RAIB

Rail Accident Investigation Branch

Rail Accident Report

Passenger accident at Brentwood station
28 January 2011

Department for Transport

Report 19/2011
November 2011

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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Passenger accident at Brentwood station 28 January 2011

Contents

Summary

At 23:42 hrs on 28 January 2011, a passenger alighting from the last coach of a train at Brentwood station fell, head first, between the side of the train and the platform. Another passenger who had alighted from the same train saw her begin to fall and was able to hold on to one of her legs. The driver of the train did not see this happen and the train departed from the station with the passenger still in the gap between the train and the platform. The passenger sustained injuries to her leg and head in the accident.

At Brentwood station train drivers are required to undertake a safety check after closing the train's doors and before moving out of the platform. To do this, the driver needs to look out of his cab window at the first six coaches of the train and look at a platform-mounted monitor to see the last two coaches of the train.

The driver of the train involved in the accident had stopped beyond the monitor and in a position where it was only just possible to see the image. He performed the safety check as the train started to move and it is therefore unlikely that he was able to see the events happening at the last coach of the train before the image in the monitor was obscured. It is also possible that his view of the last coach was obstructed by a passenger walking along the platform.

The investigation found that the passenger had tried to alight as the doors started to close and then fell as she squeezed between the leaves of the door. The investigation also identified weaknesses in the way that the train operator, National Express East Anglia, had trained, briefed and monitored its drivers who are required to dispatch trains from unstaffed platforms and in the way that it addressed the risk from driver-only operation of trains. There were also weaknesses in the way that key items of equipment (monitors and signage provided to indicate to a train driver where to stop) were configured on the platform where the accident occurred.

The RAIB has made five recommendations:

- three to National Express East Anglia relating to driver training and assessment, risk assessment reviews and the availability of CCTV equipment on trains;
- one to Network Rail relating to working with train operators to assess periodically the suitability of equipment provided at unstaffed platforms to assist train drivers to dispatch trains; and
- one to the Rail Safety and Standards Board relating to the inclusion within industry guidance of a clause on observing train doors while they are closing by all staff involved in train dispatch, so far as is reasonably practicable.

Preface

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

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

Key Definitions

3 Dimensions in this report are given in metric units, with the exception of speeds which are given in imperial units with the equivalent metric value.

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

The accident

Summary of the accident

5 At 23:42 hrs on Friday 28 January 2011, a passenger alighting from the 23:05 hrs National Express East Anglia (NXEA) service from Liverpool Street to Shenfield (train reporting number 2W10), fell between the train and the platform at Brentwood station, Essex (figures 1 and 2).

6 A member of the public (a passenger who had just alighted from the same train) saw the passenger start to fall and was able to reach her in time to hold on to one of her legs as she was falling between the train and the platform.

7 The driver of the train did not observe this happen and the train departed from the platform. The member of the public continued to support the passenger as the train passed by before lowering her onto the tracks. The passenger was assisted back onto the platform by other passengers. She received minor injuries, including cuts and bruising.

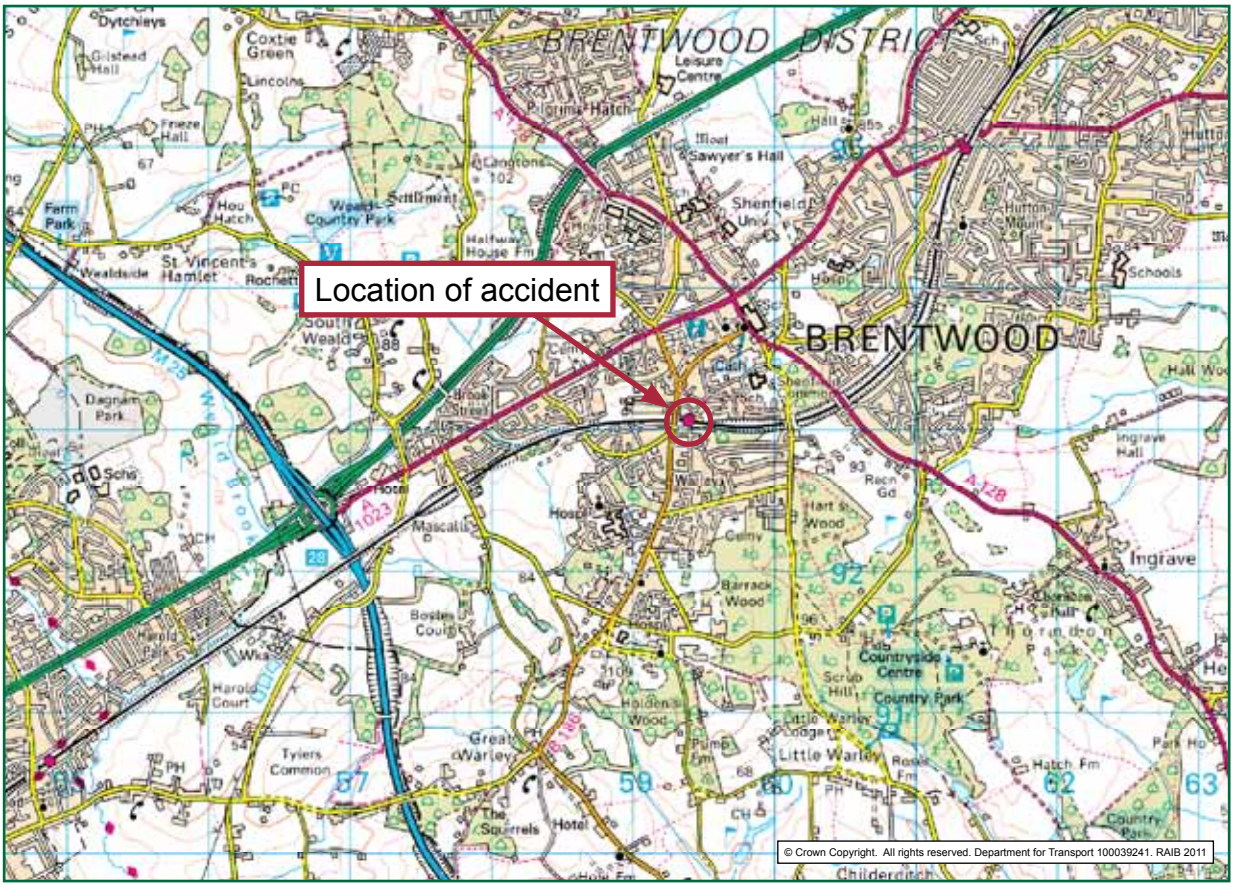

Figure 1: Extract from Ordnance Survey map showing location of accident.

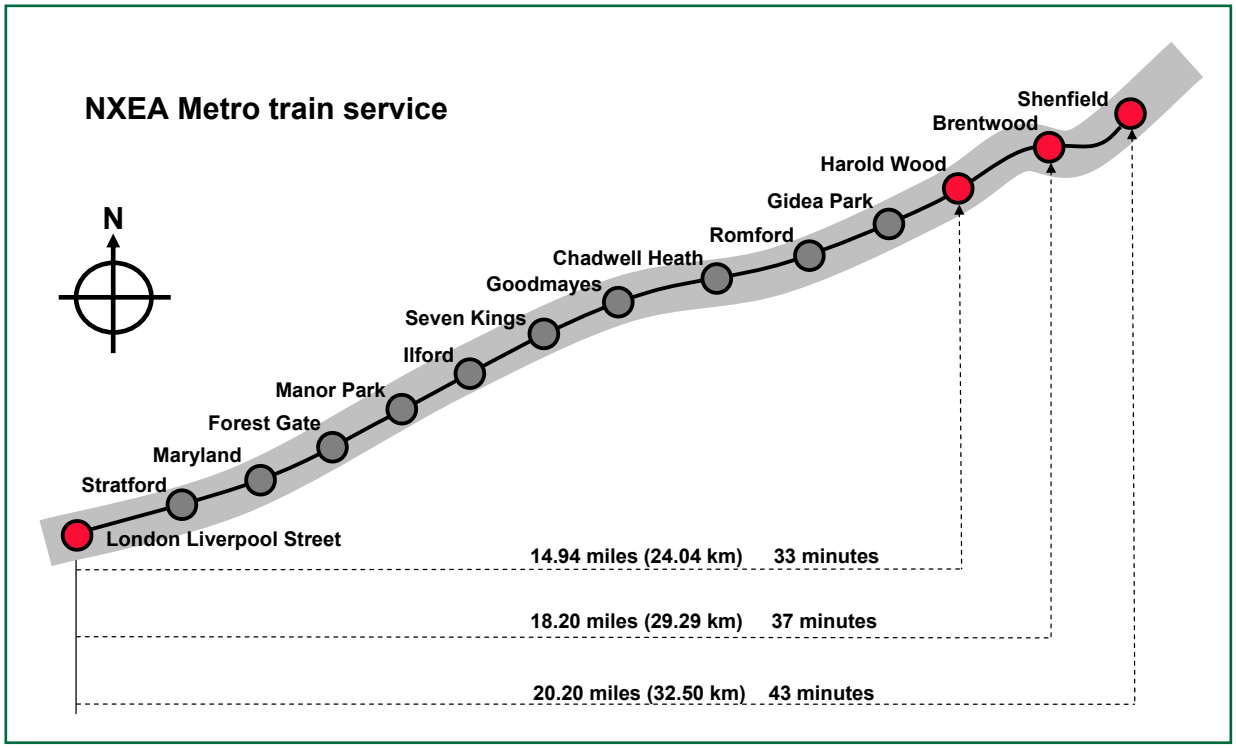

Figure 2: National Express East Anglia 'Metro' route. The dotted lines indicate the distance and running time to the relevant stations from London Liverpool Street station.

Organisations involved

8 Brentwood station is owned by Network Rail. Network Rail maintains the CCTV camera and two monitors provided to assist train drivers with train dispatch. NXEA leases the station from Network Rail and is the station operator.

9 The train involved in the accident was operated by NXEA, who also employed the driver of the train.

Location

10 Brentwood station is located on the main line between London Liverpool Street and Ipswich and is approximately 18 miles (29 km) from Liverpool Street station. The route is electrified using the 25 kV overhead line system to provide power for electric trains.

11 The accident occurred in platform four at Brentwood station. Platform four is 182 metres long. The platform has a gentle right-hand curve (in the direction of travel) over the first 100 metres, followed by a straight section of approximately 15 metres and a left-hand curve for the remaining 67 metres (figure 3).

12 The platform edge at the location of the accident was approximately 845 mm vertically above the level of the rails and approximately 746 mm laterally from the nearest rail. These dimensions are shown in figure 4. A recess is built into the face of the platform and provides an emergency refuge.

Figure 3: Brentwood platform 4. Photograph depicting curvature of platform.

