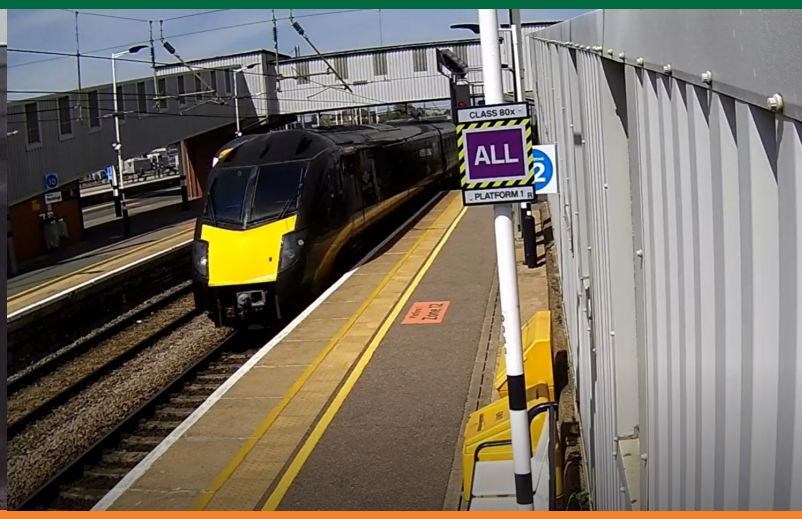
RAIB
Rail Accident Investigation Branch

Rail Accident Report



Overspeed at Spital Junction, Peterborough
4 May 2023

Report 10/2024
September 2024

This investigation was carried out in accordance with:

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

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Preface

The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

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

Any information about casualties is based on figures provided to 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. 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.

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 Spital Junction, Peterborough 4 May 2023

Contents

Summary

At around 13:00 hrs on 4 May 2023, the 09:54 hrs Sunderland to London King's Cross Grand Central service passed over three sets of points forming part of Spital Junction at excessive speed. The maximum permitted speed over the junction, which is to the north of Peterborough station, is initially 30 mph (48 km/h) reducing to 25 mph (40 km/h). The data recorder from the train indicated that the points had been traversed at a speed of 66 mph (106 km/h).

The speed of the train over the junction resulted in sudden sideways movements of the coaches. This led to some passengers being thrown from their seats, with some receiving minor injuries.

RAIB's investigation found that the overspeeding was caused by the driver of the train not reacting appropriately to the signal indication they had received on the approach to the junction. This signal was indicating that the train was to take a diverging route ahead which had a lower speed limit than the straight-ahead route. The driver's expectation was that the train was being routed straight ahead and their application of driving awareness skills was not sufficient to overcome that expectation.

UK railway signalling principles mean that the control of speed at diverging junctions such as this is dependent on drivers reacting to signal information given at considerable distances. This, and exemptions granted in the past from fitting engineered protective measures beyond the signal, places the reliance on drivers correctly observing and responding to all the information given by the signal. This was a factor in this incident.

Testing and analysis by RAIB also found that the junction indicator element of the signal may not have been as conspicuous as the main aspect of the signal at the point the driver observed and reacted to the signal. This is a possible factor.

Three underlying factors were identified by the investigation. Grand Central had not provided the driver with the necessary non-technical skills or additional strategies to manage the risk present at this signal. This was a possible underlying factor. Network Rail and East Coast Main Line train operators had not effectively controlled the risk of overspeeding at this junction both at the time the signal's operation was changed in 2013 and following a previous overspeeding incident at the same location in April 2022. Thirdly, Network Rail does not control the risk of overspeeding at locations where there is a long distance between the approach released protecting signal and the junction itself, once a proceed aspect has been given to drivers.

RAIB observed that Grand Central had not identified the risks associated with the signal in its route risk assessment and was not managing the development plans for the driver in accordance with its own processes. RAIB also observed that Network Rail's reliability centred maintenance regime does not include a means to effectively manage degradation of junction indicator modules fitted with light emitting diodes (LEDs).

A similar incident occurred at the same location (RAIB report 06/2023), 13 months before this incident. Following this more recent incident, RAIB issued urgent safety advice in May 2023 to Network Rail and operators of trains on the East Coast Main Line through Peterborough station. This advice alerted them that suitable arrangements may not be in place to mitigate the risk of trains travelling southbound through Spital Junction at excessive speeds when signalled from the Up Fast line on to the Up Slow lines at Peterborough station. Duty holders were advised that they should take immediate steps, either operationally, or by technical means, to mitigate this risk.

RAIB has made four new recommendations as a result of this investigation. The first recommendation is for Grand Central to review and amend its training and competence management processes to provide its drivers with the necessary non-technical skills or additional strategies to manage the risk encountered at signals which may show different aspects to those usually encountered.

The second recommendation asks Network Rail and train operators to review the processes by which they derive, share and implement safety learning from accidents and incidents that involve shared risks across organisations.

The third recommendation is for RSSB to review the standards specifying the relative brightness of main aspects and junction indicators on signals to understand the effects on conspicuity of the complete signal up to the maximum distance at which a signal is required to be readable, to minimise the risk of drivers not correctly reading signals.

The fourth recommendation, arising from an observation, is for Network Rail to manage the risk of a driver not seeing a route indication because of the gradual reduction in light output of LED signals, which occurs over time.

RAIB has also identified two learning points during the investigation. The first relates to train operators ensuring that their route risk assessments include the risks to their services from signals which may show different aspects to those usually encountered. The second reminds transport undertakings of the importance of managing the competence of safety-critical staff effectively and in accordance with their own processes.

Also mentioned within this report are the learning points from RAIB's investigation into a previous incident at this location on 17 April 2022. These relate to the need for train operators to ensure that drivers maintain alertness when approaching junction signals and that train operator emergency plans should specifically include processes to deal with the aftermath of overspeeding incidents.

Introduction

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 acronyms, which are explained in appendix A. Sources of evidence used in the investigation are listed in appendix B. Appendix C contains a copy of urgent safety advice issued by RAIB following the incident to Network Rail and transport undertakings who operate trains on the East Coast Main Line through Peterborough station.

The incident

Summary of the incident

3 At around 13:00 hrs on 4 May 2023, train reporting number 1A64, the 09:54 hrs Grand Central service from Sunderland to London King's Cross, passed over three sets of points at Spital Junction (at the northern approach to Peterborough station) at excessive speed. The maximum permitted speed over the junction is initially 30 mph (48 km/h) reducing to 25 mph (40 km/h). The data recorder from the train indicated that the points had been traversed at a speed of 66 mph (106 km/h). Following the driver's application of the emergency brake, the train came to a stand within platform 1.

4 The train was not due to call at Peterborough and was travelling on the Up Fast line before reaching the junction's protecting signal, P468, on the approach to Spital Junction. At the time of the overspeed, P468 signal was indicating that the route ahead was set for a diverging route, directing the train to the Up Slow line via platform 1.

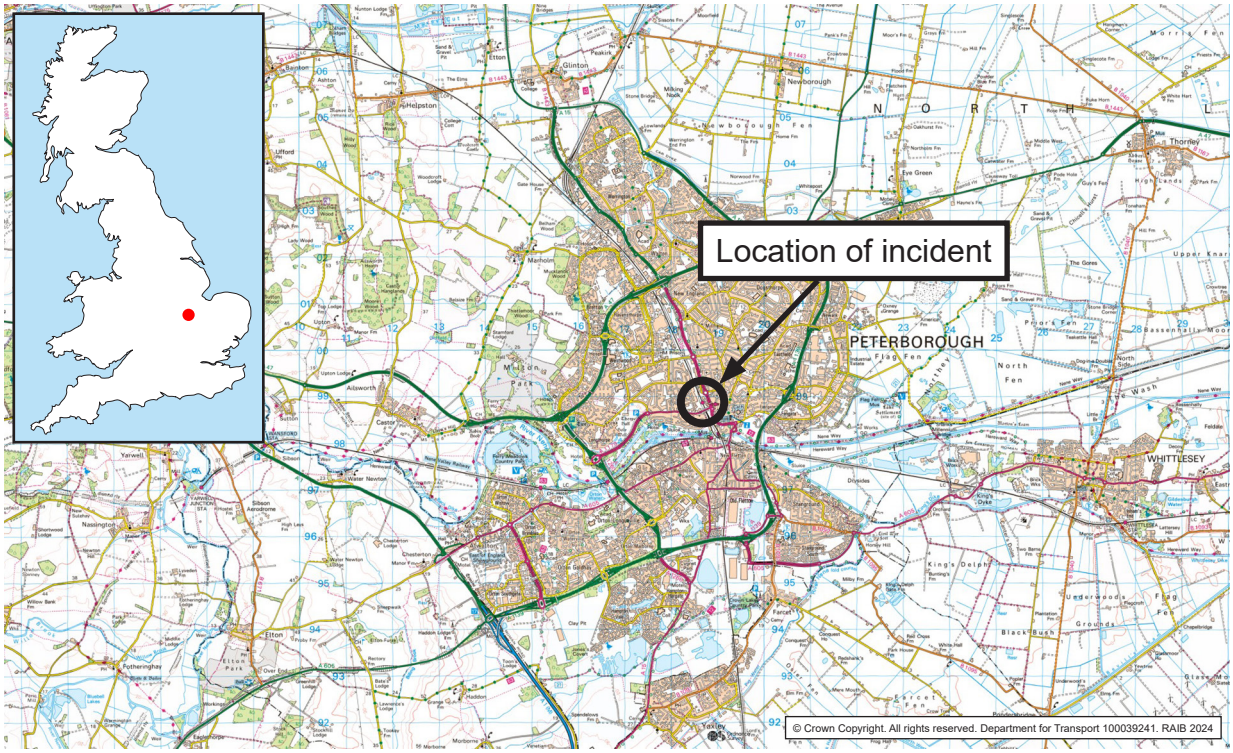

Figure 1: Extract from Ordnance Survey map showing location of the incident at Peterborough station.

5 The driver of train 1A64 did not observe this junction indicator and reacted only to the main aspect of the signal by applying full power to the train when it had changed from showing a red aspect (danger) to a green aspect (proceed).

6 The train did not derail and no damage was caused to the train or track. However, the train's speed over the junction resulted in sudden sideways movements of the coaches. This led to some passengers being thrown from their seats, with some receiving minor injuries as a result.

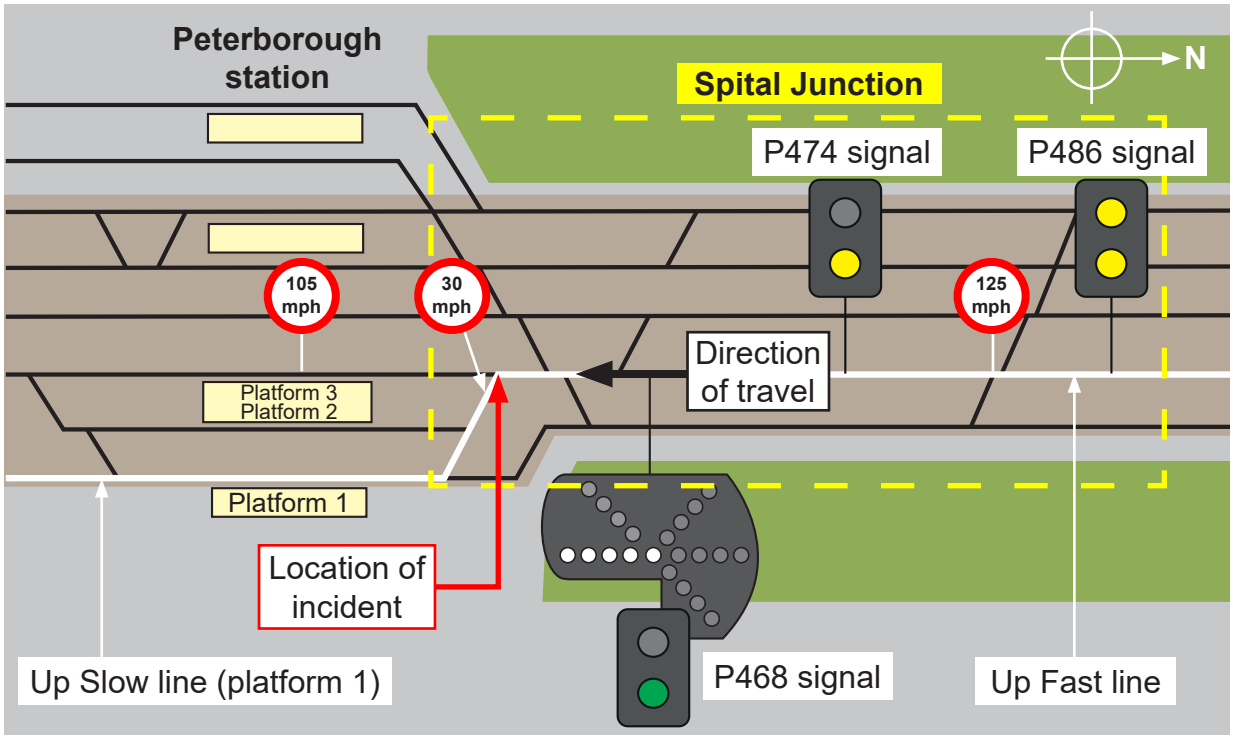

Figure 2: Location of the incident and a schematic diagram of the main features on the north approach to Peterborough station.

Context

Location

7 Spital Junction is located to the north of Peterborough station on the East Coast Main Line. The Up Fast line leads to the junction and then continues through the station alongside platform 3. The maximum allowable line speed on the Up Fast line is 125 mph (201 km/h), reducing to 105 mph (169 km/h) shortly after the junction and through platform 3. The diverging junction over which the train passed has a maximum allowable speed of 30 mph (48 km/h) and directs trains to the Up Slow lines via platforms 1 and 2 (figure 2).

