake that allows the driver to directly apply main reservoir pressure to the brake cylinders (not shown in figure 3). However, this cannot be used while control via the brake pipe is being used, and a change to this mode of operation can only be selected when the MPV is stationary. This mode was not being used at the time of the accident, and is discussed later (paragraph 40).

Identification of the immediate cause

23 **The train's brakes were released, and the driver was unable to reapply them, as a result of a collision with a tree that had fallen onto the line.**

Identification of causal factors

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

a. The brakes were released because the brake distributor release mechanisms were operated on both vehicles by the debris from the tree passing underneath the train(paragraph 29)

b. The driver was unable to reapply the brakes after the debris from the tree had caused all three brake system pipes to be separated between the vehicles (paragraph 33)

25 It is likely that the localised wind conditions caused the tree to fall onto the track. Local weather records from the weather station at Leuchars (15 miles/24 km north-east of the collision site) show that wind speeds reached 36 mph (57 km/h), gusting to 49 mph (76 km/h) in the hour before the collision. However, at 01:00 hrs, the recorded wind speed was much lower, at 21 mph (33 km/h).

26 Network Rail defines the actions required during extreme weather conditions in standard NR/L3/OCS/045/3.17 'National Control Instructions - Section 3.17 Weather Arrangements'. These instructions require speed restrictions to be imposed if high winds are forecast. A blanket restriction of 50mph (80 km/h) applies for all trains where gusts in excess of 60mph (97 km/h) are expected, or where gusts over 50 mph (80 km/h) are forecast to be sustained for at least 4 hours.

27 On the night of the accident, gusts did not exceed the 60 mph limit, and were only above the 50 mph limit for about an hour, so no speed restrictions would have been required. In addition, the train was only operating at approximately 43 mph (70 km/h) at the time of the collision, so a speed limit of 50 mph (80 km/h) would not have altered the circumstances of the collision.

28 The tree came from outside the Network Rail infrastructure boundary. The RAIB has previously investigated the risk posed by trees external to the railway boundary (paragraph 50), so this has not been examined further in this investigation.

Initial release of the brakes

29 **The brakes were released because the brake distributor release mechanisms were operated on both vehicles by the debris from the tree passing underneath the train.**

30 The OTDR data shows that the train brakes were applied when the driver operated the emergency brake plunger. However, RAIB analysis of the data shows that the train came to a stop approximately 400 metres after hitting the tree. This equates to an average deceleration rate of approximately 5 %g[1]. This is less than would be expected for an emergency brake application, but more than would be expected for an unbraked stop on the 1 in 102 uphill gradient.

31 The OTDR data also shows that the brake on the trailing vehicle was released approximately 20 seconds after the collision, following which the rate of deceleration was reduced to approximately that of an unbraked train. The reduced braking rate is consistent with the brake distributor release mechanism on the leading vehicle being operated at the time of the collision, resulting in only the rear vehicle brakes being operative in response to the emergency brake demand. The delayed loss of all braking is consistent with the brake distributor release on the trailing vehicle being operated about 20 seconds after the collision.

32 Examination of the front and rear vehicle distributor release mechanisms indicates that both had been distorted towards the rear of the train, as it was travelling at the time of the collision with the tree (figure 6). This is consistent with them having been hit by the tree debris. It is likely that the release spindle (figures 5 and 6) on each brake distributor was rotated briefly during the impact, causing the air pressure to be vented from the brake cylinders for each vehicle and the brakes to be released.

[1] Brake retardation rates are quoted in percentage of g (%g), where g is the rate of downwards acceleration experienced by an object due to gravity (9.81 ms^{-2}).

