RAIB
Rail Accident Investigation Branch

Rail Accident Report

Runaway of two wagons from Camden Road Tunnel
19 July 2007

Department for Transport

Report 12/2008
May 2008

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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Introduction

1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.

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

3 Access was freely given by Network Rail and English Welsh & Scottish Railway (EWS) to their staff, data and records in connection with the investigation.

4 Appendices at the rear of this report contain the following glossaries:

- acronyms and abbreviations are explained in Appendix A; and
- technical terms (shown in *italics* the first time they appear in the report) are explained in Appendix B.

Summary of the report

Key facts about the incident

5 When EWS train 7M59, the 20:10 hrs from Angerstein Wharf to London St Pancras Churchyard Sidings, started from signal WH204 at the south end of Camden Road Tunnel, the *screw coupling* broke between the second and third wagons from the back of the train.

6 The driver examined the rear of the front portion of the train and concluded that while the train was stopped at signal WH204, vandals had opened the *brake pipe cock* and *main reservoir cock* and had removed the *tail lamp*. He did not realise that the train had divided and did not see the two detached wagons which were in the tunnel.

7 After the front portion had worked into Churchyard Sidings, the two detached wagons ran away southwards for 200 to 300 metres, reversed direction and came to rest about 140 metres from where the runaway started.

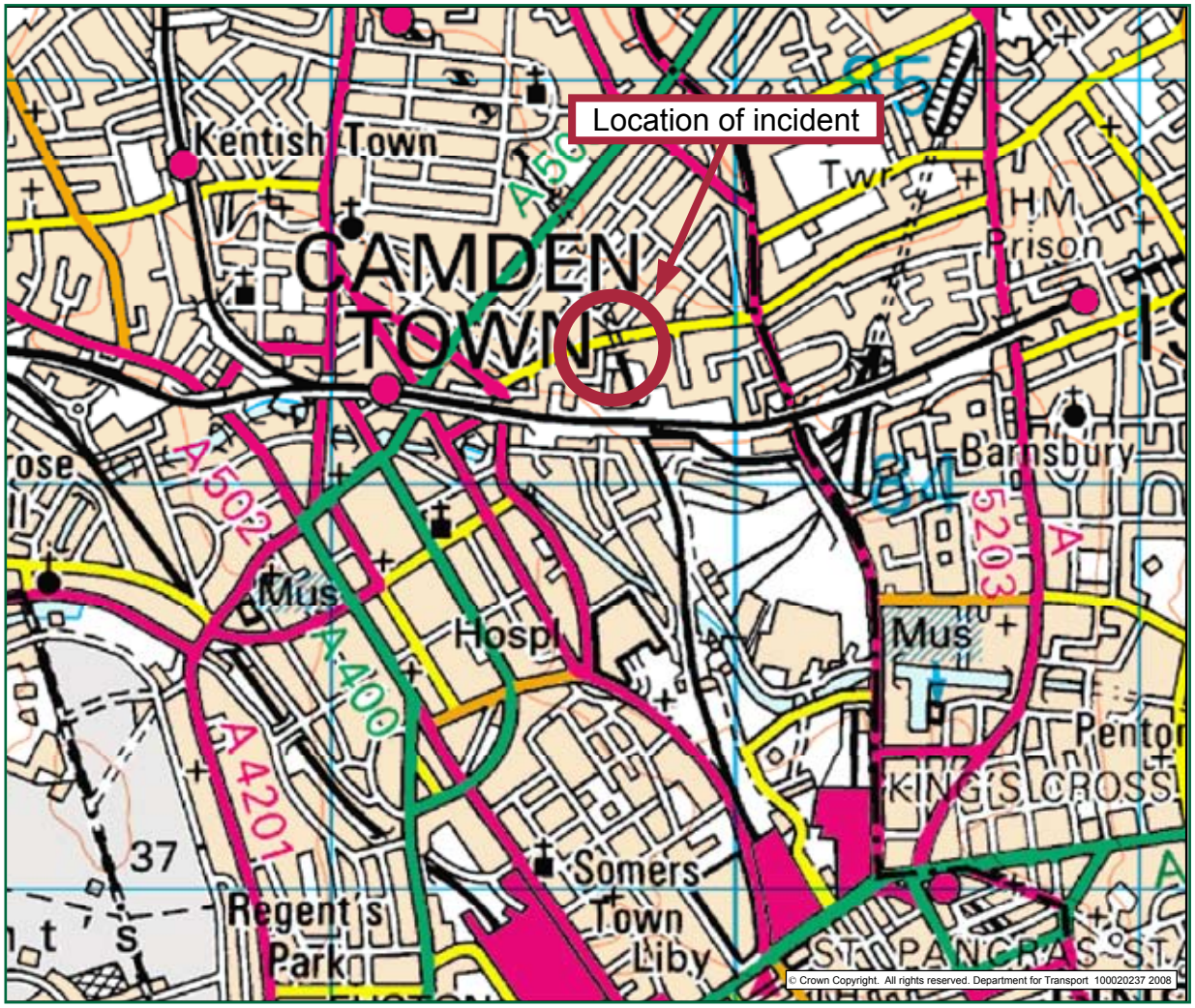

Figure 1: Extract from Ordnance Survey map showing location of incident

Immediate cause, causal and contributory factors, underlying causes

Immediate cause

8 The immediate cause of the incident was the division of the train between wagons MAR17704 and MAR17712 as the train started away on a down gradient after standing at signal WH204. This was followed by the runaway of the two detached wagons because the brakes leaked off wagon MAR17712 and wagon MAR17725 had incorrectly set *slack adjuster*s.

Causal factors

9 Causal factors were:

a. the driver did not follow the rule book requirements concerning divided trains and assumed that vandals were responsible for the missing tail lamp and open *brake pipe* and main reservoir cocks;

b. the condition of the brakes fitted to the two runaway wagons was such that the brake force was reduced and the brakes were able to leak off before the situation could be discovered and the wagons secured; and

c. the screw coupling fitted to MAR17712 failed when train 7M59 started away from signal WH204.

Contributory factors

10 Contributory factors were:

a. the driver did not take the *TOPS list* with him when he went to examine the train following the automatic brake application on starting from signal WH204;

b. the driver did not see the detached wagons standing in the darkness about 24 metres apart from the front portion of train 7M59;

c. the signaller did not challenge the driver's explanation of the cause of the brake application on starting from signal WH204 and did not consider the possibility train 7M59 had divided;

d. the competence management system applied to the signaller did not include the opportunity to be familiar with degraded working (such as by use of a simulator);

e. EWS Maintenance Control did not prompt the driver to consider the possibility that the train had divided; and

f. the coupling material in the area where it failed was outside specification and harder than it should have been.

Possible contributory factors

11 The following factors were considered to be possibly contributory:

a. the driver's thinking was conditioned by a previous signal passed at danger (SPAD) incident which occurred after the integrity of the braking system had been compromised;

b. the driver's thinking was influenced by the amount of graffiti in the area of Camden Road Tunnel indicating frequent trespass of individuals on to the railway;

c. deficient maintenance processes at the last *vehicle inspection and brake test* (VIBT) carried out on the two runaway wagons; and

d. the JHA/HLA wagons were marshalled at the rear of the train rather than the front.

Observations

12 The following observations are made:

a. EWS do not analyse coupling failures by type of coupling making it difficult to monitor trends in the failures of specific coupling types.

b. The number of EWS train divisions has gradually reduced over the last ten years, the main reason probably being the reduction in the size of the HAA coal wagon fleet. It is too early to tell whether the significant reduction in the number of train divisions in 2007/08 is part of the longer term trend.

c. EWS could not produce all the wagon maintenance records requested. The RAIB also found that this was the case during its investigation of the derailment of a freight train at King Edward Bridge, Newcastle upon Tyne, on 10 May 2007 (report 02/2008 - www.raib.gov.uk).

Severity of consequences

13 No one was injured as a result of the incident and there was no damage to either rolling stock or infrastructure.

Recommendations

14 Recommendations can be found in paragraph 111. They relate to the following areas:

- drivers' actions following a train division;
- the maintenance of HLA/JHA and HGA wagons;
- reducing the number of train divisions that occur; and
- the competence management system applied to signallers.

The Incident

Summary of the incident

15 At 22:30 hrs on 19 July 2007, EWS freight train 7M59, the 20:10 hrs from Angerstein Wharf to London St Pancras Churchyard Sidings, stopped at WH204 signal, south of Camden Road Tunnel, awaiting *acceptance* to Churchyard Sidings. When the signal cleared and the train started off, the screw coupling between the second and third wagons from the back of the train broke. The parting of the brake pipe caused a full brake application to occur and both portions of the train were brought to a halt some 24 metres apart.

16 The driver examined the rear of the front portion and concluded that while the train had been stopped at signal WH204 for 13 minutes, vandals had opened the brake pipe cock and the main reservoir cock and had removed the tail lamp. He did not see the other two wagons in the darkness of the tunnel, and it did not occur to him that the train had divided.

17 The driver therefore closed the brake pipe and main reservoir cocks and fitted another tail lamp. On clearance of signal WH204, the front portion of train 7M59 moved forward to Churchyard Sidings.

18 At around 23:50 hrs, due to a combination of air leaking out of the brake cylinders of one wagon and incorrectly set slack adjusters on the other, the two detached wagons, loaded with stone, ran away southwards down the gradient out of Camden Road Tunnel. After travelling for 200 to 300 metres, the wagons changed direction due to a local reversal of the gradient, eventually coming to rest about 140 metres from where the runaway started. The key features of the incident location are shown in Figure 2.

19 No one was injured as a result of the incident, and there was no damage to either rolling stock or infrastructure. The incident had the potential for a more severe outcome.