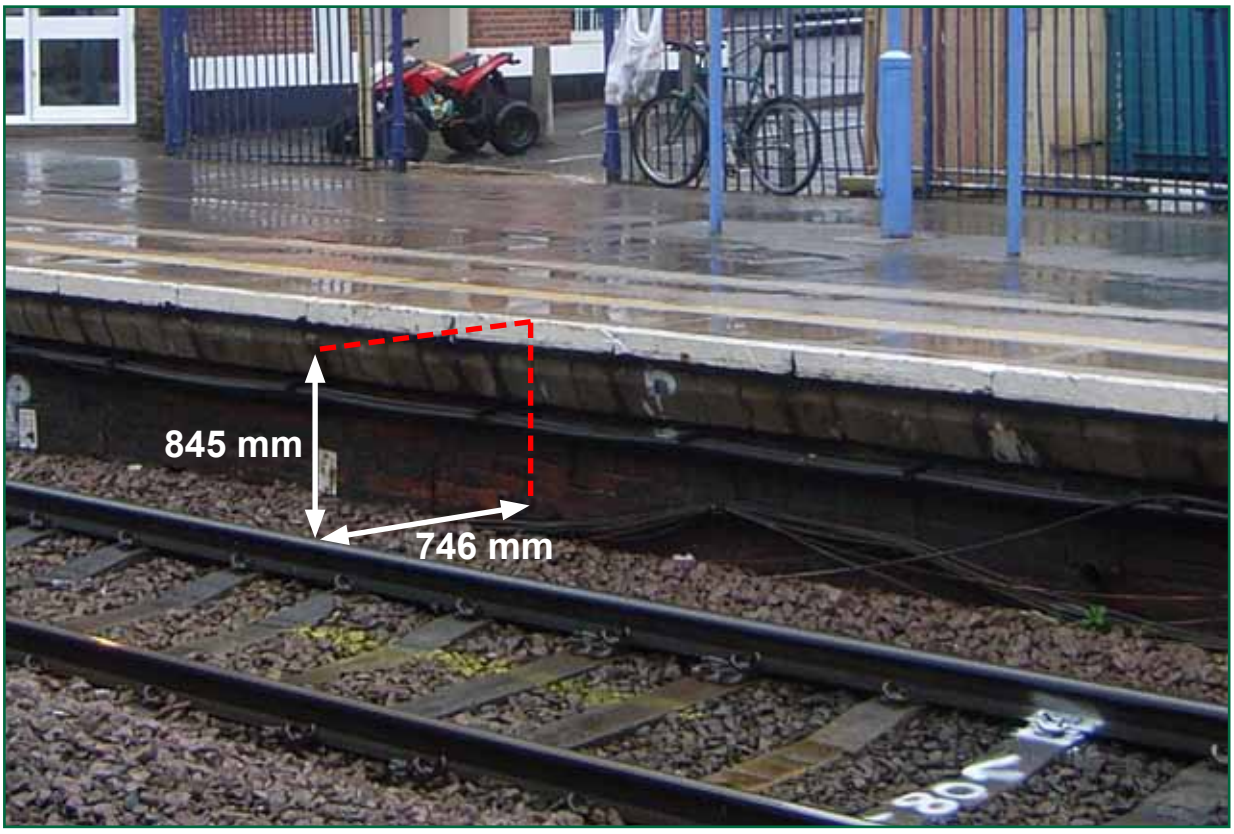

Figure 4: Platform-track dimensions at location of accident on platform 4 Brentwood station.

13 The track through platform four at the location of the accident had a *cant* of approximately 77 mm to allow trains that do not stop at the station to pass through at speeds up to 75 mph (120 km/h). The platform curve radius at the location of the accident was approximately 1,428 metres.

14 The platforms at Brentwood station are unstaffed, as are other stations on the route. The trains that form the Metro[1] service are operated by a train driver alone and no train *guard* is provided: this is known as *Driver Only Operation* (DOO). Two *greyscale* Cathode Ray Tube (CRT) monitors linked to a single CCTV camera are provided to assist train drivers in operating their trains safely at the platform. One monitor is provided for the drivers of four-car[2] trains and one is provided for the drivers of eight-car trains. This is necessary because four-car and eight-car trains are required to stop at different points at the platform. A *stop board (*for eight-car trains) was provided 3.43 metres beyond the centre of the eight-car DOO monitor.

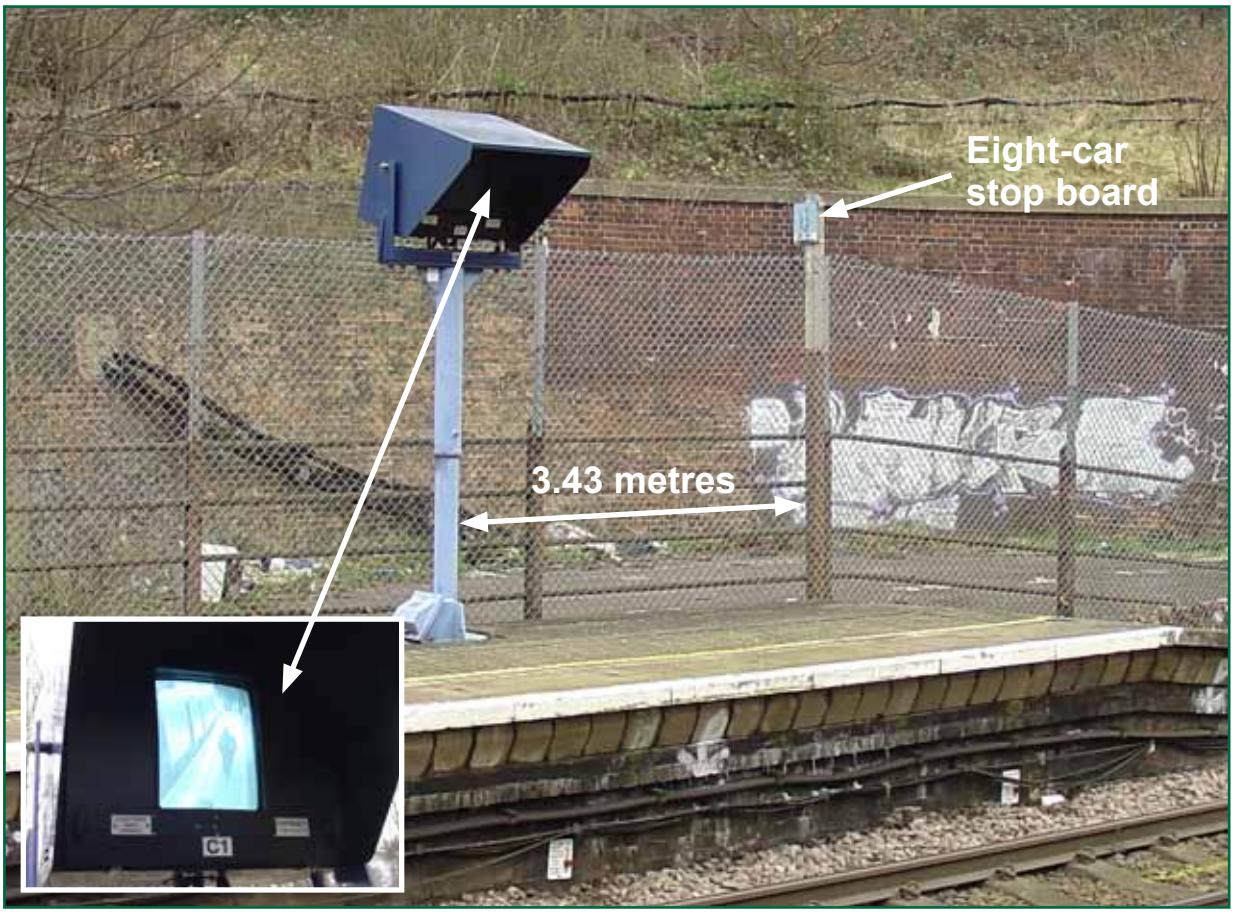

Figure 5: Brentwood platform four. Eight-car DOO monitor and stop-board. Inset: Image displayed on CCTV monitor.

[1] 'Metro' is the name given by NXEA to a group of local services including those operating on the route from London Liverpool Street to Shenfield.

[2] The term 'car' means the same as vehicle, coach or carriage when discussing passenger carrying accommodation in railway terminology.

15 The accident occurred during the hours of darkness. CCTV evidence indicated that the platform lighting was functioning in the vicinity of the accident location. The internal train lighting was also functioning, including at the doorway through which the passenger alighted. There is no evidence to indicate that the level of lighting was a factor in this accident. The RAIB examined the condition of the platform edge, including the platform surface and coping stones, in the vicinity of the location of the accident. No faults or defects were observed that could have contributed to the accident.

Trains involved

16 Train 2W10 was formed of two four-car class 315 electric multiple units coupled together. The train was approximately 160 metres long.

17 Class 315 trains were built between 1980 and 1981 by British Rail Engineering Limited. Each carriage has passenger doors located 1/3 and 2/3 along the length of the carriage bodyside (figure 6).

Figure 6: Class 315 EMU with doors at 1/3 and 2/3 positions.

18 Each passenger doorway is approximately 1.45 metres wide and is fitted with two sliding doors. Internal and external push-buttons are provided at each doorway to allow passengers to operate the doors once the train driver has released them using the controls in the driving cab. Audible alarms are provided at each doorway position to warn passengers when the doors are about to close. Warning signs above each doorway state that passengers should not attempt to leave the train when the doors are closing. An orange light illuminates on the outside of each carriage when the passenger doors are released.

19 The passenger doors are powered by electric motors. An obstacle detection system is provided. If an obstruction is detected (by sensors located in the door edge), the doors will stop closing for approximately 0.5 seconds and then attempt to continue closing. This will happen up to four times. If the doors are still obstructed after the fourth attempt, the doors will open fully and remain open.

20 A fixed step is provided at each passenger doorway. The step is approximately 1.57 metres long and extends 40 mm out from the carriage bodyside.

21 The RAIB has found no evidence that the condition of the train, including the maintenance and operation of the door system and the condition of the passenger door step at the passenger door used by the passenger who fell, contributed to the accident.

Persons involved

22 The train driver had around 20 months' train driving experience at the time of the accident. A significant portion of this time had been spent driving class 315 trains on the Metro route under DOO conditions. At the time of the accident the train driver was medically fit and was not required to wear corrective lenses for eyesight. There is no evidence that the train driver was fatigued at the time of the accident.

23 The passenger who was involved in the accident was a frequent user of the Metro service and regularly travelled between Liverpool Street and Harold Wood stations on class 315 trains. Although her normal station was Harold Wood she had used Brentwood station before.

External circumstances

24 It was a cold, dry night. The platform surface was dry. External circumstances did not contribute to the accident.

Events preceding the accident

25 At around 22:55 hrs the passenger involved in the accident joined train 2W10 at Liverpool Street station. She sat in the rear carriage of the eight-carriage train. She was travelling alone and had two bags with her.

26 At around 23:00 hrs the driver of train 2W10 *mobilised* it for service. The driver had previously operated a train into Liverpool Street station, arriving at around 22:42 hrs.

27 Train 2W10 departed from Liverpool Street on time at 23:05 hrs and remained on time throughout its journey. During the journey the passenger fell asleep and missed her stop at Harold Wood station.

28 At around 23:41 hrs train 2W10 arrived in platform four at Brentwood station. The train driver stopped the train with its leading end approximately three metres beyond the DOO monitor (around 0.4 metres before the stop board) and released the train doors.

29 Shortly after the train had arrived at Brentwood station, the passenger awoke and realised that she had missed her intended stop. She decided to alight at Brentwood.

30 Around 17 seconds after the train had arrived in the platform the driver pressed the 'doors close' button in the driving cab. This resulted in an alarm sounding on the train to warn passengers that the doors were about to close. As the doors on the train closed, the passenger squeezed between the *door leaves* of the last set of passenger doors on the train. This was witnessed by another passenger who had already got off the train and was walking towards the station exit.

Events during the accident

31 The witness stated that he saw the female passenger appear to get momentarily caught as the doors closed on one or both bags she was carrying on her back or shoulder. On pulling herself free of the closing doors he saw the passenger begin to fall into the gap between the platform and the train bodyside. The witness stated that he dropped the bags he was carrying and leapt towards the falling passenger and was able to hold on to a leg to prevent her disappearing completely into the gap.

32 When the train's doors had closed the driver saw the *train door interlock* light illuminate in the driving cab. The interlock light, when illuminated, tells the driver that all the train doors are closed. He applied power and as the train began to move he looked back along the train and up at the DOO monitor. Seeing nothing unusual the driver continued out of the station. As the rear of the train passed, the witness lowered the passenger down onto the track.

33 Other passengers on the platform heard shouting at the rear of the train and saw a person in the gap between the platform and train being supported by the witness.