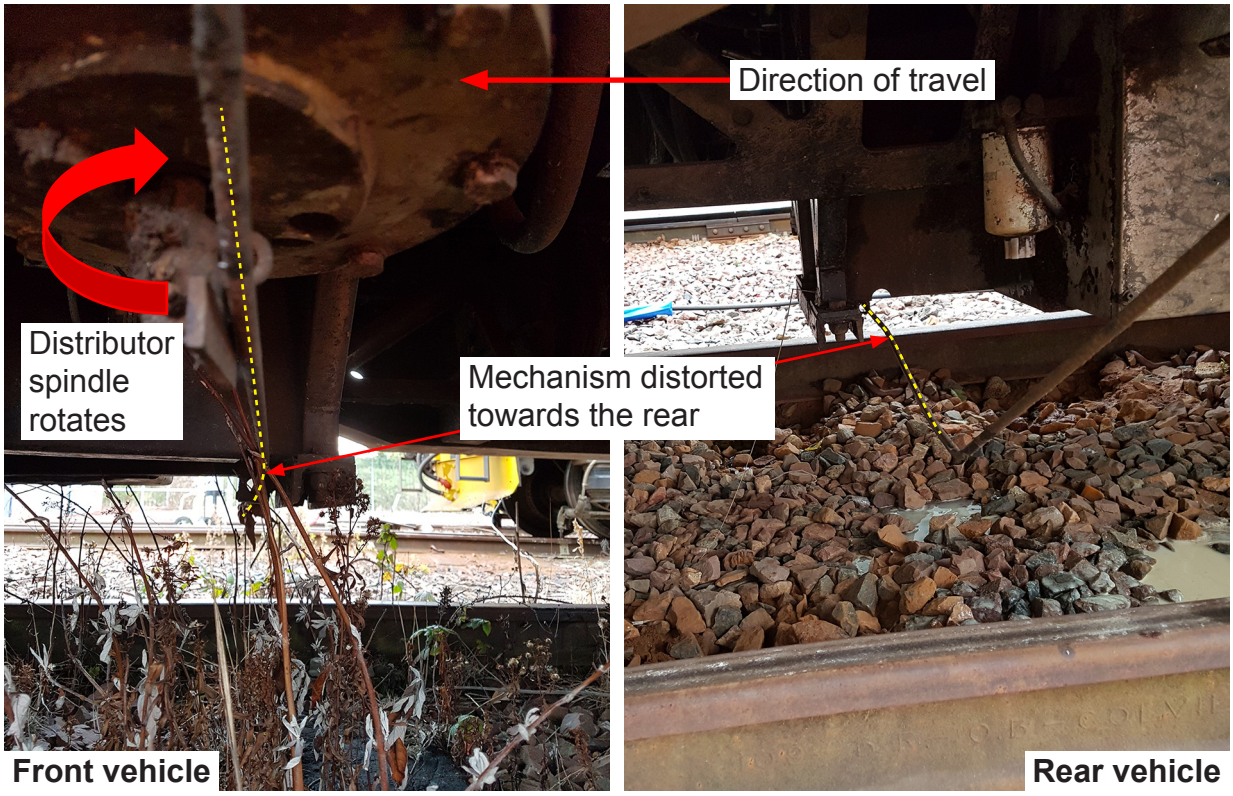

Figure 6: Distortion to brake distributor release mechanisms.

Inability to reapply the brakes

33 **The driver was unable to reapply the brakes after the debris from the tree had caused all three brake system pipes to be separated between the vehicles.**

34 The driver's application of the emergency brake released the air pressure in the brake pipe, causing the distributors to apply maximum pressure into the brake cylinders and therefore maximum brake demand. However, the tree debris operated the distributor release mechanisms (paragraph 32) and released the air pressure from the brake cylinders, thus releasing the brakes. Although the train crew recognised that the deceleration felt unusual, it was only after the train had stopped and started to roll backwards that they realised that the brakes were not working.

35 The driver initially tried several times to apply the brakes using the emergency brake plunger and the brake controller handle. However, these had no effect because the tree debris passing underneath the train had separated all three brake pipes connecting the vehicles (figure 7).