Organisations involved

8 Grand Central was the operator of train 1A64 and is the employer of the driver and train crew. Grand Central is an open-access operator[1] and a subsidiary of Arriva UK Trains Limited. It started passenger operations in December 2007.

9 Network Rail is the owner and maintainer of the infrastructure on which the incident took place. It is the employer of the signalling staff on duty at Peterborough signal box on the day of the incident.

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

The train involved

11 Train 1A64 was formed of a five-car class 180, diesel-hydraulic, multiple unit (figure 3), which was manufactured by Alstom. There were around 125 passengers on board the train at the time of the incident.

[1] Open-access operators run trains on the rail infrastructure, having commercial agreements to buy train paths, rather than operating via a franchise agreement through contracts with the government.

12 Grand Central advised RAIB that there were no faults showing on the train's management system and that it was running on all five engines, giving it maximum acceleration capability. The train was not fitted with either forward-facing or internal saloon closed-circuit television (CCTV).

Figure 3: Grand Central class 180 diesel-hydraulic multiple unit (courtesy of Grand Central).

The junction involved

13 The diverging route at the junction over which the train passed, comprises three turnouts[2] (figure 4). The first turnout of the junction, which includes 1243 points, has a maximum permitted speed of 30 mph (48 km/h). The remaining two turnouts have maximum permitted speeds of 25 mph (40 km/h). When viewed in the direction of the train's travel, the first and second sets of points are facing points while the third are trailing points. The maximum line speed on the Up Slow line through platform 1 is 50 mph (80 km/h).

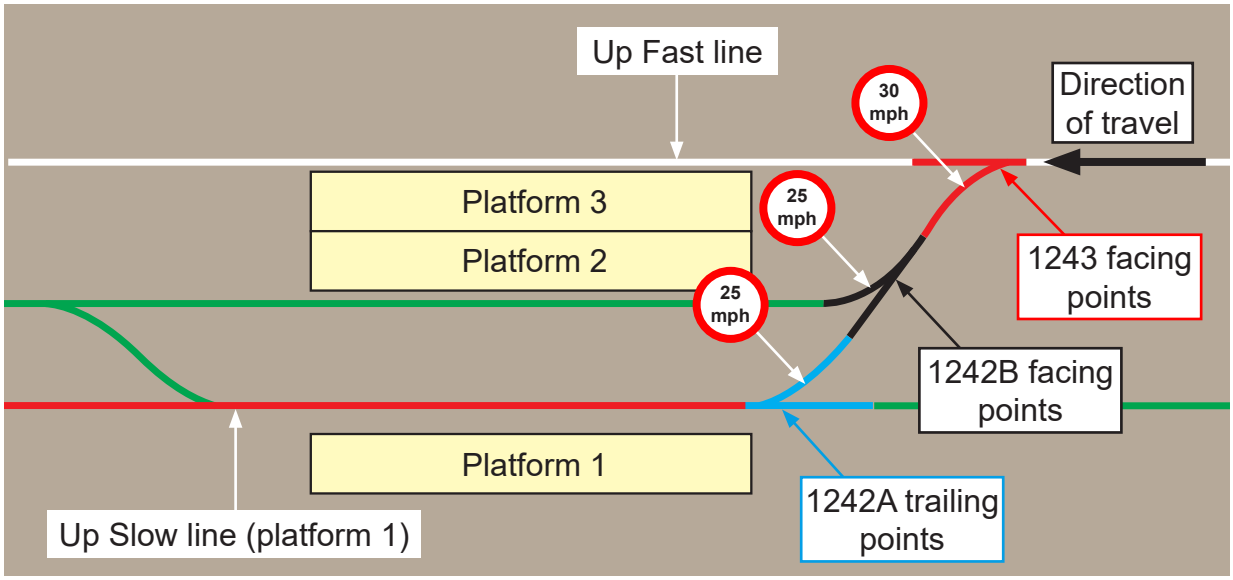

Figure 4: Details of the track layout at the diverging junction to the Up Slow lines.

[2] A turnout consists of a set of points and a crossing.

14 Trains approaching on the Up Fast line are signalled from P468 signal across the junction. The signal is located around 700 metres on the approach to the point of divergence towards the Up Slow No 1 and Up Slow No 2 lines which lead to platforms 1 and 2 respectively. P468 signal is a four-aspect colour light signal with a position light junction indicator (referred to as a junction indicator (JI) in this report) (figure 5). P468 signal can display red, yellow (caution) and green aspects in the lower aperture and an additional yellow in the top aperture when required to display double yellow (preliminary caution) aspects.

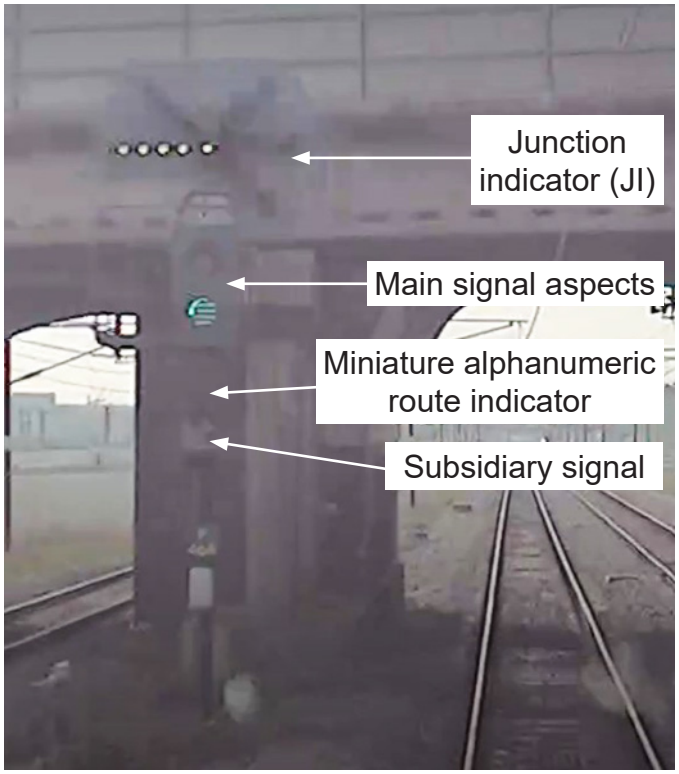

Figure 5: Annotated image of P468 signal.

15 The JI on P468 signal can show five different indications, meaning a train can be signalled to go in one of six different ways beyond the signal (the JI is not illuminated for trains going straight ahead on the Up Fast line). Figure 6 shows where a train can go to from this signal and what the associated JI indication will be for that route. The signal is also fitted with a subsidiary signal and a miniature alphanumeric route indicator. These are for occasions when a train is signalled into a platform at Peterborough station that is already occupied by another train and are not relevant to this incident.

16 P468 signal protects a complex junction and so has controls applied to the signal aspects it displays. A junction signal protecting a diverging route with a slower permissible speed can be held at red, or sometimes yellow, until the train reaches a predetermined point where the driver has an unrestricted view of the signal to read what it is displaying. This predetermined point is normally defined by the train occupying a particular track section. If needed, the predetermined point can be adjusted by using a timer to require the track section to be occupied for a specified period, although this does introduce some variance as the predetermined point is dependent upon the train's speed.

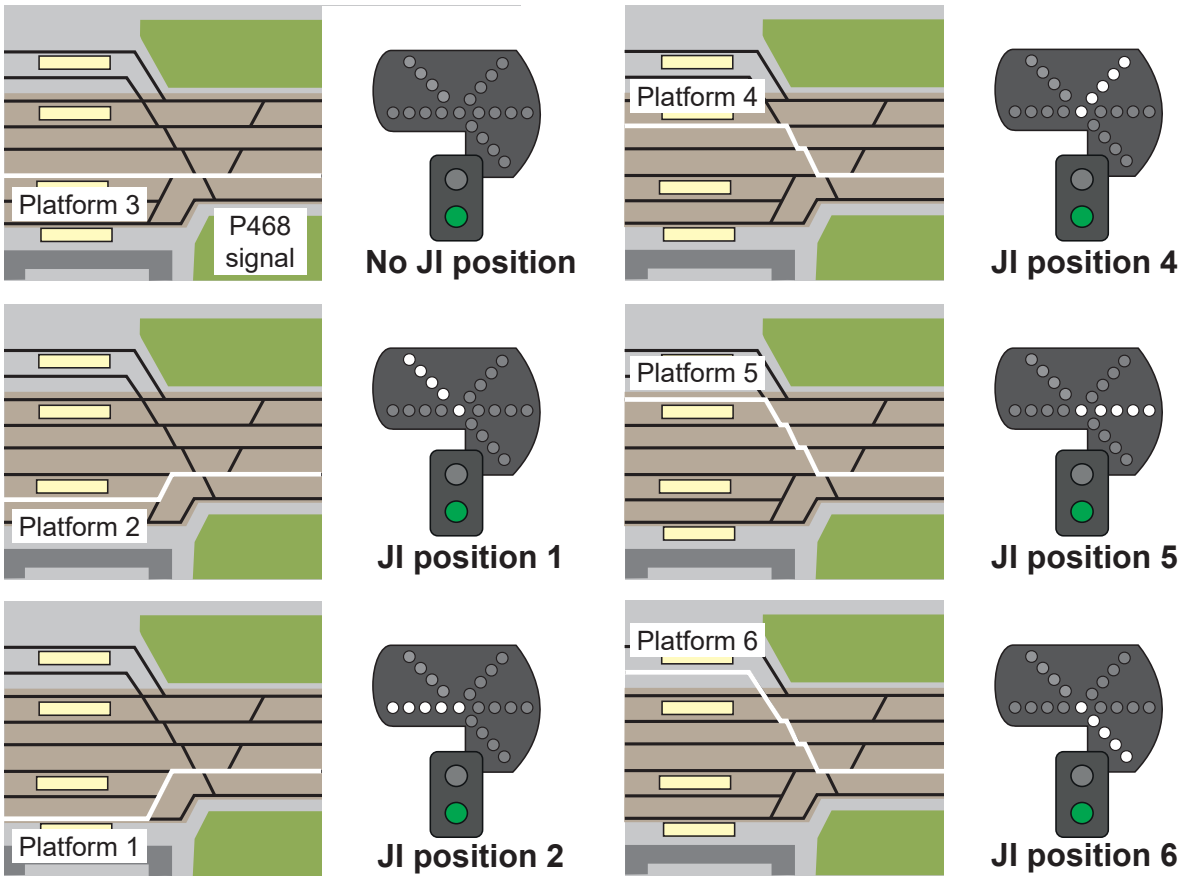

Figure 6: Routes from P468 signal and the associated JI indication.

17 A driver responding to the preceding cautionary signals will slow the speed of their train as they would do approaching a stop signal. When the train reaches the predetermined point, the aspect on the junction signal is allowed to step up to a less restrictive aspect. This form of control is known as approach release and does not give a driver any indication of the divergence until the train is sufficiently close to the junction signal for it to be readable.

18 P468 signal can also be part of a sequence of signals which use flashing yellow aspects to advise drivers that they will be taking a slower speed divergence at an upcoming junction. This sequence is used for routes with smaller reductions in speed at the diverging junction compared to the less restrictive straight on route. It provides an advanced warning of the slower speed divergence by flashing the preceding caution signals and by holding the junction signal at yellow. Drivers should respond to this advance warning by reducing the speed of their trains to the speed of the diverging route before being able to see the junction signal step up from yellow and read the associated route indication.

Staff involved

19 The driver of train 1A64 began driving with another train operating company in 2010. They joined Grand Central as a driver in 2013 and had also qualified as a driver mentor with this company. Their regular route when driving is between Sunderland and London King's Cross stations.

20 Grand Central normally rosters two drivers for train 1A64. One driver will work the train from Sunderland to York, the other from York to London King's Cross. This is to ensure adequate break times in London, before the return trip north. The other driver on train 1A64 on the day of the incident drove the train from Sunderland to York while the incident driver travelled in one of the coaches. Following the incident, the other driver drove the train onwards from Peterborough to London King's Cross station.

21 There were two signallers working the north panel in Peterborough signal box responsible for controlling trains through Spital Junction at the time of the incident. One had been a signaller since 2001 and had been based at Peterborough signal box since 2005. This signaller was supervising a trainee signaller. The trainee had been a signaller since 2021 and was close to the end of their training period, qualifying at the end of May 2023.

External circumstances

22 The weather at the time of the incident was dry, clear and sunny. The driver has stated that although the windscreen's visor was not fully retracted, the bright conditions did not affect his vision. The driver was not wearing sunglasses as the train approached Spital Junction.

Background information

The signalling system

23 The signalling system at Spital Junction was operated by signallers using the north panel in Peterborough signal box. The junction is signalled using the track circuit block system, with signals placed at specified distances along the railway. The spacing of the signals must be sufficient to allow a train, travelling at the maximum permissible speed for the line at the first signal displaying a cautionary aspect, to stop in the distance between the first signal showing a cautionary aspect and the red signal at which the train must stop. The locations of signals, and the distance between them, is affected by many factors, including the permissible speed on approach, gradient, and the visibility on approach.

24 The path from one signal to the next signal is called a route. In track circuit block signalling, the routes between the signals are divided into one or more track sections. The signalling system uses equipment, usually track circuits or axle counters, to determine if each track section is clear (meaning trains are detected as being absent from the track section) or occupied (meaning a train is detected or a fault exists in the track section).