Events following the accident

34 The injured passenger was assisted back on to the platform and was given transport to her home by another passenger.

35 The following day, the injured passenger returned to Brentwood station to report the accident and her lost travel ticket, which was later found on the track near to the location of the accident. As the station was unstaffed[3] at the time of the accident it was not possible to report the accident immediately after it had happened.

Consequences of the accident

36 The passenger received cuts and bruising to her legs and to the top of her head which required medical attention.

[3] Staff were provided in the ticket office at Brentwood station during peak hours. These staff members were not trained in train dispatch duties.

The Investigation

Sources of evidence

37 The following sources of evidence were used:

- witness statements;
- the train's On Train Data Recorder (OTDR) data and OTDR data from other class 315 trains that operated the Liverpool Street to Shenfield Metro service in 2010 and 2011;
- CCTV recordings of platforms three and four at Brentwood station;
- site photographs and measurements;
- a reconstruction of the circumstances of the accident at Brentwood station;
- Network Rail platform and track survey data and documents relating to the maintenance of the DOO equipment at Brentwood station;
- documents from NXEA relating to train driving, train dispatch and safety management systems;
- Railway Group Standards and Network Rail company standards relating to the platform-train interface, DOO, and train dispatch;
- a Rail Safety and Standards Board (RSSB) special topic report on passenger risk at the platform-train interface;
- a review of previous reported incidents and accidents at the platform-train interface; and
- a review of previous RAIB investigations relevant to this accident.

Key facts and analysis

Identification of the immediate cause[4]

38 **Train 2W10 departed from Brentwood station with a passenger in an unsafe position between the platform edge and the train.**

39 The main witness to the accident saw the passenger fall into the gap between the train and platform as the train doors were closing. He held onto the passenger's leg while she was in the gap as the train departed from the platform. Several witnesses on the platform saw the passenger being supported in the gap by a fellow passenger as the train departed.

40 CCTV images from a security camera located on platform four recorded witnesses looking towards the accident location just before the train started moving at 23:43:04 hrs[5]. In the next recorded frame[6] at 23:43:07 the same witnesses are still looking towards the same area as the train is departing.

41 The passenger's injuries were consistent with the back of her right leg having been struck by the steps that provide access to the rear driving cab of the train.

Identification of causal[7] and underlying factors[8]

The actions of the passenger

42 **The passenger alighted from the train at a time when the audible alarm was sounding and the doors had started to close. This was a causal factor.**

43 Having overslept and missed her intended stop, the passenger decided to alight from the train despite the audible warning that the doors were about to close. The factors that may have caused the passenger to attempt to alight were:

- she had consumed alcohol during the evening before catching the train; and
- when she awoke she realised that she had already missed her intended stop and did not want to be over-carried to the next station.

44 **The passenger lost her balance and fell into the gap between the platform edge and train bodyside. This was a causal factor.**

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

[5] The RAIB established that the time recorded by the CCTV system at Brentwood station was 1 minute 03 seconds ahead of the radio time signal transmitted from Anthorn Radio Station, Cumbria.

[6] The CCTV system installed at Brentwood station recorded images at a rate of one frame every 3 seconds.

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

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

45 A witness to the accident recalled that the passenger moved towards the rear set of passenger doors on the last carriage as he was walking along the platform having alighted from the fourth or fifth vehicle from the front of the train. The train doors were beginning to close and the door closing audible warning was sounding. The same witness thought it likely that the person would not get off the train in time. Moments later, he saw the passenger in the doorway. She appeared to get momentarily caught by the closing doors by at least one of the bags she was carrying on her back or shoulder. An image from the platform CCTV shows the rear doors of the eighth (rearmost) carriage partially open, while the leading doors on the same carriage are closed (figure 7). This is consistent with witness evidence that the injured passenger's bag(s) obstructed the closing of the doors.

Figure 7: CCTV still showing accident door at the rear of the train partially open (and partially obscured by a station information sign) and leading door closed.

46 The witness saw the passenger pull herself free of the closing doors and fall to her right towards the gap between the platform edge and train bodyside (not between the train step and platform edge). He ran forward and was able to hold onto her leg as she fell into the gap. Analysis[9] by the RAIB indicates that she was almost completely head-down in the gap (figure 8). As the train began to depart the witness supported the passenger by holding her left leg until the rear of the train had passed by.

47 The passenger received minor injuries as the train passed by. The main injury, a severe graze to the back of the upper right leg, was consistent with her right leg having been struck by the steps that provide access to the rear driving cab of the train (figure 9).

[9] The RAIB used computer-based simulation to recreate the accident sequence. Data sources included site measurements of the platform and track, dimensions from a class 315 train and information on the location and type of injuries sustained by the injured passenger.

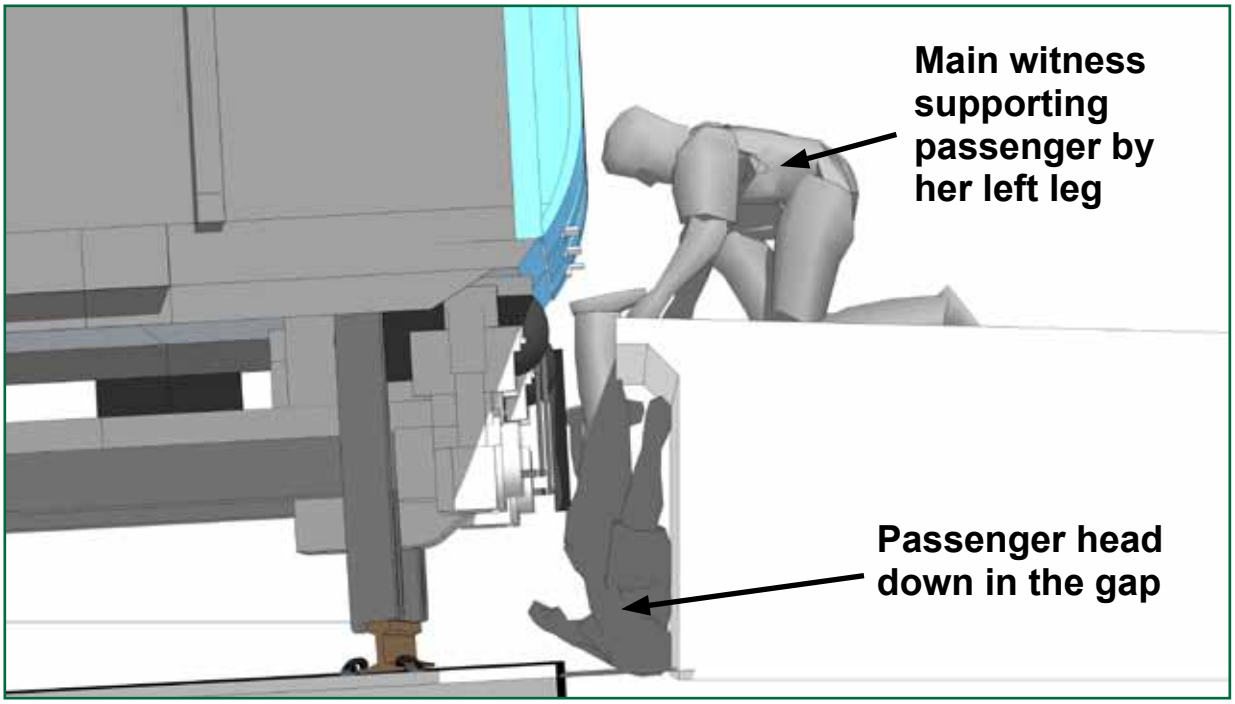

Figure 8: Positions of witness and passenger looking towards the back of the train.

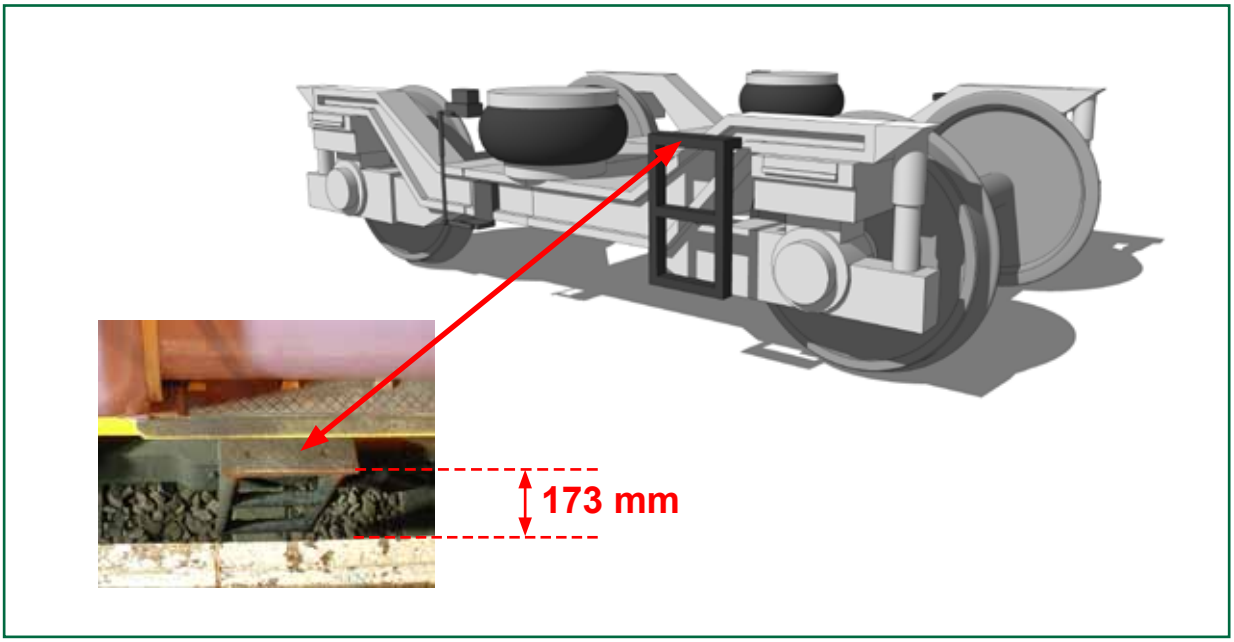

Figure 9: Class 315 bogie from driving cab vehicle. The inset photograph shows the tread plate fixed to the top of the cab access steps and the 173 mm gap that existed between the edges of the cab access step tread plate and the platform edge.

48 The RAIB has considered why the passenger lost her balance while getting off the train. It is likely that the passenger was rushing to alight from the train (paragraph 41). At least one of the two bags that the passenger was carrying was over her shoulder (witnesses were unsure which shoulder). One or two bags are likely to have got caught in the closing doors as the passenger squeezed between them. As she pulled herself through the doors the momentum sent her sideways (to her right), and head-first, towards the gap between the platform edge and the bodyside of the train. Other factors that are likely to have contributed to the passenger losing her balance are discussed at paragraph 43.

49 It is unlikely that the passenger's footwear contributed to the accident because she was wearing flat bottomed boots that also provided a degree of ankle support.

The gap between the platform and the bodyside of the train

50 The gap between the train bodyside and platform edge was wide enough for the passenger to fall into.

51 The national main line rail network was constructed by a number of different private companies. These companies built trains and platforms to their own specifications. This resulted in platforms of different heights and vehicles of different widths. Modern trains and platforms are built to common standards. However, many platforms that were built before common standards were imposed are still in use today, including those at Brentwood station.

52 Railway lines have to be positioned sufficiently far from platform edges to make sure that trains do not strike them as they pass through. To allow for vehicle suspension movement and vehicle body sway as trains pass through stations at speed, a safety margin is provided. Railway Group Standard GC/RT5212 'Requirements for Defining and Maintaining Clearances' mandates the positioning of track relative to structures such as platforms. Where the line speed is equal to or less than 125 mph (201 km/h) the minimum normal clearance between a structure and a rail vehicle mandated in standard GC/RT5212 is 50 mm. The standard does not mandate a maximum clearance dimension.