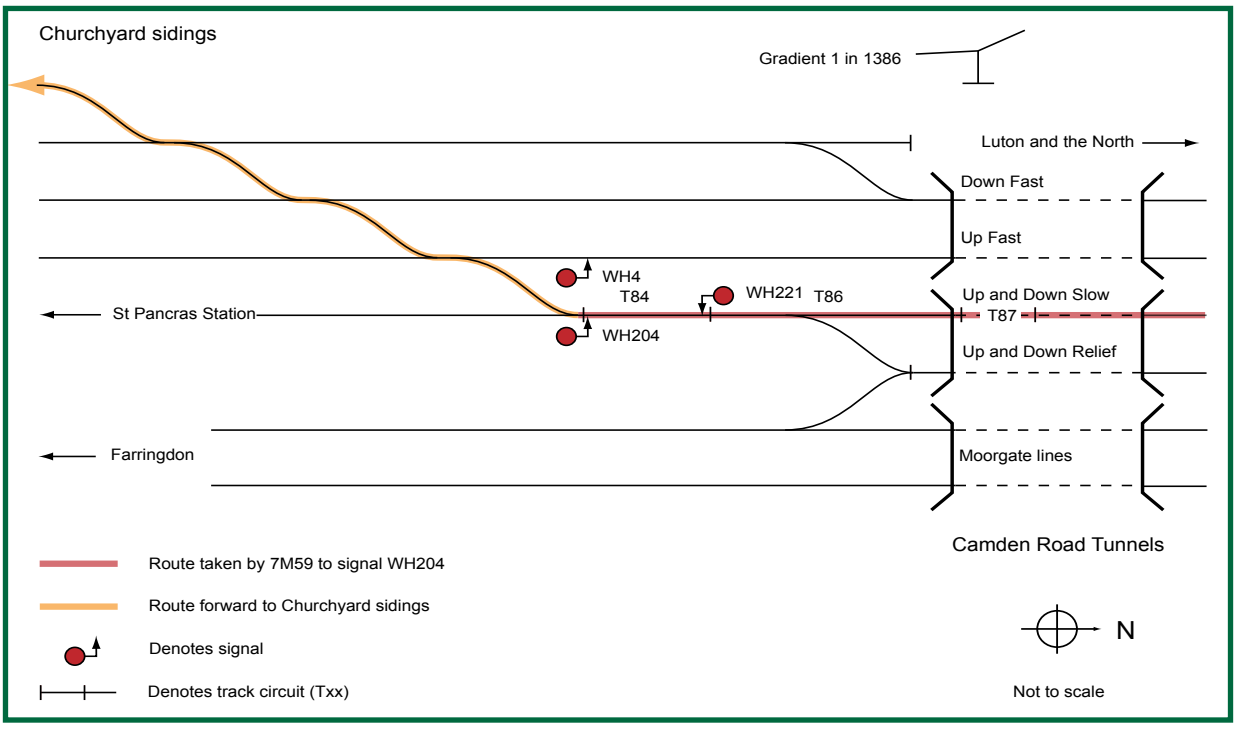

Figure 2: Key features of the incident location

The parties involved

20 Network Rail is the owner of the infrastructure where the incident occurred, and the employer of the signaller based at West Hampstead power signal box.

21 EWS was the owner, maintainer and operator of train 7M59, including the rear two wagons that ran away, and the employer of the driver.

Location

22 Figure 3 shows the location of the incident. Camden Road Tunnel is on the main railway route between London and the East Midlands and South Yorkshire. The southern portal is 79 chains (1.59 km) from London St Pancras International station and the tunnel is 308 yds (282 metres) long.

23 The line through Camden Road Tunnel is on a generally falling gradient of 1 in 1386 to the south.

24 The area around Camden Road Tunnel is defaced by graffiti on the retaining walls, equipment cases etc (see Figure 11).

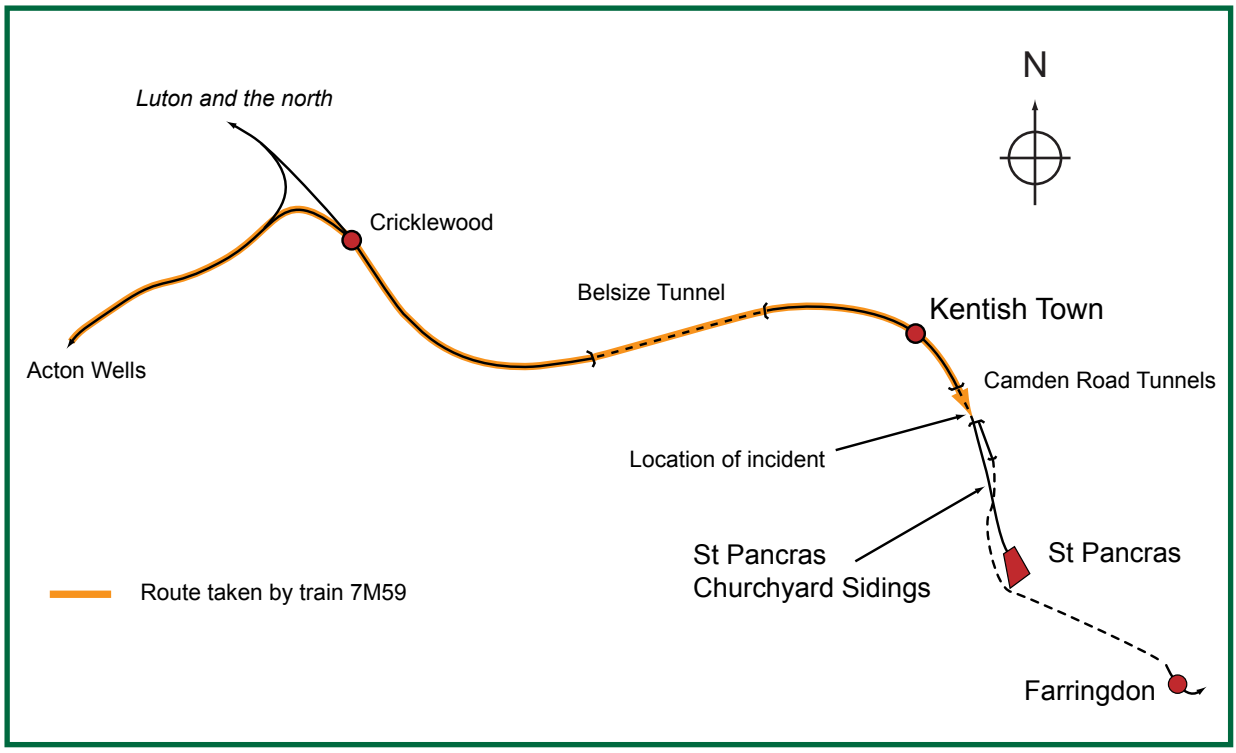

Figure 3: Location of incident

The train and the signalling

25 Train 7M59 comprised locomotive 66238 and 28 wagons loaded with stone for the construction industry. The leading 21 wagons were four wheeled wagons of *TOPS code* HGA, whereas the final seven wagons, including the two that ran away, were bogie wagons of TOPS code JHA and HLA (those of TOPS code JHA were being reclassified as HLA and renumbered). The wagons were coupled together by a mixture of screw couplings and *instanter couplings*. The route taken by train 7M59 is shown in Figure 4.

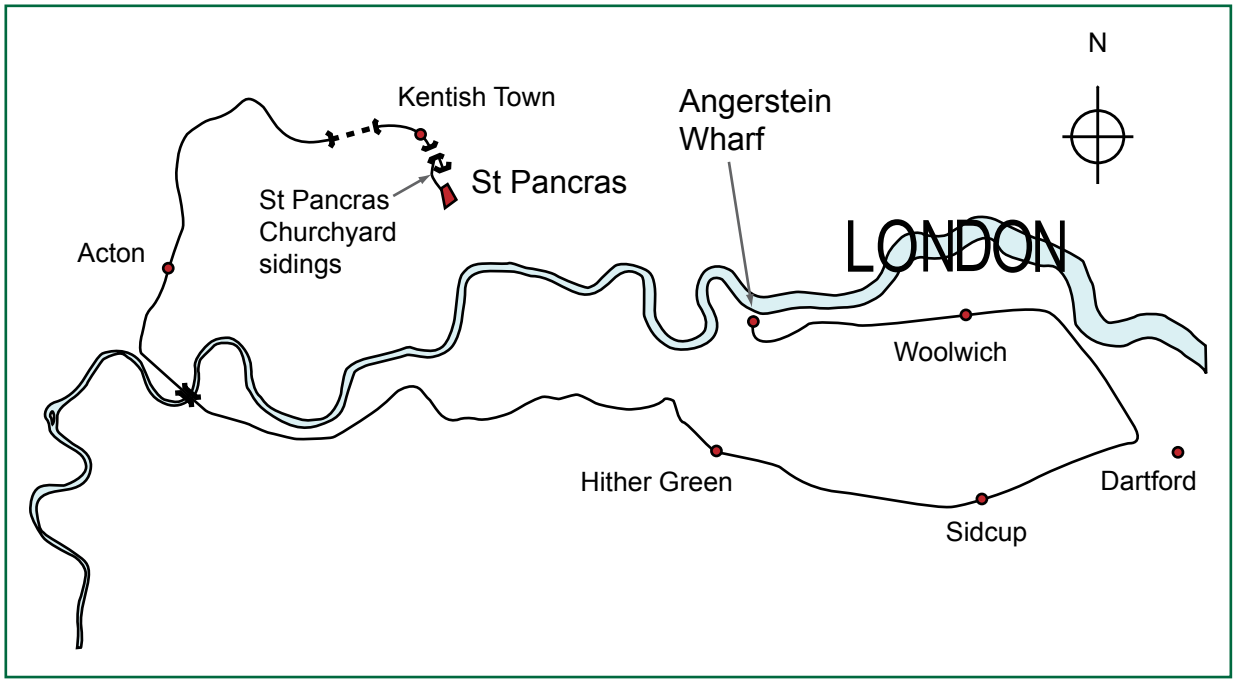

Figure 4: Route taken by train 7M59

26 The total train weight excluding the locomotive was 1680 tonnes and the complete train length was 305 metres. The rear two wagons that ran away, JHA MAR17725 (rearmost) and JHA MAR17712, were each of nominal 25 tonnes *tare weight*, 102 tonnes *gross laden weight.* Figure 5 is a picture of the same type of wagon.

Figure 5: HLA wagon of the type involved in the incident (by courtesy of ukrailrollingstock.fotopic.net)

27 The signalling is controlled from a *WestCad* VDU workstation in the power signal box at West Hampstead and consists of *multiple-aspect colour light signals,* with train detection in the area of Camden Road Tunnel being provided by *track circuits.* Figure 6 shows the signaller's VDU workstation and Figure 7 shows the area of Camden Road Tunnel displayed on the VDU screen.

