RAIB

Rail Accident Investigation Branch

Rail Accident Report

Collision with buffer stops at King's Cross
17 September 2015

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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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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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Collision with buffer stops at King's Cross 17 September 2015

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Summary

At around 12:18 hrs on Thursday 17 September 2015, the 10:55 hrs service from Cambridge collided with the buffer stops at platform 11 of King's Cross station, London. The train was formed of a four-car class 317 electric multiple unit and was being driven at the time by a trainee driver under the supervision of a driver instructor. The train came into the platform at normal speed, but the brakes were not applied so as to bring the train to a stand before the collision with the buffer stops occurred. At the time of the collision, the train was travelling at around 7.5 mph (12 km/h). Upon contact with the buffers, the train stopped rapidly, with the buffer stops moving back a short distance.

Fourteen passengers reported injuries: of those, four were treated by the London Ambulance Service and two were taken to hospital. Both were released later the same day. There was minor damage caused to the buffer stops and the outside of the train. A small number of interior fittings were dislodged during the impact and at least one passenger was struck by a detached lighting diffuser as it fell from the ceiling of the train.

The accident occurred because the trainee driver did not apply the brakes in time. The driver instructor told the trainee when the brakes needed to be applied, but the trainee selected the wrong control handle. He may have been distracted by seeing a person on the platform, and because he was still at an early stage of his practical training, he had not yet acquired instinctive competence in the selection of the correct control. The driver instructor was very experienced, but he had not been trained to teach, and his employer's monitoring and assessment of his work as an instructor had not identified any deficiency in his ability to teach.

RAIB has made two recommendations to the train operator, Govia Thameslink Railway. The first covers possible ways of minimising the risk from mistakes made by inexperienced trainee train drivers. The second relates to improvements to the way the company trains and manages driver instructors.

Introduction

Key definitions

1 Metric units are used in this report, except when it is normal railway practice to give dimensions relating to speeds and locations 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. Sources of evidence used in the investigation are listed in appendix C.

The accident

Summary of the accident

3 At 12:18 hrs on Thursday 17 September 2015, a passenger train collided with the *buffer stops* in platform 11 at King's Cross station, London (figure 1), while travelling at about 7.5 mph (12 km/h). There were about 109 passengers and two train crew on the train. Emergency services attended, and two people were taken to hospital, with injuries which did not require them to be detained overnight. Twelve other people suffered minor injuries and four were treated at the scene. There was minor damage to the train and the buffer stops.

4 The train was the 10:55 hrs Govia Thameslink Railway[1] (GTR) service from Cambridge to King's Cross (train 2C43), and was formed of a four-car class 317 *electric multiple unit*. It was being driven by a trainee driver, under the supervision of a driver instructor.

Context

Location

5 King's Cross station is the terminus of routes from Scotland, the north-east of England and East Anglia, as well as suburban services from north London and Hertfordshire. Platform 11 is the westernmost platform of the station, and is in the suburban section which is outside the main train shed. This section has an overall roof which covers the circulating area and the first 110 metres of platforms 9, 10 and 11.