53 There are no standards for maximum clearances between train bodysides and platforms. This is because the governing dimension is that between the platform and the train steps, which are provided to minimise the stepping distance from train to platform.

54 In the absence of standards governing gaps between train bodysides and platforms, the RAIB has attempted to establish whether the bodyside-platform gap at the location of the accident was unusually large by examining the distance between the train step and the platform at the location of the accident (for which there are standards).

55 The current issue of Railway Group Standard GI/RT7016 'Interface between Station Platforms, Track and Trains', which came into force in April 2004, includes requirements for platform height and platform offset relative to the track, and the relative position of the passenger door step to the platform. These dimensions are applied to new platforms or to existing platforms that have been altered, such as by lengthening or rebuilding, but do not apply retrospectively.

56 Before April 2004, Railway Group Standard GC/RT5161 'Station Platform Design Requirements' issued in December 1995, and its predecessor, GC/TT0196, of the same name, issued in October 1993, contained broadly similar requirements to standard GI/RT7016. Brentwood platform four had not been significantly altered since 1993 and it had not therefore been necessary to bring it into compliance with any of the standards referred to in this or the preceding paragraph.

57 Table 1 indicates the actual dimensions[10] recorded at Brentwood platform four against the dimensions in standard GI/RT7016.

[10] The dimensions are measured parallel and perpendicular to the plane of the rails and include the measurement of cant at the location.

Dimension	Dimension measured at stopping position of rear door of train 2W10 at Brentwood (mm)	Dimensions in standard GI/RT7016 (mm)	Comment on compliance with current standard
Platform offset	746	730-745	Marginally greater than current standards permit.
Platform height	845	890-915	Lower than current standards permit.
Horizontal stepping distance from step to platform	163	275 (maximum)	Complies with the current standard.
Vertical stepping distance from step to platform	289	250 (maximum)	Greater than current standards permit.
Diagonal stepping distance from step to platform	332	350 (maximum)	Complies with the current standard.

Table 1: Platform interface dimensions at Brentwood platform four compared to the requirements of Railway Group Standard GI/RT7016.

58 Table 1 shows that the vertical stepping distance at Brentwood platform four was greater than current standards would permit. This is unlikely to have affected the passenger's loss of balance (there is no evidence that she actually set foot on the platform surface). However, for this type of train, it would have resulted in a larger gap between the bodyside of the train and the platform edge than if this dimension had been compliant with current standards.

59 The RAIB has considered whether the gap between the bodyside of the train and the edge of the platform would still have been large enough for the passenger to have fallen into if Brentwood platform four was fully compliant with the requirements of the current railway group standard, GI/RT7016. The diagonal gap between the bodyside of the train and the edge of the platform at the site of the accident was approximately 345 mm (including the effect of the 77 mm cant at the location). To align with the values in standard GI/RT7016 the platform height would need to be increased by 45 mm and the track would need to be positioned 1 mm closer to the platform edge. If these changes were made the diagonal gap between the bodyside of the train and the edge of the platform would be reduced to approximately 320 mm (ie a reduction of 25 mm). It is unlikely that a reduction of 25 mm in the diagonal dimension of the gap between the bodyside of the train and the edge of the platform would have prevented the passenger from falling between the train and the platform (figures 10 and 11).

60 The train did not stop with the driving cab alongside the CCTV monitor. The significance of this is discussed later. The RAIB has established that if the train driver had stopped the train alongside the CCTV monitor on the night of the accident, the diagonal dimension between the bodyside of the train and the edge of the platform would have been 9 mm greater (ie 354 mm) due to slight variances in platform height, track lateral position and carriage suspension movement.

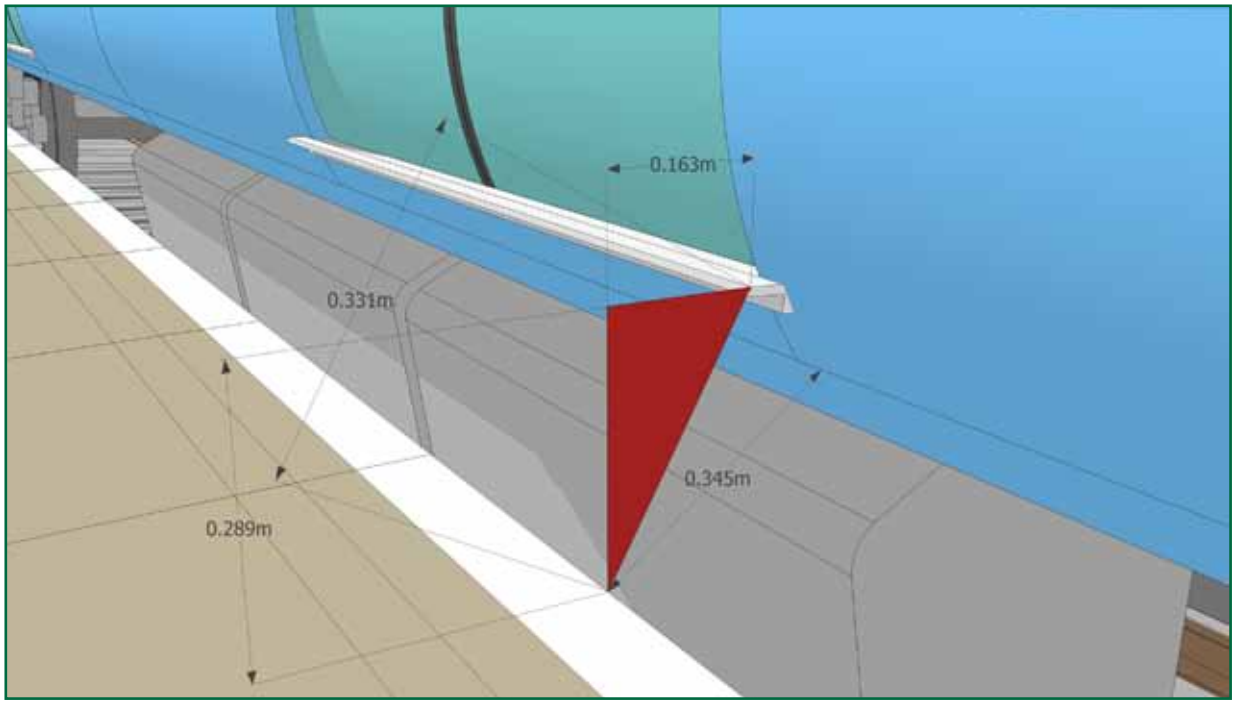

Figure 10: Platform-train interface dimensions as measured at Brentwood platform four.

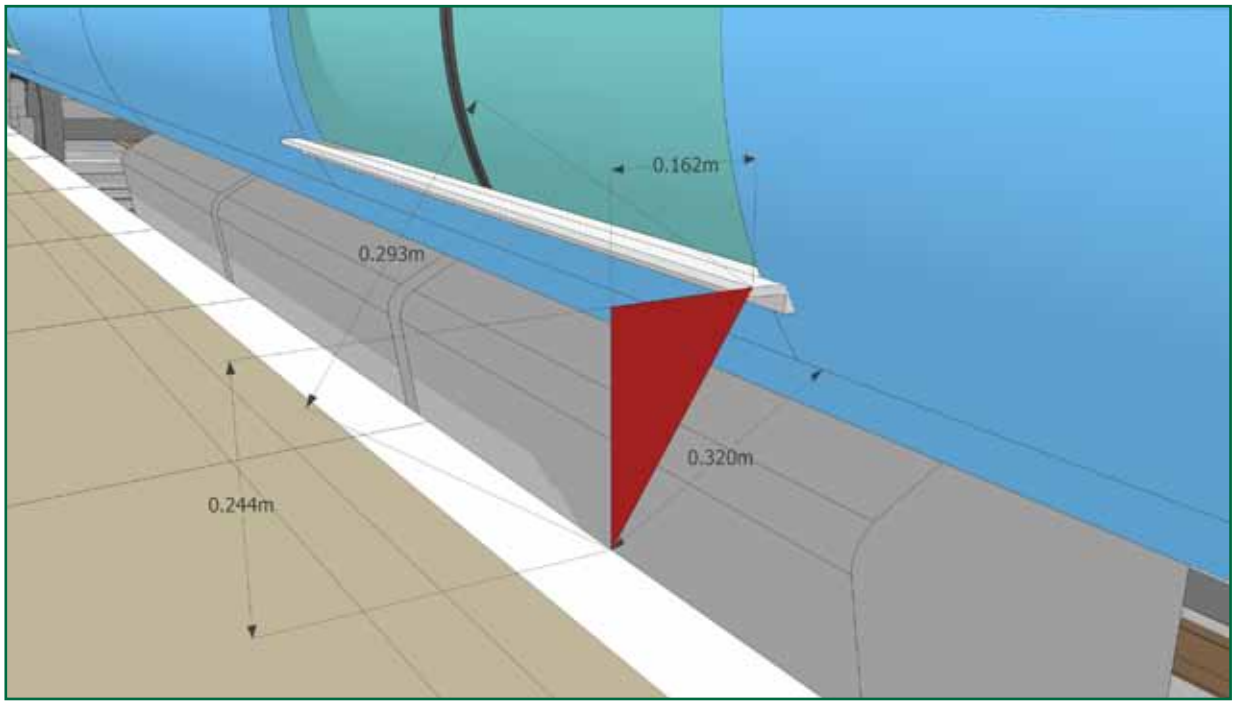

Figure 11: Dimensions if Brentwood platform four was compliant with modern standards.

61 The distance between the platform edge and the train bodyside at Brentwood was not exceptional. There are other platforms on the national rail network[11] where the gap is much greater due to platform curvature, track off-set or low platform height.

[11] The RAIB measured the diagonal platform to train bodyside gap at platforms at London Waterloo and London Paddington stations. The diagonal gaps measured were significantly greater that those measured at platform four, Brentwood station.

62 A recess was available between the face of the platform and the nearest rail. This provided a survival space and meant that the passenger was not subject to more serious injury as the train passed her by. All new platforms, and any platforms that are subject to significant alteration[12], are required to be provided with a recess beneath the platform edge.

The actions of the train driver

63 The driver of train 2W10 departed from Brentwood station without having seen anything that alerted him to the events taking place at the rear of his train. There are three possible reasons why this happened:

- he was not required to observe the train while the doors were closing;
- he did not complete a train safety check[13] before starting his train; and
- a person on the platform may have obscured the train driver's view of events on the CCTV monitor.

Observing the train's doors as they close

64 **The train driver did not observe the train's doors as they were closing and was not required to do so by current rules and regulations. Had he observed the closing doors, it is possible that he would have seen the passenger getting off the train and the accident occurring. This was possibly a causal factor.**

65 To dispatch eight-car trains from platform four at Brentwood station, the train driver must look out of the driving cab side window to view the first six cars. The driver must also look at the eight-car DOO monitor display to see the last two cars of the train because of a curve in the platform which prevents the train driver from being able to see all eight cars (figure 12).

66 There were no rules or instructions within the railway rule book (GE/RT8000) or NXEA's company standards and driver training material that required train drivers to observe the train's doors as they close. Rule book GE/RT8000 module SS1 describes the instructions and responsibilities associated with station duties and train dispatch. Train drivers dispatching trains from an unstaffed DOO platform must:

- check the whole length of the train to make sure it is safe to close the doors;
- check that the door interlock light is lit when the doors have closed; and then
- carry out the train safety check.

67 Depending on the location and method of train dispatch in use, platform staff and train guards can also be involved in train dispatch and are similarly not instructed by GE/RT8000 to observe the closing doors of trains during the train dispatch process.