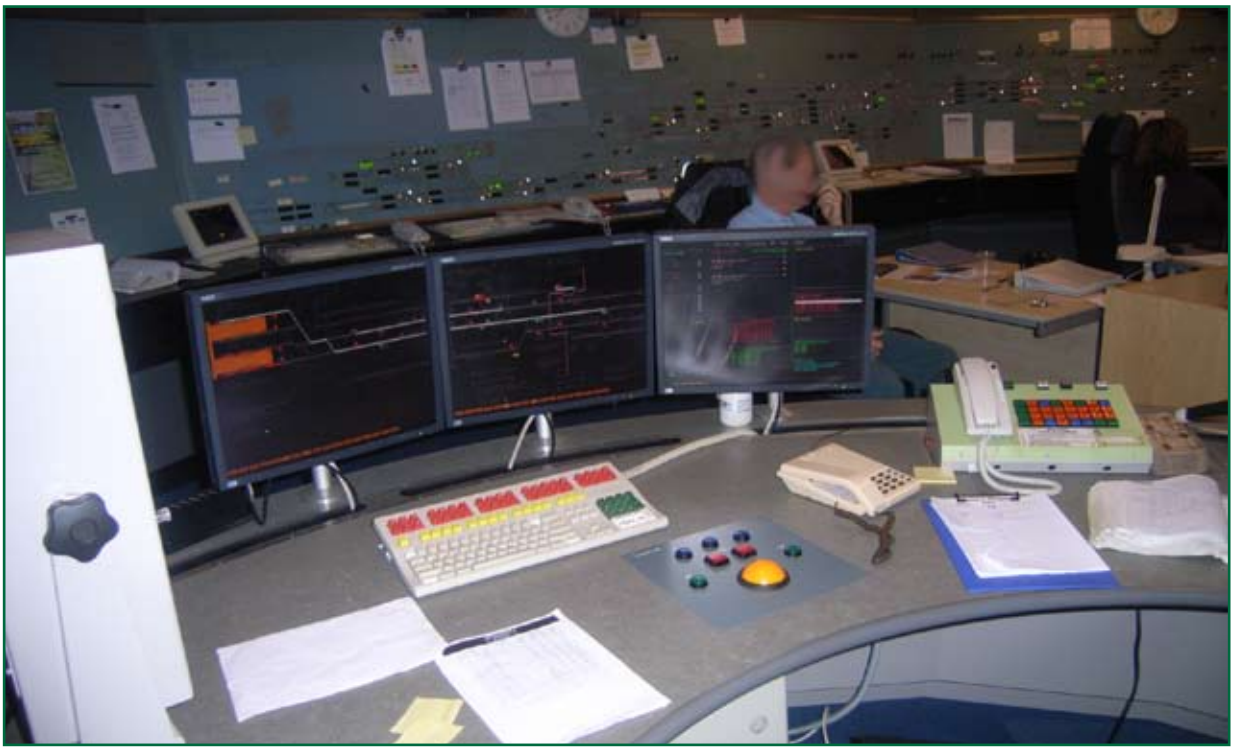

Figure 6: Signaller's workstation at the WestCad terminal at West Hampstead

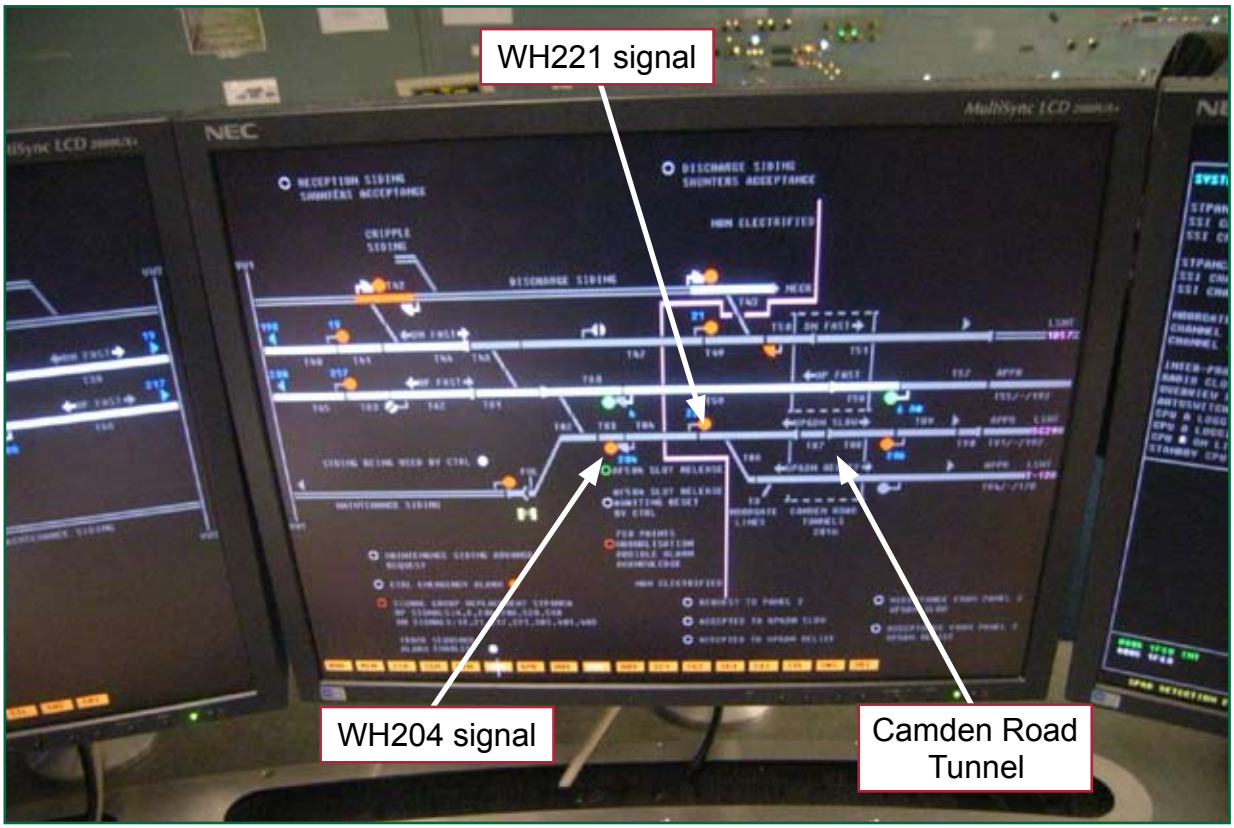

Figure 7: Area of Camden Road Tunnel displayed on the VDU at the signaller's workstation

Events preceding the incident

28 Train 7M59 departed from Angerstein Wharf at 19:50 hrs, 20 minutes early. The operational pre-departure check, consisting of a physical examination of the train, did not require a specific check to detect any air leaks in the brake system (Railway Group Standard (RGS) GO/RM3056, 'Working Manual for Rail Staff Freight Operations').

29 The driver from Hither Green onwards (see Figure 4) booked on duty at Hither Green at 20:46 hrs. He reported that he had not worked the day or night before the incident, had slept well, and was therefore well-rested. The train departed from Hither Green at 21:07 hrs and the journey to signal WH204, just south of Camden Road Tunnel, was uneventful. From 22:30 hrs the train was held there awaiting acceptance to Churchyard Sidings. The driver stopped the train using the *service brake* and then held it with the *straight air brake,* having released the service brake. This was to enable a quicker release of the brakes to occur when the signal cleared.

30 At 22:43 hrs, the signaller at West Hampstead cleared signal WH204 and the driver applied power to the locomotive. After the locomotive had moved about 8 metres, taking up the slack in the couplings, the coupling broke between the second and third wagons from the rear of the train causing an *automatic brake application* to occur when the *brake pipe* was pulled apart. This caused the train to be brought to a halt with the locomotive having moved forward 24 metres.

31 The driver tried unsuccessfully to recharge the brake pipe and then contacted the West Hampstead signaller by mobile telephone to explain that he could not release the brakes and therefore could not move the train. Subsequently, he contacted maintenance control in EWS for advice. The advice given included closing the brake pipe cocks between the locomotive and its train to determine whether the fault was with the locomotive or the train. Finding that there was no problem with the locomotive, the driver decided to examine his train, but he did not take the TOPS list with him, which listed the wagons that made up the train. He therefore had no means to hand to confirm the consist of the train was correct.

32 At 23:19 hrs, the driver contacted the signaller (but not EWS maintenance control) and advised that he had found the brake pipe and main reservoir cocks on the end vehicle open and the tail lamp to be missing (the main purpose of the tail lamp being to show that a train is complete). He concluded that this had been done by vandals while the train was stopped at signal WH204 between 22:30 hrs and 22:43 hrs (paragraphs 29 and 30), and the signaller did not challenge this. The driver closed the cocks and fitted a spare tail lamp that had been carried on the locomotive. At 23:39 hrs, the front portion of the train moved off to Churchyard Sidings, about 800 metres away.

33 At 23:41 hrs, the signaller noticed that track circuit 87 (see Figure 2), covering the southern end of Camden Road Tunnel, was still showing occupied. He contacted the driver and asked him to check his train was complete. The driver checked the train with the assistance of the shunter in Churchyard Sidings and found that the rear two wagons were missing.

Events during the incident

34 Between 23:50 hrs and 00:05 hrs, the signaller saw track circuit 86 show occupied closely followed by track circuit 84 (Figure 2). This was followed by the S*PAD alarm* associated with signal WH221 sounding. These events indicated that railway vehicles were moving out of control and after having run towards St Pancras International station, stopped and reversed direction at a local change in gradient. From calculations, the RAIB believes that the speed of the runaway vehicles did not exceed walking pace.

35 At about 00:10 hrs, the shunter from Churchyard Sidings and the driver found the south end of the rear two wagons of train 7M59 stationary about 16 metres north of WH221 signal on the up and down slow line. They applied the handbrakes to these vehicles to prevent any further movement. The driver also applied three *detonators* to the rail on either side of the wagons to provide protection, although he was not required by the rule book (RGS GE/RT8000) to do so, and the signalling system protected the wagons from the risk of collision with other trains.

Events following the incident

36 With the permission of the signaller, the locomotive from train 7M59 was used to retrieve the two wagons and haul them to Churchyard Sidings.

37 The shunter and the driver found that the screw coupling at the south end of MAR17712 had broken with only part of it still attached to the wagon's *drawhook* (see Figure 8).

Figure 8: Remains of screw coupling, south end of MAR17712 (by courtesy of Network Rail)

38 Network Rail staff found the other portion of the broken coupling inside Camden Road Tunnel, 40 metres from the south portal (see Figure 9). The portion of broken coupling was retrieved for metallurgical examination to determine the cause of failure before trains re-commenced running.

39 The driver was subjected to the standard railway industry tests for drugs and alcohol and the results were negative.

Figure 9: Other portion of coupler from south end of MAR17712 in the location where it was found (by courtesy of Network Rail)

40 The complete train was brake tested at Acton on 21 July 2007. The results are discussed in paragraphs 55 to 62.

41 The incident was not notified to the RAIB, contrary to Regulation 4 of the Railways (Accident Investigation and Reporting) Regulations 2005, which states that an incident which in slightly different circumstances could lead to a serious accident should be immediately reported to the RAIB. The RAIB identified the incident from the Network Rail daily incident report the following day and commenced an investigation.