36 The main reservoir pipe and the brake pipe had separated at the couplings, but were undamaged. The design is such that the coupling is easily released when the two hoses are perpendicular to each other. It is likely that the tree debris lifted the hanging part of the hoses, rotating the coupling until the two hoses became perpendicular. The direct brake pipe remained coupled but was pulled out of the end of the rear vehicle (figure 8).

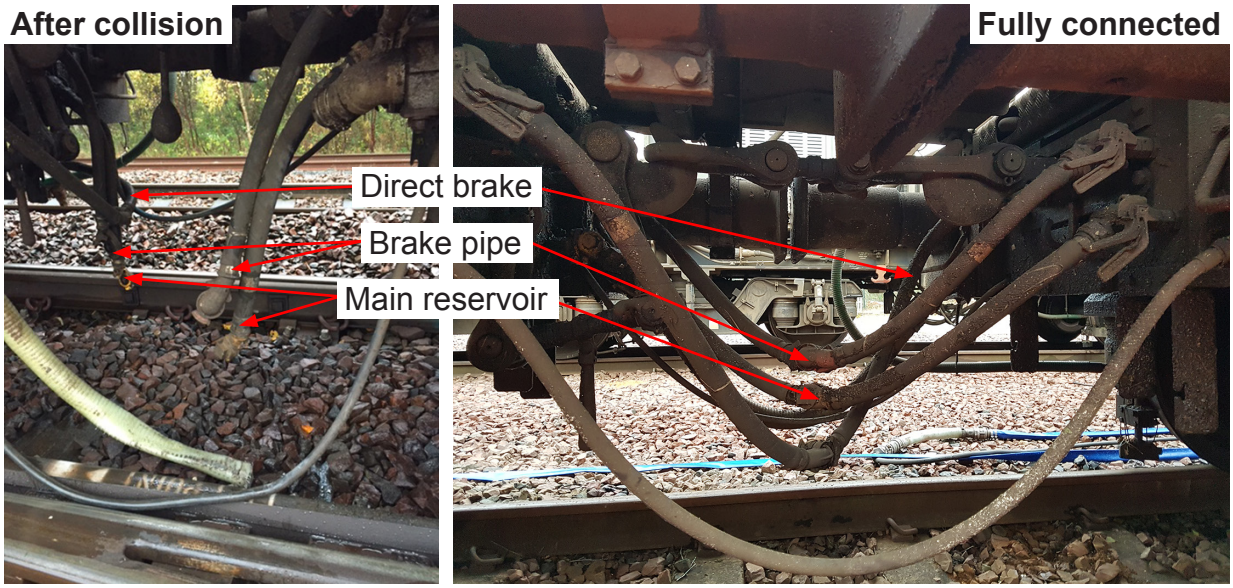

Figure 7: Comparison of normal configuration of brake pipes with that after collision (Post-collision photograph (left) courtesy of Network Rail)