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[12] Railway Group Standard GI/RT7016 defines 'alteration of a platform' as the substantial lengthening or rebuilding of all or part of an existing platform and/or an associated structure, or renewal of station equipment or platform furniture, which provides a reasonable opportunity to bring the items concerned into conformity with the requirements of GI/RT7016.

[13] The train safety check must be completed before starting the train (ie applying power). The check consists of looking along the train to ensure that the train doors are properly closed, nobody is trapped in the doors *and* it is safe for the train to start.

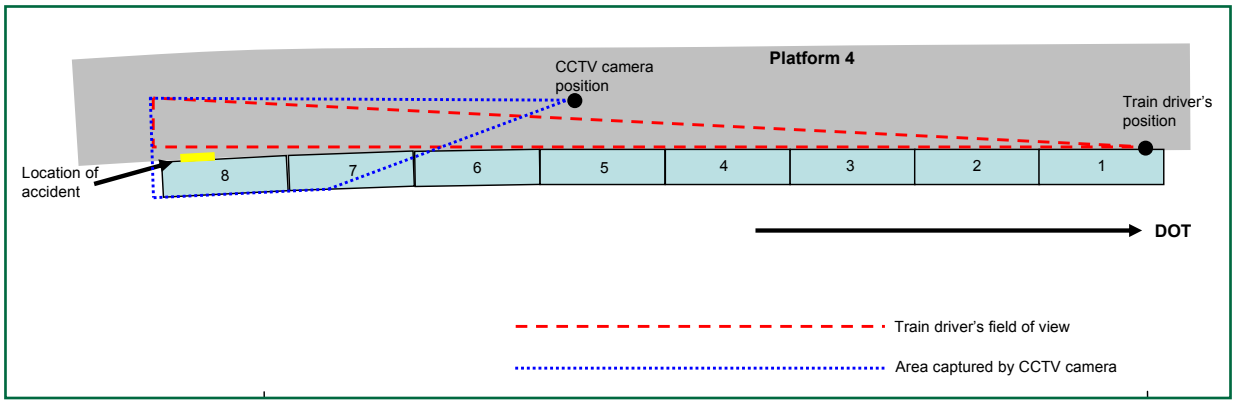

Figure 12: Train drivers' view of an eight-car train and area captured by DOO CCTV system.

68 However, even if there had been a requirement for the train driver to observe the closing train doors, it is not certain that he would have been looking at the monitor when the passenger alighted from the rear door, because the train dispatch arrangements at Brentwood required drivers to look along the length of their trains as well as in the monitor (paragraph 65).

69 The RAIB considered whether the presence of platform dispatch staff and/or a train guard might have prevented the accident occurring. In both cases opportunities exist for an event to be missed because:

- a particular part of the platform and/or train is not being actively observed as the dispatcher and/or guard need to look both ways along the train and platform; and
- dispatchers and/or guards can be temporarily distracted while engaged in dealing with passenger queries.

70 However, a member of platform dispatch staff might have seen the person who was holding the passenger's leg. In these circumstances, the platform dispatcher would not have signalled to the driver that the train was safe to start and the passenger could have been retrieved before the train departed.

The train safety check

71 **The train driver did not complete the train safety check before he started the train. Had he done so he might have seen that there was a person crouched beside the train in a potentially unsafe position. This was a possible causal factor.**

72 Rule book module GE/RT8000/SS1 states that the train driver must carry out the train safety check before starting a DOO train from an unstaffed platform. Rule book module GE/RT8000/SS1 describes the train safety check as comprising a review that:

- the train doors are properly closed;
- nobody is trapped in the train doors; and
- it is safe to start the train.

73 The driver of train 2W10 stated that his normal routine when stopping at Brentwood platform four was to position the train approximately between the eight-car monitor and eight-car stop board (paragraph 83). When the driver judged it was time for the train to depart, he stated that he would check it was safe to close the train doors by looking back along the train and at the CCTV monitor. The driver would then press the 'doors close' button in the cab. When the doors had closed, confirmed by the illumination of the door interlock light in the driving cab, the driver would check the signal ahead of the train, release the train's brakes and apply power to start the train. The driver stated that he would complete the train safety check as the train started to move by looking back out of the cab window and looking at the eight-car CCTV monitor. The reasons why the train driver did not fully comply with the requirements of GE/RT8000/SS1 are described at paragraphs 105 to 120.

74 Analysis of the data from the OTDR showed that the train driver selected power 0.4 seconds after the train doors had closed. This implies that if the driver was to be compliant with the requirements of the rule book, he had to complete the train safety check during 0.4 seconds.

75 To establish how long it takes to complete the train safety check at Brentwood platform four and other locations[14], the RAIB analysed data from the OTDRs of 10 other trains on the route between 2009 and 2011. The RAIB also observed a train being driven by one of NXEA's driver managers[15] between Liverpool Street and Shenfield to establish a benchmark performance to compare with the OTDR data.

76 OTDR data shows that on the benchmark run, around 4.6 seconds elapsed between the driver manager receiving confirmation that the doors were closed (door interlock light in the cab) and him applying power to depart from Brentwood platform four. This is over 4 seconds longer than the driver of train 2W10 took on the night of the accident and confirms that the incident driver could not have carried out a complete train safety check before the train moved away. The OTDR review identified that the average time taken between drivers receiving the cab indication that all doors were closed and applying power at Brentwood platform four was around 2.0 seconds and that a number of train drivers were taking less time to complete the safety check than was the case during the benchmark run. A summary of the results of the RAIB's OTDR analysis is presented in table 2.

DOO dispatch method	Accident train (seconds)	Other trains (seconds)	Benchmark train (seconds)	Quickest time recorded
Look-back only	0.9 (average)	1.77 (average)	4.87 (average)	0.2
Combination of look-back and look at monitor	1.0 (average)	1.56 (average)	5.5 (average)	0.3
Brentwood platform four	0.4	2.0 (average)	4.6	0.4

Table 2: Summary of the RAIB's findings from a review of OTDR data of trains working between Liverpool Street and Shenfield stations to determine elapsed time between door interlock and driver taking power.

[14] At some locations it may be possible to begin to carry out the train safety check while the train's doors are closing, for example by looking back along the train or at the DOO equipment. However, it is unlikely that the driver of train 2W10 did this, because he would have seen events occurring near to where the passenger had got off the train (ie the witness dropping his bags and moving towards the train and holding the passenger by the leg).

[15] The driver manager had recently been appointed into the role having previously been an experienced train driver. The driver manager had extensive experience of driving class 315 trains over the Metro route.

77 The short time between the driver taking power, the train moving, and the driver carrying out the train safety check had greater significance because of the stopping position of the train. This is discussed in paragraphs 80 to 85.

The train driver's view

78 **The train driver's view of the person holding the passenger's leg may have been obscured by a person on the platform standing close to the train. This is a possible causal factor.**

79 The CCTV evidence showed that around the time of the accident, a person was standing close to the side of the train, alongside the gap between the rear two coaches looking towards the rear of the train in the direction of the accident. The RAIB established, during a reconstruction, that this person may have partially obscured the witness who was crouching down low at the edge of the platform. If the driver had been looking at the eight-car monitor at that time he may not have been able to see the accident occurring.

The stopping position of the train on the night of the accident

80 **The train driver had stopped with the front of the train around 3.1 metres beyond the DOO monitor. As a consequence, the monitor's shroud obscured his view of that part of the platform where the accident occurred once the train had moved forward 20 cm on departure. This was a possible causal factor.**

81 The railway rule book GE/RT8000[16], module TW2 'Preparation and movement of passenger trains', states that train drivers must stop their trains at the platform as indicated by the train stop markers. Module TW2 does not include any reference to situations where DOO CCTV monitors are provided. NXEA issues its train drivers with a *Professional Driving Policy* (PDP) booklet. The aim of this policy is to provide train drivers with guidance and good practice advice on many aspects of train driving. There is no guidance or advice within NXEA's policy or in the railway rule book regarding stopping trains in platforms where a conflict exists between the position of a stop board and a DOO CCTV monitor.

82 The RAIB reconstructed the stopping position of train 2W10 using an eight-car class 315 train referenced against CCTV recordings that were captured by the security camera on platform four on the night of the accident (figure 7). The reconstruction established that the accident train had stopped around 3.1 metres beyond the DOO monitor (figure 13).

83 The train driver chose to stop the train in this position because he believed that if he stopped alongside the DOO monitor, the rear set of passenger doors on the train would not be fully on the platform, possibly putting passengers getting off the train at risk (this was not actually the case). The driver also believed that if he stopped at the eight-car stop board he might not be able to see the DOO monitor image at all and might have to strain to look back along the train.

84 The route information given to train drivers by NXEA indicated that platform four at Brentwood could accommodate a maximum train length of eight cars and reinforced the driver's understanding that stopping his train at the eight-car monitor, and not at the eight-car stop board, may position the rear passenger door beyond the end of the platform.

[16] The modules of the railway rule book, GE/RT8000 are available to view or download from www.rgsonline.co.uk.

Figure 13: View of DOO CCTV monitor from train drivers stopping position on the night of the accident.

85 The driver of train 2W10 stated that as the train started to depart from Brentwood station he carried out the train safety check. Once the train had moved forward 20 cm (taking under two seconds from the application of power[17]) the sun shroud on the right-hand side of the DOO monitor partially obscured the monitor's image and, crucially, it obscured the area of the image where the accident was occurring.

The positioning of the eight-car DOO monitor and the stop board

86 **The orientation of the eight-car DOO monitor and the position of the eight-car stop board 3.43 metres beyond it led to the driver of train 2W10 stopping his train in a position from which it was more difficult for him to observe the eight-car DOO monitor. This was a causal factor.**

87 A document from the British Railways Board dated 1 March 1990 indicated that DOO working was planned for implementation at Brentwood that year. Network Rail was not able to locate any records relating to the original installation of the DOO equipment, and in particular records concerning the basis of the relative locations of the eight-car monitor and eight-car stop board at Brentwood platform four. A photograph from October 2001 shows the eight-car monitor head set at a slight angle to the platform edge (figure 14). No records were found indicating that any work had been undertaken on the monitor that would have affected its position between its installation around 1990 and 2001 (the date of the photograph). It is likely that this was the orientation of the eight-car monitor at installation.

[17] The RAIB carried out a timing exercise of an eight-car class 315 train departing from platform four at Brentwood station to establish how long it took from the train driver's application of power to the train moving forward 20 cm. The time taken was just under two seconds.

88 In 2003, Network Rail authorised the renewal of the DOO CCTV system on platform four at Brentwood station as part of an ongoing national renewal programme. The work was carried out by a Network Rail approved subcontractor. The existing 15 inch greyscale monitors were replaced with 20 inch greyscale monitors. The monitor housings and posts were also replaced. These monitors have, respectively, screens measuring approximately 38 and 50 cm on the diagonal. Photographic evidence from October 2004 indicated that the eight-car DOO monitor head was now parallel to the platform edge (figure 15), having been rotated from the position shown in figure 14.

Figure 14: Eight-car monitor position in October 2001. The head of the DOO monitor is rotated to the left and not an at angle to the platform edge (photograph courtesy of Network Rail)

Figure 15: Eight-car monitor position in 2004. The head of the DOO monitor is now parallel to the platform edge (photograph courtesy of Network Rail)

89 In its original position, it appears that the eight-car DOO monitor was angled to enable drivers stopping at the eight-car stop board to see the monitor from that position. A shroud with deep side covers was provided to shade the monitor image from sun glare. When the monitor and housing were renewed in 2003, narrower, angled side covers were provided. The RAIB has not been able to establish why the eight-car DOO monitor head angle was altered during the 2003 renewal work.

90 In June 2003 the RSSB published Railway Group Standard, GE/RT8060. This standard mandates the minimum engineering requirements for the dispatch of trains from platforms. Among the requirements of GE/RT8060 is a need to ensure that station-mounted monitors are compatible with train operations and that a train driver is able to see the required monitor image for +/- 1 metre from the train stop location.