25 Track circuit block signalling allows a signal to show an aspect other than red when all the track sections beyond that signal, up to and including the overlap[3] of the next signal on the intended route, are clear. Where points are included within a route between signals, these must also be locked and detected in the correct position for a train to pass safely. These requirements are proved in the interlocking,[4] which determines when a signal can be allowed to show a proceed aspect. As well as controlling the operation of signals, the interlocking controls points and other signalling apparatus to prevent an unsafe condition of the signalling system arising during the passage of trains.

26 Signallers in Peterborough signal box use an electro-mechanical human-machine interface known as an entrance-exit (NX) panel to operate the signalling system that controls Spital Junction (figure 7). The panel shows the layout of the railway being controlled, along with indications which show the status of signals, the position of points and track section occupancy. The signaller requests a route by pressing a button for the signal at the start of the route (the entrance) and then pressing the appropriate button for the signal at the end of the route (the exit). The interlocking checks for conflicting train movements and, if the requested route is available, commands and locks any points to the required position to ‘set’ the route. When a route has been set, the signal will change to a proceed aspect when the track sections ahead are clear.

27 Signalling interlockings are split geographically and P468 signal falls within the control of Peterborough Central interlocking. To determine if a route can be set and what aspect P468 signal can display, information is taken from the adjacent Peterborough North and Peterborough South interlockings.

[3] Overlap is distance beyond a signal, usually 200 yards (183 metres) over which the signal’s track circuit extends.

[4] Interlocking is the arrangement of signalling equipment that prevents undesired train movements.

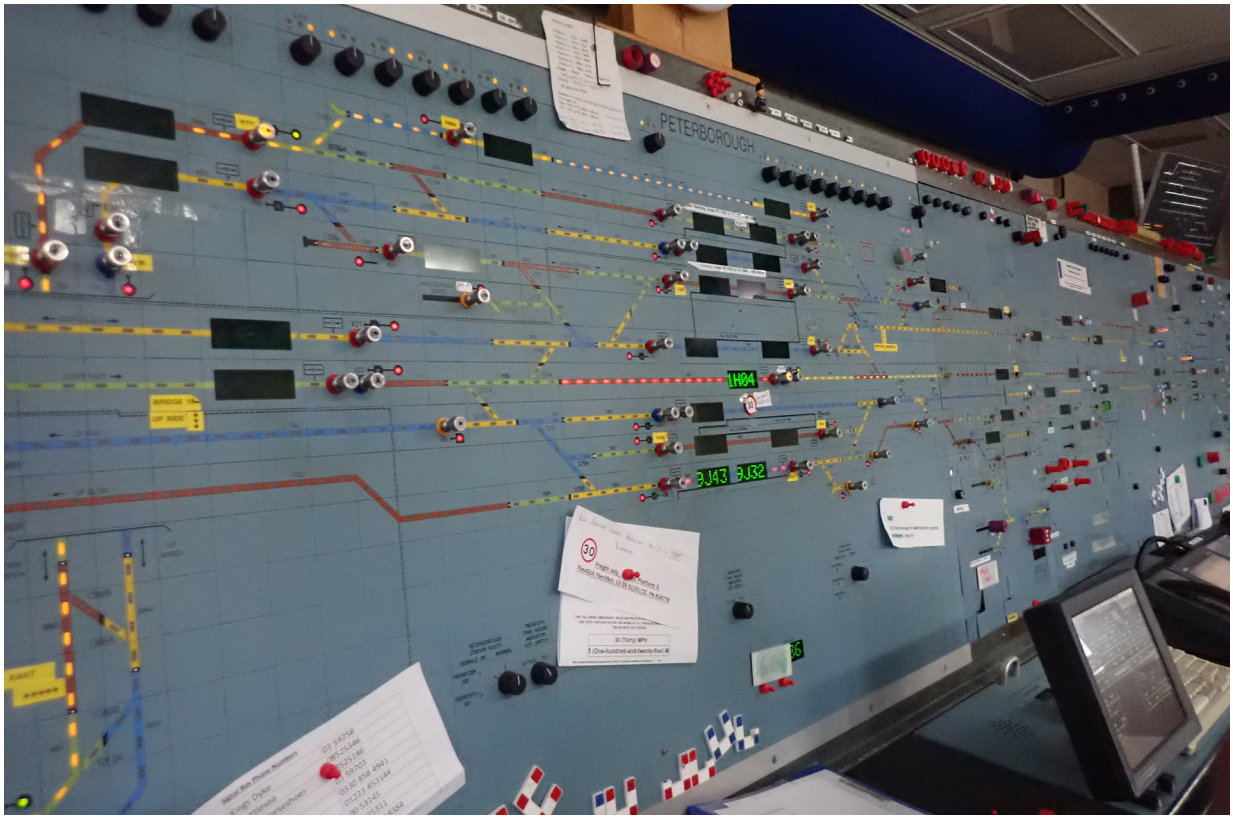

Figure 7: Peterborough NX panel.

28 Details of the six routes from P468 signal that a signaller can set (paragraph 15) and the associated approach release conditions (paragraph 16) are shown in table 1. Note that signals referenced in column 2 below are located near the south end of their respective platforms.

To location	To signal	JI position	Route number	Condition(s) within the interlocking
Platform 1	P436	2	5(M)	Approach release from yellow (with flashing yellow aspect sequence) or approach release from red
Platform 2	P438	1	4(M)	Approach release from yellow (with flashing yellow aspect sequence) or approach release from red
Platform 3	P440	None	3(M)	None
Platform 4	P442	4	2(M)	Approach release from red
Platform 5	P444	5	1(M)	Approach release from red
Platform 6	P446	6	8(M)	Approach release from red

Table 1: The routes from P468 signal.

29 When the signaller sets a route towards platform 4, 5 or 6 for a train approaching on the Up Fast line, the interlocking applies 'approach release from red' control to P468 signal. This prompts the driver of the approaching train to slow down as the signal continues to display a red aspect on the junction signal until the train reaches a predetermined point (paragraph 16).

30 In this case, approach release from red control is applied to P468 signal because trains can approach Peterborough on the Up Fast line at 125 mph (201 km/h), and if routed from this signal towards platform 4, 5 or 6, they will pass over sets of points which have permissible speeds of 15 mph (24 km/h). Approaching P468 signal displaying a red aspect prompts the driver to slow down. When the train reaches the predetermined point, and the junction signal changes to show a proceed aspect, along with the required JI indication, the driver can then drive accordingly for the route which the train is signalled to take.

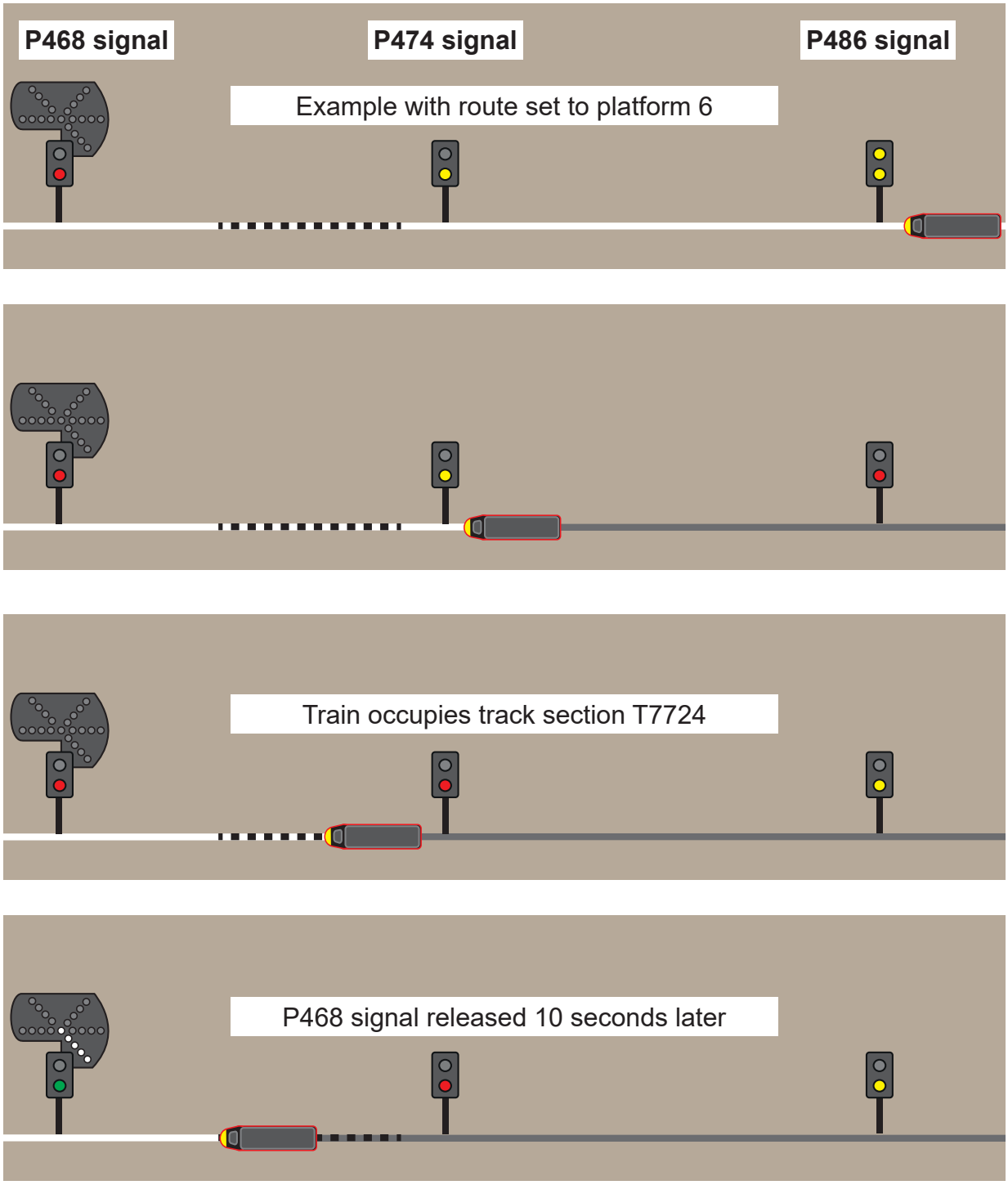

Figure 8: The aspect sequence for P468 signal when a route with approach release from red control is set.

31 Figure 8 shows that the sequence of aspects for P468 signal when a route towards platform 6 with approach release from red control is set (in this example figure P468 signal is shown displaying a green aspect when released, as a route is already set beyond the next signal at the end of platform 6). As the train travels towards P468 signal at red, it will occupy track section T7724, (indicated on figure 8 by a black dashed line) and start a timer. When the timer reaches 10 seconds, the interlocking releases the aspect control on P468 signal and allows it to display a proceed aspect and JI indication.

32 For the routes to platforms 1 and 2, there is less of a difference between the permissible speed approaching the junction and the permissible speed at the point of divergence. For these routes, 'approach release from yellow', with a flashing yellow aspect sequence on preceding signals, is used instead. This sequence still prompts the driver to slow the train down through the cautionary aspects displayed to the driver, but it is less restrictive than approach release from red, and hence provides some performance (time) benefits. It also has the advantage of providing the driver with information at the preceding signals that the train is signalled to take a diverging route at the junction signal.

33 When this control was implemented within the signalling system at Peterborough, the criteria for when the flashing yellow aspect sequence control could be used was defined in issue 3 of Railway Group Standard GKRT0045, 'Lineside Signals, Indicators and Layout of Signals'[5] shown in table 2.

Permissible speed approaching the diverging junction	Permissible speed at the point of divergence
80 mph (129 km/h) to 125 mph (201 km/h)	40 mph (64 km/h) or greater
40 mph (64 km/h) to 75 mph (121 km/h)	25 mph (40 km/h) to 40 mph (64 km/h)

Table 2: Speed ranges for using the flashing yellow aspect sequence control.

34 For the routes from P468 signal to platforms 1 and 2, the permissible speed at the point of divergence is 30 mph (48 km/h). As the permissible speed on the approach is 125 mph (201 km/h), which falls outside of the criteria defined in table 2, a deviation to allow this was granted in 2014 (see paragraphs 44 to 47).

35 In its simplest form, when a route is set from P468 signal to either platform 1 or 2, and the required conditions in the interlocking are met, P468 signal will change to display a single yellow aspect and the relevant JI indication for the route to the chosen platform. In response, the driver of an approaching train will see flashing yellow caution aspects on P486 and P474 signals in the sequence shown in figure 9. These cautionary flashing yellow aspects indicate that the route is clear up to the next signal beyond the junction, and that the train is to take a slower speed divergence at P468 signal towards either platform 1 or 2. In this situation, the driver should be prepared to react to the aspect being displayed on P468 signal as to the status of the first signal beyond the junction.

[5] Copies of Railway Group Standards, Rail Industry Guidance Notes, and Rail Industry Standards can be obtained from the Rail Safety and Standards Board at www.rssb.co.uk.

