RAIB

Rail Accident Investigation Branch

Rail Accident Report

Overspeed at Sandy South Junction, Bedfordshire
19 October 2018

Report 10/2019
August 2019

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.

Any enquiries about this publication should be sent to:

RAIB
The Wharf
Stores Road
Derby UK
DE21 4BA

Email: enquiries@raib.gov.uk
Telephone: 01332 253300
Website: www.gov.uk/raib

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

Cover images courtesy of London North Eastern Railway Ltd

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 words such as '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, words such as 'probable' or 'possible' can also be used to qualify 'underlying factor'.

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

An 'observation' is a safety issue discovered as part of the investigation that is not considered to be causal or underlying to the 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.

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

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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Overspeed at Sandy South Junction, Bedfordshire, 19 October 2018

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Summary

At around 14:32 hrs on 19 October 2018, a London bound, London North Eastern Railway passenger train traversed a section of track at Sandy South Junction, where an emergency speed restriction of 20 mph (32 km/h) was in place, at approximately 121 mph (195 km/h).

The emergency speed restriction had been put in place at around 14:00 hrs the previous afternoon because a crack had been found in a crossing associated with a set of points.

The train driver had become unwell earlier in the journey. On experiencing worsening symptoms, the driver decided to take medication which he kept in his bag. He was reaching for the medication when the train approached the warning equipment associated with the emergency speed restriction. As a consequence of feeling unwell and reaching for his medication, he was distracted and did not reduce the speed of the train in response to the audible and visual warnings that he received.

The driver was not aware prior to starting his journey that there were any emergency speed restrictions in place on the route, although Network Rail had sent out a notice to all the affected train and freight operating companies to inform them that the speed restriction was in place. London North Eastern Railway's control centre did not pass this message on to its drivers, in line with its then current procedures. These procedures had been in place since a Rule Book change in June 2008 when the requirement to notify drivers of freight and passenger trains of the presence of emergency speed restrictions was removed from the Railway Rule Book after a request from a freight operating company and an analysis by RSSB. This led to the committee responsible for the decision concluding that lineside warning equipment placed on the approach to a restriction to indicate its presence was sufficient notification for drivers. The RAIB has found that the information that this conclusion was based on did not cover all the factors that should have been considered and that the way the railway industry handled the Rule Book change was inconsistent.

The RAIB has made five recommendations, the first of which is addressed to train and freight operating companies to minimise the risk of drivers not being aware of speed restrictions in their route before commencing their journeys. The second is addressed to Rail Delivery Group and Network Rail, to look at available technologies to provide drivers with additional warnings of speed restrictions near to the location of the restriction. The next, addressed to Network Rail, is to consider the design of the emergency speed indicator to ensure it is conspicuous for as long as possible in bright sunlight and in shadow. The fourth is to London North Eastern Railway to train its drivers in the safest ways to divide their attention between the line ahead and things which may temporarily require some of their attention if it is not practical to stop the train. The last recommendation is addressed is to RSSB, to review the processes around the removal of existing rules from the Rule Book, and monitoring the consequences of such changes.

Introduction

Key definitions

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

2 The report contains abbreviations and technical terms (shown in italics the first time they appear in the report). These are explained in appendix A. Sources of evidence used in the investigation are listed in Appendix B.

The incident

Summary of the incident

3 At about 14:32 hrs on 19 October 2018, the 07:52 hrs London North Eastern Railway (LNER) service from Aberdeen to London King's Cross, travelling on the up[1] fast line, passed over a set of trailing points at Sandy South Junction, Bedfordshire, at 121 mph (195 km/h) (see figures 1 and 2).

4 An emergency speed restriction of 20 mph (32 km/h) had been in place at the location since 13:58 hrs on 18 October 2018 because a crack, 85 mm long, had been found in the crossing (see figure 3) associated with the points. Network Rail's standards applicable in these circumstances require the immediate implementation of the speed restriction, hourly inspections of the crossing, and a watchman to be appointed on site to observe the crossing and the passage of trains over it.

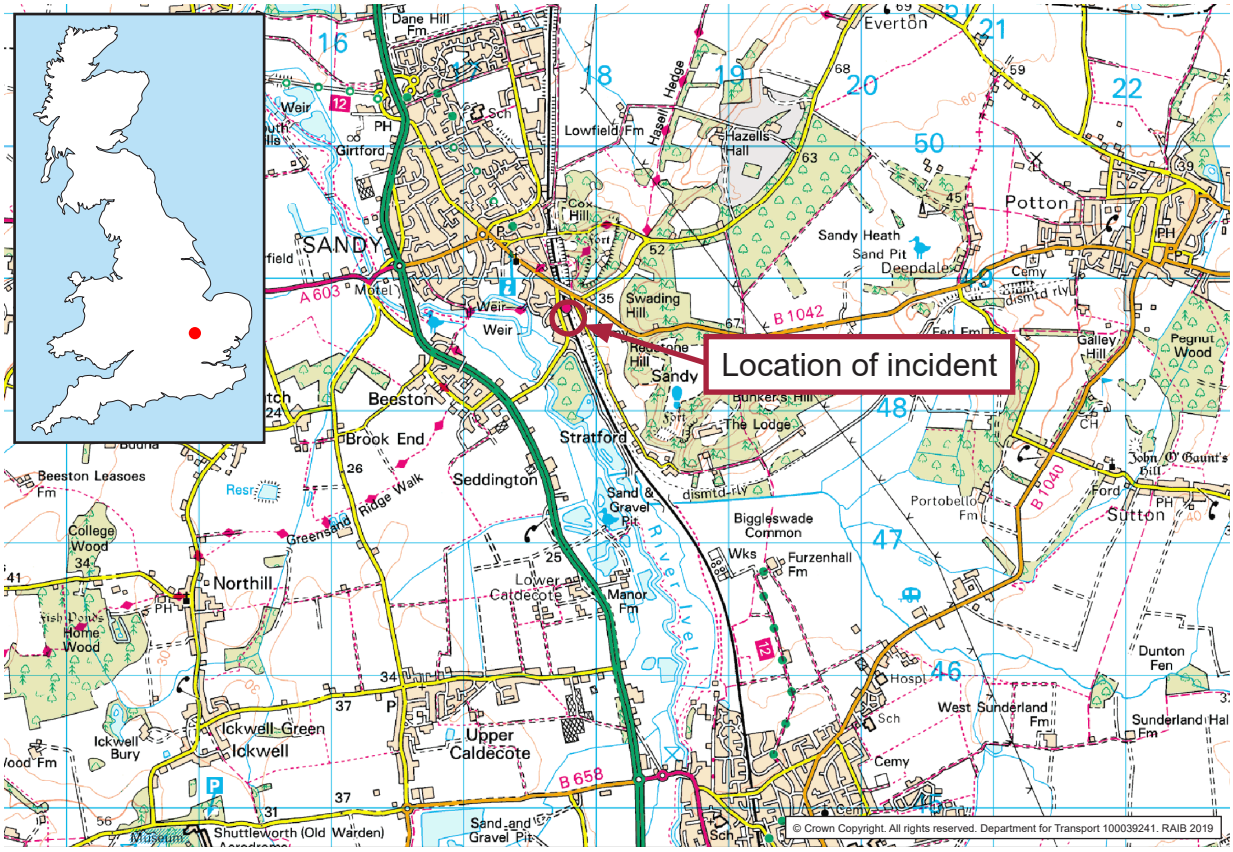

Figure 1: Extract from Ordnance Survey map showing location of incident

5 After passing over the speed restriction, the train continued its journey to London. Although in this case no-one was hurt, and there was no damage to the train or the track, overspeeding creates the potential for a serious accident if a train passes over a defective section of track at high speed.

[1] In this case the lines used by trains travelling towards London are known as the 'up' lines and the lines heading away from London are known as the 'down' lines.

Figure 2: Forward facing closed-circuit television view of points 1100A and its associated crossing on the East Coast Main Line at Sandy South Junction annotated to show key features (image courtesy of LNER)

Context

Location

6 Sandy South Junction is on the East Coast Main Line to the south of Sandy station, which is about 44 miles (71 km) from London King's Cross (see figure 4).

7 Points 1100A, where the crack in the crossing was found, are located in the up fast line, at 43 miles and 61 chains (380 m south of Sandy station), and are part of a crossover which allows trains to pass from the up slow line on to the up fast line.