91 This assessment could not have been undertaken following the 2003 renewal work because at the time of the accident the monitor image was partially obscured by the angled side covers if viewed from a train driving cab stopped at the eight-car stop board. There are two possible reasons why the assessment was not undertaken:

- standard GE/RT8060 did not apply at the time the work was completed (because the design of the work at Brentwood had already been finalised); or
- those persons completing the work were unaware of the requirements of standard GE/RT8060.

92 The RAIB reviewed CCTV recordings of 25, eight-car trains stopping at platform four at Brentwood station. The review identified inconsistency in the stopping position[18] of trains:

- fifteen trains stopped at the eight-car monitor;
- nine trains stopped between the eight-car monitor and eight-car stop board; and
- one train stopped adjacent to the eight-car stop board.

It is likely that the nine drivers that stopped between the eight-car monitor and eight-car stop board had identified that the monitor could not be fully seen from the stop board.

93 Some modern rolling stock is equipped with cameras mounted on the side of the train, and monitors located within the driving cab. Such an arrangement obviates the need for platform-mounted DOO monitors and cameras and a driver's view of the images is not sensitive to the stopping position of the train. In addition, the cameras offer a better view along the platform/train interface than is possible from cameras that are located on the platform and angled towards the train.

The conflict arising from the positions of the CCTV monitor and the eight-car stop board was not identified by NXEA or Network Rail

NXEA's actions

94 **The stopping practice of NXEA drivers indicates that most recognised that the eight-car monitor was not fully visible from the eight-car stop board. NXEA's management arrangements did not identify this problem. This was an underlying factor.**

95 Railway Group Standard GO/RT3475, which applied from February 2004 to December 2007, mandated that station operators, in conjunction with the infrastructure manager (ie Network Rail), undertake risk assessments once every three years for each platform to ensure compatibility between trains, platform, process and infrastructure. NXEA produced company standard 4.11 'Risk Assessments (Train Dispatch)' in 2005 which broadly reflected the requirements of GO/RT3475. However, there was no requirement to include Network Rail in the risk assessment process.

[18] Stopping position referred to is the train driver's cab window.

96 NXEA had undertaken an initial dispatch risk assessment for Brentwood platform four in December 2006. The assessment was undertaken by one of the local driver management team as required by NXEA company standard 4.11. It concluded that a train driver would have an unobstructed view of the eight-car DOO monitor from the eight-car stop board. This was incorrect (paragraph 89). The dispatch risk assessment for Brentwood platform four should have been reviewed in 2009. This did not happen because the local driver manager (who was responsible for ensuring the assessment was completed) incorrectly believed that the responsibility lay with the customer services function within NXEA. Nobody within NXEA had identified that the three-year review had not been undertaken.

97 NXEA produced, reviewed, or amended platform specific train dispatch method statements based on the findings of dispatch risk assessments (initial or review). The purpose of dispatch method statements was to provide staff with a step-by-step method for train dispatch at a particular platform. However, dispatch method statements were not normally produced for DOO platforms because NXEA considered that DOO dispatch for train drivers was sufficiently covered in the railway rule book.

98 There was no requirement in NXEA company standard 4.11 for DOO train dispatch at unstaffed platforms to be monitored. However, from April 2006, there was such a requirement in NXEA company standard 13.3 'Operational procedural checks and documentation' for a station check[19] to be carried out each month at a station selected by the local management team. The local driver manager stated that no station checks had been undertaken at Brentwood platform four because he believed that station checks should be undertaken at stations such as Liverpool Street, Shenfield or Gidea Park where more effective use of the assessor's time could be made by observing more train driving actions than would be seen at through stations such as Brentwood.

Network Rail's actions

99 **Network Rail had not undertaken cab rides, as required by Network Rail company standard NR/L2/TEL/30072, to review the DOO equipment set-up at Brentwood. This was an underlying factor.**

100 Network Rail's involvement with the DOO equipment at Brentwood platform four in recent years was limited to maintaining the CCTV and monitor equipment. The maintenance requirements applicable to DOO CCTV systems are defined in Network Rail company standard NR/L2/TEL/30072, 'Specification for the maintenance of DOO(P) CCTV, guard assisted CCTV and DOO mirror systems'. This standard mandates a monthly functional check and a three-monthly maintenance service of CRT type monitor systems, such as those installed at Brentwood platform four. Neither the functional check, nor the maintenance service includes a requirement to assess the positioning of stop boards and monitors (including the angular position of the monitor). The RAIB reviewed the maintenance history of the eight-car CCTV DOO equipment on platform four at Brentwood. There was no evidence of faults that could have affected its performance and contributed to the accident.

[19] The scope of the station check included monitoring the approach speed of trains into the platform, that there were no unauthorised persons in the driving cab, that the train doors were released on the correct side of the train, sufficient dwell time was allowed, and the correct dispatch method was used.

101 Standard NR/L2/TEL/30072 was issued in March 2009, replacing standard NR/WI/TEL/30072 which had addressed the same subject. Among the changes to the standard was a requirement from September 2009 for Network Rail to undertake DOO system monitoring (appendix D within NR/L2/TEL/30072). DOO system monitoring consisted of annual train cab rides (in day and night (dark) conditions) to assess each platform where DOO systems were installed. Appendix D stated that joint attendance with a representative of the train operating company concerned was to be encouraged, but was not essential. Factors that should be observed during the cab ride included:

- the ability of the driver to observe the monitor(s) and or mirror(s) from their normal driving position;
- that the stop boards are correctly positioned in association with the CCTV monitor(s);
- that the CCTV monitor(s) are displaying the correct images; and
- the quality and contrast of the displayed picture(s).

102 Between September 2009 and January 2011 Network Rail maintenance staff should have undertaken at least two cab ride assessments (one during the day and one in dark hours) of the DOO equipment on platform four at Brentwood. However, they had not done any cab ride assessments of DOO equipment at any station on the Anglia route. Network Rail said that the reason for not carrying out these assessments was because the requirements had not been uploaded onto its maintenance planning database, which in turn had been affected by:

- delays arising from the need to align the maintenance plans of Network Rail's contractors that were being brought back 'in-house';
- implementing the requirements of approximately 20 Network Rail company standards that were reissued in a short space of time (including issue 2 of NR/L2/TEL/30072); and
- the maintenance planning database was new to the telecommunications department (although its use elsewhere within Network Rail was widespread).

103 Network Rail's programme manager (telecoms) and compliance manager (telecoms) were both aware that cab rides were not being undertaken. The programme manager (telecoms) was not able to provide the RAIB with any evidence that this non-compliance was being effectively managed. The compliance manager (telecoms) had left Network Rail before the accident occurred. The RAIB has been unable to establish whether Network Rail was managing its non-compliance with the requirement to undertake cab rides to assess DOO platform equipment. Had Network Rail undertaken cab rides, as required by its company standard, it is likely that the sub-optimal positioning of the eight-car monitor relative to the stop board would have been identified, and Network Rail could have rectified the problem.

104 No evidence was presented to the RAIB by either Network Rail or NXEA that any train drivers had reported the conflict between the CCTV monitor and the eight-car stop board. Such reports might have been expected in 2003 when the CCTV monitor was renewed (paragraph 88). Over time train drivers found their own ways of managing the conflict.

NXEA's management of train drivers

105 **National Express East Anglia's driver management processes did not identify the driver of train 2W10's non-compliance with the train safety check procedure. This was an underlying factor.**

Driver training

106 The driver of train 2W10 was fully qualified and had been driving on his own for around 20 months prior to the accident. During his training, he had spent over 200 hours in the company of one particular instructor driver, mainly driving trains on the Metro route. The instructor driver also carried out his train safety checks as the train started to move off from the platform and had taught this technique to the train driver involved in the accident.

107 The train driver did not appear to be fully aware of the risk to passengers that existed when the train safety check was completed after the train had begun to move, nor was he aware that this would prevent him seeing the full monitor screen display. The train driver felt that during his training the focus had been on the risk of failing to stop at red signals, overrunning a platform and *Train Protection and Warning System* interventions. Neither the train driver nor the instructor driver could recall receiving any safety briefings in the last few years on train dispatch risk from a driver's perspective or the importance of the train safety check (paragraph 113).

108 NXEA had completed a train driving task analysis[20] in 2007 but had not identified the core safety elements associated with DOO train dispatch from unstaffed platforms, including the train safety check. Therefore the trainee drivers' course and assessment process did not address these issues. NXEA had relied on its instructor drivers to address areas of specific train driving risk. The guidance material issued to instructor drivers did not identify areas of risk with regard to DOO, and in particular, DOO train dispatch.

109 NXEA's train driver training programme was delivered by dedicated trainers and consisted of classroom based theoretical training, the use of train driving simulators and practical train handling under the supervision of instructor drivers. The training programme was managed by the Head of Driver Training, who reported to the Head of Operations Standards and Training. The core theoretical elements of the driver training course were based around the requirements of GE/RT8000, the railway rule book, and delivered in a modular format in a classroom environment. The module titled 'drive trains' included information on stopping trains at platforms and at DOO CCTV monitors. Reference was made on one of the slides to the importance of stopping trains at the correct position at DOO CCTV monitors.

110 The train safety check was described in the 'working of trains' module. Within this module a set of trainer's briefing notes supported a slide that outlined the train dispatch procedure. The briefing notes set out the procedure for dispatching a DOO train from an unstaffed platform and mentioned the train safety check.

[20] The purpose of a train driving task analysis is to identify the individual elements that form the tasks completed by train drivers. An example would include the task of operating a train safety system where the elements within that task include monitoring the status of a system, reacting to system warnings and isolating defective equipment. The task analysis output can be used to identify the consequences of non-compliance with an element that has been identified as critical to safe operation.

111 Following the classroom-based training the trainees drove passenger trains under the guidance and supervision of instructor drivers. The instructor drivers were issued with a handbook to assist them in their role. The handbook stated that the instructor drivers' role was to *'mould a person who has the theoretical knowledge of train driving, but does not yet have the skills to put this into practice, into a person ready to go forward for their final assessment to be a competent train driver'.* To achieve this, the instructor driver had to ensure the trainee driver could demonstrate they had achieved the necessary performance criteria[21] in line with NXEA's driver competence management system using a checklist of the criteria. The criteria did not include the train safety check. The RAIB concludes that the importance of the train safety check was not sufficiently reinforced to the driver of train 2W10 during the classroom-based or practical training with the instructor driver.

Driver assessment

112 During his practical train handling period with the instructor driver, and during the 20 months of driving alone, the driver of train 2W10 had been assessed on over 20 occasions by driver managers using a variety of methods including direct observation from within the driving cab and unobtrusive assessments using OTDR data. The instructor driver had also been subject to regular assessments by the driver management team[22]. None of these assessments identified that the driver and the instructor driver had been carrying out the train safety check as their trains had started to move away from the platform as opposed to before starting the train. The reasons why this practice had not been identified during assessments included:

- the train safety check was not one of the identified items for assessors (driver managers and instructor drivers) to observe during in-cab assessments within the NXEA driver competence management system;
- the train safety check was not one of the identified items to be reviewed during OTDR assessments within the NXEA driver competence management system;
- the rules assessments (both computer based and pre-written) did not include any questions on the train safety check; and
- it was not possible to simulate the train safety check on the train driving simulator because the DOO CCTV monitor image is projected on to the windscreen and it was not possible to identify at what point the train driver carried out the train safety check.

[21] Performance criteria included preparing for duty, personal track safety, preparing trains for service, train control and economical driving practices, station duties, shunting, and dealing with out-of-course and emergency situations.

[22] For an instructor driver NXEA carried out, as a minimum, an annual practical assessment and an annual assessment on the train driving simulator to practise out-of-course events.