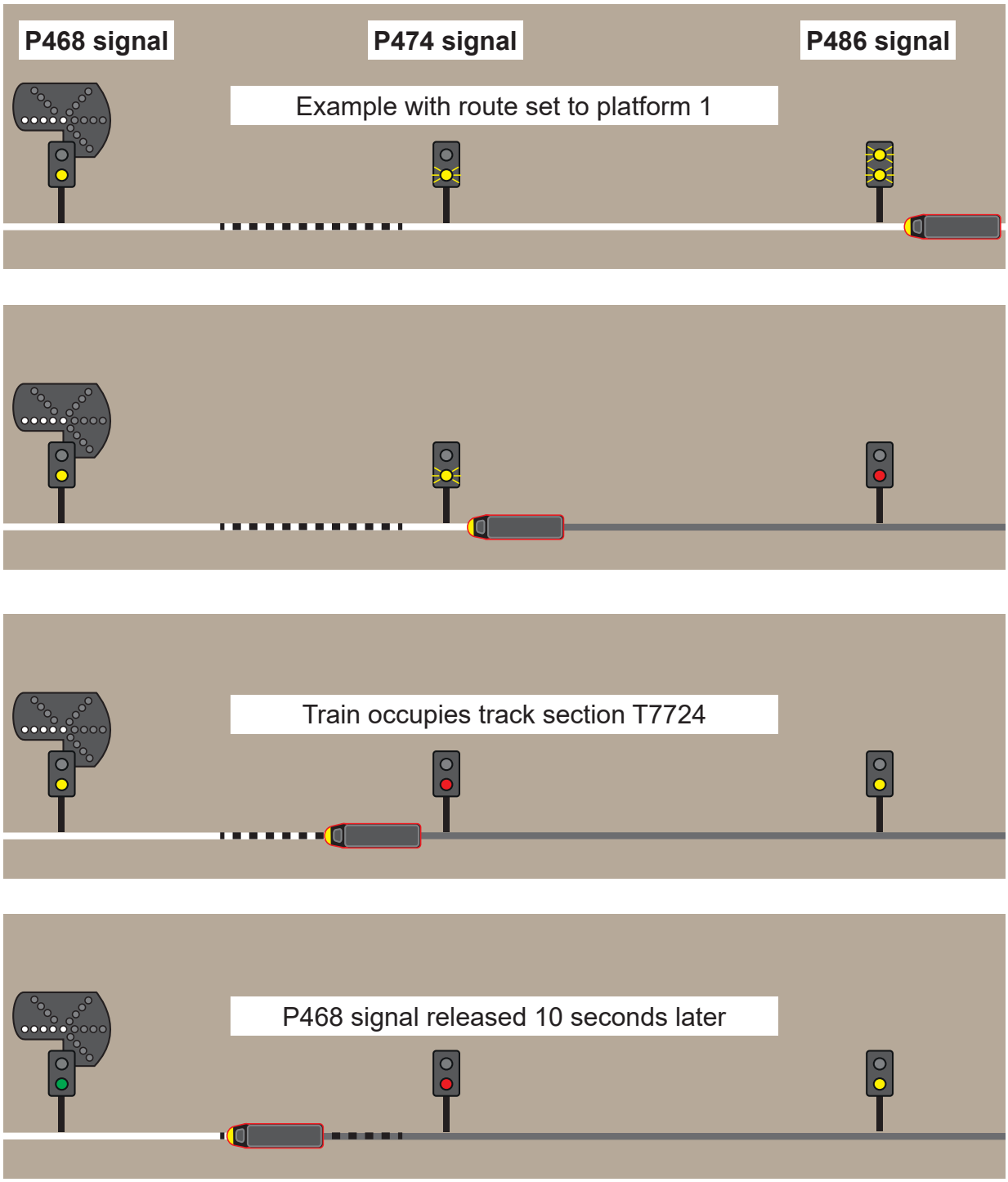

Figure 9: The aspect sequence for P468 signal when a route with flashing yellow aspect sequence control is set to platform 1.

36 Figure 9 shows an approaching train passing P486 signal displaying a flashing double yellow aspect and P474 signal displaying a flashing single yellow aspect. After passing P474 signal, the train will occupy track section T7724 as it continues towards P468 signal. As it was for the approach release from red control (paragraph 31), when this track section is occupied for 10 seconds, the interlocking releases the restriction on P468 signal and allows it to display a less restrictive proceed aspect as permitted by the aspect of the signal ahead.

37 If a train approaches on the Up Fast line when no route is set beyond P468 signal, P486 signal will display a double yellow aspect, P474 signal will display a single yellow aspect and P468 signal will display a red aspect. If the signaller then requests a route from P468 signal into platform 1 or 2 with a train approaching P474 signal, but not yet occupying track sections T7726 or T7725 (located between P486 and P474 signals), the interlocking will apply a flashing yellow sequence with a single flashing yellow aspect on P474 signal. At this distance from P474 signal, the driver has had sufficient time to read the single flashing yellow aspect and apply their route knowledge to understand that they are being routed at the junction signal towards either platform 1 or 2.

38 If, however, a train has already occupied either track section T7726 or T7725 when a route is subsequently set from P468 signal towards platform 1 or 2, the interlocking will not allow the flashing yellow aspect sequence control to be used. This is because the location of the train at this point means the driver will not have adequate time to read the flashing yellow aspect on P474 signal and take the appropriate action in response to it. In these circumstances, the interlocking applies the approach release from red control to P468 signal in the same way as when a route is set to platforms 4, 5 or 6 (paragraph 30).

39 Train drivers on Network Rail infrastructure are provided with lineside signs to provide a point of reference where a permissible speed changes. Drivers are warned of a large speed reduction by a permissible speed warning indicator (PSWI). Trains approaching Spital Junction on the Up Fast line pass a PSWI which warns drivers about the reduction in speed for the 30 mph (48 km/h) divergence for the routes towards platforms 1 and 2. Figure 10 shows the PSWI and its location in relation to the other signalling equipment. The sign shows the 30 mph (48 km/h) permissible speed for the divergence and a directional arrow to indicate that it applies to the tracks to the left of the Up Fast line, that is, to the lines which lead to platforms 1 and 2.

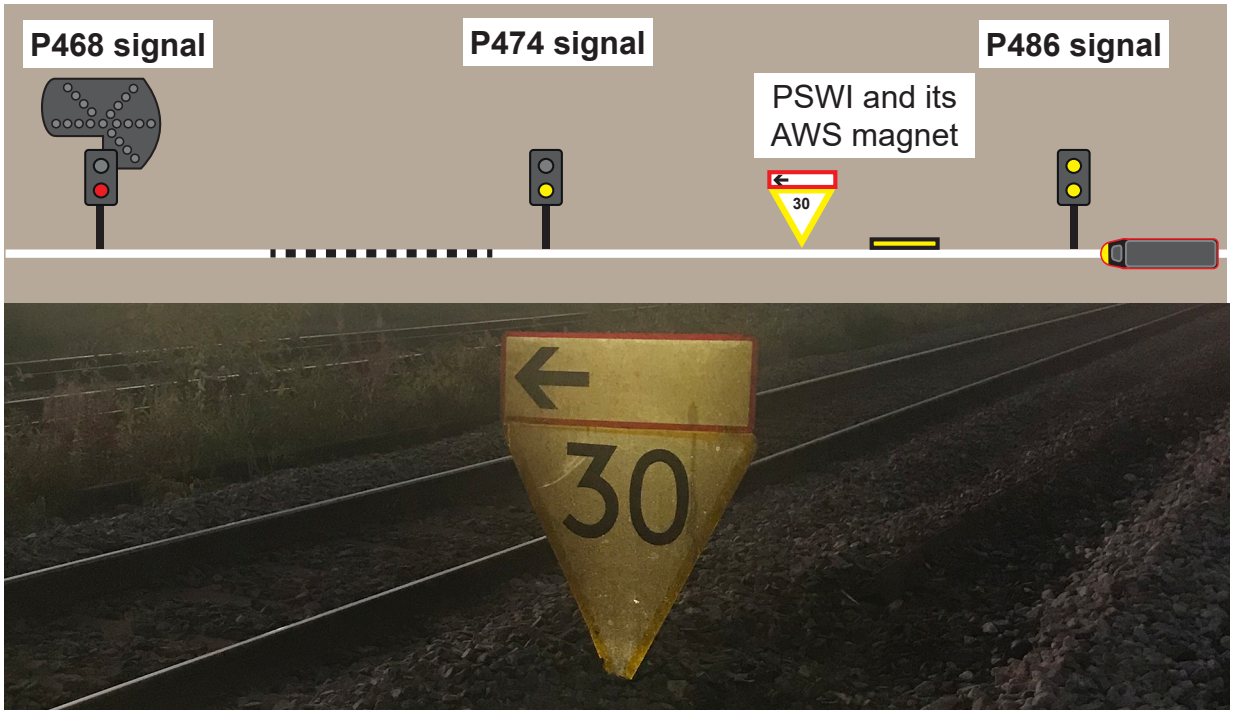

Figure 10: The location of the PSWI in relation to the other signalling equipment and an image of it (courtesy of Network Rail).

40 The PSWI is placed at the required deceleration distance of 2058 metres from the point of divergence, which is the distance needed for a train travelling at the permissible speed of 125 mph (201 km/h) to slow to 30 mph (48 km/h) for the divergence. This distance placed the PSWI between P486 and P474 signals. This PSWI, which is located between signals, is provided with its own automatic warning system (AWS) magnet situated about 180 metres on the approach to the PSWI sign. When a train passes over the magnet, it causes an audible warning in the cab which the driver must acknowledge within a specified time, or an emergency brake application will occur. The aim of this AWS warning is to alert the driver to the PSWI, which in turn aims to remind the driver about the slower speed divergence that is ahead.

41 At the time the signalling was commissioned, issue 2 of Railway Group Standard GKRT0075, 'Lineside Signal Spacing and Speed Signage', dated 2011, was in force. This standard required the AWS magnet to be suppressed when the junction signal, and any intervening signals between the PSWI and the junction signal, had been cleared for a route for which the PSWI does not apply. This was so that drivers of trains signalled towards these other routes did not receive an AWS warning for the PSWI when these routes were set, and the signals had cleared. A similar requirement is made by the currently applicable standard, Rail Industry Standard RIS-0734-CCS, 'Signing of permissible speeds' issue 2 dated December 2020. This states that the AWS magnet provided for the PSWI should be suppressed when the route is set for a train to proceed on a line to which the PSWI does not apply. However, the current standard does not require the junction signal and any intervening signals to have cleared as well.

42 The interlocking for the signalling at Spital Junction only suppresses this AWS magnet when the straight-ahead route from P468 signal towards platform 3 is set, as, for this route, the junction signal can show a proceed aspect before the train passes the PSWI. This configuration met the requirements of issue 2 of GKRT0075. For all the other routes which can be set from P468 signal, including those for trains going to platforms 4, 5 or 6 where the PSWI does not apply, the AWS magnet is not suppressed, as the junction signal cannot show a proceed aspect at the time the train is passing the AWS magnet (paragraph 16). This means that unless the route straight ahead to platform 3 has been set, a driver will receive an AWS warning at the PSWI. If no route has been set from P468 signal at the time a train passes the PWSI, a driver will get an AWS warning, even if the train is subsequently routed straight on the Up Fast line through platform 3.

The history of P468 signal

43 The last time P468 signal's operation was changed was in 2013 and 2014. This followed the remodelling of the station infrastructure at Peterborough which had begun in 2012 (see paragraph 176). This work included the removal of a bay platform that had previously been platform 1, the previous platforms 2 and 3 being lengthened and renumbered as platforms 1 and 2 respectively, and the construction of three new platforms. This included a new platform 3 for trains on the Up Fast line. The remodelling work was completed by mid-2014.

44 A process exists for engineering projects to implement work outside of the requirements of railway standards. When this work took place, the project implementing the changes to the signalling system sought a deviation against clause 5.2.3.1 in GKRT0045 (paragraph 32) from the control command and signalling committee at the Rail Safety and Standards Board[6] (RSSB). Contrary to the requirements of this clause, the project wished to provide flashing yellow aspect sequence controls for the routes from P468 signal to platforms 1 and 2. This was in addition to the existing approach release from red controls required for platforms 4, 5 and 6. This deviation was needed because the permissible speed at the divergence for these routes was 30 mph (48 km/h), whereas the clause required the permissible speed to be a minimum of 40 mph (64 km/h) as shown in table 2 (paragraph 33).

45 In its submission for the deviation, the project argued that approach release from red controls carry with them a risk of drivers wrongly anticipating a signal clearing to a proceed aspect when it remains at red, leading to the signal being passed at danger (SPAD). In addition, this form of control required trains to accelerate towards the junction to the Up Slow lines after the signal had cleared, due to the point of divergence being 700 metres from P468 signal. It also said that train operating companies had raised these issues from a journey performance and a safety perspective, so had requested that the controls for P468 signal were amended.

46 The project had considered alternative options. These included:

a. Relaxing the existing approach release from red controls to allow the junction signal to show a proceed aspect when the JI indication was readable. The project stated that while this option would provide a reduction in anticipation and acceleration risk, this would not be as great as providing flashing yellow aspect sequence controls.

b. Imposing a permanent speed restriction of 75 mph (121 km/h) on the approach to the divergence, so that it met the requirements shown in table 2. The project explained that this would have a negative journey performance impact on all trains and was deemed to be unacceptable.

c. Renewing the turnouts to allow a divergent speed of at least 40 mph (64 km/h). The project stated that the cost of this option was deemed to significantly exceed any safety benefit. However, if the turnouts were to be renewed in the future which allowed the permissible speed over them to be raised to at least 40 mph (64 km/h), then minimal subsequent signalling alterations would be required.

47 The project submitted its application for a deviation in December 2013. It was authorised by the control command and signalling committee at RSSB in February 2014 which enabled the current signalling arrangement to be commissioned.

[6] A not-for-profit body whose members are the companies making up the railway industry.

The sequence of events

Events preceding the incident

48 On the morning of Thursday 4 May 2023, the driver involved in the incident booked on for duty remotely at 09:30 hrs with Cross Country control (which Grand Central uses for its operations control function). The driver then arrived at Sunderland station at around 09:40 hrs, meeting their driver manager and the second driver with whom the driving turn was to be shared (paragraph 20). The train departed from Sunderland, on time, at 09:54 hrs.