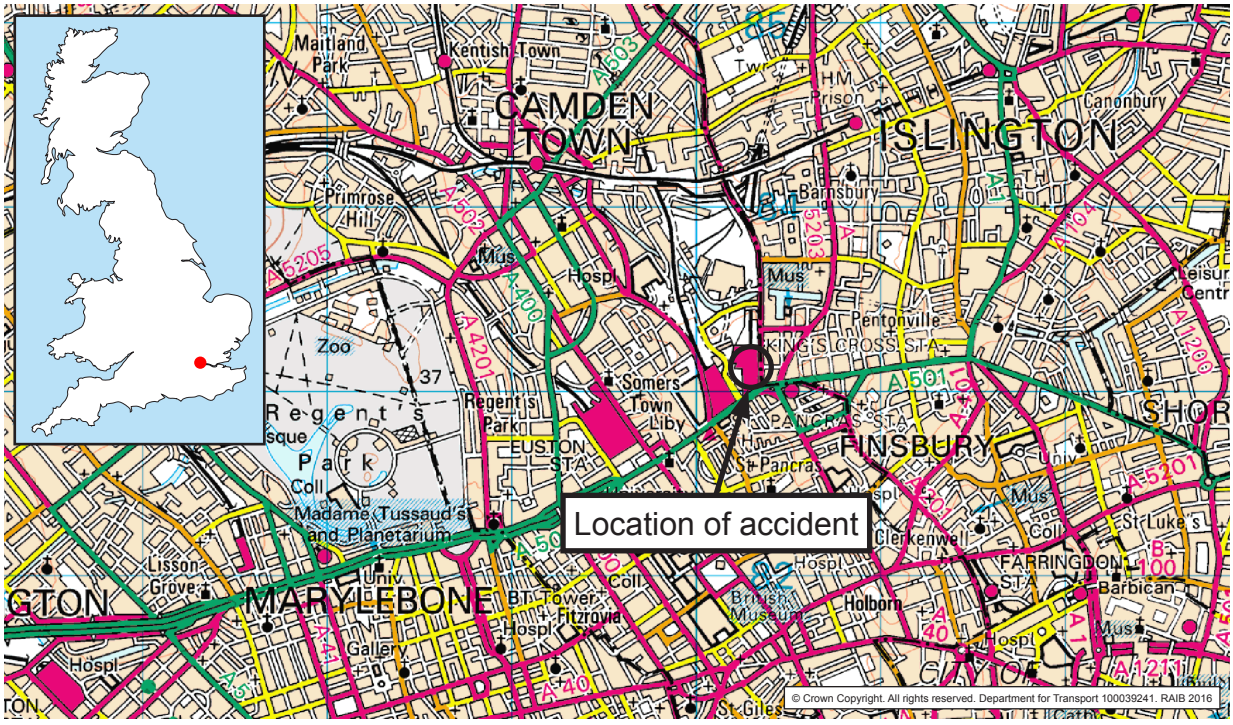

Figure 1: Extract from Ordnance Survey map showing location of accident

[1] GTR operates the combined Thameslink, Southern and Great Northern franchise, and brands the trains on the different sections accordingly. The train involved in this accident was a Great Northern service.

6 Platform 11 is 170 metres long, and will accommodate an eight-car train. The maximum permitted speed for trains entering and leaving King's Cross station is 15 mph (24 km/h). Platform 11 is fitted with TPWS equipment which is designed to apply an arriving train's brakes if it is travelling at more than 10 mph (16 km/h) at a point 55 metres from the buffer stops.

Figure 2: Platform 11 at King's Cross

Organisations involved

7 Network Rail owns, operates and maintains all the infrastructure at King's Cross station, including the track and buffer stops in platform 11.

8 GTR operated train 2C43, employed the train crew, and maintained the unit that made up the train.

9 Network Rail and GTR freely co-operated with the investigation.

Train involved

10 Train 2C43 was made up of unit 317346, which was built in 1982. It was one of twelve similar units leased to GTR and used on services from King's Cross to Peterborough and Cambridge. It was maintained at Hornsey depot in north London.

11 There was no evidence that the condition of the train contributed to the causes of the accident.

Rail equipment/systems involved

12 The buffer stops were manufactured by Henry Boot Engineering Ltd, probably in the 1970s or 1980s. They are fabricated from steel and recycled rails, and are of the sliding friction type (see paragraph 32). The performance of the buffer stops in the accident is discussed further in paragraphs 35 and 36.

Staff involved

13 The trainee driver had been recruited by GTR from outside the railway industry, and had been under training since April 2015.

14 The driver instructor joined British Rail in 1974 and became a driver in 1980, and an instructor in 2000. He had spent the whole of his career working on the routes out of King's Cross.

External circumstances

15 Weather conditions were dry and cool, and played no part in the accident.

16 Platform 11 was largely empty as the train arrived, but there were a few people near the buffer stops. The presence of people may have been a factor in the accident (see paragraph 44).

The sequence of events

Events preceding the accident

17 The trainee driver had reached the point in his training where he was to drive a passenger train in service for the first time. In the morning he travelled by train from his home to King's Cross, where he met the driver instructor and signed on for duty at 08:30 hrs.

18 The trainee driver and driver instructor then took over unit 317346 at King's Cross, and departed in passenger service as the 09:05 hrs train to Cambridge. The trainee drove the train throughout the journey, including the arrival about five minutes late into a terminal platform at Cambridge.

19 The train crew had a break of about 20 minutes at Cambridge station before they returned to the unit, and departed at 10:55 hrs as train 2C43, with the trainee continuing to drive.

20 The journey was uneventful, and the train departed on time from Finsbury Park, the last calling point (of 15) between Cambridge and King's Cross, at 12:13 hrs.

Events during the accident

21 Train 2C43 accelerated to 49 mph (79 km/h) after leaving Finsbury Park, but then encountered signals with restrictive aspects (not displaying a green light). In response to these, and to comply with the speed restrictions in the area, the trainee driver reduced the train's speed. As the train was running through Gasworks Tunnel, just to the north of King's Cross station, the trainee driver reduced the speed to 15 mph (24 km/h), which was maintained through the tunnel and into platform 11. The brakes were then applied to bring the speed down to 8.3 mph (13 km/h) about 85 metres from the buffer stops, reducing to 7.5 mph (12 km/h) about 40 metres from the stops, at which time the train was coasting.

22 Evidence from the on-train data recorder (OTDR) shows that at 12:18:04 hrs, the trainee driver applied power, increasing to notch 4 (the maximum) over a period of three seconds, before immediately shutting off power and, less than 0.5 seconds later, applying the emergency brake. The train's speed did not change, and it was still travelling at 7.5 mph (12 km/h) when it struck the buffer stops at 12:18:09.5 hrs, and came to a stop 1.5 seconds later.

Events following the accident

23 The two men in the cab were both shaken by the accident, but unhurt. The driver instructor called the signal box on the train radio and asked for the emergency services. The trainee driver released the train doors, 21 seconds after the train stopped. CCTV evidence shows that there were about 109 passengers on train 2C43, and most of them alighted at once and left the area. British Transport Police officers who were already on duty on the station attended the scene immediately.