Organisations involved

8 London North Eastern Railway (LNER) employed the train driver and operated the train involved in the incident.

9 Network Rail is the infrastructure manager, and owned and maintained the section of line over which the train was travelling at the time of the incident.

10 LNER and Network Rail freely co-operated with the investigation.

Train involved

11 Train 1E11 was formed by a class 253/254 high speed train (HST) and comprised nine passenger coaches with a power car (locomotive) at each end.

Figure 3: Photograph of a crossing within a set of points

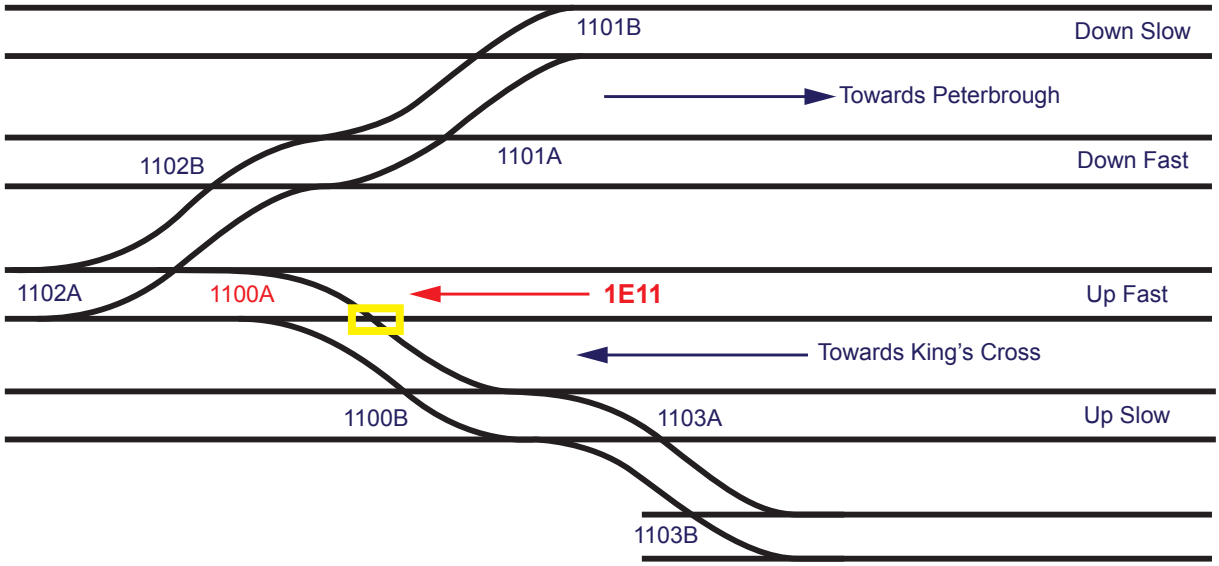

Figure 4: Sandy South Junction, with yellow box around the relevant crossing

12 RAIB has found no evidence to link the condition of the train with the incident.

Rail equipment/systems involved

13 Points 1100A were renewed in February 2017 as part of a high speed junction change project and are of a modern design.

14 The UK national network is equipped with the automatic warning system (AWS), which is intended to warn drivers about restrictive signals and speed restrictions. It uses magnets, which may be permanently or temporarily installed in the track. The AWS equipment associated with most signals includes a permanent magnet and an electromagnet. These are configured in such a way that the driver is given a visual and audible indication of whether the aspect of the signal ahead is clear or restrictive. The AWS magnets associated with speed restrictions only have a permanent magnet so that only the restrictive audible and visual indications are received (see paragraph 75).

15 Emergency speed restriction lineside equipment (figure 5) consists of an AWS permanent magnet, which is intended to alert the train driver to the presence of an emergency speed indicator (ESI) board (figure 6), which is approximately 180 metres further along the track. A second AWS magnet is placed alongside the ESI board, and this is intended to alert the driver to look for the the warning board which describes the speed restriction ahead. The driver must control the speed of the train to the indicated value by the time it reaches the commencement board, which is placed at the point where the restriction begins.

16 The speed warning board is placed a prescribed distance from the commencement board; in this case, the distance was 2.17 km. At the end of the restriction there is a termination board, which in this case was 60 metres beyond the commencement board. The train may return to line speed once the rear of the train has passed the termination board. The position of the emergency speed restriction warning equipment at Sandy was in accordance with Railway Group standard GK/RT0075.

Staff involved

17 The driver began work on the railways as a driver's assistant on 5 March 1979. In October 1984 he became a driver on the Southern Region and in 1987 he moved to Newcastle as a driver of local trains. He has been a mainline driver at Newcastle since 1989.

18 The driver is rostered in the lodge link, so termed because the regular turns of duty involve lodging overnight in Inverness or Aberdeen.

19 The driver's competence records, route knowledge and licence were up to date.

20 He was involved in a train dispatch irregularity in 2016, following which he had undertaken some additional training, and in July 2018 he was recorded as travelling at 24 mph (38 km/h) in a 20 mph (32 km/h) permanent speed restriction at Arbroath. Following this incident he had a discussion with his manager which covered the use of risk triggered commentary as a tool to assist with focus. An additional on-train data recorder download was to be taken after one of the driver's journeys to check his driving was to the required standards, but this had not been done by the time the incident at Sandy occurred.

External circumstances

21 It was a dry day and the temperature was 14°C around the time of the incident. The sun was relatively low in the sky (approximately 24° up from the horizon) and at an angle of about 48° to the right of the direction of travel of the train. Due to the brightness of the sun, the driver had the blind pulled roughly a third of the way down the windscreen.

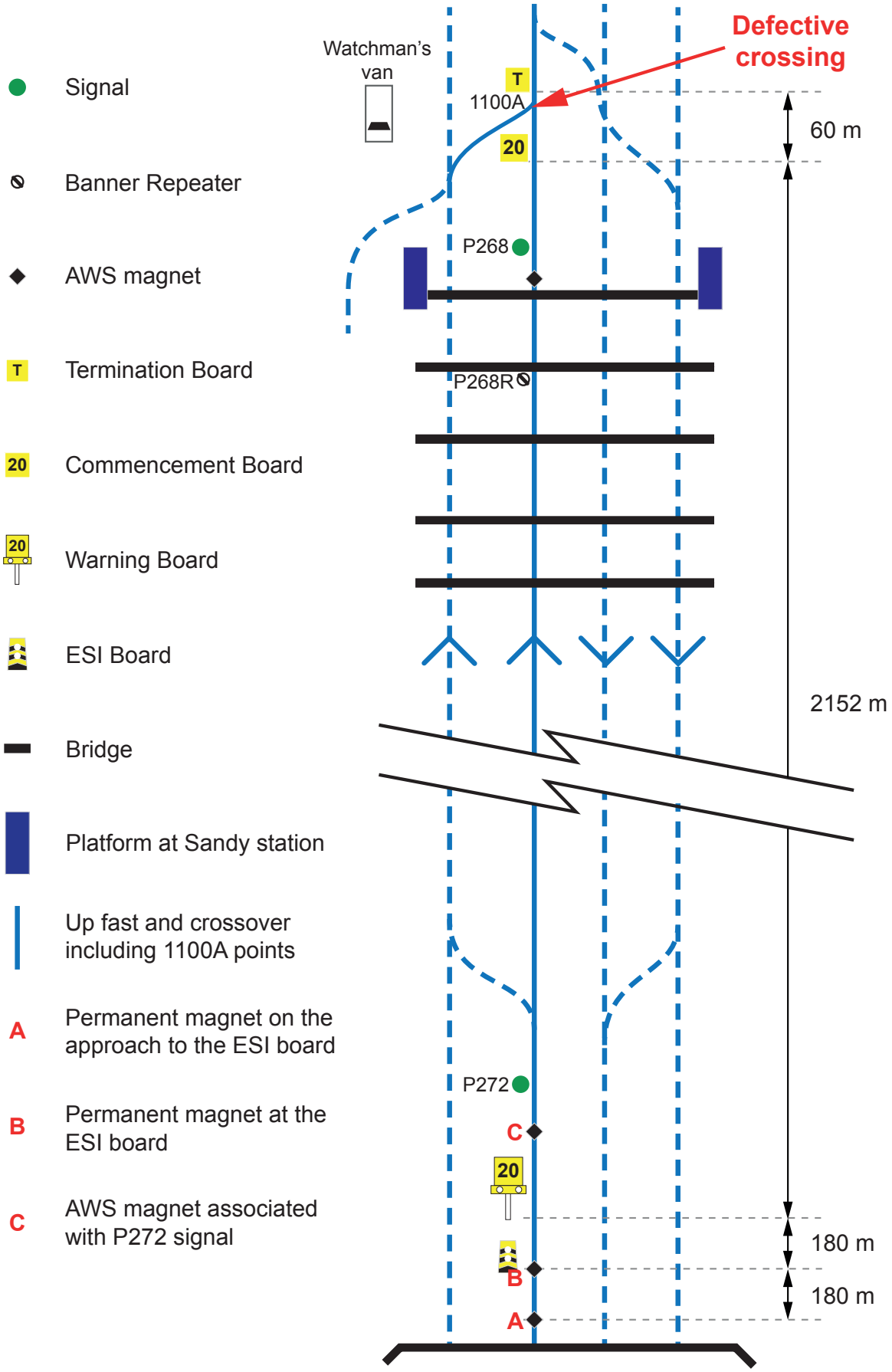

Figure 5: Layout of emergency speed restriction equipment at Sandy (not to scale)