Driver safety briefings

113 NXEA delivered structured safety briefings to its drivers on a six-monthly cycle. The content of the safety briefings was decided by a panel that normally included the Deputy Operations Director, Head of Operations Standards and Training, and driver managers. The RAIB reviewed the content of the safety briefings that were delivered by NXEA to its drivers between 2008 and the time of the accident: none of the briefing topics covered DOO train dispatch risk. While NXEA provided all of its drivers with the Red Alert publication[23], there was no guarantee that each driver had read and understood the articles within it. Between 2008 and the day of the accident, Red Alert had published articles on the risk of DOO train dispatch. Two articles were particularly relevant to the accident at Brentwood platform four:

- a reminder to train drivers to be alert to factors (although the article did not detail what factors) that cause dragging incidents or result in someone falling into the gap between the train and the platform (March 2010); and
- a reminder to train drivers to maintain focus during train dispatch and to be aware of the key risk areas associated with train dispatch (although the article did not identify the key risk areas) (November 2008).

114 While neither of these articles specifically mentioned the train safety check, they did act as a reminder to NXEA's driver management team, and its train drivers, of the risk to passengers when dispatching trains from platforms.

NXEA's management of risk associated with DOO train dispatch

115 **NXEA had not focused sufficient attention on the risk associated with DOO train dispatch from unstaffed platforms, despite the prevalence of DOO operations on its train services. This was an underlying factor.**

116 NXEA had produced a generic risk assessment covering train dispatch at stations on DOO routes and specific train dispatch method statements for some platforms. Train dispatch risk assessments were based on the identification of hazards at each location, such as high numbers of school children, the dispatch method in use, the provision and condition of the station signage and painted lines on platforms, and the train driver's ability to view their train. The risk assessment forms did not prompt the risk assessor to consider the effects of a train driver not following particular steps of the train dispatch process. However, this information should have been identified in the train driving task analysis (paragraph 108).

117 Train dispatch method statements were not usually produced for unstaffed platforms at stations on DOO routes. NXEA believed train dispatch risk was greater where dispatch duties were undertaken by platform staff and train guards because train dispatch methods were more flexible for those grades than for train drivers (eg more than one member of platform dispatch staff can be involved in train dispatch, therefore roles and responsibilities need to be clearly defined and a train guard may be able to dispatch a train from more than one position). At unstaffed platforms NXEA believed that the DOO equipment effectively dictated how train dispatch was to be performed by the drivers of DOO trains.

[23] Red Alert is an operational safety newsletter issued three times each year to the railway industry. It is produced by the Halcrow Group (www.halcrowspad.com). The project is managed by voluntary subscription, with participating companies contributing on a yearly basis.

118 With no dispatch method statements produced for unstaffed DOO platforms, NXEA train drivers learnt the dispatch method to follow at each platform from the knowledge and experience of other train drivers and their instructors when they were route learning[24]. Although NXEA provided its train drivers with route information, that information did not include in detail how train drivers were to dispatch their trains from each unstaffed platform.

119 NXEA's incident and accident records (up to and including 2010) indicated that one passenger had suffered a major injury while alighting from a train in 2007, one in 2008 and none in 2009. There had not been any passenger fatalities when alighting from trains during this period. There had been 318 reported accidents at NXEA stations in 2009 and 264 in 2008. These were mainly slips, trips and falls and passenger accidents at automatic ticket barriers. For this reason, NXEA had directed its resources to managing the risk in those areas.

120 NXEA believed its safety management system was adequately managing the risk of DOO train dispatch from unstaffed platforms. NXEA did not have any concerns with its train drivers performing DOO train dispatch because its accident and incident monitoring did not identify any significant problems with passenger accidents associated with DOO train dispatch, and its train driver competence management system was not highlighting any deficiencies in that area.

Risk associated with boarding and alighting from trains

121 In June 2011, the RSSB published a special topic report on passenger risk at the platform-train interface[25]. The report identified that there were two passenger fatalities attributed to getting on and off trains on the national rail network between 2001 and 2010, with the last one recorded in 2007. During this same period the figure for *fatalities and weighted injuries* (FWI) arising from accidents at the platform-train interface had varied between its highest value of 7.3 FWI/year in 2002/2003 to its lowest value of 4.5 FWI/year in 2005/2006. In 2009/2010 the value was 5.4 FWI/year (figure 16).

122 The RSSB established that the number of passenger accidents at the platform-train interface had increased at a greater rate than the number of passenger journeys and that harm caused to passengers when getting on and off trains had increased steadily over the years. The report identified several factors that can have an effect on the occurrence of accidents at the platform-train interface, including:

- more females than males are involved in boarding and alighting accidents (footwear may be a factor);
- passenger intoxication (between 21:00 hrs and 00:00 hrs the number of intoxication-related accidents is around twice that of accidents not related to intoxication);
- there are slightly more alighting than boarding accidents; and
- the harm from alighting accidents is more than twice that from boarding accidents.

[24] The process of acquiring knowledge of a route including; speeds, gradients, signal locations, station names, platform lengths and level crossings. The route learning process normally includes cab riding, watching route specific DVD's and referring to reference documents.

[25] The special topic report 'Passenger risk at the platform-train interface' is available at www.rssb.co.uk.

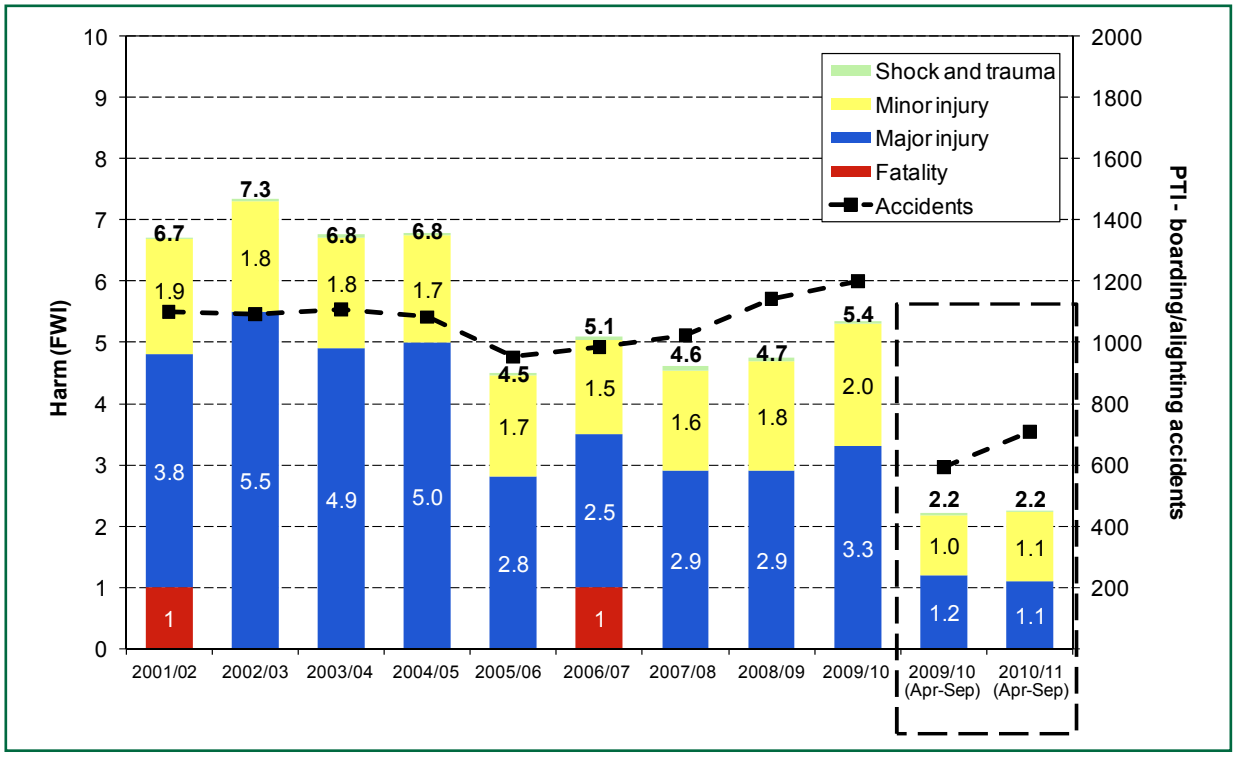

Figure 16: RSSB data on harm to passengers while boarding or alighting trains at the platform-train interface (PTI). The hatched box contains data from two half-financial years to allow comparison with data up to September 2010.

123 The RSSB report included data on train and station operator performance at the platform-train interface. The data indicated that NXEA's safety performance was similar to that of other operators of DOO suburban trains allowing for the number of occasions the platform-train interface was crossed by passengers at its stations, or the number of passenger journeys made on its trains. The report concluded that most of the platform-train interface passenger fatality risk occurs in accidents such as falling off a platform and being struck by an approaching train, or being struck by a passing train while standing too close to the platform edge, and not when getting on and off trains. The report refers to previous RSSB research projects including improving the arrangements for train dispatch from stations (research project T743) and minimisation of accidents at the train-platform interface (research project T426)[26].

Previous occurrences of a similar character

124 On the national rail network during 2010, there were 564 reported passenger accidents associated with getting off trains and 306 reported incidents of passengers falling between the train and the platform. Accidents where a passenger has fallen between the train and platform when getting off a train and are then injured by the departing train are fortunately rare. Normally the passenger is seen and assisted back onto the platform before the train is dispatched.

[26] RSSB research project reports are available at www.rssb.co.uk.

125 Since 2001, two passengers have been fatally injured when getting off trains on the national rail network:

- In July 2001, a passenger fell between the train and platform after he had opened the door (a *slam door*) as the train was departing from Clapham Junction station; and
- In February 2007 at Haddenham and Thame Parkway station, a passenger was fatally injured when he was run over by a departing train. The RAIB carried out a preliminary examination of the accident, which established that the train driver carried out the DOO dispatch procedure correctly and the platform edge-train interface was compliant with the relevant standards. CCTV evidence indicated that the passenger did not appear to trip, nor lose his balance after he had got off the train, but walked a short distance along the platform then sat down on the platform edge before disappearing into the space between the platform edge and the train. The passenger did not reappear on the platform before the train moved off, 75 seconds later. The RAIB concluded that there were no safety lessons to be learned by the railway industry from this accident and therefore did not undertake a full investigation.

126 In February 2006, the RAIB investigated[27] an accident at Huntingdon station, where a member of the public, who was seeing a passenger off on a train, became trapped by the edge of his coat (RAIB report 11/2007). As the train departed the person ran alongside before falling down into the gap between the platform and train. The person sustained serious injuries to his left arm and hand. The train was being operated under DOO conditions. The RAIB recommended that the train operator involved should increase the emphasis in its driver training on aligning the train correctly with the monitor banks. NXEA[28], although not the operator of the train involved in the accident at Huntingdon, did brief its drivers on the circumstances of the accident and the lessons arising in 2007. The RAIB reviewed the briefing prepared by NXEA and observed that the content of the briefing was not carried forward into driver training material. Neither the driver of train 2W10 nor the instructor driver could recall this briefing (paragraph 109).

127 In November 2007, the RAIB investigated an incident where a passenger's coat became trapped in the closing doors of a southbound Northern Line train at Tooting Broadway station on the London Underground system (RAIB report 17/2008). The passenger managed to free herself from her coat and was not seriously injured. The train operator had not observed that all the passengers were clear of the train doors before starting the train and may have used the doors closed indicator (door interlock light) as confirmation that it was safe to start the train. The train operator may also have been preoccupied with looking at the signal ahead of his train.

[27] RAIB investigation reports are available at www.raib.gov.uk.

[28] Train operator National Express East Anglia was commercially branded as 'One' until February 2008.

Severity of consequences

The actions of the main witness

128 Had the main witness not intervened and held on to the passenger's left leg as she fell into the gap between the train and platform, her injuries could have been more severe (figure 8).