24 Some passengers in the leading coach remained on board for a short time, where they were given assistance and reassurance by station staff and police. All the passengers had left the train by the time ambulances arrived at the station at 12:45 hrs, and the ambulance service treated people with minor injuries on the station.

Figure 3: The train and the buffer stops after the accident

25 The train remained in the platform, and was examined there by RAIB inspectors. The train was then taken to GTR's depot at Hornsey for mechanical examination, and the platform was returned to service at 18:34 hrs.

Key facts and analysis

Background information

Driver training

26 Training people to drive trains is a well-established process which involves a mixture of classroom teaching and practical experience. It relies heavily on giving trainee drivers experience of the task, under supervision, at various stages in the training programme. The initial introduction to practical driving techniques is done using trains without any passengers on board, in sidings and on the main line. It would not be practicable for the whole of the practical handling experience needed by trainees to be gained in these conditions, because of the limited capacity of the railway network, and so the later stages of training take place on trains in passenger service. In all these situations, the trainee driver must be properly supervised by a trained driver instructor.

27 Most train operating companies (including GTR) possess simulators which are used for driver training and competence management. These can be particularly valuable for giving trainees experience of emergencies and unusual events which are rarely encountered in practice, but which they need to know how to deal with. GTR does not normally use simulators in the basic training of new drivers, because real trains (initially in sidings and depots) are available for them to familiarise themselves with the controls and the cab environment, and get a feel for the way that trains are handled.

28 The trainee driver of the train involved in this accident had been recruited by GTR without any previous railway experience, and was going through the company's driver training course. This was designed to make him fully qualified to drive trains, alone, about eight months after joining the company.

29 The GTR driver training course consists of five modules, taken sequentially, each of which is assessed on completion and must be passed before the trainee can move on to the next stage. Module 1 (four weeks) covers induction and operating rules; module 2 (3 weeks) introduces trainees to the cab environment; module 3 (6 weeks) is concerned with drivers' rules; in module 4 (10 weeks) trainees are taught the technicalities of the trains they will drive ('traction'), and driving techniques; and in module 5 (up to 10 weeks) they gain experience in practical train handling, and learn the routes over which they will be working. The training course is made up of classroom and practical training, delivered by internal and external trainers and driver instructors.

30 At the time of the accident the trainee driver was part way through module 4 of the training course. He had been taught about how the trains that GTR operate work, and had been introduced to the techniques of driving, including driving class 313 trains for about five hours in depots and sidings, and on the main line but not in passenger service. On the day of the accident he was being introduced to driving the class 317 train, which has a similar driving desk layout to the class 313 train (figure 4). He had been allocated to a driver instructor for this purpose.

31 Later in the training programme, trainees spend at least 250 hours on practical train handling and route learning, accompanied by a driver instructor, driving trains in passenger service. At the end of the practical train handling course, their competence in all aspects of the task is assessed before they are permitted to drive unaccompanied.

The buffer stops

32 The buffer stops in platform 11 at King's Cross are of the sliding friction type. They are designed to absorb the kinetic energy of a train impact by using the frictional forces between the buffer stops and the rails they are clamped to, and bringing the train to a stop in a controlled manner.

33 The requirements for buffer stops on the national network are set out in Railway Group standard GC/RT5033, supported by GC/RC5633 which gives guidance on the risk assessment of buffer stops, arresting devices and end impact walls.

34 The standard requires that energy absorbing buffer stops are provided at all terminal platforms. A risk assessment should be in place for each location which 'indicates that the buffer stop or arresting device is adequate for the location concerned'. The risk assessment should take account of the risk of harm to people and critical structures, the position of structures, supports, workplaces and retail outlets, areas where people are likely to congregate, the type and condition of the device provided, and the history of buffer stop collisions at the location.

35 Clause 2.1.1.4 of GC/RT5033 defines the retardation rates that buffer stops should be designed to achieve. The standard requirement for the average retardation rate for the full range of trains (from the lightest to the heaviest) is a maximum of 0.15g (1.47 m/s^2). In situations where site constraints make it unavoidable (ie where space is limited), lightweight trains (such as the electric multiple unit involved in this accident) may be subjected to higher rates, up to a maximum of 0.25g (2.45 m/s^2).

36 In this accident, the average deceleration of the train (from 7.5 mph (12 km/h) to zero) was 0.23g (2.24 m/s^2). The performance of the buffer stops was therefore within the standard specification.

Identification of the immediate cause

37 **The trainee driver did not apply the brake in time to stop the train before it hit the buffer stops.**

38 Evidence from the OTDR showed that the trainee driver did not operate the control to apply the brakes until about two seconds before the train struck the buffer stops. This was not enough time for the brakes to begin to affect the speed of the train, and there was no reduction in speed until the buffer stops began to absorb the kinetic energy of the train.

39 There was no evidence on the rail heads of any loss of adhesion, and no suggestion from the trainee driver or driver instructor that the brakes were in any way defective. Following the accident, the train's brakes were tested by GTR and found to be working normally.