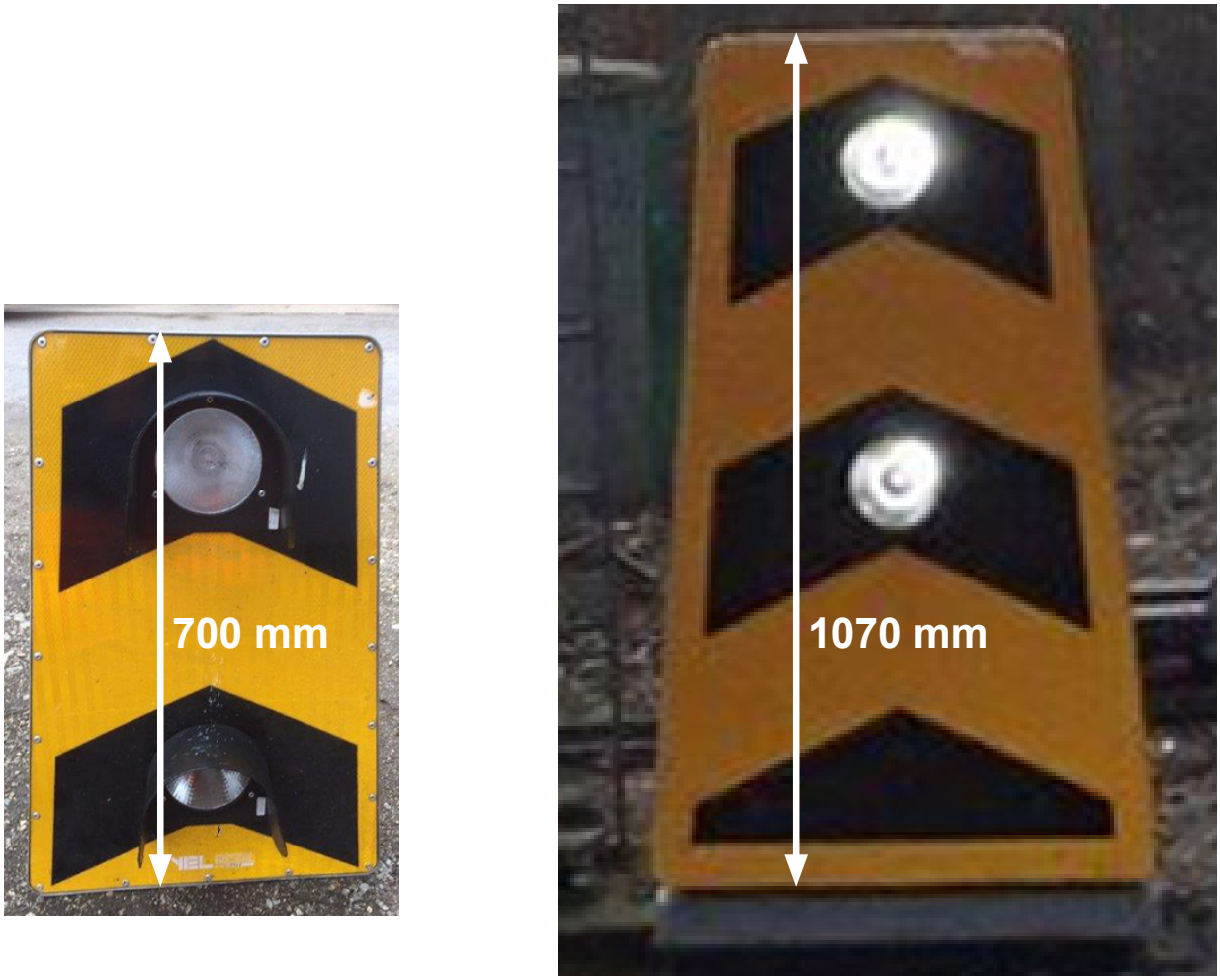

Figure 6: An example of a miniature ESI board on the left, similar to the type used at Sandy (see paragraph 69), and a full size board on the right, shown at the same scale

22 The position and the brightness of the sun may have contributed to the driver mis-reading the warning board (see paragraph 73), and shadowing may have contributed to the driver not seeing the ESI board (see paragraph 66).

The sequence of events

Events preceding the incident

23 On 18 October 2018 at around 10:00 hrs, a Network Rail patroller carrying out a basic visual inspection of the track identified a crack estimated to measure 60 mm long in the crossing of 1100A points at Sandy South Junction.

24 Network Rail's maintenance delivery unit sent out a team to implement a 40/70[2] mph speed restriction, in accordance with the Network Rail company standard governing such situations. Around 13:30 hrs a member of this team measured the crack at 85 mm in length.

25 Due to the length of the crack, the 40/70 mph emergency speed restriction was no longer appropriate and, in accordance with Network Rail standard, NR/L2/TRK/1054, a 20 mph (32 km/h) emergency speed restriction was imposed. Hourly line blockages were also imposed to enable an inspection of the crack, and a watchman was appointed to keep a watch on the crossing and the trains traversing the points.

26 The team installed emergency speed restriction signage in accordance with railway group standard GK/RT0075. Because of the presence of a signal and its associated AWS magnets, the warning AWS magnets and associated boards for the emergency speed restriction were placed further back along the line than the standard distance, giving an additional 221 metres of deceleration distance for trains before they encountered the restriction.

27 As this was being done, Network Rail issued a notice to all affected train and freight operating companies to advise them of the location, value and reason for the emergency speed restriction.

28 The LNER control room received this notice from Network Rail at 13:58 hrs on 18 October, but in line with LNER's procedures at the time the notice was not communicated further. Between the imposition of the emergency speed restriction and the incident at 14:31 hrs the next day, around 150 trains passed through Sandy on the up fast line.

29 At 07:52 hrs on 19 October, train 1E11 departed from Aberdeen bound for London's King's Cross. At 12:00 hrs, five minutes late, the train arrived at Newcastle, where the driver who had brought the train from Aberdeen was relieved by the driver involved in the incident, who had signed on at Newcastle depot at 11:42 hrs. The train then made two further scheduled stops at Darlington and York.

30 As the train was departing from York at 13:12 hrs, the driver felt mild symptoms of a medical condition coming on. He had experienced this condition before (see paragraph 54) and knew what the ongoing symptoms were likely to be.

[2] Differential speed restrictions apply where heavier trains, usually locomotive hauled freight services, are required to travel at the lower of the two speeds and passenger trains may travel at the higher speed due to the increased damage heavier trains are likely to cause to the track.

Events during the incident

31 Timings given in this section of the report have been rounded to the nearest second. Because of the design of the on-train AWS equipment, there may be a delay of up to one second between the time recorded in the train's data recorder for passing over an AWS magnet, and the resulting warning sounding in the cab. At around 14:30, as the train was approaching Sandy at about 125 mph (201 km/h), the driver felt his symptoms worsening and decided to take medication to relieve them. He observed that visibility was good and the train had green signals ahead.

32 The medication was kept in the front pocket of his bag, which was on the seat to his right and slightly behind him. The driver leaned to the right to reach into his bag, and stated that he kept looking out of the windscreen, though he glanced back to look at his bag to find his tablets.