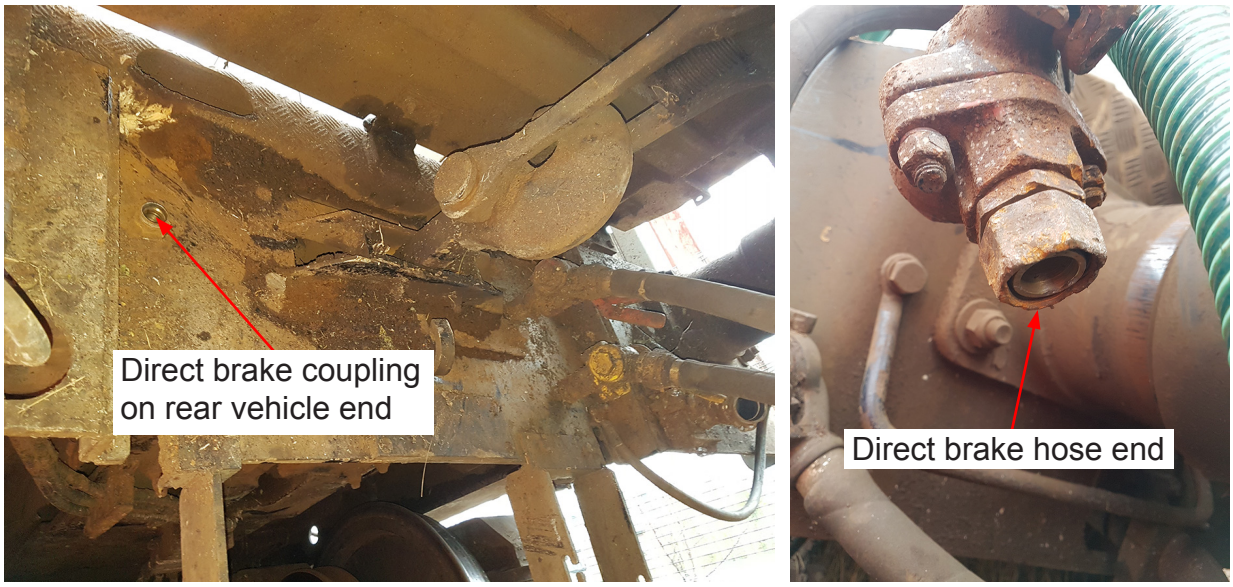

Figure 8: Direct brake pipe pulled out

37 The loss of the brake pipe in isolation would have resulted in an emergency brake application. However, as discussed above, because both of the brake distributor release mechanisms had been operated, no brake application was possible.

38 In normal operation, after the brake distributor release mechanism has been operated to release the vehicle brakes, the system requires pressure in the brake pipe to be able to re-establish the operation of the brakes. So, if the brake distributor release mechanisms are operated after the driver makes an emergency brake application, the brakes can be reapplied by releasing the emergency brake to regain brake pipe pressure, and then reapplying the brakes. However, this was not possible during the runaway, because the brake pipe had separated and so no pressure could be established in it.

39 The separation of the main reservoir pipe had little effect on the operation of the brakes, as non-return valves in both halves of the coupling caused that pipe to remain pressurised in both vehicles.

40 Separation of the direct brake pipe also had little effect on the operation of the brakes. The system is configured such that the direct brake can be used as an alternative to control via the brake pipe. That means that the direct brake cannot be used while the brake pipe is being used. Selection of which system is active is made using a control on the desk which can only be used when the train is stationary, and therefore was unavailable. Furthermore, the direct brake would not have been operative because the direct brake pipe had separated between the two vehicles.

41 The train is also fitted with a hand brake[2], which is hydraulically operated via a button on the control desk. However, this is fitted with an interlock to prevent its use while the train is moving; the hand brake is designed to prevent a stationary train from moving, not to stop a moving train. Therefore, the driver was unable to use this desk control after the train had started rolling backwards. There is a manual pump on the exterior of the cab that the driver can operate to apply the hand brake, using a handle that is kept in the cab. However, this is slow to operate and may not be fully able to stop a moving train, and the driver had to consider the possibility that this was also inoperative. Use of the hand brake while moving is not a documented or approved procedure, but this was the only brake that would still have been operable, albeit it was not designed to stop a moving train.

Underlying factors

Approval of the MPV

42 **The MPV was approved for operation on Network Rail infrastructure with the brake distributor release mechanism vulnerable to operation by obstructions on the track.**

43 The braking system on the MPV is very similar to that used on most modern freight wagons. However, because freight wagons normally operate in longer trains, inadvertent operation of two brake distributor release mechanisms would not result in a total loss of braking (the rest of the wagons would remain braked). As a result, the MPVs are more vulnerable to a common cause total loss of braking than similarly braked freight trains.

44 The MPVs first entered service in 1999 and were approved for operation on Railtrack infrastructure. Subsequent re-approval certificates were issued for Network Rail following changes to the maintenance regimes. The most recent of these was in 2012.