49 At 11:21 hrs, the train arrived at York, one minute early, and the incident driver took over driving duties. The driver did not report the change of driver to Cross Country control as required by Grand Central procedures, stating that this was because they were distracted by clearing luggage from the aisles on the way to the cab. The driver who had been relieved rode as a passenger in one of the coaches.

50 The train left York one minute early at 11:40 hrs and arrived at Doncaster two minutes late, at 12:07 hrs. It was routed through Doncaster on the Up Slow line and was held at platform 3 for around 4 minutes. This was a timetabled station stop, to allow train 1E82, the 09:24 hrs Lumo service from Edinburgh Waverley to London King's Cross, to overtake it on the Up Fast line.

51 At 12:11 hrs, the train departed from Doncaster 1 minute early and rejoined the Up Fast line at Loversall Carr Junction, approximately 4 miles to the south of Doncaster station.

52 Train 1A64 continued travelling on the Up Fast line towards Peterborough, following train 1E82. Behind train 1A64 was train 1E09, the 09:30 hrs London North Eastern Railway (LNER) service from Edinburgh Waverley to London King's Cross. The driver of incident train 1A64 reported that this part of the journey was uneventful.

53 At 12:52 hrs, train 1A64 reached Tallington Junction, approximately 8 miles to the north of Peterborough, on time. The trains immediately ahead and behind train 1A64 passed this junction 1 minute ahead of schedule at 12:46 hrs and 12:55 hrs respectively (figure 11).

54 Although the timetable stated that train 1A64 was to be diverted to the Up Slow line at Tallington Junction to allow train 1E09 behind it to overtake, it remained on the Up Fast line until Spital Junction on the approach to Peterborough station. The reason for this is explained further in paragraph 78.

55 As train 1A64 reached Werrington Junction, approximately 3 miles to the north of Peterborough, the train encountered restrictive signal aspects, and the driver slowed the train accordingly.

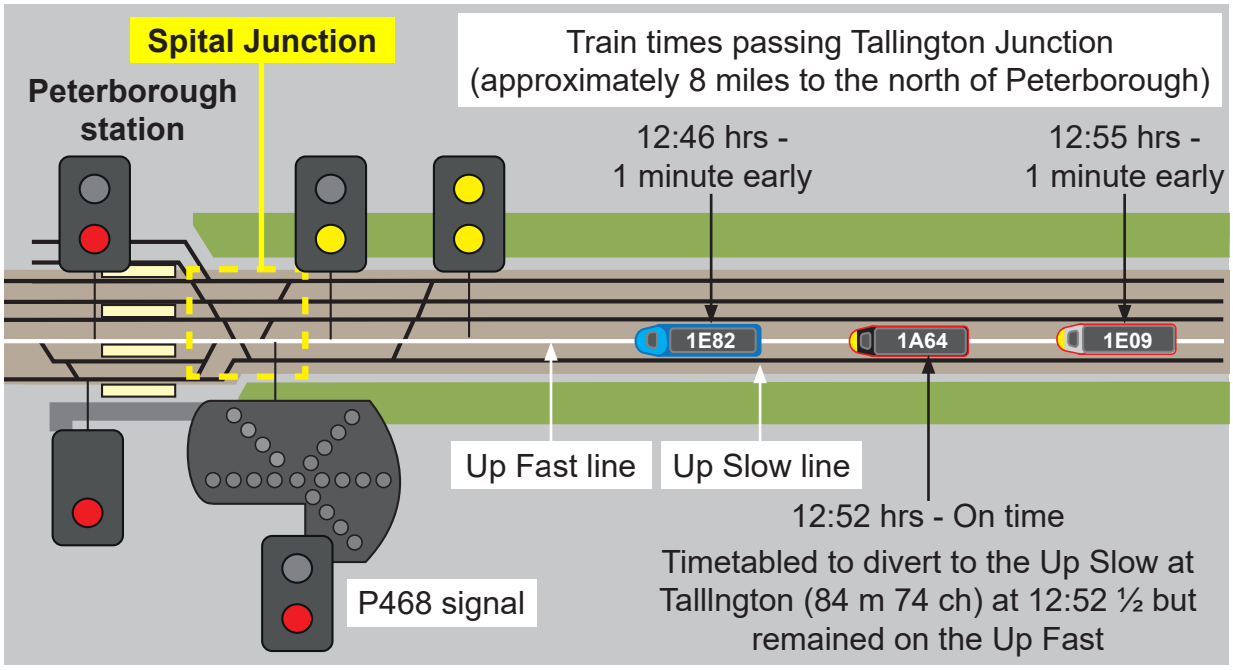

Figure 11: The three trains and their timings approaching Peterborough station from the north.

Events during the incident

56 At 12:56:00 hrs, the signallers made a route request to set the route on the Up Slow line beyond P436 signal (situated at the end of platform 1) for train 1A64. At this time, train 1A64 was travelling at 31 mph (50 km/h) and was close to passing P494 signal, which was displaying double yellow aspects. However, the route ahead of train 1A64 could not yet be set as train 1E82 was occupying the Up Fast line approaching P468 signal (figure 12).

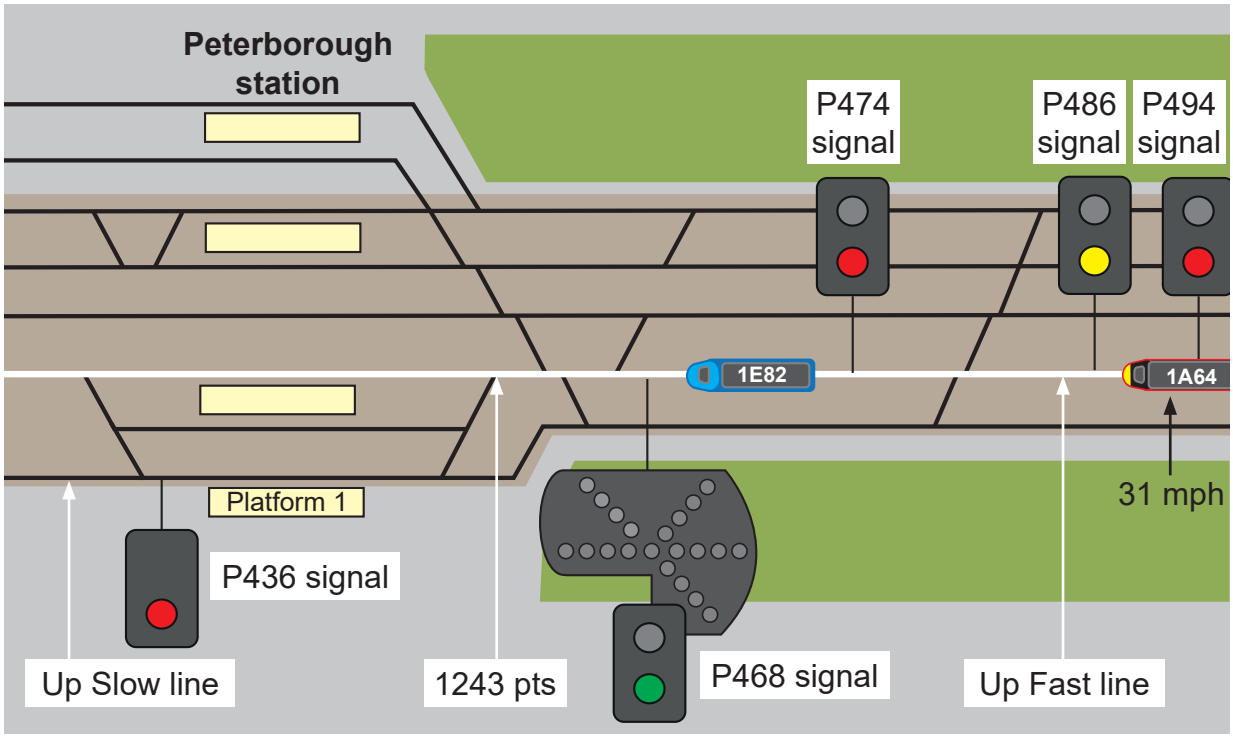

Figure 12: The position of train 1A64 and train 1E82 ahead of it shortly after 12:56:00 hrs..

57 At 12:56:46 hrs, train 1E82 cleared the conflict point of the junction beyond P468 signal. This is the earliest time that a signaller could have set the route for train 1A64 from P468 signal to the Up Slow line. By this time, train 1A64 had passed P486 signal travelling at 31 mph (50 km/h) (figure 13).

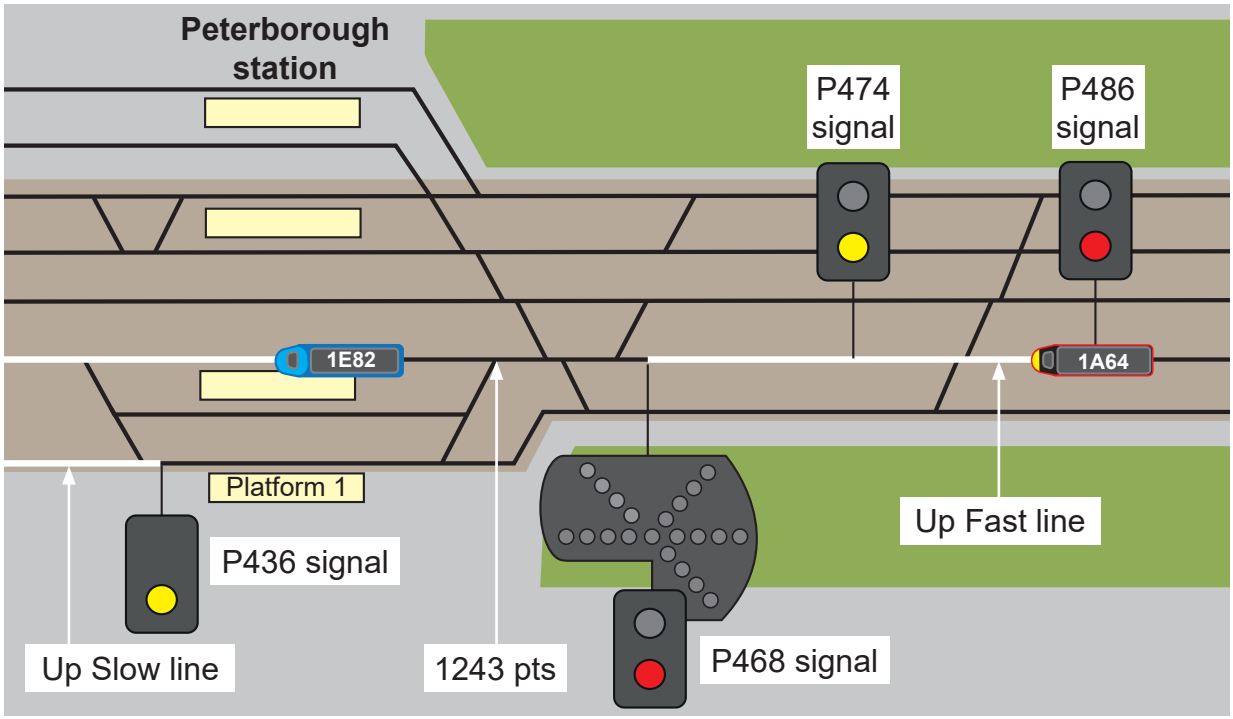

Figure 13: Train 1E82 clears Spital Junction which is the earliest time that the signaller could have set the route to the Up Slow line for train 1A64 at 12:56:46 hrs.

58 At 12:57:00 hrs, train 1A64 reached the inhibition point for flashing aspects (paragraph 38), meaning that the signalling control for P468 signal reverted to being approach released from red (figure 14).

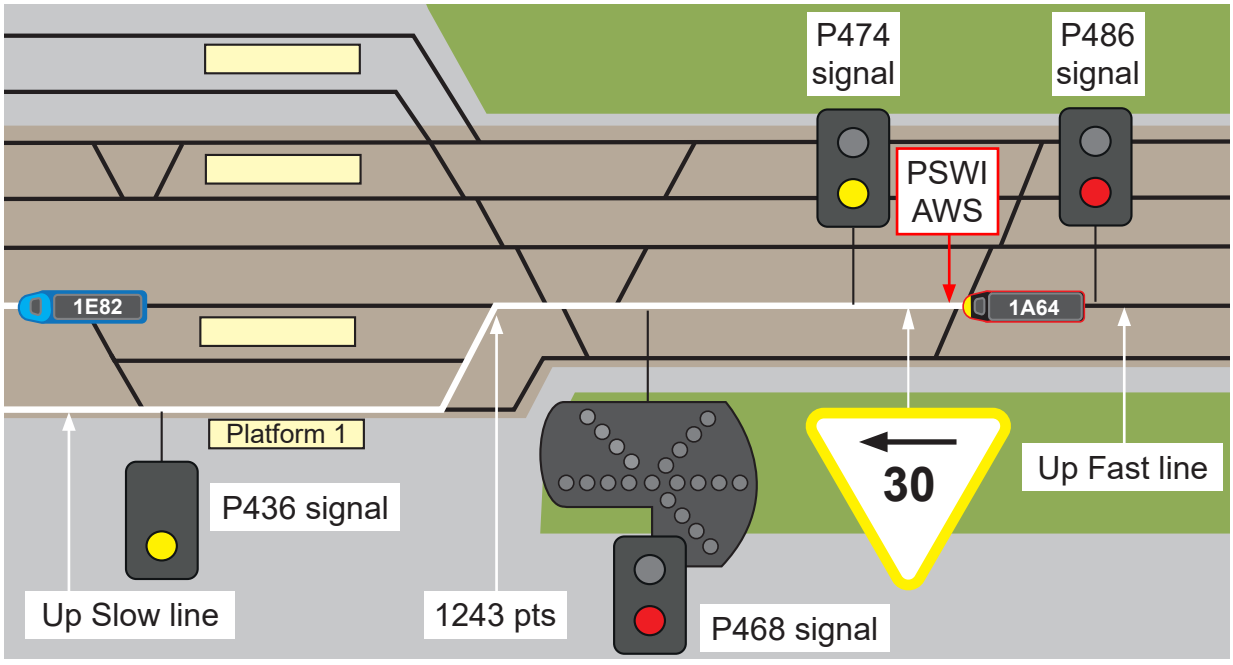

Figure 14: Train 1A64 reaches the inhibition point for flashing aspects at 12:57:00 hrs. The signaller then requested the route for train 1A64 from P468 signal 16 seconds later.