33 At 14:31:06 hrs train 1E11 passed over the first AWS magnet associated with the emergency speed restriction ahead. The driver stated that he had no recollection of the horn that sounded in his cab, however he did acknowledge this warning one second later, by pressing a button on the desk in front of him. He stated that he did not see the ESI board.

34 In between the AWS warning sounding and the driver cancelling it, he also received an audible alarm from the driver's safety device[3] at 14:31:07 hrs, and cancelled it less than one second later by operating a foot pedal.

35 At 14:31:09 hrs the train passed over the AWS magnet located at the ESI board. The driver stated that he looked up, as he immediately acknowledged this second warning, to establish why the AWS warning had sounded.

36 The driver saw the warning board, and stated that he thought there was an arrow associated with it, indicating that it applied only to trains on a diverging route.

37 The train passed over the AWS magnet for signal P272 at 14:31:13 hrs, which was about a second after passing the warning board and four seconds after passing over the permanent magnet at the ESI board. The signal was displaying a green aspect, so passing over this AWS resulted in a 'clear' audible indication, which the driver did not need to acknowledge.

38 At around 14:31:46 hrs, shortly after passing over the AWS magnet for signal P268 at the end of Sandy station platform, the driver saw the commencement board ahead and realised the speed restriction applied to his train. He ceased applying power and made a full service brake application, but the speed of the train only reduced to approximately 121 mph (195 km/h) as it went over the set of points.

Events following the incident

39 The driver has stated that he was shocked by this incident, but once he had established that nothing serious had resulted from going over the speed restriction at an excessive speed, he focused on getting the train safely to King's Cross without further incident.

[3] A device installed in train cabs which drivers must acknowledge to prevent the brakes automatically applying and bringing the train to a halt. The device is installed to prevent accidents that might arise in the event that a train driver becomes incapacitated during a journey and is unable to call for help or operate the cab controls.

40 The watchman, who was in a van parked adjacent to the line, immediately telephoned the signaller at Peterborough signal box to report the incident.

41 The signaller identified which train was involved, by which time the train had left the area controlled by Peterborough signal box, and was then within the area controlled from King's Cross signal box. The Peterborough signaller informed Network Rail's route control of the incident. Network Rail informed LNER's control centre of what had happened, and LNER made arrangements for the driver to be met, on arrival of the train at King's Cross at 15:06 hrs, for interview and drugs and alcohol screening.

Background information

Notification of speed restrictions to drivers

42 The permanent speed restrictions (line speeds) on the national network are shown in table A of the Sectional Appendix, which is issued to all train drivers. Speed limits are displayed on signs alongside the track, placed at the locations where the permitted speed changes. The railway industry has procedures covering the introduction of emergency, temporary and permanent changes to these speeds.

43 Generally, when an emergency, such as the discovery of a cracked or broken rail, requires the immediate imposition of a speed restriction, signallers must use signals to stop each train approaching the site of the restriction. The signaller then explains to the driver the reason they are being cautioned, the location of and the reason for the speed restriction and the speed which must not be exceeded until the whole train has passed over the location. When they are satisfied that this information has been understood, the signaller then gives the driver authority to proceed.

44 These arrangements apply until the signage and other equipment described in the Rule Book has been set up. Lineside warning equipment for emergency speed restrictions consists of the following. First an AWS magnet is placed to alert the driver's attention to the ESI board ahead. Aligned with the ESI board is another AWS magnet to alert the driver to the warning board which displays the speed of the upcoming restriction. After a suitable deceleration distance (defined in railway group standard GKRT0075) the commencement board is reached, by which time the train must be travelling at no more than the speed displayed. Finally, once the area for which the restriction applies has been passed, there is a termination board. Once the rear of the train has passed this board, the train may accelerate back to line speed.

45 Once the lineside warning equipment has been set up, signallers are no longer required to stop and caution trains. Network Rail then issues a notice to all affected operators describing the reason, location and value of the restriction (paragraph 91).

46 If the emergency speed restriction remains in place for more than a few days, details of it will be published in the weekly operating notice, and it can then be converted into a temporary speed restriction. In this event the emergency indicator and associated AWS equipment are removed. The placing of the equipment for both an emergency and a temporary speed restriction must be designed by a suitably qualified person.

47 Prior to 2008, module SP section 9.3 of the railway rule book stated:

> ***'9.3 Information to drivers***
>
> *If the emergency speed restriction is continuing for more than a short time, Operations Control will arrange to issue a special notice to each train operator affected.*
>
> *Arrangements will be made for you [the driver] to be informed of the emergency speed restriction.'*

From 7 June 2008, module SP section 9.3 was withdrawn.

48 The pre 2008 arrangements for bringing emergency speed restrictions to the attention of drivers at the time they booked on duty were introduced following a serious accident at Goswick on the East Coast Main Line in 1947 where a train derailed due to excessive speed over a diversionary route. They were implemented by means of Late Notice Cases, which is the name given to the notice boards at driver booking-on points, where notices relating to speed restrictions, diversions and other important and urgent matters are displayed. Late Notice Cases are painted red and used for notices which have been issued after the publication of the current weekly operating notice and which, usually, are only applicable for a short period of time. These arrangements were intended to ensure that as far as reasonably practicable, train crews were notified of any short notice changes to their routes when signing on for duty.

Key facts and analysis

Identification of the immediate cause

49 The driver did not reduce the train's speed to 20 mph (32 km/h) in response to the emergency speed restriction.

50 The RAIB did not find any evidence of faults with the train.

51 The evidence from the on-train data recorder shows that the driver did not take any action to reduce the speed of the train from 125 mph (201 km/h) until it was too late to make any significant difference before passing over the area where the restriction was in force.

Identification of causal factors

52 The incident occurred due to a combination of the following causal factors:

a. The driver was distracted due to both a medical condition and searching for paracetamol in his bag, so was not paying full attention to the line (paragraph 53)

b. The driver did not respond to the ESI board, and then mis-interpreted the warning board (paragraph 64); and

c. LNER did not provide drivers with notification of emergency speed restrictions (where available) prior to them starting their journeys, following a change to the rule book in June 2008 (paragraph 78);

Each of these factors is now considered in turn.

Driver distraction

53 The driver was distracted due to both a medical condition and searching for paracetamol in his bag, so was not paying full attention to the line.

54 The driver had suffered from a medical condition requiring specific medication to assist with pain management since 21 May 2015. The condition had been notified to his employers and initially, when the driver was prescribed the medication, he was removed from safety critical duties until the effects of the medication were understood and it could be determined whether he would be safe to operate trains while taking it. The driver kept his employer informed of increases and decreases in dosage.

55 Sometime in late 2017 or early 2018 the driver stopped taking any medication for the condition, as he stated he was able to manage the remaining minimal symptoms without it. His general practitioner had advised him that there were potential concerns with taking the medication over a prolonged period. The driver did not specifically inform LNER that he had stopped taking the medication. He had a company medical examination carried out on 18 February 2018, and the medication is not listed in the record of this examination.

56 LNER informed the RAIB that for the majority of medical conditions, it is not necessary for drivers to inform the company when they cease taking medication, and therefore it would not expect to have been told of that change.

57 The driver stated that as the train departed from York (the last stop before King's Cross), he felt symptoms of his medical condition coming on. He took a sip of water and continued to focus on driving.

58 The driver stated that it was a normal journey, though he was almost brought to a stand by signals at Peterborough, after which the pain started to get worse. As he approached Sandy, the pain was increasing and he felt the need to take paracetamol. He noted that there was nothing out of the ordinary occurring on the journey, visibility was good, and there were clear signals ahead.

59 He reached slightly behind him into the front pocket of his bag to try and find the soluble paracetamol which he kept there. He stated that he kept glancing out of the windscreen and back to the bag.

60 LNER's professional driving policy states:

- [Arrange that] anything you need is within easy reach
- When the train is in motion
  - …never attempt to retrieve an item from your bag.
- Special care must be taken when approaching
  - …speed restrictions applicable to your train which necessitates braking caution and stop signals
  - …approaching a station or a speed restriction.

61 Although it is not written down in any document issued by the company, LNER managers stated that their expectation is that if drivers become too ill during a journey to continue, they should contact the signaller, bring their train safely to a halt (ideally at the next station) and request to be relieved. However, drivers are expected to use their common sense to safely manage minor conditions such as headaches. It is impractical to suggest that each time a driver gets a minor ailment, they should stop their train and ask to be relieved.

62 LNER stated that it advises drivers during their initial classroom training how to safely manage situations where they need to relax their focus on the driving task to enable them to complete other tasks which may require their attention.