Identification of causal factors

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

a. when prompted by the driver instructor to apply the brakes, the trainee initially selected the wrong control handle (paragraph 41);

b. the driver instructor permitted the trainee to drive on the approach to the buffer stops (paragraph 51); and

c. the driver instructor did not sufficiently monitor the actions of the trainee driver on the approach to the buffer stops at King's Cross (paragraph 58).

Each of these factors is now considered in turn.

The actions of the trainee driver

41 **When prompted by the driver instructor to apply the brakes, the trainee initially selected the wrong control handle.**

42 The OTDR evidence shows that the trainee driver applied power shortly before the train struck the buffers. The trainee driver's evidence is that he intended to apply the brake, but selected the power handle (on the right of the control desk) instead of the brake handle (on the left).

43 This causal factor arose due to a combination of the following:

a. the trainee driver may have been distracted or suffered a lapse in concentration (paragraph 44); and

b. the trainee driver had not yet gained instinctive competence in selection of the correct control (paragraph 46).

Each of these factors is now considered in turn.

Distraction

44 The trainee driver was driving a train into King's Cross station for the first time, an important milestone in his driving career. His evidence is that as the train was approaching the buffer stops, he saw another person who he thought was a driver that he knew, on the platform. He made eye contact with this person, and nodded to him, and at that moment the driver instructor told him to apply the brake for the buffer stops. Still looking out of the window, rather than at the control desk, he pulled the power controller with his right hand, instead of pushing the brake handle with his left.

45 It is possible that seeing a person he thought to be an acquaintance on the platform distracted the trainee driver at a crucial moment, when he needed to concentrate on the task of stopping the train in the right place. The driver did not think he had been distracted, but he did consider that he might have suffered a lapse in concentration. Gaining experience in maintaining attention is one of the purposes of the practical handling element of the driver training course, and it is important that, in the early stages, the driver instructor monitors the trainee's performance in this area closely (see paragraph 55).

Selection of the correct control

46 The trainee driver had driven class 313 trains, in sidings and empty on the main line, for about five hours, but 17 September 2015 was the first time he had driven a train in passenger service on the main line. His previous work had been driving mechanical handling machinery (fork lift trucks) in which the driver controls speed and braking using their feet, as with a road vehicle.

47 The class 317 is typical of electric trains of its era (1970s and 80s) in having separate controls for brake and power (figure 4). More modern passenger trains have the two functions combined into a single controller, usually placed to the left of the driver.