59 At 12:57:16 hrs, the signallers requested a route for train 1A64 from P468 signal to the Up Slow line via platform 1. The route was set approximately 8 seconds later, but the aspect control, requiring a track circuit closer to P468 signal to be occupied for 10 seconds, meant that P468 signal remained at red (paragraph 31).

60 At 12:57:41 hrs, train 1A64 passed the AWS magnet for the PSWI coasting at 21 mph (34 km/h). Data from the train's on-train data recorder (OTDR) indicates that the driver received an AWS audible 'horn' warning which they then cancelled with the acknowledge button. Ahead of the train was P474 signal, which was displaying a single yellow aspect (figure 15).

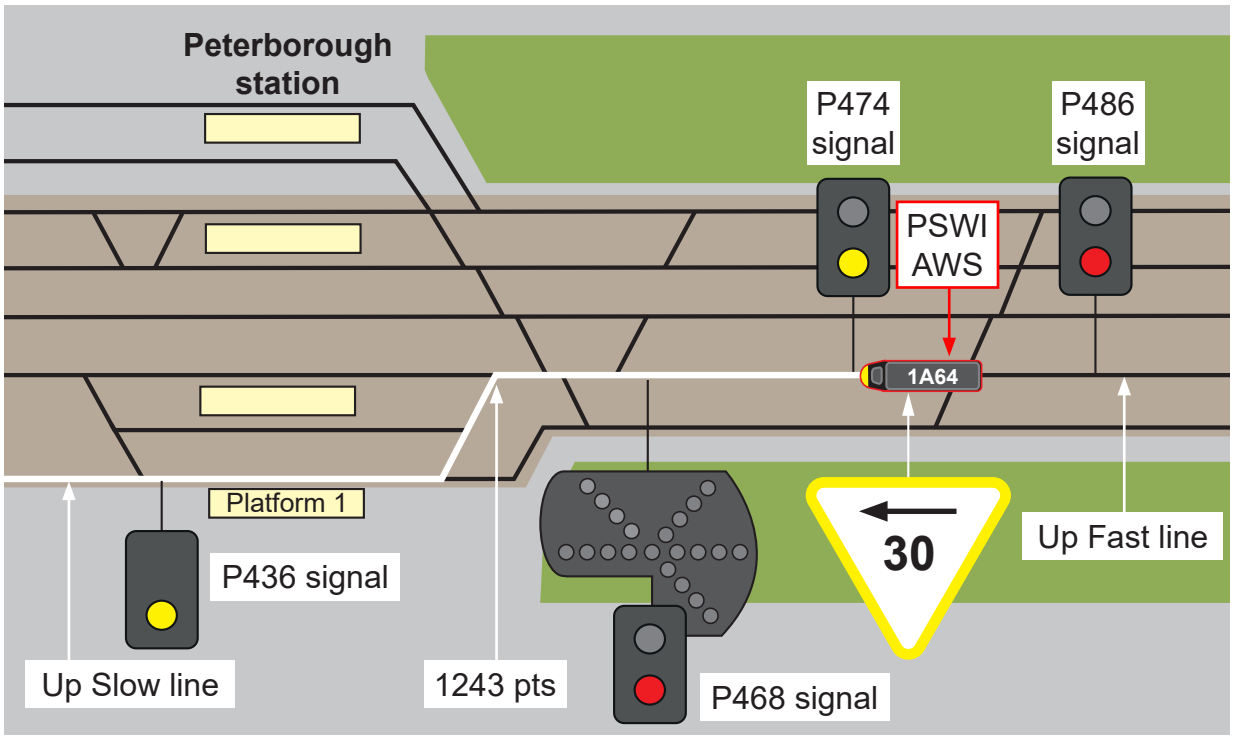

Figure 15: Train 1A64 passes the AWS magnet for the PSWI indicating the maximum permissible speed for the junction to the Up Slow line at 12:57:41 hrs.

61 At 12:58:59 hrs, train 1A64 reached the track circuit which started the 10-second release timer of P468 signal. It was coasting at 16 mph (26 km/h). Ahead of the train, P468 signal was displaying a red aspect (figure 16).

62 At 12:59:08 hrs, the JI for the Up Slow line to platform 1 illuminated, followed within a second by the main aspect of P468 signal changing from red to green. Train 1A64 was at this time approximately 800 metres from the signal and coasting at 17 mph (27 km/h) (figure 17).

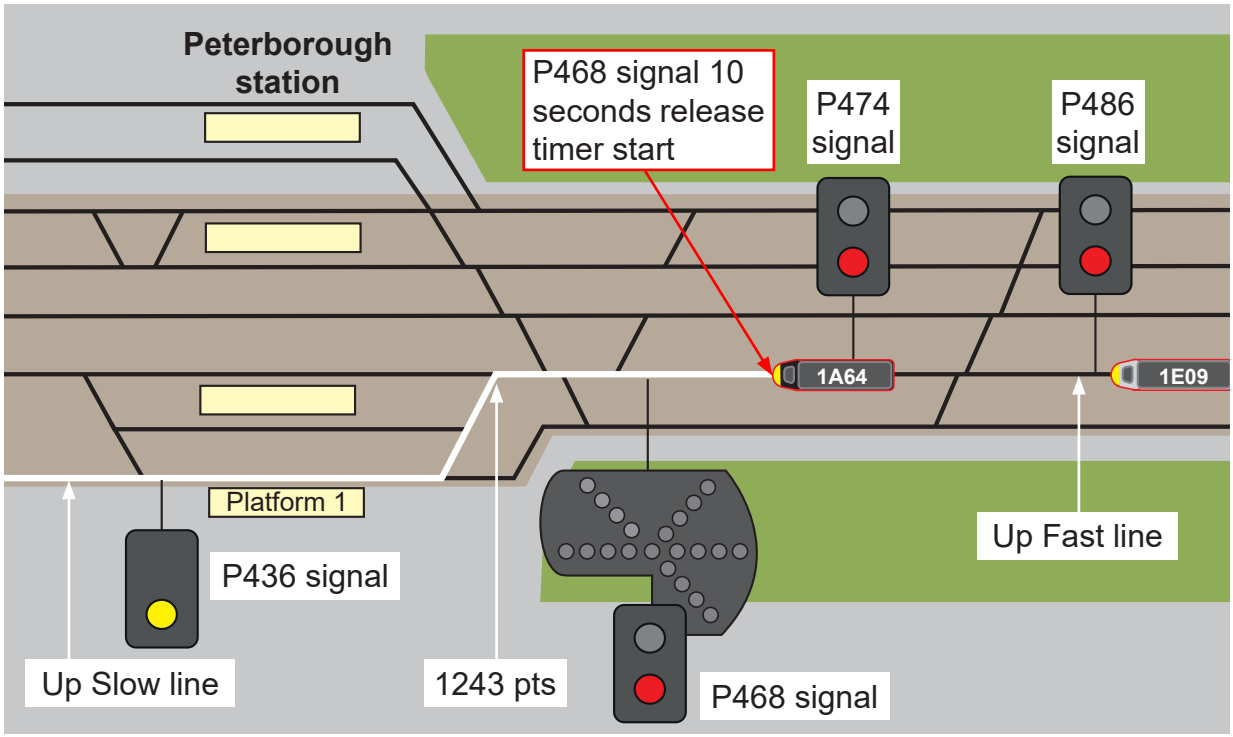

Figure 16: Train 1A64 reaches the start of the timer release track circuit for P468 signal at 12:58:59 hrs.

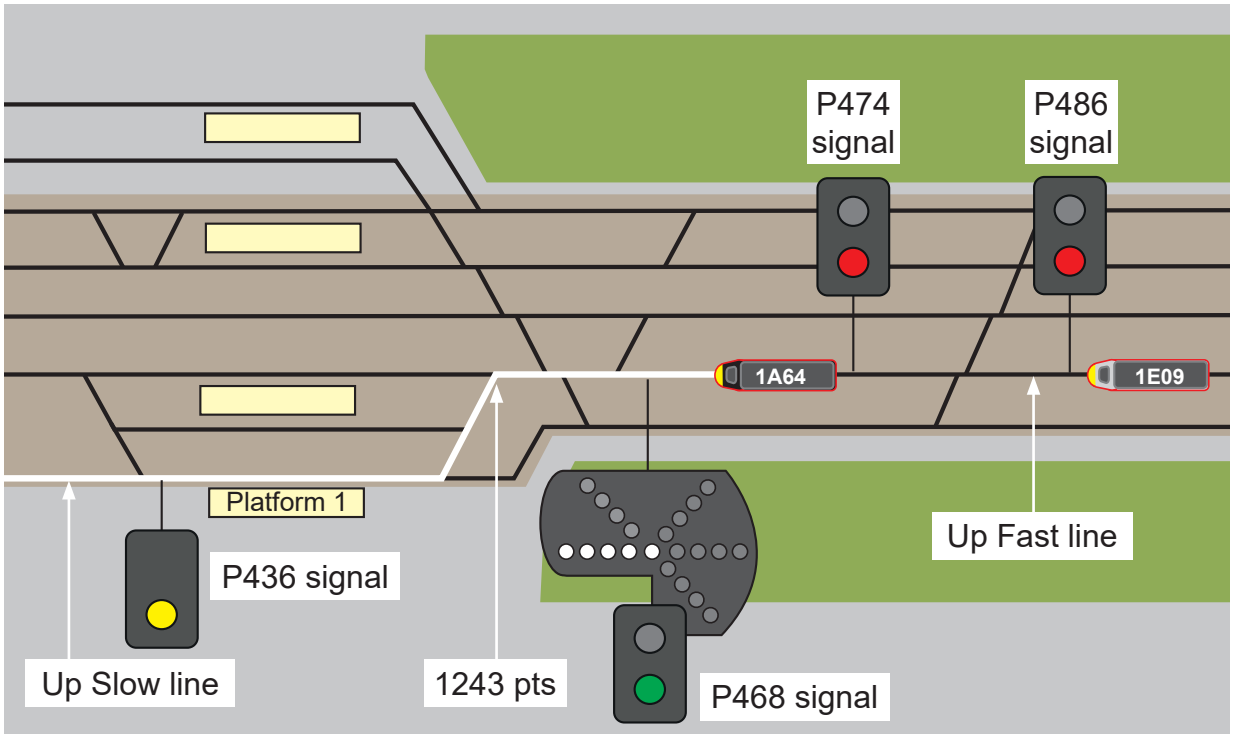

Figure 17: P468 signal is released from a red to a green main aspect with illuminated JI for the Up Slow line, platform 1 at 12:59:08 hrs.

63 At 12:59:19 hrs, when the train was approximately 750 metres from the signal and coasting at 16 mph (26 km/h), the driver responded to the green main aspect by moving the power brake controller to apply power to the train (figure 18).

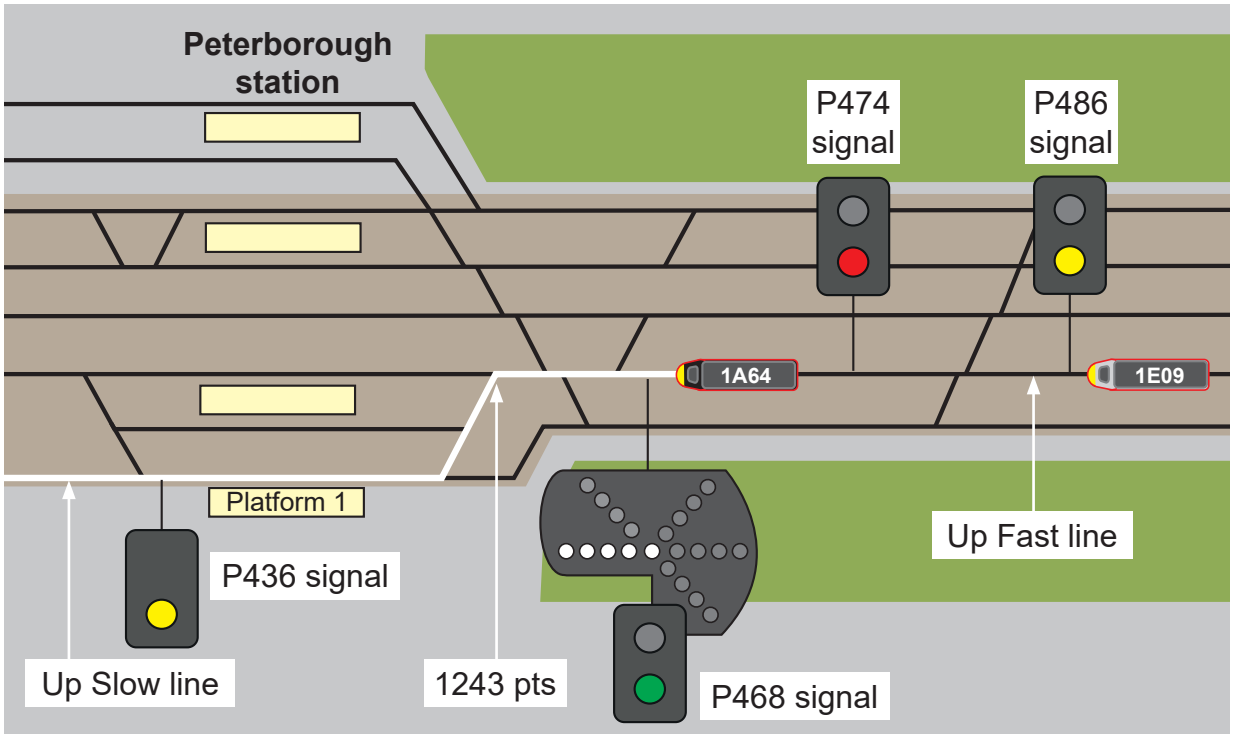

Figure 18: The driver applies power to train 1A64 when approximately 750 metres from P468 signal at 12:59:19 hrs, with full power being applied 8 seconds later when approximately 680 metres from the signal.