63 The professional driving policy does explain techniques drivers can use to re-focus on the driving task if they realise that they have become distracted, and how to switch their attention from the route ahead to indications in the cab and not to stay focused on one thing for too long, but there is nothing describing the most suitable circumstances and any precautions that drivers should take before they relax their attention.

Lineside emergency speed restriction equipment

64 **The driver did not respond to the Emergency Speed Indicator (ESI) board, and then misinterpreted the warning board.**

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

a. The lack of conspicuity of the ESI board led the already distracted driver to miss it (paragraph 66).

b. The driver only had a short time to view the warning board (paragraph 73).

Each of these is now considered in turn.

Conspicuity of the miniature ESI board

66 The driver stated that he did not see the ESI board. The board would have come into view at a range of around 400 metres, 7 seconds before the train passed it. However, the miniature ESI board is not conspicuous in the forward facing closed circuit television (FFCCTV) footage provided to the RAIB (figures 7a-7d) (see paragraph 69). While the quality of the video recording may not reflect the actual conditions, it is apparent that the sun was shining brightly from behind the ESI board and there was significant shadowing cast over the board by structures and vegetation on the right hand-side of the railway line. There are also some reflections from small unidentifiable items in the space between the up slow and up fast running lines a short distance on the approach to the ESI board, which may have diverted attention from the board itself.

Figure 7a: FFCCTV view of ESI about 5 seconds away from it (image courtesy of LNER)

Figure 7b: FFCCTV view of ESI about 3 seconds away from it (image courtesy of LNER)

Figure 7c: FFCCTV view of ESI about 2 seconds away from it (image courtesy of LNER)

Figure 7d: FFCCTV view of ESI board about a second away from it (image courtesy of LNER)

67 The lights on the board flash with the aim of drawing the driver's attention to the sign. The RAIB conducted some subjective tests with a similar ESI board and found that a slight horizontal rotation of the board made the lights on the board very hard to see, and this could have reduced the conspicuity of the board itself as it made it more difficult to pick the board out from its surroundings.

68 Although there is no direct evidence that the board was incorrectly aligned, RAIB found that there is a significant reduction of luminous intensity when the boards are viewed at an angle. This is in line with the requirements of the standard to which the boards are designed (figures 8a and 8b) as it is intended that only the drivers approaching on the line to which the equipment applies should view them as they may cause an unnecessary distraction to drivers on other lines. For free standing units there is no way to accurately align the boards for optimum visibility, and even the type which are held in place using clamps which attach to the rails have no adjustment to take into account any curvature of the line.

69 There are two sizes of ESI board; the full size board is approximately 1070 mm in height and weighs approximately 48 kg, and the miniature board is 700 mm in height and weighs 14 kg (figure 6). Whilst the exact sizes and weights depend on the manufacturer, these dimensions are given in the document 'Sign AF01 – Emergency Indicator', referenced from GI/GN7634 (index for Lineside Signs Issue One: June 2015). This document states that the full size ESI board is the standard, while the miniature dimensions are given with a notification of 'for limited clearance'. Stands for the miniature board can be rail clamps or bespoke self-supporting stands weighing around 18 kg.

70 The Network Rail training video 'How to install a temporary speed restriction indicator' (which includes the installation of the emergency speed indicator) states the top of the board must be no higher than 915 mm from the top of the rail, otherwise a miniature warning board must be used. The video also explains the distance the board must be from the running rail and that the board must be facing the right way. The video gives no guidance on how to horizontally align the board. Witness evidence indicates that the miniature boards are normally used, by default, probably because they are significantly lighter in weight and so easier to carry and deploy.

Table 1:Emergency Indicator beam intensity characteristics					
Vertical Angle (degrees of axis)	Horizontal Angle (degrees off axis)				
	0	2	5	10	15
10	30	30	20	-	-
5	120	120	50	35	-
3	300	200	100	40	-
1	450	450	110	45	-
0	1200	1050	120	50	20
	milli-candela per flash				

Figure 8a: Extract from Railway Group Standard GI/RT7033 issues 1 (2003) and 2 (2009) showing required reduction in luminous intensity of ESI board lights when viewed at various angles.

Typeface		Not applicable.
Colour		Black shapes on a Yellow background.
Luminance		Class RA2 retro-reflectivity. See below for lights.
Readability performance	**Readable distance**	
	Visible distance	
Associated sign(s)		Temporary speed restrictions signs.
Supplementary information		This document should be read in conjunction with GI/RT7033 Lineside Signs.

Illumination

Colour		White in accordance with 'Signal white' defined in GK/RT0057.
Flashing	**Flashing rate**	2 Hz.
	Flashing pattern	Flashing length at 60 ± 20 milliseconds.
Performance		The lights are visible at a distance required by the readability of the sign. The lights are visible at observation angles of no greater than 15° and 10° relative to the centre horizontal and vertical axis of the emitted light.
Supplementary information		The diameter for lights is 150 mm maximum. It is acceptable to use the flash length of 150 ± 50 microseconds for signs fitted with Xenon flashtubes.

Figure 8b: Extract from Sign AF01, linked to document GI/GN7634, Guidance on Lineside Signs which is linked to Railway Group Standard GI/RT7033 issue 3 2015 showing the maximum visibility offset from the vertical and horizontal axes.

71 The FFCCTV from the train shows that a miniature warning board was in place. Staff from the local maintenance delivery unit, who were responsible for setting up the emergency speed restriction, stated that they did not normally use the larger size of board, and the one that was placed would simply have been the next one available in their van.

72 In summary:

a. there is no instruction on how to align the boards correctly for optimum visibility, despite the requirement of the standard for the flashing lights to be significantly less intense when seen from quite small angles from the alignment of the beam, and not visible at a horizontal angle of more than 15°; and

b. there is no clear instruction on when full sized boards should be used.

Mis-interpretation of the warning board

73 The driver probably did not see the ESI board and did not recall the first AWS warning. Therefore, he was not expecting to encounter the warning board (paragraph 78). It is likely that he tried to make sense of it in the short time (about one second) that it was visible to him by concluding that it did not apply to him, but to the approaching diverging route, although there was no arrow that would have indicated that it applied to a diverging route (figure 9). Figure 10, shows how the signage would have appeared had the restriction applied in a similar location, but on the up slow line, as the driver believed was the case.

Figure 9: FFCCTV view of the warning board (image courtesy of LNER)

74 About two seconds after the audible warning from the second AWS magnet for the warning board sounded, the train passed over the magnet associated with signal P272 which was displaying a green aspect.

75 When a train goes over a magnet for a restrictive (yellow or red) signal or for a temporary, permanent or emergency speed restriction a warning horn sounds in the cab. The driver must acknowledge this warning, by pressing a button on the control desk. If this button is not pressed within 2.7 seconds of the horn sounding, the brakes are automatically applied. A black and yellow disc (known as a 'sunflower') is displayed as a visual reminder that the warning has been given. When the train passes the magnet associated with a signal displaying a green aspect, a bell sounds in the cab and the 'sunflower' disc changes to all-black. In this case, passing a clear signal so soon after passing the warning board removed the visual reminder in the cab for the driver that he had passed the board. This may also have confirmed to the driver that his conclusion that the restriction did not apply to him was correct.