The provision of a recess under the platform

129 The recess between the platform face and the track provided a space for the passenger's body, helping to prevent more serious injuries occurring as the train passed by.

Observations[29]

CCTV recording of evidence

130 The train involved in the accident was fitted with on-train CCTV equipment. However due to a fault with the hard drive, no images were recorded. Potentially valuable evidence was not available to the RAIB to aid its investigation into the accident. The RAIB investigated an accident involving a track worker at Cheshunt Junction (RAIB report 06/2011) where CCTV evidence from preceding trains was not available due to defective recording equipment on those trains. The RAIB also has evidence that the class 321 trains operated by NXEA have similar CCTV reliability problems. The RAIB has made a recommendation to address this.

Document retention and management

131 The original DOO equipment was installed and commissioned by British Rail. No documents relating to this work period could be found by the current infrastructure owner, Network Rail. When the 2003 renewal work was undertaken, Network Rail owned the railway infrastructure. Network Rail was also unable to locate documentation relating to the renewal of the DOO equipment in 2003.

132 The RAIB has not been able to establish how these records were managed following the initial installation and subsequent renewal of the DOO equipment at Brentwood platform four.

Periodical review of safety related processes

133 NXEA had not identified that the 2009 dispatch risk assessment review, as prescribed by its own requirements, had not been completed for platform four at Brentwood station. However, the RAIB does not consider this to be a causal factor because NXEA had not identified that the eight-car monitor was not fully visible from the eight-car stop board in 2006 (paragraph 96) nor did it identify this issue when it completed a post-accident dispatch risk assessment review in February 2011. The RAIB therefore considers that it is unlikely that NXEA would have identified the issue had it undertaken the dispatch risk assessment review due in 2009.

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

Summary of Conclusions

Immediate cause

134 Train 2W10 departed from Brentwood station with a passenger in an unsafe position between the platform edge and the train (**paragraph 38**).

Causal factors

135 The causal factors were:

a. The passenger alighted from the train at a time when the audible alarm was sounding and the doors had started to close (**paragraph 42, no recommendation**);

b. The passenger lost her balance and fell into the gap between the platform edge and train bodyside (**paragraph 44, no recommendation**); and

c. The orientation of the eight-car DOO monitor and the position of the eight-car stop board 3.43 metres beyond it led to the driver of train 2W10 stopping his train in a position from which it was more difficult for him to observe the eight-car DOO monitor (**paragraphs 86 and 142, Recommendation 1**).

136 The following factors were possibly causal:

a. The train driver did not observe the train's doors as they were closing and was not required to do so by current rules and regulations (**paragraph 64, Recommendation 2**);

b. The train driver did not complete the train safety check before he started the train (**paragraph 71, Recommendation 3**);

c. The train driver's view of the person holding the passenger's leg may have been obscured by a person on the platform standing close to the train (**paragraph 78, no recommendation**); and

d. The train driver had stopped with the front of the train around 3.1 metres beyond the DOO monitor (**paragraphs 80 and 142, Recommendations 1 and 3**).

Underlying factors

137 The underlying factors were:

a. The stopping practice of NXEA drivers indicates that most recognised that the eight-car monitor was not fully visible from the eight-car stop board. NXEA's management arrangements did not identify this problem (**paragraph 94, Recommendation 3**);

b. Network Rail had not undertaken cab rides, as required by Network Rail company standard NR/L2/TEL/30072, to review the DOO equipment set-up at Brentwood (**paragraph 99, Recommendation 1**);

c. National Express East Anglia's driver management processes did not identify the driver of train 2W10's non-compliance with the train safety check procedure (**paragraph 105, Recommendation 3**); and

d. NXEA had not focused sufficient attention on the risk associated with DOO train dispatch from unstaffed platforms, despite the prevalence of DOO operations on its train services (**paragraph 115, Recommendation 3**).

Additional observations

138 Although not linked to the accident at Brentwood station on 28 January 2011, the RAIB observed that:

a. The CCTV fitted to the train involved in the accident was defective. It did not record any data (**paragraph 130, Recommendation 4**);

b. Network Rail was unable to locate key historical documents relating to the DOO arrangements at Brentwood platform four (**paragraph 131, see paragraph 143**); and

c. National Express East Anglia had not identified that the dispatch risk assessment review, due in 2009, had not been completed for platform four at Brentwood station prior to the accident occurring (**paragraph 133, Recommendation 5**).

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

139 In June 2011 the RSSB published rail industry guidance[30] on train dispatch and station safety. Compliance with the document is not mandated unless a train operating company incorporates the document into its safety management system. It provides a standard for the development of passenger train dispatch processes and additional measures to encourage and manage the safe behaviour of passengers and the public on station platforms. The guidance note defines the train safety check as:

> 'the process carried out before giving the 'Ready to Start' signal to the member of traincrew or starting the train to check that nothing is potentially trapped on the outside of the train and it is safe to start the train. In the case of manually closed doors, the train safety check also checks whether the doors are properly closed'.

140 The underlined text refers to the case of driver only operation where the train driver is solely responsible for performing the train safety check before starting the train.

141 The RSSB has established a platform-train interface working group, appointed a station safety project manager whose remit includes looking at platform-train interface issues, and produced a DVD that included a fictional scene about a train dispatch incident where interrupted visibility during the train dispatch process was a factor.

[30] RIS-3703-TOM 'Rail Industry Standard for Passenger Train Dispatch and Platform Safety' available at www.rgsonline.co.uk.

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

142 NXEA repositioned the eight-car stop board on platform four at Brentwood station to a position adjacent to the eight-car DOO monitor and issued a notice to its drivers telling them to stop alongside the eight-car monitor (paragraphs 135c and 136d).

143 Network Rail company standard NR/L3/INF/02226 first issued in March 2009 requires that infrastructure asset records, such as installation, commissioning and renewal records, be retained for the life of the asset plus six years (paragraph 138b).

Recommendations

144 The following recommendations are made:[31]

Recommendations to address causal and underlying factors

1 *The purpose of recommendation 1 is for Network Rail, in partnership with relevant train operating companies, to make improvements to the assessment of DOO train dispatch arrangements at unstaffed platforms. The assessment should consider the equipment provided and the way in which it is used. The involvement of both infrastructure owner and train operator is necessary in order to obtain the maximum benefit from such an exercise.*

Network Rail should arrange, execute and accurately record, in partnership with relevant train operating companies, periodic assessments of the DOO equipment provided at unstaffed platforms with particular reference to the quality of the interface between the equipment provided and the way in which it is used (paragraphs 135c, 136d, and 137b).

2 *The purpose of recommendation 2 is to reduce the likelihood of a train departing from a platform with a passenger in an unsafe position relative to the train.*

The Rail Safety and Standards Board should, in consultation with train operators, consider the inclusion of guidance in Rail Industry Standard RIS-3703-TOM that those responsible for train dispatch (including the drivers of DOO trains) should, so far as is reasonably practicable, observe the closing of the train's doors and be alert for any dangerous occurrence while this is taking place (paragraph 136a).

continued

[31] 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 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 167 to 171) can be found on RAIB's website www.raib.gov.uk.

3 *The purpose of recommendation 3 is for National Express East Anglia to make improvements to its train driver training and assessment processes to promote effective management of the risk associated with DOO train working, and in particular, the dispatch of DOO trains from unstaffed platforms.*

National Express East Anglia should complete a systematic review and updating of its train driving task analysis relating to the dispatch of Driver Only Operated (DOO) trains from unstaffed platforms to assure that hazards are identified and the risk properly addressed. The results of this review should be incorporated into the train driver training programme, train driver competence management system and ongoing safety briefing processes to facilitate the changes necessary to adequately address the risk from DOO train dispatch, particularly from unstaffed platforms (paragraphs 136b and 136d, 137a, 137c and 137d).

Recommendations to address other matters observed during the investigation

4 *The purpose of recommendation 4 is for National Express East Anglia to take steps to improve the availability of data from the on-train CCTV systems fitted to its trains.*

National Express East Anglia should take the necessary steps to ensure that the on-train CCTV systems (including forward and rear facing CCTV equipment) fitted to its trains achieve a high level of availability (paragraph 138a).

5 *The purpose of recommendation 5 is for National Express East Anglia to make improvements to its monitoring processes to ensure periodic reviews, such as risk assessment reviews, are undertaken at the specified frequencies.*

National Express East Anglia should review and update as necessary its monitoring systems so that where periodic safety reviews are required they are undertaken at the necessary frequencies (paragraph 138c).

Appendices

Appendix A - Glossary of abbreviations and acronyms

CCTV	Closed Circuit Television
DOO	Driver Only Operation
NXEA	National Express East Anglia
OTDR	On Train Data Recorder
RSSB	Rail Safety and Standards Board

Appendix B - Glossary of terms

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

Cant	The design amount by which one rail of a track is raised above the other rail, measured over the rail centres.*
Door leaves	The moveable element of a door system, ie the door itself.*
Driver Only Operation	A method of working that permits a train to operate without a train guard.
Fatalities and weighted injuries	A measure of the collective risk expressed as fatalities and weighted injuries. When combining injury information into a composite measure, each fatality is given a weighting of unity and each major injury a weighting of 0.1. *RIDDOR*-reportable minor injuries and the more severe cases of shock and trauma are given a weighting of 0.005, with non-RIDDOR reportable minor injuries and less severe cases of shock and trauma being given a weighting of 0.001. The combined total is then expressed as 'fatalities and weighted injuries' (FWI).
Greyscale	Images that are composed of shades of grey, varying from black at the weakest intensity, to white at the strongest. Often referred to as black-and-white.
Guard	An employee who travels on a train and carries out certain duties in connection with the safe operation of that train.*
Mobilised	Configuring a train for its journey where that train has already been in service during that day and the driver is not relieving the previous driver of it.
Professional Driving Policy	Policies prepared by Train Operating Companies that describe, amongst other things, train driving practices that the company expects its drivers to adopt in order to ensure safe and efficient train operations.*
RIDDOR	Regulations concerning the reporting of injuries, diseases and dangerous occurrences[32].
Slam door	Passenger vehicle doors that require shutting by hand, the other type being Power Operated Doors.*
Special train	A train that is provided with a special timetable outside of the normally agreed train service timetable.
Stop board	A sign provided to inform drivers where they should stop their train in relation to the platform.
Train door interlock	A system used to detect if an external passenger door is open or is closed and locked.

[32] The RIDDOR regulations can be found at www.hse.gov.uk/RIDDOR.

Train Protection and Warning System (TPWS)	A system fitted to certain signals which will automatically apply a train's brakes if it approaches the signal at too high a speed, or fails to stop at it, when it is set at danger. It will also automatically apply a train's brakes if it is travelling too fast on the approach to certain speed restrictions and buffer stops.

Appendix C - Key standards

Railway group standard GC/RT5212, issue 1 February 2003	Requirements for defining and maintaining clearances
Railway group standard GI/RT7016, issue 1 February 2004 to issue 4 September 2010	Interface between station platforms, track and trains
Railway group standard GC/RT5161, issued December 1995	Station platform design requirements
Railway group standard GC/TT0196, October 1993 (withdrawn from December 1999)	Station platform design requirements
Railway group standard GO/RT3475, issue 1 February 2004 (withdrawn December 2007)	Operational requirements for the dispatching of trains from platforms
NXEA company standard 4.11, issue 1 November 2004 to issue 4 February 2011	Risk assessments (train dispatch)
NXEA company standard 13.3, issue 1 April 2006	Operational procedural checks and documentation
Network Rail company standard NR/L2/TEL/30072, issue 1 June 2006	Specification for the maintenance of DOO(P) CCTV, guard assisted CCTV and DOO mirror systems
Network Rail company standard NR/L2/TEL/30072, issue 2 September 2009	Specification for the maintenance of DOO(P) CCTV, guard assisted CCTV and DOO mirror systems

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