The Investigation

Investigation process

42 As part of the investigation, the RAIB:

- examined the incident location at around the same time of day as when the incident occurred;
- conducted witness interviews;
- examined the *On Train Monitoring Recorder* (OTMR) from locomotive 66238;
- examined EWS training and competence management information;
- reviewed a metallurgical examination report into the fractured drawhook;
- examined the results of the brake testing carried out by EWS following the incident; and
- examined EWS's processes to minimise the incidence of coupling failures.

Key Facts

Examination of the incident location

43 The distance between WH204 signal and the south portal of Camden Road Tunnel is 249 metres.

44 Signal WH204 is mounted on a gantry alongside signal WH4. The *signal post telephone* (SPT) for signal WH4 is in a *limited clearance* zone and an alternative means of contacting the signaller is displayed on a plate to the right of the signal head (see Figure 10).

45 The SPT for signal WH204 signal is located 20 metres before signal WH204. This is the normal stopping point for a train when the signal is at danger. Figure 10 shows signals WH204 and WH4 from the SPT for signal WH204.

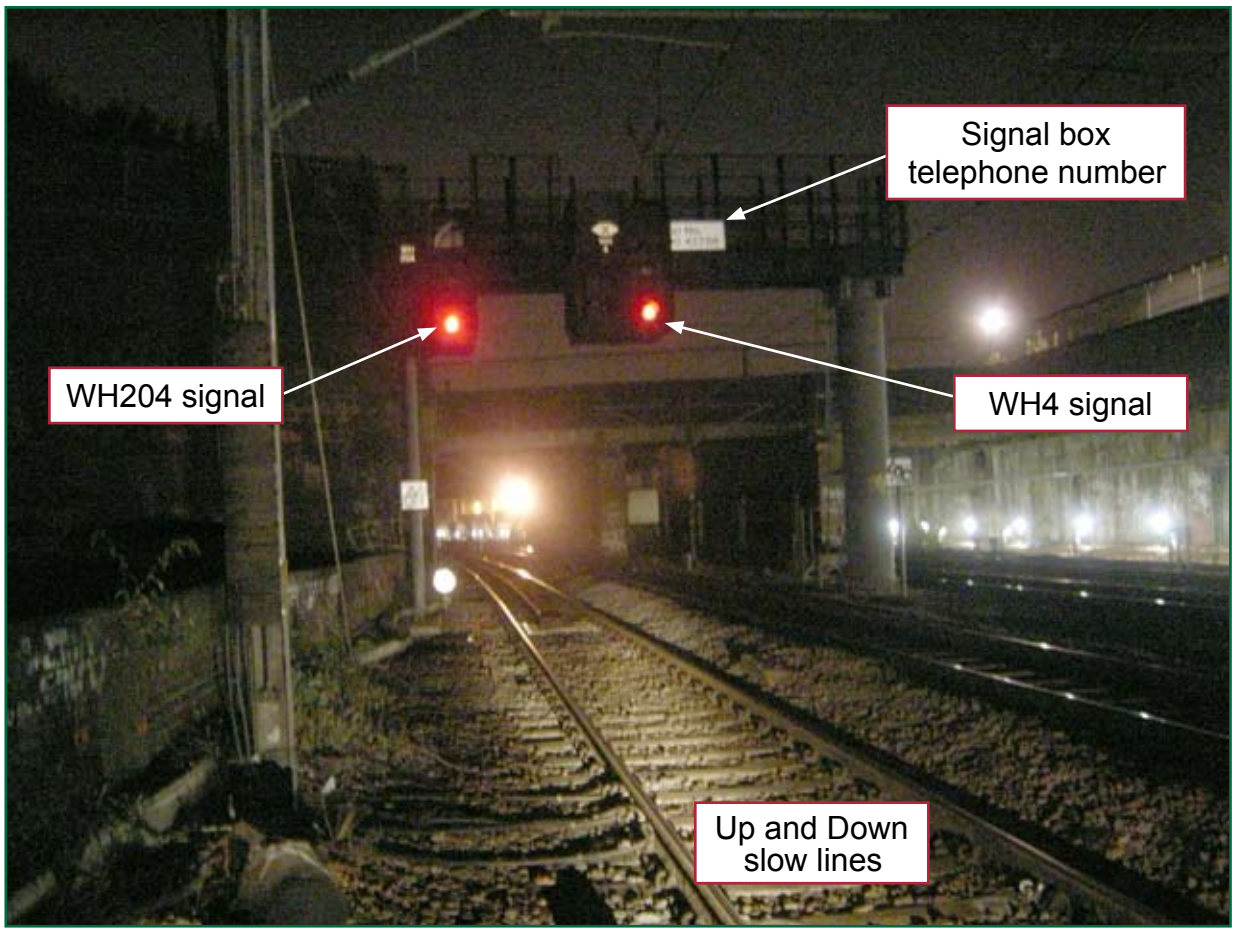

Figure 10: Signal WH204 and signal WH4

46 Camden Road Tunnel is straight, and northbound signals WH223 and WH429 beyond the north portal can be clearly seen from outside the south portal. Figure 11 shows the view through the tunnel looking north.

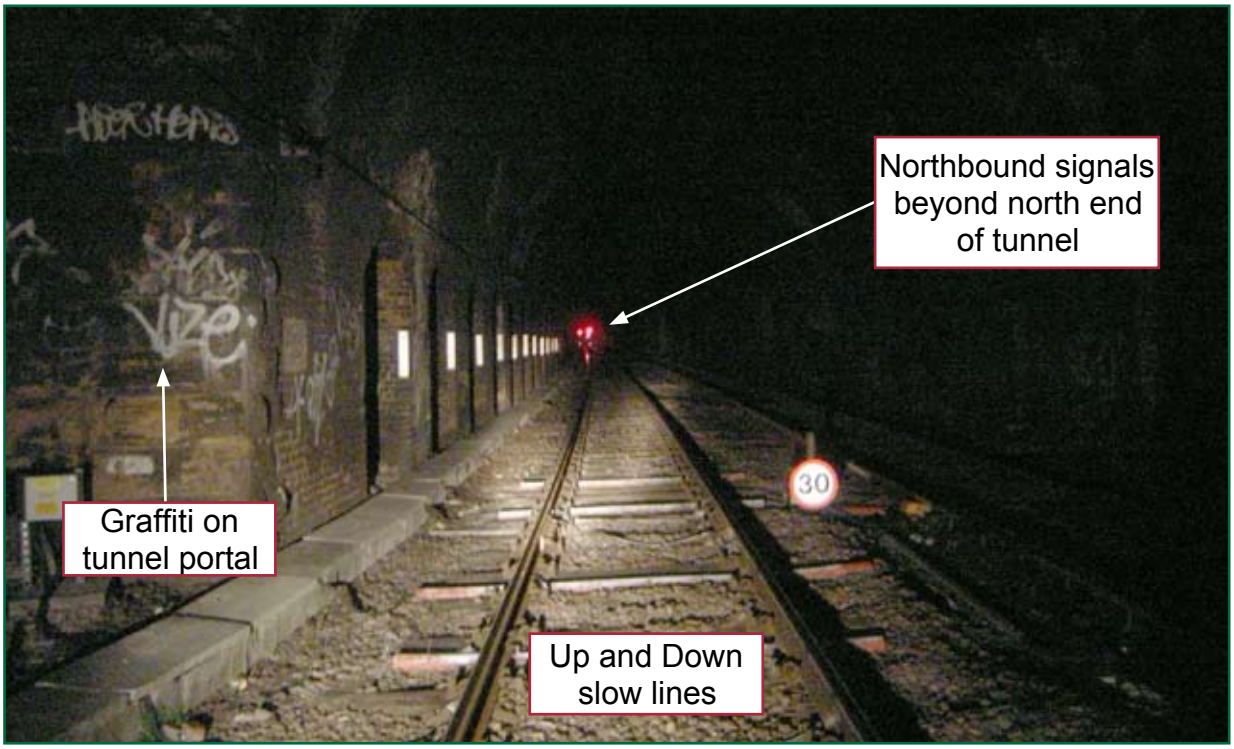

Figure 11: View looking north through Camden Road Tunnel

Results of the metallurgical examination of the broken coupling

47 Figure 12 shows a general view of the coupling and the eye which broke. The eye breaking caused the shackle to detach from the trunnion nut and deform.

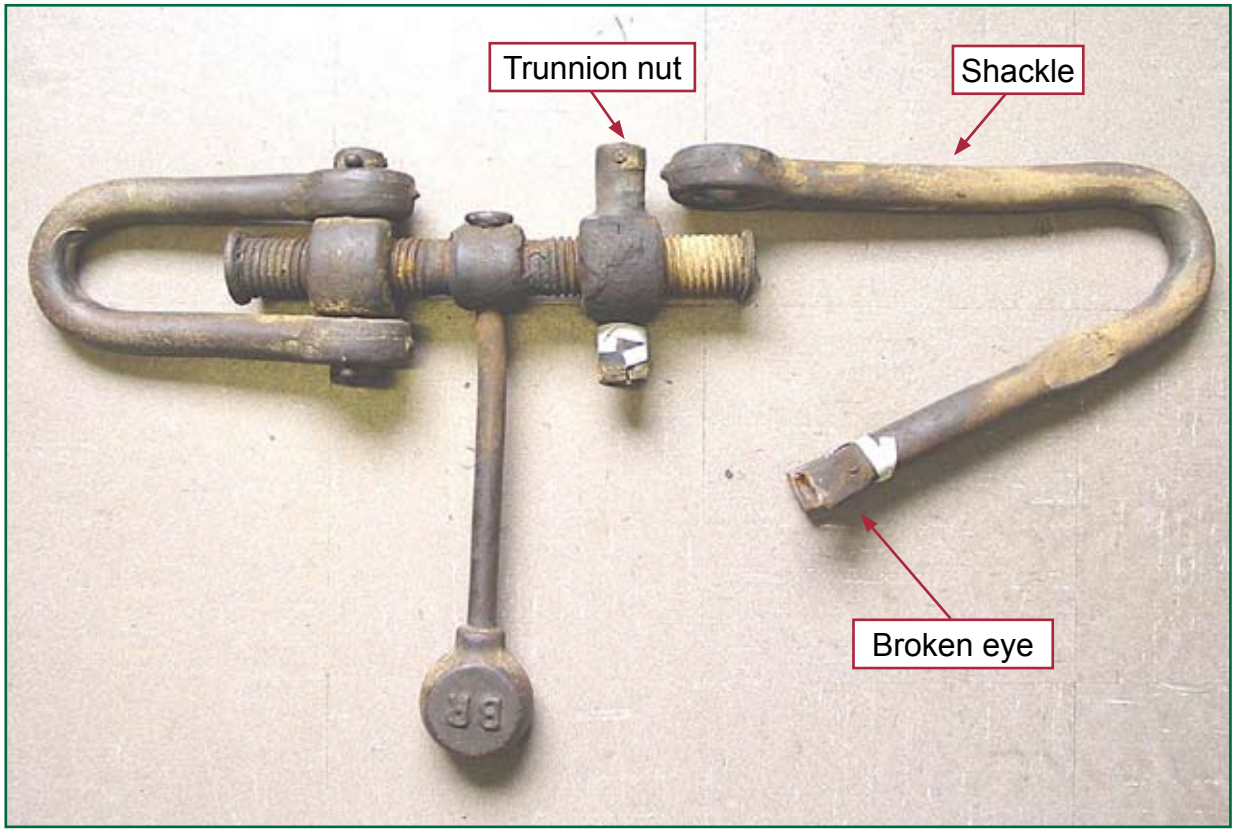

Figure 12: General view of the coupling (by courtesy of Serco Technical and Assurance Services)