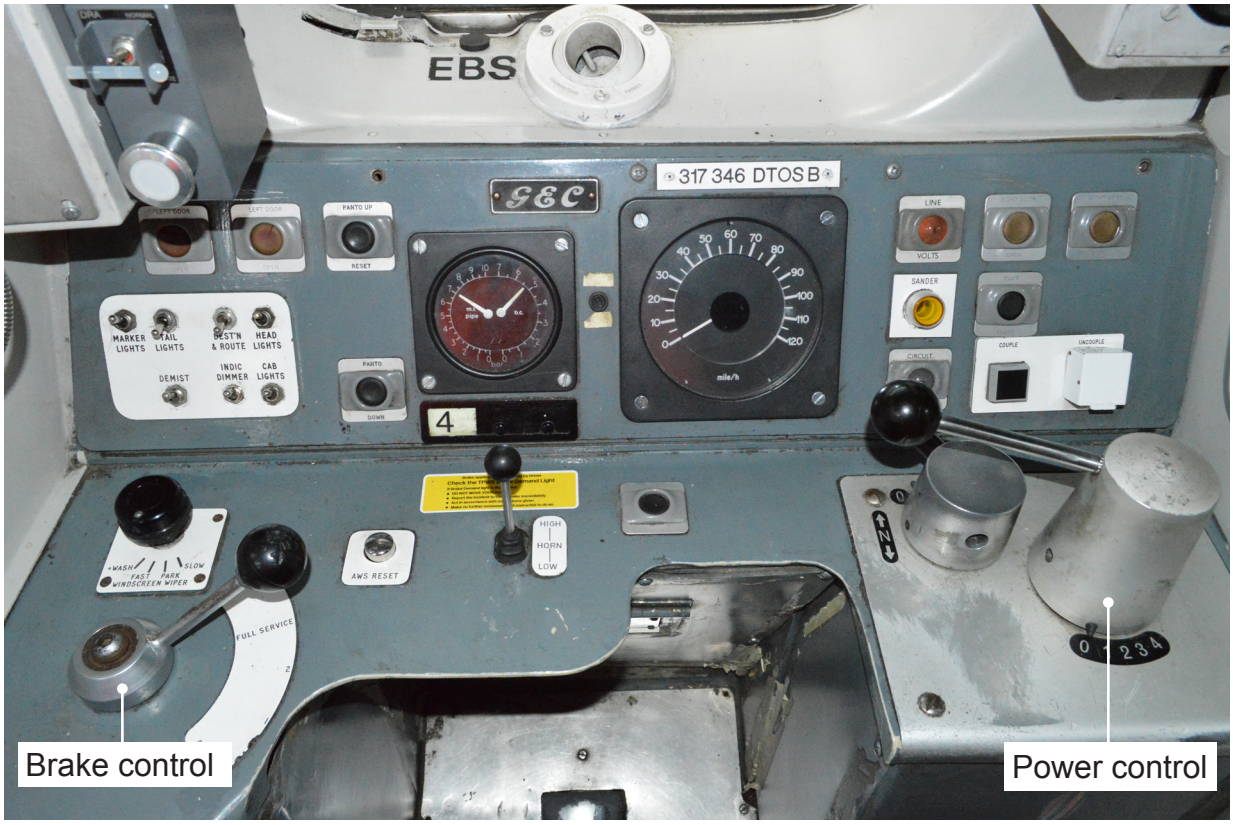

Figure 4: Layout of controls in class 317. The class 313 has a similar layout.

48 The trainee driver had driven from King's Cross to Cambridge and back again, stopping at 31 stations, and the evidence of the driver instructor was that the trainee had already demonstrated a good level of practical skill in handling the controls. However, with such limited experience (less than three hours), he had not yet acquired the instinctive response to a situation requiring a brake application, of pushing the left-hand control forward, away from his body. He was still at the stage of needing to look at the controls to confirm his actions.

49 In the situation that arose as the train approached the buffer stops, the trainee became confused when the driver instructor told him to apply the brake at a moment when he was probably distracted by something outside the train (paragraph 44). His first reaction was to reach for the control on the right, possibly because the command came from his right, where the driver instructor was standing. By the time that he had realised his mistake (prompted by the driver instructor), shut off power and applied the brake, the train was too close to the buffer stops to be able to stop before hitting them.

50 Research has shown that skill develops along a continuum from effortful, controlled processing to attention-free, automatic processing. In car driving, stopping at a red light becomes automatic after performing the same response hundreds of times[2]. Low-level, operational, skills in car driving are easier to automate (cognitively speaking) and vehicle control tasks can become automatic within one month[3]. Another study in a driving simulator found the development of vehicle control skills and hazard detection occurred in around 12 weeks[4]. It is therefore unlikely that the trainee could have been expected, or indeed would have been able, to have acquired such an automatic response after less than ten hours experience of train driving.

The actions of the driver instructor

51 **The driver instructor permitted the trainee to drive on the approach to the buffer stops.**

52 On the day of the accident, the trainee driver was driving a class 317 in passenger service on the main line for the first time. In these circumstances, an individual may feel that they are under considerable pressure to perform well.

53 The hazards associated with the task of train driving vary during each journey. When the train is running under clear (green) signals, the driver can concentrate primarily on maintaining an appropriate speed. As soon as the train encounters a restrictive signal aspect, or approaches a station where it is scheduled to stop, the complexity of the driver's task increases.

54 There are a range of systems, devices and engineering controls which exist to mitigate the consequences of a driver's error. These include the driver's safety device (DSD, sometimes referred to as the dead man's handle, although on this type of train it is foot-operated), the automatic warning system (AWS), and the train protection and warning system (TPWS). Any or all of these may intervene to apply the brakes and stop the train if the driver does not respond to external prompts from signals and other lineside signs, and operate the controls in the expected way.

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[2] Wickens, C. D., Gordon, S. E. & Liu, Y. (1998). An Introduction to Human Factors Engineering. New York: Longman. (p.173).

[3] Young, M. S. & Stanton, N. A. (2007). What's skill got to do with it? Vehicle automation and driver mental workload. Ergonomics, 50(8), 1324-1339.

[4] Charlton, S. G. & Starkey, N. J. (2011). Driving without awareness: The effects of practice and automaticity on attention and driving. Transportation Research Part F: Traffic Psychology and Behaviour, 14(6), 456-471.

55 However, on the final approach to buffer stops, the safe stopping of the train depends entirely on the actions of the driver. The TPWS will intervene if the train's speed is more than 10 mph (16 km/h) when it passes over equipment which is placed about 55 metres from the buffer stops, and the DSD will apply the brake a short time after the driver releases it. If neither of these systems has been triggered, the train will continue along the track in a terminal platform under the control of the driver, relying entirely on input from the driver to bring it to a stop before reaching the buffer stops. The risk associated with the driver's task is therefore high at this stage of the journey, because the driver must act at the right time to prevent a collision.

56 It is therefore important that the driver training process takes account of this, and that there is a proper assessment of the risk associated with placing an inexperienced driver at the controls of a train on the approach to buffer stops, where there may be little, if any, time to take action to mitigate the consequences of an error.

57 The driver instructor chose to let the trainee drive for the whole journey, from King's Cross to Cambridge and back again. He was aware that this was the trainee's first shift driving passenger trains on the main line, but he believed that the practice that the trainee had already had, driving empty class 313 units, provided sufficient grounding to enable him to cope with the whole journey, under supervision. However, this meant that it was important that the driver instructor monitored the trainee closely at the times when such high risk existed. Other experienced driver instructors stated that they would not have permitted a trainee with so little driving experience to drive the train on the approach to buffer stops.