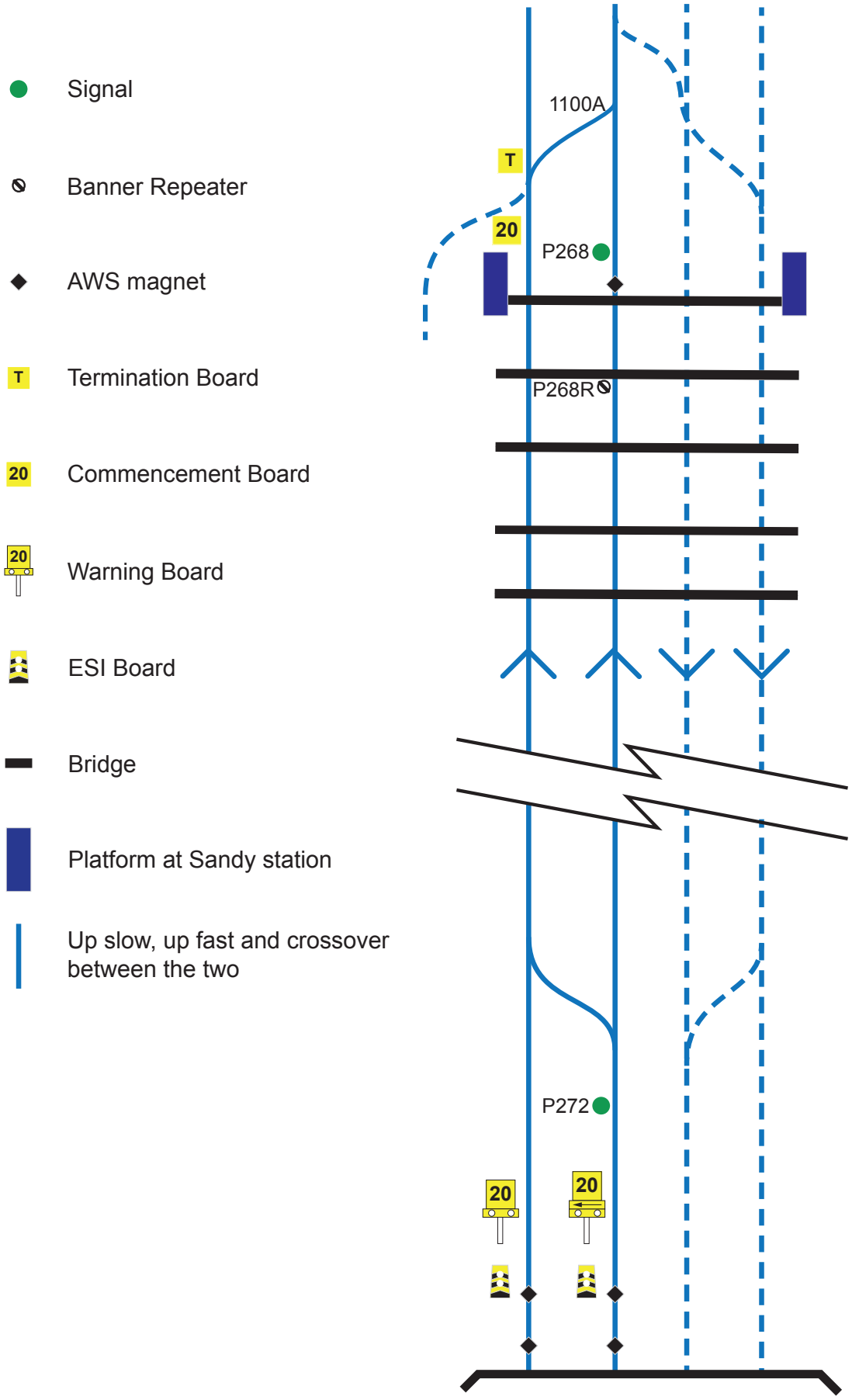

Figure 10: Lineside signage as it would have appeared, had the speed restriction applied in a similar location on the up slow

Cancellation of AWS warnings

76 Train drivers on the national network receive many AWS warnings, each of which they must acknowledge. Research[4] has shown that drivers become habituated to acknowledging the AWS and often react to these warnings without thinking, and the risk of 'repetitive cancellation' leading to a sequence of events which culminate in passing a signal at danger has been a matter of concern in the railway industry for many years.

77 The driver received the AWS warning associated with the ESI board a very short time before receiving a warning from the driver's safety device system (paragraph 34). The need to react to these two messages in rapid succession may have immediately overridden the significance of the AWS warning, and caused him to forget that he had received it.

78 **LNER did not provide drivers with notification of any emergency speed restrictions prior to them starting their journeys, following a change to the rule book in June 2008.**

79 In 2008 the requirement for train and freight operators to inform their drivers of emergency speed restrictions on their routes was removed (see paragraphs 47 and 85 to 94). Many operators continued to issue late notices (paragraph 48), or used other means to disseminate this information. However National Express East Coast, which was the franchisee of the route at the time, ceased issuing such notices to its drivers.

80 The RAIB has not found any evidence to show that National Express East Coast carried out any risk assessment before ceasing to issue emergency speed restriction notices.

81 The driver stated that he was trained to always read and make note of notices issued. He stated that he marks pages in the weekly operating notices of anything that applies to him, while any notices on the notice board which are relevant but not available anywhere else, he notes down in his notebook. It is likely, that had he read a late notice about the emergency speed restriction, he would have:

a) been aware that the restriction applied to his route;

b) been more focused on the line ahead at Sandy; and

c) chosen not to look for his pills until it was safe to do so after passing over the restriction.

82 Under a system of posting late notices in late notice cases, there is still the possibility that some drivers will have already started their shift when an emergency speed restriction is implemented on a route they are due to drive over, and may therefore encounter an emergency speed restriction without having advance notification of it. However, in this case, LNER did not put up any notice regarding the presence of the emergency speed restriction at Sandy.

[4] McLeod, R. W., Walker, G. H. & Moray, N. (2005). Analysing and modelling train driver performance. Applied Ergonomics, 36(6), 671-680

Discounted factors

83 The driver had two mobile phones, one issued by LNER and one personal, in his bag. Telephone records provide no evidence to suggest that he used either of them during the journey from Newcastle to King's Cross.

84 The RAIB has considered the possibility that the driver did not see any of the warning signs for the ESR, and only reacted when the commencement board came into view. However, after considering all the evidence, this scenario has been discounted.

Identification of underlying factor

Implementation of the change to the rule book

85 **The requirement to provide drivers with details of emergency speed restrictions before the beginning of their journey was removed from the rule book without adequate consideration of the risk associated with this change, and this has led to inconsistency between train operating companies in the information they provide to drivers.**

86 In March 2007, a freight operator challenged the requirement in the rule book (see paragraph 47) to issue notices to drivers regarding emergency speed restrictions, stating that the practice was costing it around £60,000 each year, and that the lineside warning equipment was sufficient to notify drivers of the restrictions and to give them time to bring the train down to the required speed.

87 The railway industry's traffic operations management standards committee (TOM SC) requested that RSSB[5], the body which is the custodian of the railway industry's body of standards and operating rules, carry out an investigation to understand the issue and to make a recommendation. TOM SC has the delegated authority for making decisions about creating, changing, deviating from and publishing national rules to the rail industry. At the meeting of TOM SC in March 2007 there were 15 members of the committee present, of which one was an observer, six were from RSSB, one passenger train operating company (apologies for absence were sent by another) and two from freight operating companies. The members of TOM SC are required to represent the interests of all parties in their area of interest, ie all train operating companies, rather than the interests of their specific company. In the June 2007 meeting, there were representatives from two train operating companies present, but no freight operators.

[5] A not-for-profit body whose members are the companies making up the railway industry. The company is registered as Rail Safety and Standards Board Ltd, but trades as RSSB.

88 RSSB responded to TOM SC in June 2007, concluding that there was no evidence that there would be any discernible change in safety by removing the requirement. However, the information on which this conclusion and the subsequent change to the rule book in 2008 was based did not consider whether there was a difference between the requirements of freight and passenger service drivers, or whether the risk of overspeeding as a result of driver error would be affected by the removal of the notices. In the body of the report it was noted that '*the contribution of this information in mitigating drivers' errors over an ESR leading to overspeeding is very hard to quantify and limited to those occasions when the information reaches the driver before he/she encounters the ESR, but it should be recognised in making any decision both at the industry as well as at each transport operator level*'. However, the report's conclusion makes no mention of that statement, and does not suggest any further consideration of the risks.

89 TOM SC reviewed the report and its conclusions. Although concerns were raised by the ASLEF and RMT trade unions (who attended the meeting in the capacity of observers), the committee decided that the requirement to post notices about emergency speed restrictions should be removed from the rule book. This was then implemented, without further consultation with train operators, in June 2008.