45 It is evident that the *approval process* did not recognise that external impacts could be the common cause of operation of the brake distributor release mechanisms on both vehicles and separation of the brake pipe.

[2] This is normally referred to as a parking brake, but is labelled as a hand brake on the MPV.

46 The RAIB has not investigated the details of the approval process in place at the time of approval of the MPVs, or its implementation, because that process is redundant having been replaced by alternative arrangements. In addition, a previous RAIB recommendation (paragraph 52) addresses the approvals process for new vehicles.

Previous occurrences of a similar character

47 The RAIB is aware of a previous incident involving the runaway of this type of MPV after hitting a tree. This occurred at Kingswood, Surrey, on 3 December 2006. The RAIB did not investigate this incident, but it was investigated by Network Rail. In a similar manner to this runaway, the tree operated the distributor release mechanisms. However, in that incident the runaway occurred after the driver had disembarked the train to examine the damage without applying the hand brake. He was able to reboard the train to apply the manual hand brake to stop the slow speed runaway. Network Rail's investigation recommended consideration of modifications to the braking system to protect the distributor mechanisms from operation by foreign bodies. However no changes were made to the design because the incident was seen to be very low probability and the risk was considered to be mitigated by amending the operating instructions to highlight the importance of applying the hand brake when stationary.

48 The RAIB has investigated one previous incident involving the runaway of this type of MPV. This occurred at Bury, in Greater Manchester, on 22 March 2016. The RAIB published a safety digest (Safety digest 03/2016). Although the mechanism by which the brakes were released was similar, in that case it was initiated by an operator action rather than by an obstruction on the track. As a result, none of the learning points identified were directly relevant to this accident.

Previous RAIB recommendations relevant to this investigation

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

Collision between a train and a tree at Lavington, Wiltshire, on 10 July 2010, Recommendations 1 and 2

50 The recommendations (in RAIB report 08/2011) read as follows:

Recommendation 1

Network Rail should review and enhance its processes for gathering intelligence about neighbouring land where there may be a higher risk of tree fall affecting the railway. This might be achieved by modifying the remit for the national tree survey, before this is repeated, and/or by providing suitable guidance to local off-track teams.

Recommendation 2

Network Rail should develop and implement a plan, or adapt and enhance existing plans, to communicate with those of its neighbours whose land is considered to present a high risk of tree fall affecting the railway. The objective should be to inform them about their responsibilities and the threat their trees may present to the railway.

51 Network Rail has reported that it is has expanded the guidance in its standards for vegetation management and briefed this to relevant staff. The Office of Rail and Road (ORR) has reported that it considers that both recommendations have been implemented by Network Rail.

Runaway and collision at Bryn station, Wigan, on 27 November 2014, Recommendation 4

52 The recommendation (in RAIB report 09/2016) reads as follows:

Recommendation 4

Taking into account any changes that it has recently introduced, Network Rail should review its processes for product acceptance of new and modified plant, and how they are being implemented, and make any necessary enhancements so that they consistently confirm that:

- *associated risks have been robustly assessed using a structured and systematic process, such as one that follows the risk management process of the common safety method on risk evaluation and assessment (or at least its essential elements);*
- *the safety requirements necessary to mitigate risks to an acceptable level have been determined, this includes those in adopted technical standards;*
- *there is evidence that all identified safety requirements have been complied with and that safety measures are in place; and*
- *that supporting conclusions and justifications have been suitably recorded.*

53 Network Rail has reported that it is working to embed improved risk assessment processes in the relevant rail industry standards for on-track machines. The Office of Rail and Road (ORR) has reported that it is monitoring progress with implementation of the recommendation.

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

54 Network Rail issued a *Rail Notice* (NIR 3350/221) on 20 October 2017. This outlined the circumstances of the runaway and reminded Network Rail's operations managers of the need to make specific consideration of the risk of collision with obstructions during adverse weather conditions. The notice highlighted that this is a particular risk where a train is the first to operate over a route for some time. It recommended that where this risk is identified, consideration should be given to requiring trains to run at speeds where they can stop short of any obstructions.