64 At 12:59:27 hrs, when the train was approximately 680 metres from the signal, the driver applied full power.

65 At 13:00:14 hrs, train 1A64 passed P468 signal travelling at 50 mph (80 km/h) and still accelerating under full power. P468 signal had at this point been displaying its green aspect and JI lights to the driver for 63 seconds (figure 19).

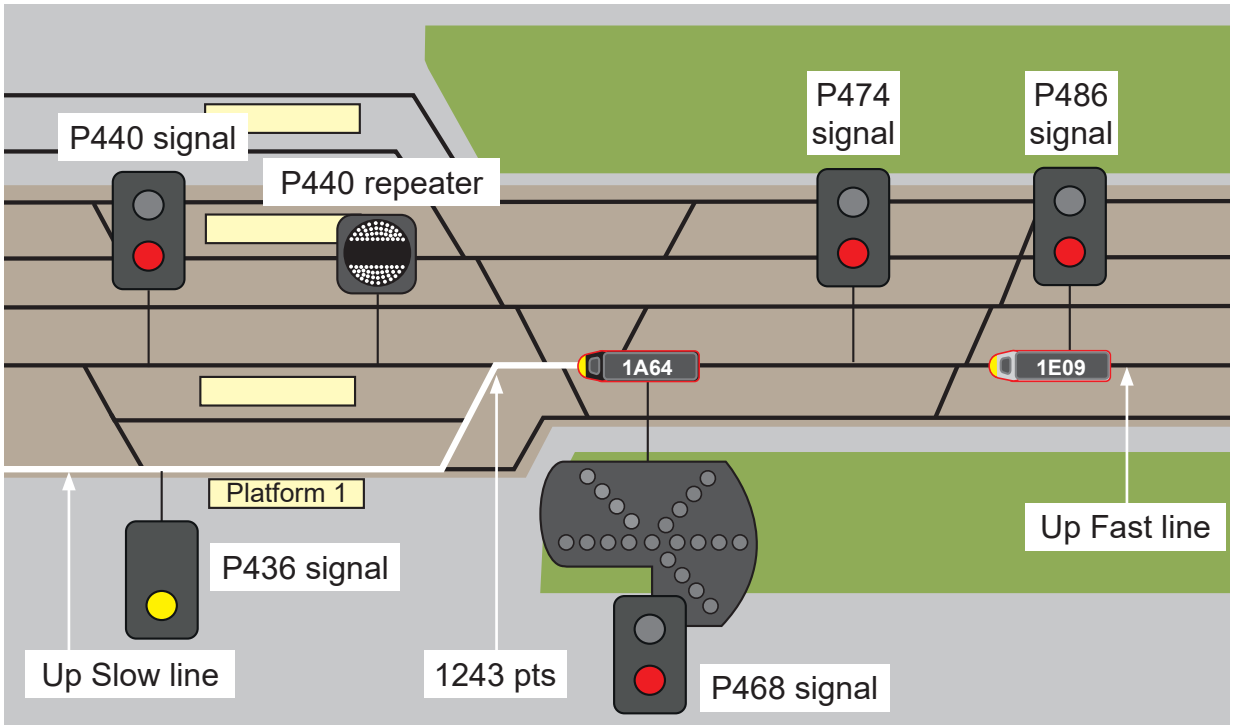

Figure 19: Train 1A64 passes P468 signal travelling at 50 mph (80km/h) still accelerating.

66 At 13:00:42 hrs, train 1A64 reached the divergence at the junction, still accelerating and travelling at 66 mph (106 km/h). Responding immediately to the train lurching at the first set of points, the driver moved the power brake controller from full power to command full emergency braking (figure 20).

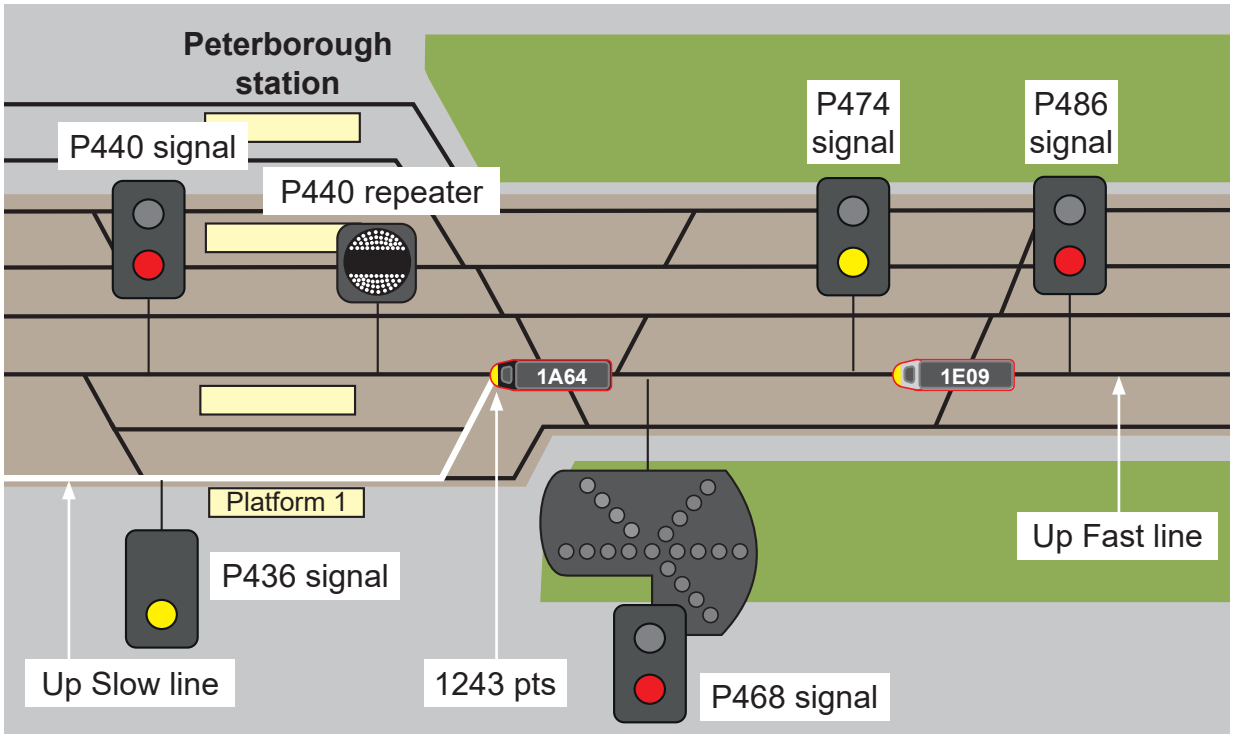

Figure 20: Train 1A64 reaches the point of divergence at the junction travelling at 66 mph (106 km/h) and still accelerating.

67 The train entered platform 1 travelling at 56 mph (90 km/h), still under emergency braking (figure 21).

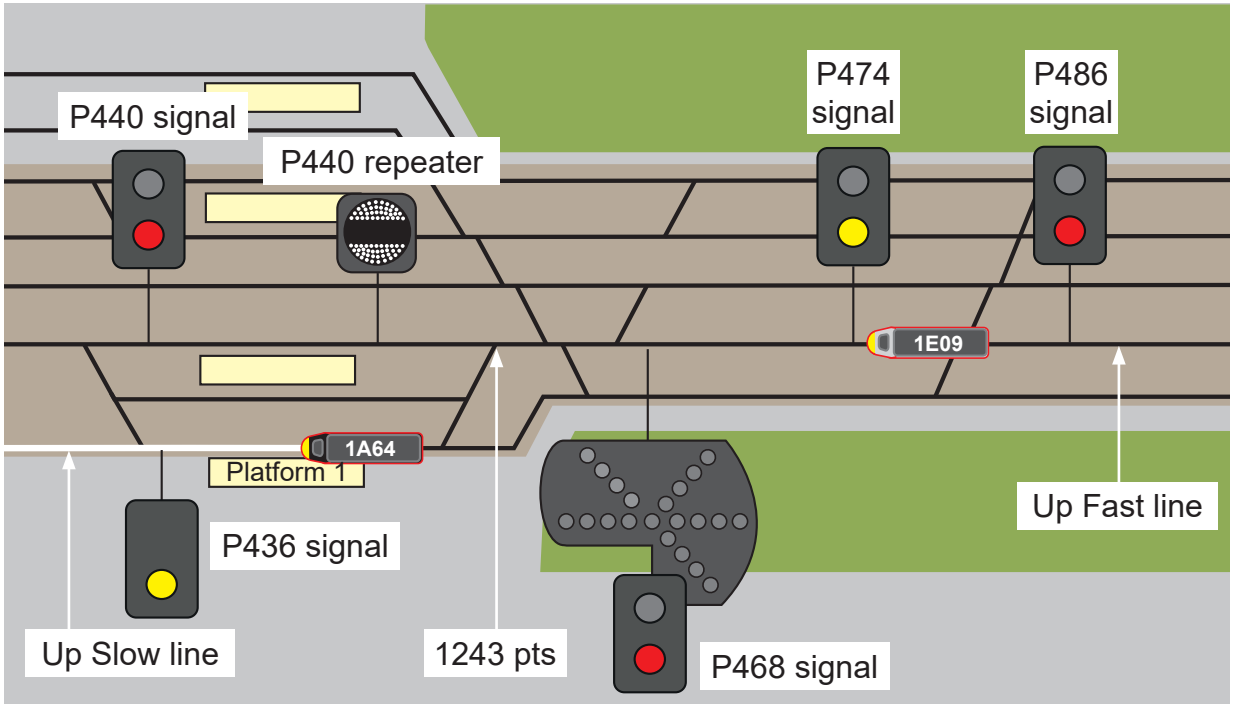

Figure 21: Train 1A64 enters platform 1 at 56 mph (90 km/h) under emergency braking.

68 Train 1A64 came to a stop at 13:00:49 hrs within the limits of platform 1 (figure 22).

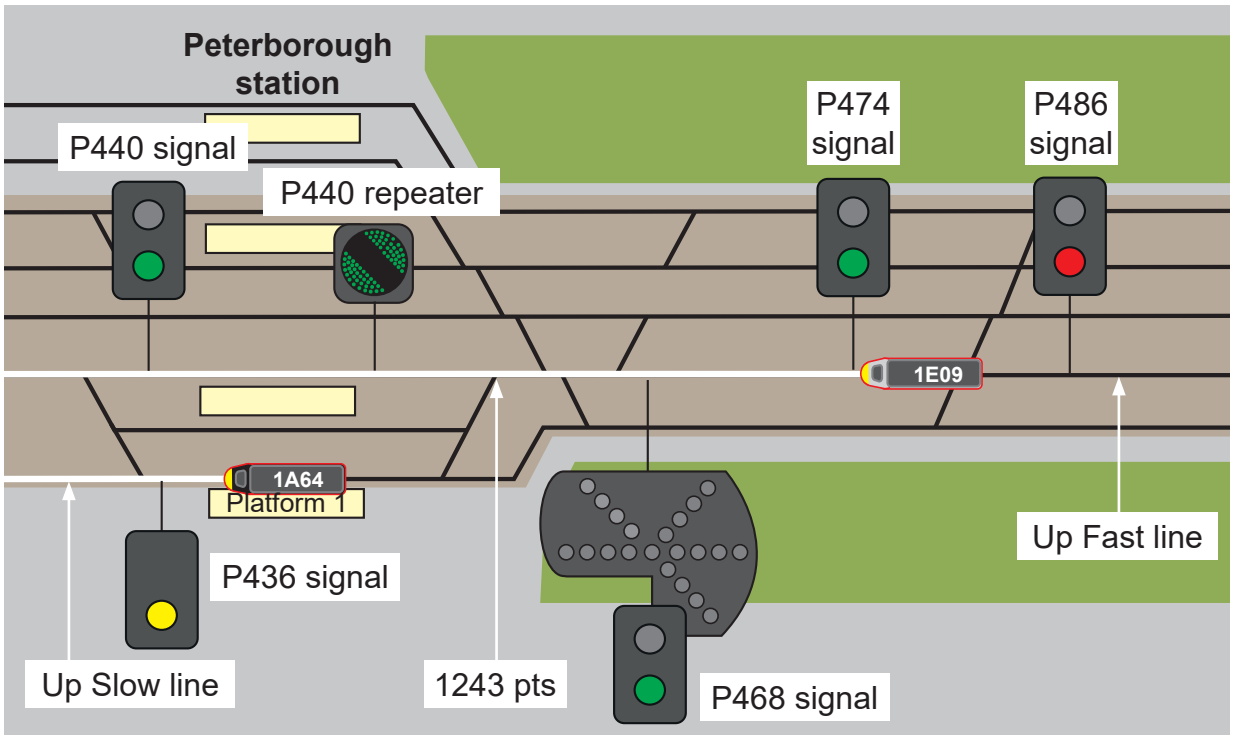

Figure 22: Train 1A64 stopped in platform 1.