90 RSSB produced a leaflet in June 2008 (figure 11) to explain the changes to the rule book for that re-issue.

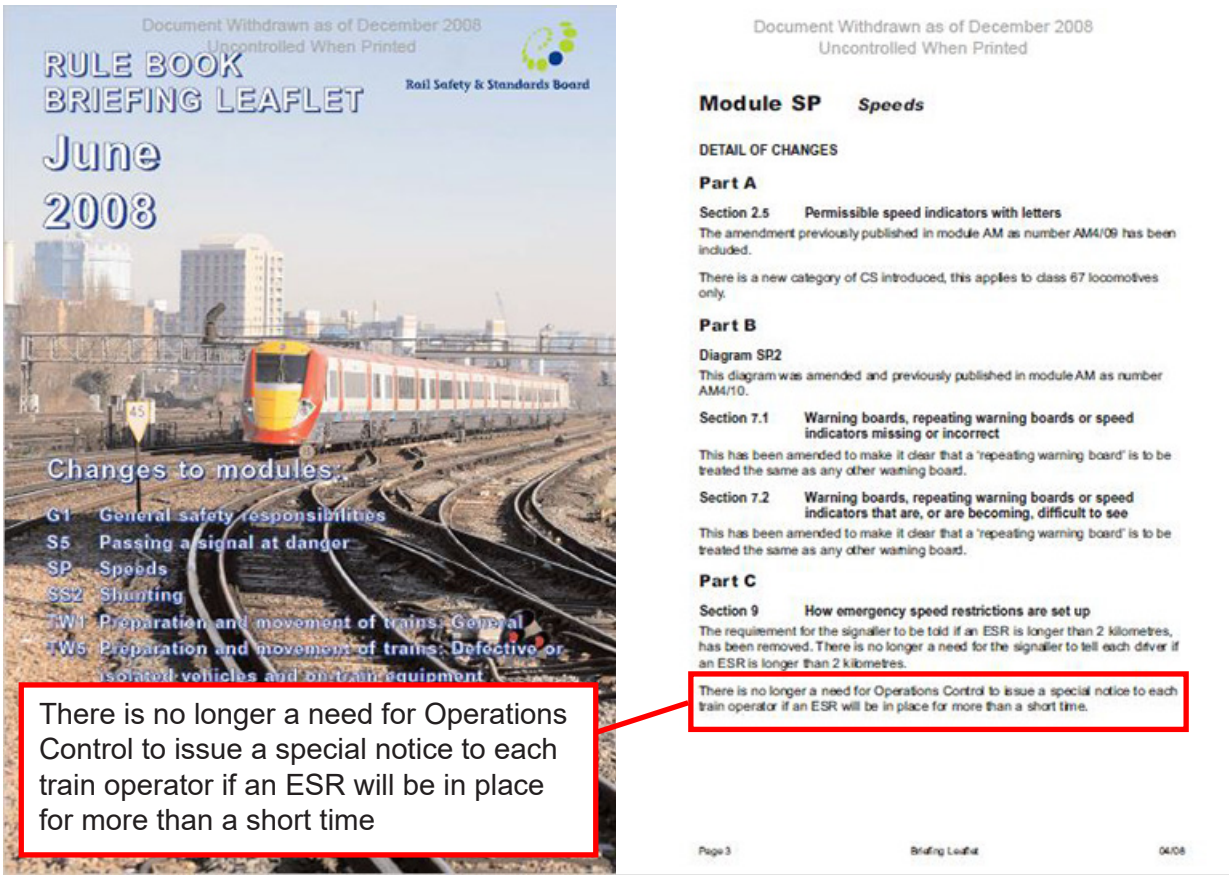

Figure 11: Extract from the RSSB's Rule book briefing leaflet June 2008

91 Network Rail incorporated the requirement to inform train and freight operating company control centres into its national operating procedure, 'Speed restrictions', currently NR/L3/OPS/045/3.19 issue 2, 2 June 2018. This was in line with the requirements of railway group standard GKRT0075. The purpose of the document is stated as:

'This procedure outlines the framework in which Route Operations Control manages speed restrictions. It sets out how Train Operating Companies (TOCs) / Freight Operating Companies (FOCs) are correctly and promptly notified, in a consistent format, when speed restrictions that might affect the running of their trains have been imposed, varied or withdrawn.'

92 This aligns with the guidance in the Association of Train Operating Companies (now the Rail Delivery Group) ATOC Good Practice Guide, ATOC/GPG006 September 2004, section 14.4 'Temporary and Emergency Speed Restrictions':

'14.4.2 Advice of Emergency Speed Restrictions

Where it becomes necessary to impose an Emergency Speed Restriction (ESR), i.e. one which has not been published in the Weekly Operating Notice, Network Rail should advise the Control Centre of the arrangements which will apply.

14.4.4 Advice to Drivers

The Control Centre should have in place appropriate arrangements for advising drivers of emergency speed restrictions, before they operate over the affected route. Acknowledgement/confirmation should be received that the details are being issued personally to staff or are being displayed in a late Notice Case.'

93 The removal of this requirement from the rule book permitted operators to cease advising drivers of emergency speed restrictions, but did not prohibit them from doing so. Consequently, most, but not all, passenger train operating companies chose to continue notifying drivers of emergency speed restrictions, when they received notice from Network Rail, in line with this guidance.

94 RSSB currently has no way of monitoring or measuring the impact of changes that it makes to the rule book. As part of this investigation, the RAIB asked similar operators to LNER what their practices were in relation to notifying their drivers of emergency speed restrictions. All of the four operators who were asked reported that they notify their drivers in advance, where possible, of emergency speed restrictions, either by written notices, email, electronic signs or using more than one of these methods, to make drivers aware of speed restrictions in the route before they start their journeys.

Summary of conclusions

Immediate cause

95 The driver did not reduce the train's speed to 20 mph (32 km/h) in response to the emergency speed restriction (paragraph 49).

Causal factors

96 The causal factors were:

a. The driver was distracted due to both a medical condition and searching for paracetamol in his bag, so was not paying full attention to the line (paragraphs 53 and 63, **Recommendations 4 and 5**).

b. The driver did not respond to the ESI board, and then mis-interpreted the warning board (paragraph 64, **Recommendation 3**).

c. LNER did not provide drivers with notification of any emergency speed restrictions prior to them starting their journeys, following a change to the rule book in June 2008 (paragraph 78, **Recommendations 1 and 2**, Actions already taken, paragraph 99).

Underlying factor

97 The underlying factor was:

a. The requirement to provide drivers with details of emergency speed restrictions before the beginning of a journey was removed from the rule book without adequate consideration of the risk associated with this change, and this led to inconsistency between operating companies in the information they provide to drivers (paragraph 85, **Recommendations 1, 2 and 5**).

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

Urgent safety advice

98 Following the incident, the RAIB issued urgent safety advice to LNER, the Rail Delivery Group (representing all train operating companies) and all freight operating companies operating on Network Rail infrastructure, on 29 November 2018 (see Appendix C). This covered the need to review their practice in relation to issuing prior notice to drivers regarding emergency speed restrictions, and to ensure that there is sufficient risk assessment in place should they have chosen not to share this information with their drivers.

99 After receiving the urgent safety advice, LNER now notifies its drivers of emergency speed restrictions by email, and puts emergency speed restriction notifications on the top and bottom of the document listing all the information the driver needs, such as the stations they need to call at, which are issued to each driver prior to the start of their journeys.

Rule book change processes

100 RSSB reports that its process for making decisions on proposed changes to the rule book now includes more robust analysis, based around recognised principles such as the Common Safety Method on Risk Evaluation and Assessment[6], and Taking Safe Decisions[7]. It believes that the use of these tools means that it has a better understanding of risk management, compared to 2008, and the basis on which a decision is made would now be explicitly recorded. It points to the recent change in which emergency special working (ESW) was introduced as an alternative to temporary block working. The process for making this change included:

a. Research (including simulator trials)

b. Risk assessment

c. Development of draft operating rules

d. Field trials authorised via deviations

e. Data collection

f. Evaluation against defined success criteria

g. Development of proposal, underpinned by all of the above

h. Scrutiny of standards committees, where decision criteria are applied, and members are required to act on behalf of their constituents

i. Draft rules developed by RSSB and presented to standards committee for authorisation to consult the wider industry

[6] The Common Safety Method for risk evaluation and assessment is a framework that describes a common mandatory European risk management process for the rail industry and does not prescribe specific tools or techniques to be used. It was promulgated in Commission Implementing Regulation 402/2013 https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:121:0008:0025:EN:PDF.