48 Examination of the broken eye revealed that the two fracture faces had different material properties (Figure 13). One of the fractures had occurred rapidly with the break being through material that was predominantly brittle while the other fracture was a rapid ductile failure. No evidence of fatigue was found. The brittle fracture suggested that the material in that part of the eye had been subjected to localised heating and cooling some time after manufacture. The hardness measured (more than 600HV30[1]) was greatly in excess of that specified for the coupling (255 – 305HV). The hardness of the ductile fracture was found to be within the specification for the type of steel used in the manufacture of the coupling (BS970 945M38).

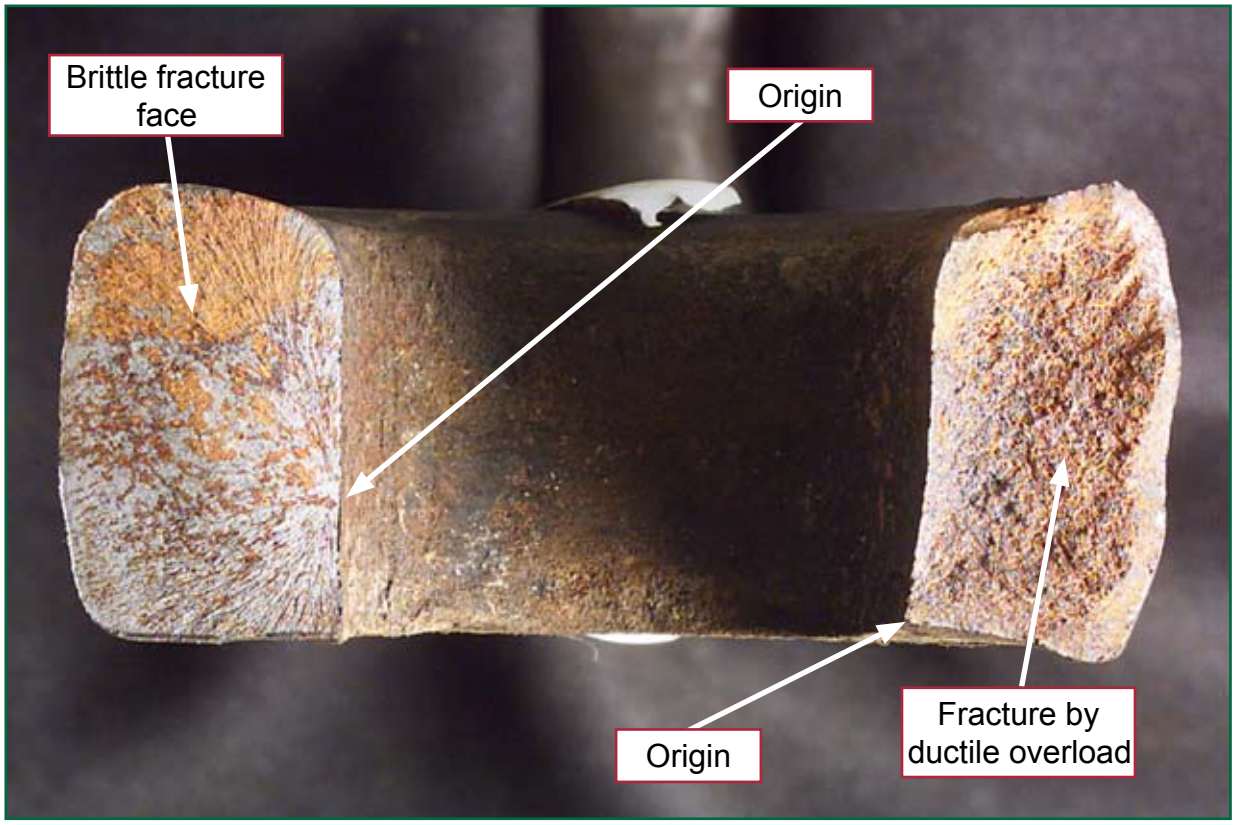

Figure 13: Eye end fracture faces (by courtesy of Serco Technical and Assurance Services)

49 From the results of the metallurgical examination, the RAIB believes that the brittle fracture occurred first, followed by the more ductile portion of the eye, which was in the correct condition.

50 Based on the amount of wear exhibited, it appeared that the coupling had been in service for some time, although the maintenance records showed that both couplings fitted to MAR17712 were renewed on 2 June 2004. Examination of the records thereafter (which were incomplete) showed no clear indication that heat might have been applied to the failed coupling as part of a repair carried out to the wagon.

51 It was not possible therefore to determine when or why the localised heating had occurred.

[1] HV is the measure of hardness using the Vickers hardness scale. HV30 means that the test was carried out using a 30 Kg load.

Maintenance of the wagons

52 The runaway wagons were both maintained by EWS at Hoo Junction and their last major maintenance dates (when they underwent a VIBT to EWS Engineering Specification EWS/ES/0085) were:

- MAR17712: 2 January 2007;
- MAR17725: 10 May 2007.

53 The maintenance of the braking system included leakage tests which the wagons passed and inspection of the couplings. There was no work arising relating to the braking system (other than renewal of brake blocks), or the couplings recorded for MAR17725. EWS could not find the record of work arising from the VIBT of MAR17712.

54 MAR17712 underwent other maintenance and repairs at Hoo Junction during 2007 and before the runaway incident as follows:

- out of course repairs 30 March 2007;
- out of course repairs 11 May 2007;
- *planned preventative maintenance* and work arising 14 May 2007.

The records detailing the work arising and repairs could not be found.

Results of the brake testing of the wagons following the incident

55 EWS arranged for the wagons in the consist of train 7M59 to have their brakes tested. This was done at the EWS yard at Acton Main on 21 July 2007. Leakage tests were carried out to EWS Engineering Standard EWS/ES/0097 Rev C 'Brake Tests Following an Incident' Appendix 6.

56 A schematic of the brake system is shown in Figure 14. The normal *running pressure* of 5 bar in the brake pipe is reduced when the driver operates the service brake in the driving cab. This is sensed by the *distributor* which operates to allow air pressure stored in the *auxiliary reservoir* to pass to the brake cylinders in proportion to the degree of reduction in brake pipe pressure. The runaway wagons were also fitted with automatic *empty/loaded changeover valves* which sense whether the wagon is loaded or empty. When the wagons are loaded, the brake cylinder pressure is increased in order to provide more brake force.

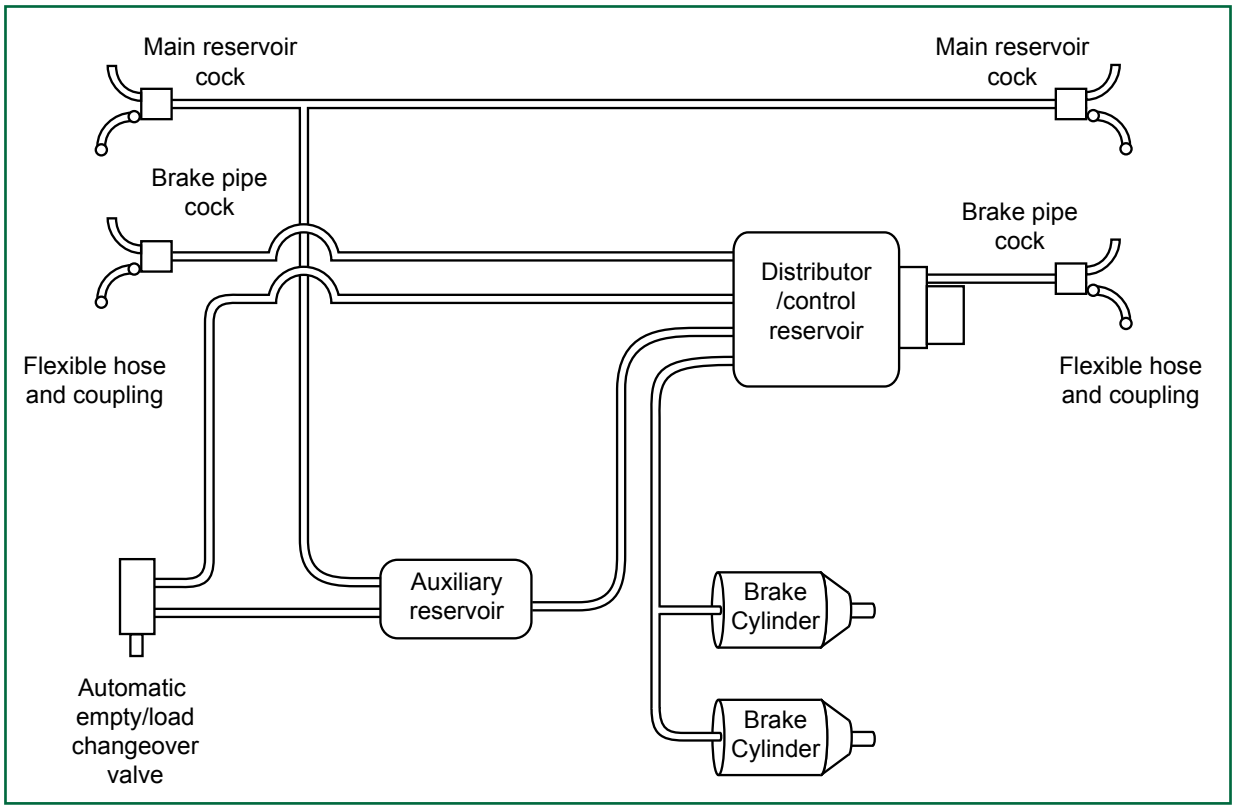

Figure 14: Schematic diagram of the brake system fitted to wagons MAR17712 and MAR17725

57 The brake system includes slack adjusters whose purpose is to ensure that slack in the brake rigging is taken up as the brake blocks wear. A dimension known as the 'A' gap in the slack adjuster assembly must be set to the value laid down in maintenance specification EWS/ES/0085 so that the brake blocks are set the correct distance from the wheels (Figure 15).