Monitoring of the trainee's actions

58 **The driver instructor did not sufficiently monitor the actions of the trainee driver on the approach to the buffer stops at King's Cross.**

59 The driver instructor was probably standing on the right-hand side of the cab. In this position, he had only a limited view of what the trainee was doing, and was not well placed to take action quickly if the trainee made an error. GTR managers stated that they would have expected the driver instructor to have stood at the trainee driver's shoulder in this situation, to be able to intervene quickly if necessary.

60 Witness evidence indicated that the driver instructor remained on the right-hand side of the cab as the train ran into the station. He stated that he could see what the trainee was doing, but that there was no time to intervene before the train hit the buffer stops.

Identification of underlying factors

Training of driver instructors

61 GTR's regime for training its driver instructors focused on their technical competence as drivers rather than their wider skills as trainers.

62 The requirements for the selection and training of people to become driver instructors are set out in GTR safety management system (SMS) document SMS 12.2 'Train Driver Training', section 4.1. This says that driver instructors who deliver training in any form of practical train handling skills must:

- meet the medical fitness and competence requirements for train driving;
- have a minimum of 3 years practical train driving experience since qualifying;
- have 12 months productive driving experience in GTR if they have transferred from another company;
- be fully conversant with and assessed as competent on any route and traction on which they are required to instruct;
- have a thorough understanding of all signalling risks, multi-SPAD signals, and known areas of low adhesion for the route over which they are required to train drivers;
- have been suitably trained in their role and deemed as a competent instructor; and
- not currently be on a DDP[5] process at the time they are appointed.

63 The driver instructor involved in the accident at King's Cross had been appointed to the role in 2000, before the above document was produced. However, GTR considered that he met all the requirements of the document.

64 GTR's current training course for driver instructors lasts four days and covers a number of topics in short classroom-based sessions. At the time the driver instructor was appointed, the training (which was done by a predecessor company) was less formal, and there is no record of what his training consisted of.

65 GTR's safety management system (SMS) references documents produced by RSSB which give guidance on competence development. These include RS/100 'Good Practice Guide on Competence Development', which was issued in March 2013, and replaced previous guidance.

66 Section 4.1 of this document describes the roles and responsibilities of training staff. It suggests an approach to the development of training staff, and emphasises the importance of carefully selecting the right people, who can deliver effective training, and suggests that staff should be formally qualified in Learning and Development. GTR's SMS says (document 12.4 Appendix E section 1) that trainers and assessors must have or be working towards a training certificate or a qualification recognised or provided by the company. GTR was unable to provide any evidence that the driver instructor had any such qualification.

[5] Driver Development Plan, now called Competence Development Plan. This sets out a time-limited action plan to improve a driver's competence, following an operational incident in which the driver has been found to be at fault.

67 Case studies in RS/100 demonstrate how coaching skills can be developed, and section 4.3 describes modern thinking and practice in the training of train drivers. Section 5 describes the evaluation of training and competence management activities. This includes a case study from Southern Railway, one of the constituent companies of GTR, relating to its creation of a driver training steering group, and a project to develop a new framework for driver training and competence management. This included making sure that training staff have the right skills. However, at the time of the accident the lessons from this project had not yet been implemented on the Great Northern section of GTR, which includes the lines from King's Cross.

Ongoing management of competence for driver instructors

68 **The driver instructor's competence in the role had not been adequately assessed or monitored.**

69 GTR's SMS describes the way in which it manages the competence of train drivers and instructors in document SMS 12.4 'Competence Management of Safety Critical Operational Staff'. Appendix E of this document refers to the arrangements for demonstrating the competence of trainers and instructors. In relation to the maintenance of competence of trainers, the document says:

> 'In circumstances where the trainer or assessor interfaces directly with front line staff: It is accepted that the operational competence of the trainer or assessor is maintained by the delivery of day to day assessment activities. This is supported by the delivery of the practical assessment activities for the trainer or assessor in line with their competence assessment plan.'

70 The document says that the responsible assessor for a driver instructor is their Driver Team Manager. However, this function is actually performed by competence development managers (CDM) in GTR. Assessments take place while the driver instructor is accompanying a trainee. Evidence from GTR is that the focus of the assessment is on whether the driver instructor's instructions are timely, but the assessor will also consider whether the instructions cover the right information, and bring the trainee's attention to the right areas. The assessor also looks to see if the driver instructor is giving instructions and if the trainee reacts appropriately. The assessor may ask questions of the trainee when it is safe to do so.

71 The practical limitations of space in cabs makes it difficult for CDMs to observe and assess the ability of a driver instructor to teach a trainee and mentor them in the handling of a train. Assessors employed by other train operating companies have addressed this problem by playing the role of the trainee themselves, and directly assessing the quality of the instruction given by the driver instructor, but the technique is not known to have been used by GTR's assessors. GTR was not able to produce any records relating to the assessment of the driver instructor's training abilities.

72 The driver instructor had been involved in two safety incidents while acting in that role (he had not had any recorded safety incidents throughout his career while he was acting as driver). These incidents occurred in 2007 and 2012, and both involved the train doors being released on the wrong side when the train stopped at a station where the platform was on the right-hand side of the train.