[7] Taking Safe Decisions is an RSSB publication which sets out the industry consensus view of how safety is taken into account when taking decisions. It describes the principles that companies apply to protect people's safety, satisfy the law, respect the interests of stakeholders and meet commercial objectives. https://www.rssb.co.uk/Standards-and-Safety/Tools--Resources/Rail-Risk-Toolkit/Taking-Safe-Decisions---Analysis-Tool.

j. Consultation with the wider industry, which included presentations at various stakeholder groups, for example, the Rail Delivery Group's Ops Standards Forum, Rail Freight Operator Group and the Mechanical and Electrical Engineering Networking Group.

k. RSSB considers comments, prepares proposed responses and presents to standards committee for consideration and approval to return responses to respondents

l. Final drafts of amendments, taking into consideration consultation comments, presented to standards committee for approval to publish

m. Amendments published three months before in-force date

n. Published amendments are accompanied by an explanation of change and briefing materials to facilitate consistency of message and quality of briefing

o. National control logs monitored for application of ESW in readiness for 12-month review

p. 12-month review planned, results / recommendation will be presented to standards committee.

101 RSSB also reported that the induction and refresher briefings that it provides to members of standards committees cover:

a. The role of RSSB in the safety and standards landscape

b. The standards landscape and its relationship with legal obligations and the overall regulatory framework

c. The committee's role under the governance of the Railway Group Standards code (which has been approved by the Office of Rail and Road (ORR)) and the Standards Manual

d. The role of individual standards committee members and how they represent their constituency

e. The decision taking principles that a standards committee member must satisfy before taking decisions on standards changes and deviations

f. The standards change and deviation process and the role and importance of consultation and engagement.

Background to RAIB recommendations

102 On 25 March 2019 an incident occurred which prompted an ad-hoc trial of a method of advising drivers by radio of an emergency speed restriction on the route ahead. A 5 mph (8 km/h) emergency speed restriction was imposed at Bushbury Junction, West Midlands, due to a crack in the stock rail of a switch diamond. A watchman was put in place, and in the space of 24 hours, three trains, from different train operating companies, exceeded the emergency speed restriction by a substantial margin. After the second case of overspeeding, Network Rail managers became concerned that any further instances could have serious consequences. After confirming that the emergency speed restriction signage was set up correctly, Network Rail decided that an additional mitigation was required to prevent overspeeding. A recorded message was broadcast to drivers of trains approaching the area over the GSM-R radio system, which is used to communicate between signallers and train drivers. However, a third overspeeding incident then occurred. The driver of this train reported misunderstanding the recorded message, and being confused about the exact location of the emergency speed restriction. The broadcast messages were subsequently suspended. Network Rail is considering the lessons from this incident.

Recommendations

103 The following recommendations are made[8]:

1 *The intent of this recommendation is to minimise the risk of drivers being unaware that they are approaching a section of track where an emergency speed restriction is in force.*

Train Operating Companies and Freight Operating Companies should review their practice in relation to drivers' prior awareness of emergency speed restrictions. This review should be based on a suitable and sufficient risk assessment, and consider any necessary measures to minimise the likelihood that a driver encountering an emergency speed restriction may not respond correctly to the trackside signs. Any necessary actions should be implemented (paragraphs 96c, 97a).

2 *The intent of this recommendation is to provide drivers with early warnings of emergency speed restrictions en route.*

Rail Delivery Group, in consultation with Network Rail, should consider and review options for a safe and suitable means of providing drivers with warning of emergency speed restrictions on the route ahead through the use of available technologies (paragraph 96c, 97a).

3 *The intent of this recommendation is to review the design and use of the emergency speed indicator board in order that the flashing lights are clearly visible for as long as possible even when the board is in shadow or bright sunlight.*

Network Rail should:

a) issue clear instructions to its staff about when it is permissible to deploy a miniature emergency speed indicator board; and

b) determine whether the lamp fittings in emergency speed indicator boards are adequate for the purpose for which they are designed, bearing in mind the difficulty of ensuring the optimum alignment when deploying these boards (paragraph 96b).

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[8] 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.

4 *The intent of this recommendation is to ensure drivers have an understanding of how to deal with tasks which may require addressing within the cab environment.*

LNER should review its professional driving policy and associated competency arrangements to ensure that drivers are provided with risk based guidance on how and when they can safely carry out tasks in the cab while the train is in motion. This guidance should ensure that drivers can be confident that they can reduce speed, or stop, if required (paragraph 96a).

This recommendation may also apply to other train operating companies.

5 *The intent of this recommendation is to learn lessons from the 2008 change to the rules relating to emergency speed restrictions and to consider the extent to which these have been addressed by the current processes which are applied by standards committees.*

RSSB should lead a review of how the proposal to remove the requirement in the rule book to notify drivers of emergency speed restrictions was managed. This review should:

- highlight any lessons learnt and consider the extent to which these have been addressed by the current processes which are applied by standards committees; and
- consider how RSSB and Railway Group members can best work together to monitor the effects of significant changes to the rule book, such that any unexpected consequences can be further managed or mitigated.

The outcomes of the review should then be used to inform any necessary improvements to the current processes and the training provided to persons involved in the evaluation of proposed changes to the rule book (paragraph 97a).

Appendices

Appendix A - Glossary of abbreviations and acronyms

ASLEF	Associated Society of Locomotive Engineers and Firemen
AWS	Automatic Warning System
ESI	Emergency Speed Indicator
ESW	Emergency Special Working
FFCCTV	Forward facing closed circuit television
GSM-R	Global System for Mobile Communications - Railway
HST	High Speed Train
LNER	London North Eastern Railway
RAIB	Rail Accident Investigation Branch
RMT	National Union of Rail, Maritime and Transport Workers
RSSB	Rail Safety and Standards Board
TOM SC	Traffic Operations Management Standards Committee

Appendix B - 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;
- forward facing closed circuit television recordings taken from the train;
- weather reports and observations at the site;
- the rule book and RSSB, Network Rail and LNER Standards;
- data from mobile phones;
- information from other TOCs;
- examination and testing of ESI boards;
- a review of previous reported incidents; and
- a review of previous RAIB investigations that had relevance to this incident.

Appendix C - Urgent Safety Advice

Urgent safety advice 03/2018: Driver awareness of emergency speed restrictions

Published 29 November 2018

1. Safety issue

Train drivers being unaware that they are approaching a section of track where an emergency speed restriction is in force because some train operators are not passing to their drivers the advice of emergency speed restrictions issued by Network Rail.

2. Safety advice

Train operating companies (TOCs) and freight operating companies (FOCs) are advised to review their practice in this area, and consider whether they are taking adequate steps to minimise the likelihood that a driver encountering an emergency speed restriction (ESR) may not respond correctly to the trackside signs.

Any train operators (passenger and freight) who have chosen not to follow ATOC (RDG) guidance relating to the notification of emergency speed restrictions should ensure that they have undertaken a suitable and sufficient risk assessment to justify the removal of a long established safety measure.

3. Issued to:

- LNER
- Rail Delivery Group (representing all train operating companies)
- All freight operating companies operating on Network Rail infrastructure

4. Background

At around 14:32 hrs on 19 October 2018, an LNER service from Aberdeen to London's King's Cross passed through an emergency speed restriction of 20 mph at approximately 120 mph (193 km/h), near Sandy, Bedfordshire.

The emergency speed restriction had been applied at around 13:50 hrs on the previous day because track maintenance staff had found a defect (a crack) in a crossing, part of a set of points. Marker boards and associated automatic warning system (AWS) magnets were in place to provide warning of the emergency speed restriction and denote where the restriction commenced and terminated. However, the driver of the train had not received any notification of the existence of the emergency speed restriction prior to the journey.

The RAIB's preliminary examination found that the requirement to issue information about ESRs to drivers was removed from the railway rule book in 2008. However, Network Rail's company procedures require it to issue advice of the restriction to TOCs and FOCs and all other relevant stakeholders. The ATOC (RDG) document 'Good Practice Guide – Control Centres: Business Process Manual' advises TOCs to have in place appropriate arrangements for advising drivers of emergency speed restrictions, before they operate over the affected route. Research by RSSB carried out in 2014 into the reasons why drivers exceed permanent, temporary and emergency speed limits found that around 10% of drivers surveyed were not receiving this advice.

Although ESRs are provided with an emergency indicator which includes flashing lights, and an associated AWS warning, it is still important that drivers are aware in advance that there is an ESR applying to the route their train will be taking. Suitable notification of drivers will alert of them of the need to look out for the start of the speed restriction, and informs them of the route to which the speed restriction applies, so reducing the chance of them missing the point at which they should start braking, or misreading the signs.

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

Any enquiries about this publication should be sent to:

RAIB
The Wharf
Stores Road
Derby UK
DE21 4BA

Email: enquiries@raib.gov.uk
Telephone: 01332 253300
Website: www.gov.uk/raib