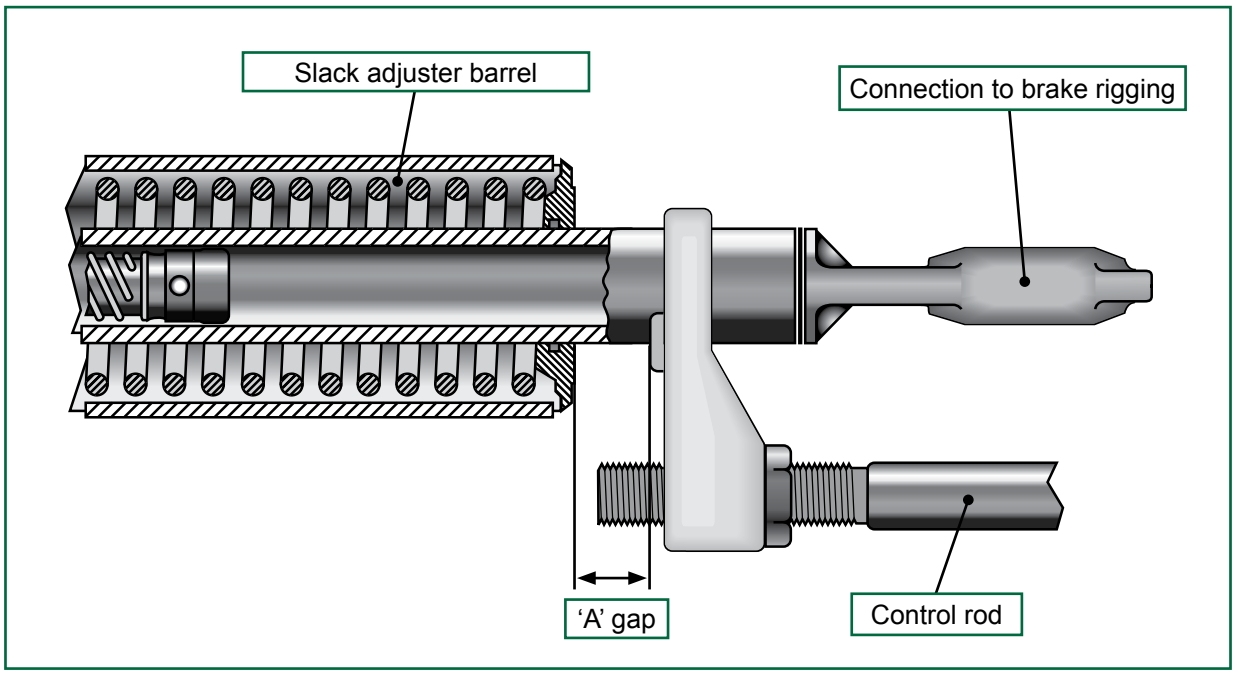

Figure 15: Slack adjuster 'A' gap

58 Following initial tests of the train consist excluding the two runaway wagons, tests were carried out on the complete train consist as it was at the time of the incident and then on the two runaway wagons themselves. The testing found that neither of the two runaway wagons met standard EWS/ES/0097 due to the following defects:

- MAR17712 did not meet EWS/ES/0097 for brake cylinder leakage (maximum 0.2 bar over 5 minutes). The results suggest that the brakes would lose half their pressure within a matter of minutes (Figure 16), although the rate of leakage would not be linear and would reduce as the brake cylinder pressure reduced. However, EWS's tests revealed no obvious air leaks.
- The 'A' Gaps for the two slack adjusters fitted to MAR17725 were found to be 80 mm and 82 mm which is more than twice the design value of 32 mm. This would probably have reduced the amount of brake force for a given brake cylinder pressure, although this was not measured during the tests.

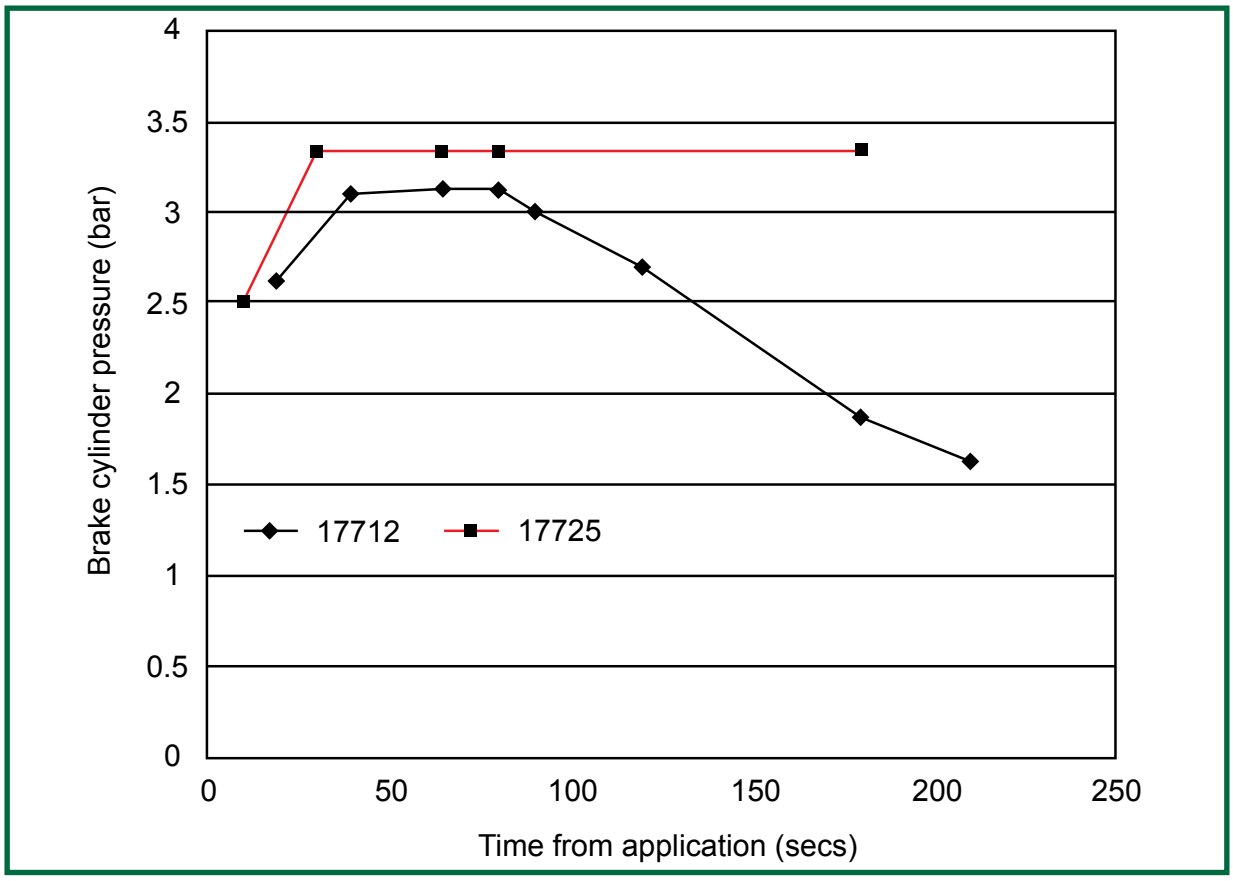

Figure 16: Results of brake cylinder leakage tests for wagons MAR17712 and MAR17725

59 The testing also found defects in the braking systems of other wagons in the train:

- HGA390520 had a leaking distributor;
- HGA390583 had a significant air leak through a brake cylinder seal;
- HGA390665 had a leaking distributor;
- HLA 300705 had a leaking reservoir feed pipe;
- JHA MAR17704, MAR17705 and MAR17711 had no effective brake application in 'initial' suggesting distributor faults; and
- JHA MAR17711 also had a faulty empty/loaded changeover valve.

60 All seven of the HLA/JHA wagons in the train failed some aspect of the brake test.

61 There was no requirement to check for air leaks before train 7M59 was dispatched from Angerstein Wharf (paragraph 28).

62 The defective HLA/JHA wagons were sent to the maintenance depot at Hoo Junction for a VIBT brake test (paragraph 106). The three HGA wagons above were labelled for repairs to be carried out. EWS's contractor who carried out the brake tests recommended that all the HGA wagons in the train should have a VIBT brake test within two weeks of the incident.

The driver of train 7M59

63 The driver joined British Rail in 1974 and was passed out as a driver in 1982. He had been based at Hither Green ever since. His most recent competence assessment on the rules prior to the incident occurring was on 16 November 2006. This included an assessment of the action required to be taken in the event of a divided train based on a specific scenario. The outcome of the rules assessment was that the driver was judged to be competent. He also had no medical restrictions.

64 The driver was involved in a SPAD incident at Radlett on 22 October 2005. The immediate cause of the SPAD was that the braking performance of the train had been reduced, because a brake pipe cock had been closed between the sixth and seventh wagons destroying the continuity of the brake pipe. This had occurred during the investigation of a problem with the operation of the train's brake earlier in its journey at Wigston, and before the driver took it over. This incident may have influenced his thinking following the train division on 19 July 2007 (paragraph 86).

The signaller on duty at West Hampstead power signal box

65 The signaller on duty when the incident happened was initially passed as competent on 17 August 2004. Since October 2006, he had been following the Network Rail system applicable to signallers of undergoing a computer based continuous assessment package every thirteen weeks. This had the aim of covering all the relevant rules in the rule book over a three year period. The most recent reassessment (on module S4 of the rule book which deals with 'Trains or shunting movements detained, or vehicles left, on running lines') prior to the occurrence of the incident was on 7 June 2007 which the signaller passed.

66 The computer based continuous assessment process had not covered the rule book sections in paragraphs 68 to 71 and relevant to the incident at Camden Road Tunnel, although at the time of the incident, the process was only about a quarter of the way through.

67 The signaller normally worked the WestCad terminal in West Hampstead power signal box controlling the immediate environs of St Pancras. He therefore dealt mostly with passenger trains and only a very few freight trains.