55 Network Rail subsequently issued a *National Incident Report* (NIR 3403) on 10 November 2017. This gave details of the mechanism by which the brakes on the train were disabled and highlighted that this mechanism was a particular hazard on short train formations. It also indicated that this mechanism could affect other types of On-Track Machines (OTM). The notice stated that Network Rail was considering options to protect the brake distributor release mechanism from impacts with objects or debris on the track.

56 Network Rail has reported to the RAIB that it is reviewing the design of the brake distributor release mechanism arrangements on the MPVs in light of this accident, to determine if there are effective measures that could be taken that would address the risk of runaway without introducing other risks. Network Rail is also reconsidering the suitability of such a design for similar, future short formation trains.

Recommendations

57 The following recommendations are made[3]:

1 *The intent of this recommendation is to prevent runaway of MPVs following collisions with objects or debris on the track.*

Network Rail should identify and implement suitable measures to mitigate the risk of a runaway initiated by multiple unintended operations of the brake distributor release mechanisms on its Windhoff Multi-Purpose Vehicles by objects and debris that might reasonably be encountered on the track during operation.

This recommendation may also apply to other infrastructure managers and railway undertakings who own and/or operate similar short formation trains.

2 *The intent of this recommendation is to prevent runaway of other short formation trains following collisions with objects or debris on the track.*

Network Rail should assess the risk of runaway on other short formation trains that operate on its infrastructure, such as On-Track Machines, as a result of a total loss of the air braking systems due to impact from objects and debris that might reasonably be encountered on the track. It should implement any necessary measures to mitigate the risk of runaway.

This recommendation may also apply to other infrastructure managers and railway undertakings who own and/or operate similar short formation trains.

[3] 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.

Appendices

Appendix A - Glossary of abbreviations and acronyms

GSM-R	Global System for Mobile Communications - Railway
MPV	Multi-Purpose Vehicle
NIR	National Incident Report
OTDR	On-Train Data Recorder
OTM	On-Track Machine
RAIB	Rail Accident Investigation Branch
RHTT	Rail Head Treatment Train

Appendix B - Glossary of terms

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

Adhesion modifier	A mixture of sand and/or other particles in a fluid medium which is used to improve friction on rails.
Air brake system	A train braking system operated by air pressure. The pressure within the air brake system can be controlled by the driver or by on-train systems.
Approval process	Process by which vehicles are assessed as compliant with relevant standards and certified as suitable for safe use on Network Rail infrastructure.
Brake cylinder	A cylinder into which pressurised air is admitted or vented by the action of the distributor. The admission of air extends a spring loaded piston producing a mechanical braking force proportional to the air pressure applied.
Brake distributor	The pneumatic component on each vehicle of a train (having a continuous and automatic air brake) that responds to changes in the brake pipe pressure and supplies compressed air to the brake cylinders.*
Emergency brake plunger	A plunger within the driver's cab which vents the brake pipe in order to initiate an emergency brake application.
GSM-R radio	A radio in the cab of a train based on a digital railway communication system that allows communication between drivers and signallers.
Multi-purpose vehicle	A self-propelled diesel powered train consisting of one or more flat-bed rail vehicles with a driving cab at the outer end(s).*
National Incident Report	A report following an incident that is circulated to the railway industry giving technical or operating advice.
On-train data recorder	A data recorder collecting information about the performance of the train, including speed, brake control positions, etc.*
Rail head treatment train	A train designed to clean the rail head by water jetting, and to apply adhesion modifying treatment.
Rail Notice	A report that alerts the rail industry to the circumstances of an operational incident.
Signal post telephone	A telephone located on or near a signal that allows a driver or other member of staff to communicate only with the controlling signal box.*
Two pipe freight wagon	A freight wagon fitted with an air brake system that utilises both a main reservoir pipe and a brake pipe.

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

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