73 Following the second of these incidents, the driver instructor was temporarily removed from acting as an instructor. GTR's investigation report on the incident recommended that he should be given additional training in managing distractions, to enable him to 'effectively instruct and manage trainees in the cab environment'. However, GTR was unable to produce any evidence that this had been done, or that the driver instructor had been put on any development or training plan, or given any additional monitoring or support following these incidents.

Factors affecting the severity of consequences

Effects of the collision

74 **Fourteen passengers were injured in the collision, some of whom were struck by items which fell from the vehicle ceiling.**

75 There were about 109 people on the train when it arrived at King's Cross. CCTV evidence shows that many of the passengers got up from their seats as the train entered platform 11, in readiness for alighting when it stopped. Consequently, when the train stopped abruptly on hitting the buffer stops, several people fell over or were thrown against seats, screens and other passengers.

The interior of the passenger saloons

76 There was very little damage to the interior of the train. None of the glass screens at the carriage doorways broke. A very few seat cushions were displaced, but all the seat mountings remained intact.

77 Two of the ceiling panels covering the door mechanisms dropped down, but were restrained by the secondary retention straps (figure 5) (one of the clips which fix these straps to the header panels broke, but the strap at the other end of the panel remained intact and stopped the panel dropping further).

78 In the leading carriage, at least three lighting *diffuser grids* dropped from the row that runs along the centre of the ceiling (figure 6), and at least one of them struck a passenger (figure 7). These grids are made from lightweight plastic and are unlikely to cause serious injury. They rest in place in the apertures in the ceiling, and are not secured in place. As originally designed, the diffusers were prone to dropping out of the ceiling if the train lurched or stopped abruptly, or if passengers interfered with them, and a modification was made in 2012 to add a metal strip to one side that hooks over one edge of the aperture, and helps to retain the diffuser in position. Evidence from GTR is that this has reduced the problem, but this accident shows that the diffusers can still be dislodged by an impact.

79 The twelve class 317 trains operated by GTR on the lines out of King's Cross are among a few remaining examples of this class of unit that retain their original design of interior fittings, including the loose diffusers in the ceiling. They are due to be replaced on these services by new class 700 trains in 2017.

Figure 5: Door header panel, dropped following the accident but restrained by secondary straps (hidden)

Figure 6: Ceiling of first vehicle, showing displaced lighting diffusers

Figure 7: Diffuser on saloon floor following the accident

The interior of the cab

80 In the cab, the fire extinguisher became detached from its bracket on the bulkhead behind the driver's seat, and flew past the trainee driver's shoulder, narrowly missing him. The extinguisher should have been retained in position by a strap, but this was missing. GTR checked the other 11 units of this type and found that the strap was missing on three of them. GTR has taken action to replace the straps and has modified its maintenance procedures to include a regular check on this item.

Observation

Buffer stops inspection and maintenance

81 **The records relating to the inspection of the buffer stops showed that incorrect inspections had been carried out on several occasions.**

82 The buffer stops in platform 11 performed as designed in the accident (paragraph 36). However, as part of the investigation, RAIB reviewed Network Rail's records of the inspection and maintenance of the buffer stops.

83 The inspection regime for buffer stops is defined in Network Rail company standard NR/L2/TRK/001/mod18 'Buffer stops'. Inspection is required annually, or after any report of a buffer stop collision.

84 The standard defines the general features to be checked for all types of buffer stops, and the special requirements for sliding/friction buffer stops. These include the condition of the holding-down bolts, the cleanliness of the running rails in the slide path, any obstructions in the slide path, and any need for the buffer stops to be returned to their normal position.

85 The buffer stops in platform 11 were inspected on 18 occasions in the years between 2002 and 2015. In four inspections from 2002 to 2005, the buffer stops were incorrectly identified as 'rail built', rather than the sliding/friction type, and the special requirements were marked as 'N/A'. For the next ten inspections, the buffer stops were correctly identified as being of the sliding friction type, and were inspected accordingly, but from 2011 onwards the next four inspections again mis-identified the type as 'rail built' (no record of any inspection could be found for 2013). This mis-identification meant that the special checks required for sliding friction type buffer stops were not carried out (paragraph 84), but there is no evidence that this resulted in any loss of effectiveness.

Previous occurrences of a similar character

86 A serious accident occurred at Cannon Street station, London, on 8 January 1991, when a crowded passenger train collided with the buffer stops of platform 3 at an estimated speed of between 9 and 11 mph (13 to 17 km/h). There were about 832 people on the train, and two passengers were killed and 542 injured, 277 of whom needed hospital treatment. In that accident many of the casualties resulted from the lack of structural strength of the vehicle bodies and the over-riding of vehicles which took place.

87 Since it became operational in 2005, the RAIB has investigated two collisions with buffer stops on the main line network: at Sudbury, Suffolk on 27 January 2006 (RAIB report 26/2006); and at Chester on 20 November 2013 (RAIB report 26/2014). No-one was seriously hurt in either of these accidents.

88 The circumstances of the three accidents referred to in paragraphs 86 and 87 were different from those applying at King's Cross.