The rule book requirements relating to divided trains

68 Clause 15.1 of rule book module TW1, 'Preparation and movement of trains, General', of the rule book deals with the action that a driver should take if an abnormal brake application occurs. At the time of the incident (module TW1 has since been revised), this stated that the driver was to immediately find out if the train was complete with a tail lamp, if the train had not been brought to a stand by a brake application made by the driver, or the guard, or the passenger communication apparatus being operated. The driver was to assume that the train had become divided and carry out the instructions shown in module M1, 'Train stopped by train accident, fire or accidental division', if:

- the tail lamp was missing; or
- the air brake pipe was open at the rear.

69 Clause 6.3 of rule book module M1 requires the driver to make sure both portions of the train are secure and all the vehicles are accounted for. He must also check the couplings where the train has divided to see if:

- they might have damaged the track or lineside equipment; and
- there is any damage to them which prevents recoupling the portions.

70 At the time of the incident, actions on the signaller were contained in clause 6.1 of rule book module TS2, 'Track circuit block regulations' (module TS2 has since been revised). This required that if the signaller became aware, or suspected, that a train or vehicle was proceeding without authority, or a train was running in two or more portions, he was to:

- have the train or vehicle stopped, placing or keeping signals at danger against the train or vehicle;
- place signals to danger against any other trains which could be put in danger;
- arrange for train radio messages to be sent as shown in signalling general instruction 1.9;
- if possible, alter the position of any points to divert trains and prevent collisions;
- take any necessary action for any level crossings; and
- take any other action to reduce the risk of collisions.

71 Clause 8.2.1 of module TS2 required that if the signaller became aware that the tail lamp was missing, or unlit, he was to find out whether the train was complete.

Previous occurrences of a similar character

72 EWS maintain statistics on train divisions and these are shown in Figure 17 for the past ten years. The figures are for train divisions due to all causes and are not sub-divided by type of coupling.

Year	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08
Number	102	109	77	69	83	72	78	57	65	62	33

Figure 17: record of train divisions in EWS over ten years

73 The figures show a generally reducing trend over the last ten years. The reduction that has occurred is thought to be mainly due to the reduction in size of the HAA coal wagon fleet which is fitted with instanter couplings. The failure of instanter couplings fitted to this fleet is the largest single cause of train division.

74 In 2005, EWS implemented mandatory *magnetic particle inspection* (MPI) of instanter couplings when VIBTs were due to be carried out.

75 EWS's analysis is that most train divisions have been found to occur either within the first few wagons close to the locomotive or within the rear few wagons.

76 The incident near East Didsbury on 27 August 2006 is an example of a previous incident where a runaway occurred following the failure of a coupling.

77 That incident occurred when an EWS class 66 locomotive that was being dead hauled became uncoupled from the rear of a train (following the breaking of the drawhook on the rearmost wagon) and ran backwards in the direction in which it had just come for around 4.8 km, including through an *engineer's work site*. There were no injuries and there was no derailment. The incident was investigated by the RAIB (report no.13/2007 - www.raib.gov.uk).

78 The immediate cause was that the rearmost wagon drawhook broke when the train was on an upward gradient and when the trailing locomotive had no air supply available in its air reservoirs to apply the brakes. The drawhook should have been inspected using MPI in January 2006, but this had not been carried out. The maintenance documentation indicated however that the MPI had been carried out.

79 Among the recommendations made was one that EWS should review and modify its procedures covering maintenance actions not carried out at the scheduled time. The recommendation was still open at the time of this report.

Analysis

Identification of the immediate cause

80 When initially stopped at signal WH204, the driver's evidence is that he contacted the signaller using the telephone number displayed on a plate attached to the side of signal WH4 (Figure 10). This number had been recorded into his mobile phone the first time he used it to contact the signaller when initially stopped at signal WH204 (paragraph 44). The plate displaying the telephone number becomes progressively more difficult to read the closer a train draws up to the signal and provides evidence that he stopped at the correct stopping point, adjacent to the SPT, some 20 metres before the signal.

81 Evidence from the OTMR showed that the locomotive moved forward 8 metres before the pressure in the brake pipe at the locomotive reduced indicating that train division had occurred. However, taking account of the time taken for the air to propagate from the back of the train following rupture of the brake pipes to the locomotive and the slack in the couplings, the front of the train would have moved only a short distance before train division occurred.

82 From the OTMR, the front of the train moved 24 metres, taking the cab just beyond signal WH204. This was confirmed by the evidence given by the driver. The rear of the front portion of the train would have moved about a metre less than this because of slack in the couplings.

83 The driver's evidence also was that the rear of the front portion of the divided train was outside the south portal of Camden Road Tunnel. However, from measurements taken on site (paragraphs 43 to 45), and on the assumption the driver stopped at the correct position 20 metres from signal WH204 (paragraph 80), the rear of the front portion of the divided train must have been about 17 metres inside the tunnel from the south end portal, having moved from an initial position around 41 metres inside the tunnel. The two portions of the divided train would therefore have been about 24 metres apart.

84 The figures in paragraph 83 are confirmed by the fact that railway staff reported that they found part of the broken coupling 40 metres from the south end of Camden Road Tunnel, inside the tunnel (paragraph 38).

85 The immediate cause of the incident therefore was the division of the train between wagons MAR17704 and MAR17712 as the train started away on a down gradient after standing at signal WH204, followed by the leaking off of the brakes on the detached wagon MAR17712 and incorrectly set slack adjusters reducing the amount of brake force on wagon MAR17725.

Identification of causal, contributory and underlying factors

Driver's actions

86 When the driver experienced an unsolicited brake application on starting from signal WH204 (paragraph 30), he assumed that vandals had been responsible for removing the tail lamp and opening the brake pipe and main reservoir cocks (paragraph 32). The rule book describes the action required of the driver (paragraph 68 and 69); he should have assumed that the train had divided given the absence of the tail lamp and the open brake pipe and main reservoir cocks (paragraph 32).

87 The driver not following the rule book was a causal factor of the incident.

88 If the driver had taken the TOPS list with him when he went to examine his train, it would have been apparent to him that the train was not complete. While there was no specific instruction requiring the driver to take the TOPS list with him, EWS's opinion was that by custom and practice most drivers would do so. This is a contributory factor.

89 The driver's thinking was probably conditioned by the apparent high level of trespass in the area of Camden Road Tunnel as evidenced by the amount of graffiti present (paragraph 24) and his previous experience of working a train where the integrity of the brake pipe had been compromised before he had taken it over (paragraph 64). These are possibly contributory factors.

90 Despite the two detached wagons being only about 24 metres away from the rear of the front portion of the train (paragraph 83), the driver did not see them standing there in the darkness of Camden Road Tunnel, even though they might have been visible, given the ambient light conditions (Figure 11 and paragraph 46). This is a contributory factor.

Signaller's actions

91 When the driver reported to the signaller that the tail lamp was missing and the brake cocks were open (paragraph 32), with the cause being vandalism, the signaller accepted this account at face value. The main purpose of the tail lamp is to show that a train is complete but the signaller did not find out whether this was the case by asking the driver to check whether his train was complete (paragraph 71). He therefore only took the actions required by clause 6.1 of rule book module TS2 (paragraph 70) when it became apparent later that the train had divided. This is a contributory factor.

92 The ongoing competence management system used a computer based package (paragraph 65) to test the signaller's understanding of all the relevant rule book requirements every three months over a three year period. This process did not include the facility to be able to practice the response required to those incidents that signallers might be expected to deal with, sometimes infrequently. This would require access to a simulator, or at least a process where specific incident scenarios were explored through a process of discussion.

93 The signaller on duty at the time of the incident normally worked the WestCad terminal (paragraph 67) so the chance of a freight train dividing while he was on duty was very low and he therefore lacked experience of dealing with train divisions.

94 Had simulation or some other means to practice the response to incidents been used as part of the competence management system, the signaller might have been more effective in dealing with the incident that arose. This is also a contributory factor.

EWS Maintenance Control actions

95 The driver contacted EWS maintenance control for advice after he had contacted the signaller (paragraph 31). Maintenance control advised the driver to close the brake pipe between the locomotive and the train to identify whether the problem was with the locomotive or the train. Maintenance control did not consider that a train division might have caused the problem, or suggest this to the driver, although they were not told by the driver that the tail lamp was missing (paragraph 32). This is a contributory factor.

Braking system

96 RGS GO/RT3056/E clause 5.5 states that wagon handbrakes need not be applied before a locomotive is detached to *run round* a train unless there are ten or fewer wagons in the train, or it will be more than an hour before a locomotive is reattached to the wagons. RGS GM/RT2043 states in clause 10.2 that wagon hand brakes should be capable of holding a laden vehicle stationary on a 1 in 40 gradient. In order to implement a simplified run round procedure, EWS has derived from these requirements that as a worst case a freight train of ten or more wagons should be capable of being held by the train brake on a gradient up to a maximum 1 in 40 for at least an hour while the locomotive is running round its train. Under these circumstances, there is no need to apply any handbrakes providing the operation takes less than an hour.

97 At Camden Road Tunnel, only two wagons were detached and they were on a gradient that was considerably less steep than 1 in 40 (paragraph 23). It would be reasonable to expect therefore, that these two wagons would have remained stationary for much longer than they did. However, the combination of rapid leak off of the brake cylinder pressure in one wagon and degraded brake force in the other due to incorrectly set slack adjusters (paragraph 58) caused the two detached wagons to run away when they did (paragraph 34). Had the braking system met the specification, the runaway would not have occurred, because the presence of the detached wagons would have been discovered before the brakes had leaked off sufficiently to allow the wagons to run away (the wagons were detached for 58 minutes before it became apparent from the signalling system that the train was in two parts – see paragraphs 30 and 33). The condition of the brakes fitted to the two runaway wagons is therefore a causal factor.

98 The range of defects found in the braking system of train 7M59 (paragraphs 58 to 60) suggests there were likely to have been deficiencies in the maintenance processes at Hoo Junction depot where the wagons were maintained. This is a possible contributory factor.

Failure of the coupling fitted to MAR17712

99 The metallurgical examination of the failed coupling concluded that the failure occurred where the hardness was much greater than that specified in BS970 945M38 (paragraph 48). The metallurgist thought this could have occurred due to localised heating and cooling of the coupling in the area where the failure occurred, although it has not been possible to determine why such heating and cooling might have occurred. The failure of the coupling is a causal factor of the runaway and the hardness of the coupling material in the area where the coupling failed is a contributory factor.

100 The loaded bogie JHA/HLA wagons were marshalled at the rear of the train rather than the front. This would possibly have caused greater forces in the couplings between these wagons than would have been the case had they been marshalled at the front of the train because the HGA wagons, fitted with instanter couplings which give rise to significant slack in the train, would have increased the amount of snatching. This effect could not be quantified so it is a possible contributory factor.

Conclusions

Immediate cause

101 The immediate cause of the incident was the division of the train between wagons MAR17704 and MAR17712 as the train started away on a down gradient after standing at signal WH204. This was followed by the runaway of the two detached wagons because the brakes leaked off wagon MAR17712 and wagon MAR17725 had incorrectly set slack adjusters.

Causal factors

102 Causal factors were:

a. the driver did not follow the rule book requirements concerning divided trains and assumed that vandals were responsible for the missing tail lamp and open brake pipe and main reservoir cocks (paragraphs 86 and 87);

b. the condition of the brakes fitted to the two runaway wagons was such that the braking force was reduced and the brakes were able to leak off before the situation could be discovered and the wagons secured (paragraphs 96 and 97); and

c. the screw coupling fitted to MAR17712 failed when train 7M59 started away from signal WH204 (paragraph 99).

Contributory factors

103 Contributory factors were:

a. the driver did not take the TOPS list with him when he went to examine the train following the automatic brake application on starting from signal WH204 (paragraph 88, Recommendation 1);

b. the driver did not see the detached wagons standing in the darkness about 24 metres apart from the front portion of train 7M59 (paragraph 90);

c. the signaller did not challenge the driver's explanation of the cause of the brake application on starting from signal WH204 and did not consider the possibility train 7M59 had divided (paragraph 91);

d. the competence management system applied to the signaller did not include the opportunity to be familiar with degraded working (such as by use of a simulator) (paragraph 92, Recommendation 2);

e. EWS Maintenance Control did not prompt the driver to consider the possibility that the train had divided (paragraph 95, Recommendation 3); and

f. the coupling material in the area where it failed was outside specification and harder than it should have been (paragraph 99, Recommendation 4).

Possible contributory factors

104 The following factors were considered to be possibly contributory:

a. the driver's thinking was conditioned by a previous SPAD incident which occurred after the integrity of the braking system had been compromised (paragraph 89);

b. the driver's thinking was influenced by the amount of graffiti in the area of Camden Road Tunnel indicating frequent trespass of individuals on to the railway (paragraph 89);

c. deficient maintenance processes at the last VIBT carried out on the two runaway wagons (paragraph 98, Recommendation 5); and

d. the JHA/HLA wagons were marshalled at the rear of the train rather than the front (paragraph 100).

Observations

105 The following observations are made:

a. EWS do not analyse coupling failures by type of coupling making it difficult to monitor trends in the failures of specific coupling types (paragraph 72, Recommendation 6).

b. The number of EWS train divisions has gradually reduced over the last ten years, the main reason probably being the reduction in the size of the HAA coal wagon fleet. It is too early to tell whether the significant reduction in the number of train divisions in 2007/08 is part of the longer term trend (paragraph 73, Recommendation 7).

c. EWS could not produce all the maintenance records requested (paragraphs 53 and 54). The RAIB also found that this was the case during its investigation of the derailment of a freight train at King Edward Bridge, Newcastle upon Tyne, on 10 May 2007 (report 02/2008) (Recommendation 8).

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

106 EWS transferred the maintenance of the wagons that were in the consist of train 7M59 to Marcroft Engineering, a company owned by EWS Holdings. During brake testing as part of the VIBT, faulty distributors were found which have subsequently been overhauled by Marcroft Engineering.

107 Further HGA type wagons were obtained to avoid the necessity to mix different types of wagon in the same train (paragraph 100).

108 EWS started a process to brief its drivers on the driving procedure and application of the rules in relation to a train becoming divided. The brief was based on the lessons learned from the Camden Road Tunnel runaway incident and included a reminder to drivers that they must take the TOPS list with them when checking their train following an unsolicited brake application. At the time of this report, the contents of the brief were to be formalised into a company instruction.

109 The driver involved in the incident at Camden Road Tunnel was given the above brief and was also to receive additional competence assessments.

110 At the time of this report, inspectors from HM Railway Inspectorate are carrying out, as part of their *delivery plan,* a review of freight train division incidents and to consider whether all reasonably practicable measures are being taken to prevent such incidents. This is being carried out over a three year period:

(a) 2007: collect data (type of coupling, type of vehicle, position in train, location, date, company) from incidents;

(b) quarter 1 of 2008: review data from incidents and decide where inspection intervention is most appropriate;

(c) quarters 2 and 3 of 2008: carry out inspections;

(d) quarter 4 of 2008: review inspection findings and consider what action is necessary;

(e) 2009: collect data to compare with 2007.

Recommendations

111 The following safety recommendations are made[2]:

Recommendations to address causal and contributory factors and observations

1 EWS should revise their operational procedures to require drivers to take the TOPS list with them and use this to check the consist if they need to examine their train following an unsolicited brake application (paragraph 103 a).

2 Network Rail should review the competence management system applied to signallers with the aim of improving the way that signallers' actions in response to accidents and incidents are practised and assessed (paragraph 103 d).

3 EWS should revise their operational procedures to require maintenance controllers to always consider the possibility of a divided train when giving advice to drivers following a report of an unsolicited brake application (paragraph 103 e).

4 EWS should implement a process to brief its maintenance staff that heat should not be applied to forged components such as couplings to prevent a degradation in the material properties (paragraph 103 f).

5 EWS should review and amend, if necessary, its maintenance processes relating to the brake system of HLA/JHA and HGA wagons to ensure that all required maintenance and quality assurance measures are covered (paragraphs 104 c).

6 EWS should introduce a system to monitor incidents of coupling failures by type of coupling (paragraph 105 a).

7 EWS should introduce a system to analyse coupling failures for individual types of coupling and implement any necessary measures to reduce the number of occurrences of train divisions for specific coupling types (paragraph 104 b).

8 EWS should revise its procedures for keeping wagon maintenance records to ensure that continuous records are available which provide an auditable trail of the maintenance history throughout each individual wagon's life (paragraph 105 c).

[2] 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 Regulation (HM Railway Inspectorate) to enable them to carry out their 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 167 to 171) can be found on RAIB's web site at www.raib.gov.uk.

Appendices

Appendix A - Glossary of abbreviations and acronyms

EWS	English, Welsh & Scottish Railway
MPI	Magnetic Particle Inspection
OTMR	On Train Monitoring Recorder
RGS	Railway Group Standard
SPAD	Signal Passed at Danger
SPT	Signal Post Telephone
VIBT	Vehicle Inspection and Brake Test

Appendix B - Glossary of terms

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

Acceptance	Where the person in charge of a yard or sidings gives their agreement (usually to the signaller) to the arrival of a train into that yard or sidings following the fulfilment of certain conditions.
Automatic brake application	A brake application made without the intervention of the driver through the parting of the brake pipe.
Auxiliary reservoir	A pressure vessel fitted to an air braked vehicle which stores compressed air to supply the brake cylinders when required.*
Brake pipe	In an air brake system, this pipe is pressurised to release the brakes of the vehicles in the train.*
Brake pipe cock	Railway industry term for a manually operated valve, typically part of the braking system.*
Delivery plan	The programme of work to be undertaken by HMRI and timescale for achieving it relating to a specific railway topic area.
Detonators	A small explosive device that is fastened to the rail head and exploded by the passage of a railway vehicle.
Distributor	The pneumatic component of the train air braking system that responds to changes in brake pipe pressure and initiates charging of the brake cylinders.
Drawhook	The large heavy duty hooks placed centrally on a buffer beam of a rail vehicle, which are used as the attachment point for connecting the vehicle to another.*
Empty/loaded changeover valves	Part of a wagon's braking system that can be set to adjust the amount of braking effort dependent on whether the wagon is empty or loaded.
Engineer's work site	The subdivision of a possession that is delimited by marker boards and managed by an engineering supervisor.*
Gross laden weight	The maximum weight of a rail vehicle, including its maximum load.*
Instanter coupling	A chain-like assembly of two standard oval links connected by a special pear shaped link, used to connect the drawhooks of two adjacent rail vehicles. The special middle link allows the chain to be shortened once it is fitted, so ensuring that the assembly is secure.*
Limited clearance	An area where there is insufficient space to stand safely during the passage of trains on the adjacent line. These areas are normally marked by a red and white chequered sign.*
Magnetic Particle Inspection	A method of detecting the presence of surface cracks that takes advantage of the effect such cracks have on the passage of a magnetic field through steel.*

Main reservoir cock	Manually operated valve at the end of the main reservoir pipe. Only some wagons are so fitted and when connected to the locomotive provides a means to directly charge the auxiliary reservoirs.
Multiple-aspect colour light signals	Signals which convey movement authorities to train drivers by means of coloured lights. These signals are described as having a number of aspects, eg four aspect signal.*
On Train Monitoring Recorder	A data recorder fitted to traction units collecting information about the performance of the train.
Planned preventative maintenance	Maintenance activity planned to take place on a regular basis to reduce the incidence of failures in service.* - Carried out between VIBTs.
Run round	The act of moving a locomotive from one end of a train to the other.*
Running pressure	The pressure in the brake pipe that causes the brakes to be released and to be maintained released.
Screw coupling	A type of coupling used to connect rail vehicles together. It consists of a pair of loops connected by a threaded bar with left and right-hand threads on opposite ends, allowing the coupling to be lengthened and shortened as required when connected between the drawhooks of the vehicles.*
Service brake	The normal train brake producing a comfortable deceleration, typically 7% to 9% of g. This is less severe deceleration than that produced under emergency braking.*
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.*
Slack adjusters	A component of the brake system that automatically takes up any slack in the rigging caused by the wearing of the brake blocks or pads and therefore maintains constant braking effort as such wear occurs.
SPAD alarm	An audible and visual alarm in a signal box to alert the signaller, arising from a train passing a signal at danger.
Straight air brake	The air braking system that applies the brakes to the locomotive (or other rail vehicle) only and not to any attached vehicles.
Tail lamp	The red light carried at the rear of a train, which serves to assure staff that the entire train has passed complete and no parts have become detached.*
Tare weight	The weight of a rail vehicle capable of carrying a load when it is not carrying any load.*
Track circuits	A weak electrical current in the running rails which will confirm the absence of a train in a signal section and which is used as the basis for clearing a signal.
TOPS Code	A unique code applied to a type of rail vehicle recognised by TOPS which is a computer system used to track rail vehicles.
TOPS list	A list generated by TOPS of the consist of a train.

Vehicle Inspection and Brake Test	Vehicle Inspection and Brake Test, a regular inspection performed on all Rail Vehicles.*
WestCad	Westinghouse Control and Display System, a signalling control system.*

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