Summary of conclusions

Immediate cause

89 The trainee driver did not apply the brake in time to stop the train before it hit the buffer stops (paragraph 37).

Causal factors

90 The causal factors were:

a. When prompted by the driver instructor to apply the brakes, the trainee selected the wrong control handle (paragraph 41, **Recommendation 1**);

b. The driver instructor permitted the trainee to drive on the approach to the buffer stops (paragraph 51, see paragraph 94 and **Recommendations 1 and 2**); and

c. The driver instructor did not sufficiently monitor the actions of the trainee driver on the approach to the buffer stops at King's Cross (paragraph 58, **Recommendations 1 and 2**).

Underlying factors

91 The underlying factors were:

a. GTR's regime for training its driver instructors focused on their technical competence as drivers rather than their wider skills as trainers (paragraph 61, **Recommendation 2**); and

b. The driver instructor's competence in the role had not been adequately assessed or monitored (paragraph 68, **Recommendation 2**).

Factors affecting the severity of consequences

92 Fourteen passengers were injured in the collision, and some passengers were struck by items which fell from the vehicle ceiling. Action has previously been taken to minimise the risks from this cause (paragraph 78), and no further recommendation is made.

Additional observations

93 Although not linked to the accident on 17 September 2015, the RAIB observes that the records relating to the inspection of the buffer stops in platform 11 at King's Cross showed that incorrect inspections had been carried out on several occasions (paragraph 81, see paragraph 85).

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

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

94 GTR has issued guidance to its driver instructors on maintaining increased vigilance when trainee drivers are engaging in critical tasks such as approaching signals at danger, buffer stops and platforms.

95 Network Rail has made arrangements to re-brief staff who carry out inspections of buffer stops on the different types of equipment, and the necessary maintenance actions.

Recommendations

96 The following recommendations are made[6]:

1 *The intent of this recommendation is to reduce the risk of accidents arising from errors by inexperienced drivers.*

Govia Thameslink Railway should review its arrangements for managing trainee drivers, to minimise the risks that may arise from errors associated with inexperience. The review should include consideration of:

- the stage of training at which new drivers are permitted to drive on higher-risk sections of route, such as the approach to buffer stops;
- the amount and type of training, and experience, necessary for trainee drivers to achieve competence in other circumstances in which they may need to respond quickly to events, or otherwise act in a timely manner, such as sounding the warning horn, entering occupied platforms, and drawing up to other vehicles and obstructions; and
- additional measures to enhance trainees' familiarity with train controls before first driving trains in passenger service (eg the greater use of simulators and/or practice on trains in sidings).

Govia Thameslink Railway should then put in place a programme for the implementation of any reasonably practicable measures for improvement that are identified during the review (paragraphs 90a, 90b and 90c).

This recommendation may also apply to other train operating companies.

continued

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

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

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

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

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

2 *The intent of this recommendation is to improve the quality of the training given to new drivers by driver instructors on GTR, to reduce the risk of accidents and incidents occurring during training.*

Govia Thameslink Railway should review the selection, training and management of its driver instructors, to improve the quality of training delivered to drivers. The review should draw on the guidance in RSSB publication RS/100 'Good practice guide on competence development' and ORR publication RSP1 'Developing and maintaining staff competence', and include:

- the criteria for selection of individuals to act as driver instructors;
- the training given to driver instructors on methods of teaching, the supervision and mentoring of trainees, and development of non-technical skills; and
- how the competence of driver instructors is assessed, with particular reference to the ability to teach, and possible techniques for assessment, including assessment from the driving seat.

The management arrangements should be updated with relevant findings from this review (paragraphs 90b, 90c, 91a and 91b).

This recommendation may also apply to other train operating companies.

Appendices

Appendix A - Glossary of abbreviations and acronyms

AWS	Automatic warning system
CCTV	Closed circuit television
CDM	Competence development manager
DDP	Driver development plan
DSD	Driver's safety device
GTR	Govia Thameslink Railway
OTDR	On-train data recorder
SMS	Safety management system
TPWS	Train protection and warning system

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.

Buffer stops	Equipment provided at the end of a railway track to mark the end of the line and provide a means of stopping and restraining vehicles on the track. They may have limited capacity to absorb energy.
Electric multiple unit	A train consisting of one or more vehicles (semi-permanently coupled together) with a driving cab at both ends, that can be driven and controlled as a single unit from the driving cab at the leading end and whose motive power is electricity supplied externally from overhead line equipment or conductor rails.*
Diffuser grid	Lightweight plastic grid which is placed below a fluorescent lamp to reduce glare and improve the appearance of the lamp.

Appendix C - Investigation details

The RAIB used the following sources of evidence in this investigation:

- information provided by witnesses;
- information taken from the train's on-train data recorder (OTDR);
- closed circuit television (CCTV) recordings taken from the train and from King's Cross station;
- site photographs and measurements;
- weather reports and observations at the site;
- a review of GTR's safety management system;
- Network Rail's records relating to buffer stop maintenance; and
- a review of previous RAIB investigations that had relevance to this accident.

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