Events following the incident

69 The driver reported the incident to one of the signallers and to Cross County control and was relieved of duty at Peterborough. The service was taken forward 20 minutes later by the other driver who was travelling on the train.

70 The driver was breathalysed and screened for drugs on arrival at London King's Cross station in line with the relevant rail industry standard for post-incident testing.[7] This was arranged by Cross Country control. Both tests returned clear results.

71 The train was not examined before the onward journey from Peterborough, but a subsequent examination later that day found it had sustained no damage.

72 At 14:33 hrs, Network Rail had P468 signal checked by a driver of a subsequent train service which was pathed to make the same move from the Up Fast line to the Up Slow lines via platform 1. The driver of this train confirmed that the main aspect and the JI were displayed correctly.

73 The points were examined by Network Rail staff and passed fit for use without restriction at 14:38 hrs.

[7] RIS-8070-TOM, 'Drugs and alcohol testing for safety-critical workers', issue 2 dated 5 March 2022.

Analysis

Identification of the immediate cause

74 Train 1A64 passed over the junction at excessive speed because the driver had controlled the speed appropriately for the through route rather than the slower, diverging route.

75 The maximum permissible speed limit over the first set of points at the junction was 30 mph (50 km/h) and the train travelled over this at 66 mph (106 km/h). The maximum permissible speed limit over the subsequent two sets of points was 25 mph (40 km/h), and although the emergency brake had been applied, these were traversed at a speed in excess of 60 mph (97 km/h).

76 The driver had accelerated the train after the signal showed a green aspect and a JI showing that the route was set for the Up Slow line via platform 1. The driver responded to the main aspect but not the illuminated JI.

77 The timetable for train 1A64 showed that it was planned to be diverted onto the Up Slow line at Tallington Junction on its approach towards Peterborough station and to pass through platform 1. This was to allow train 1E09 behind it to pass it to keep the correct running order for arrival at London King's Cross station.

78 There were two signallers on duty on the Peterborough North panel that day (paragraph 21). The lead signaller confirmed that train 1A64 should have been routed to the Up Slow line at Tallington Junction, but that both signallers were occupied with another issue at the time and did not realise it had entered the area controlled by the panel until it had passed that junction. Once they both realised this, they took the decision to route the train on to the Up Slow line at Spital Junction to keep the order of the trains to the timetable. Although it was not a planned regulating decision to route train 1A64 to the Up Slow line via P468 signal, signallers are able to make decisions on regulating trains using available routes.

79 A review by RAIB of services using the train reporting number 1A64 on Mondays to Fridays between 1 April and 5 May 2023 shows that it was not unusual for this service to be kept on the Up Fast line beyond Tallington Junction. During that period, 54% of services ran on the Up Fast line through Peterborough station and only 28% of services were routed from the Up Fast to the Up Slow lines at Tallington Junction. Some of the services that were kept on the Up Fast line are likely to have been routed on the Up Fast line if the service designated as train 1A64, or the train behind, was running early or late to the timetable.

80 The lead signaller told RAIB that diverting trains at Tallington Junction to the Up Slow line can take several minutes due to the signalling arrangements at that location. There is, therefore, a preference to either divert trains to the Up Slow line before reaching that junction, or at Spital Junction to keep services to the timetable and avoid delays. There is also consideration that the Up Slow line is bi-directional and can get busy with freight traffic.

Identification of causal factors

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

a. The driver did not react appropriately to the JI at P468 signal (paragraph 82).

b. The control of speed at this diverging junction is reliant on drivers correctly observing and responding to all signal information at up to 800 metres from P468 signal (paragraph 110).

c. The conspicuity of the signal's JI, and its level of association with the main aspect, may have reduced the likelihood of the driver observing it (paragraph 127).

d. The distance between the location at which the driver observed the main aspect and the diverging junction was sufficient for the driver to accelerate the train to an unsafe speed (paragraph 152).

Each of these factors is now considered in turn.

The reaction of the driver to the signal

82 The driver did not react appropriately to the JI at P468 signal.

83 The driver's view of the main signal and JI is not obstructed on the approach to P468 signal. Therefore, the green main aspect and route indication to platform 1 would have been visible to the driver of train 1A64 for 63 seconds (paragraph 65). However, the driver did not react correctly to the JI at P468 signal, and this resulted in the train's speed not being appropriately controlled for the diverging route to platform 1.

84 RAIB found no evidence that fatigue was a factor in this incident. The driver stated that they were well rested, and that this was their first day driving for three days.

85 The investigation found that the driver had both their company's and own mobile phone switched on during the journey. Although Grand Central's professional train driving handbook prohibits the use of mobile phones while driving, the driver stated that these were both in a bag which was placed out of arm's reach. Records obtained by RAIB indicate that neither mobile phone had received or sent phone calls or text messages during the journey between York and Peterborough.

86 Although there is no evidence to suggest that the driver was distracted during the approach to Spital Junction, they had reported being distracted earlier by clearing luggage on their way to the cab (paragraph 49). Following the incident, the driver also could not recall that they were stopped at Doncaster earlier in the journey (paragraph 50 and see paragraph 91). This may indicate that the driver was not fully engaged in the driving task at various points in the journey. However, OTDR and signalling data show they were controlling the train's speed appropriately and acknowledging all signals and warnings until they passed P468 signal at an excessive speed for the junction ahead.

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

a. The driver had formed an expectation that the train would be routed straight ahead (paragraph 88).

b. The advanced warnings provided as part of the signalling system (flashing aspects and the AWS for the PSWI) were ineffective as a warning to the driver of the diverging route ahead (paragraph 93).

c. The driver only reacted to the main aspect and did not actively check for the JI (paragraph 105).

Each of these factors is now considered in turn.

The expectation of the driver

88 The driver had formed an expectation that the train would be routed straight ahead.

89 The driver was aware of how this signal functioned, the previous incident at it and the risk it presented (see paragraph 161). However, in this instance their prior experiences and the information they had been presented with on their approach to the signal convinced them that the train was being routed straight ahead. They also stated that, in retrospect, they felt that they were driving in "autopilot" on the day of the incident. This is discussed further in paragraph 165.

Experience of the train's routing

90 Train 1A64 was timetabled to be routed from the Up Fast to the Up Slow line at Tallington Junction passing through Peterborough via platform 1. It is a non-stopping service, so was not due to stop at Peterborough. RAIB reviewed the routing information for Grand Central services from Mondays to Fridays, between 1 April and 5 May 2023. Out of the ten Grand Central services running each weekday, only train 1A64 saw any significant variation in its routing. The majority of the other nine services, when they ran, approached on the Up Fast line and remained on it, via platform 3.

91 The driver stated that they had driven train service 1A64 only around 20 to 30 times, and that if the train was going to be routed onto the Up Slow line, they would have expected to be diverted at Doncaster, Stoke Junction, or Tallington Junction. They stated that they would normally be routed onto the Up Slow line at Doncaster to allow a Lumo or an LNER service to go in front. Although the driver did not recall being routed onto the slow line at Doncaster on the day of the incident (paragraph 82), RAIB analysis shows that train 1A64 was routed on to the Up Slow line at Doncaster and had stopped at platform 3 for approximately 4 minutes (paragraph 50).

92 The driver was kept on the Up Fast line at Stoke Junction, which reinforced their belief they would remain on the Up Fast line for the entire route. By the time the driver reached P468 signal, they had formed the expectation that they would now be staying on the Up Fast line through platform 3 of Peterborough station. This was due to them not being diverted at the expected junctions and having been diverted into platform 1 only around 10 times previously. Such expectations are a natural part of skill acquisition and can help to improve efficiency in performance. However, problems can occur when the external situation changes, and the learned behaviour and decisions are no longer appropriate.

No effective advanced warning of the route ahead

93 The advanced warnings provided as part of the signalling system (flashing aspects and the AWS for the PSWI) were ineffective as a warning to the driver of the diverging route ahead.

Flashing yellow aspects

94 P468 signal is configured to be approach released from yellow with flashing aspects for the diverging route to the Up Slow line (paragraph 28). The two signals on the approach to it, P486 and P474 signals, can show double flashing yellow aspects and a single flashing yellow aspect respectively when a diverging route has been set for a train to the Up Slow line. This is to give drivers advanced warning that the route ahead is set for the junction divergence, so that the train's speed can be controlled as it approaches the junction.

95 However, displaying flashing yellow aspects is conditional upon the location of the train approaching the signals and the status of the route set beyond P468 signal (paragraph 37). Because of the proximity of train 1A64 to P468 signal, and because the route beyond the signal had not at that time been set (paragraph 58), the signalling was configured approach released from red. In this state, flashing aspects on P486 and P474 signals were inhibited and no flashing aspects were shown to the driver of train 1A64 as they approached the diverging route.

96 The route for train 1A64 could not be set until the train ahead, train 1E82, was clear of the route beyond P468 signal. Evidence from signalling logs and the OTDR indicates that, had train 1A64 reached the inhibition track circuit for P474 signal 14 seconds or more later, the driver would have been presented with a single flashing yellow aspect on P474 signal, giving advanced warning of the diverging route set ahead.

97 The driver recalled that they had only been routed to the Up Slow line from this signal around 10 times during their time with Grand Central. This is mostly because train 1A64 was not their normal service turn and the majority of the previous services they had driven were routed on the Up Fast line through platform 3. However, on all the occasions that the train had been routed to the Up Slow line from P468 signal, the driver could not recall ever having had flashing aspects on the approach to it.

98 The presence of flashing aspects on the approach to the junction would have given the driver of train 1A64 a different signalling aspect sequence to that which they were accustomed to seeing when the train was routed on to the Up Fast line. This would have alerted the driver to the diverging route set ahead of the train and likely challenged their expectation that the train was continuing on the Up Fast line.

Diverging route speed warning

99 The purpose of the AWS magnet associated with the PSWI (paragraph 39) is to give a warning to remind drivers that they are approaching a PSWI. This sign reminds them that the maximum permissible speed limit for the first set of points at the diverging junction to the Up Slow lines is 30 mph (48 km/h).

100 This warning was given to, and acknowledged by, the driver of train 1A64. However, a warning from this AWS magnet is not solely given for a route set, or subsequently set, for the divergence to the Up Slow lines. It is also given to all trains approaching P468 signal, except when a through route on the Up Fast line has been set and other conditions are in place at the time a train reaches the AWS magnet (paragraph 42).

101 Therefore, while this AWS warning provided additional information to drivers on the speed of the diverging junction, it is not only given for the diverging route and can be legitimately disregarded by drivers in many operational conditions. This would have been the case on all the driver's previous journeys approaching P468 signal when it was displaying a cautionary or red aspect, as the route beyond had not been set.

102 The driver was aware of the maximum permissible speed over the diverging route of the junction and that the warning was a reminder to look at the PSWI. But the driver also stated that they were unclear about the reasons and the conditions for which this AWS warning was given, due to its frequent sounding. Other Grand Central drivers have reported that the warning was given on all of their journeys through Peterborough station. This was also found to be the case with the driver of the Lumo train involved in a similar incident in 2022 (see paragraph 245). This is related to the short separation between trains approaching Peterborough station (see paragraph 186).

103 On the approach to Peterborough station, the driver had received an AWS warning at P486 signal, another for the PSWI, and another at P474 signal. Using the same warning type for different types of hazards exacerbates the problem of routine acknowledgment and places more demands on drivers to differentiate between the warnings. Additionally, the warning for the PSWI was between those for the two cautionary signal aspects. This sequence, the lack of distinction in the warnings for different hazards, and the driver's previous experiences of receiving this warning frequently, even when being routed on the Up Fast line, may have led to them not associating the specific PSWI warning with a diverging route being set ahead of the train.

104 The sounding of the in-cab AWS warning which had been regularly encountered on journeys through the station on the Up Fast line, together with an absence of a warning from the flashing yellow aspects on the approach, did not serve to challenge the driver's expectation.

The driver's reaction to seeing the signal aspect

105 The driver only reacted to the main aspect and did not actively check for the JI.

106 Signalling and OTDR data shows P468 signal changed from red to green when the train was around 800 metres away and travelling at 17 mph (27 km/h). The data also records that electrical current was passing through the JI, proving that the position 2 indication was lit. The driver said they looked up and saw the green aspect of P468 signal and assumed the train was going straight on. At this time, the train was around 740 metres from the signal which was within the limit of the maximum distance of readability required by standards (see paragraph 131). OTDR data shows that the driver applied full power around 680 metres from the signal in response to this green aspect. At the point of passing the signal, the JI and main aspect had been displaying a green aspect and a position 2 route indication uninterrupted for 63 seconds.

107 During the approach, both the main aspect and JI of P468 signal would have become more conspicuous to the driver, although this would begin to diminish with an increasing viewing angle in the last 100 metres. Train 1A64 passed P468 signal at 50 mph (80 km/h) and was still accelerating, which is indicative of a driver responding only to the main aspect and handling their train for the faster straight through route. Nothing was provided to the driver (other than the JI) to challenge their expectation that they were going straight on. The driver stated that they did not look at the signal again after initially seeing, and processing, the green main aspect, and taking that as an indication that they were staying on the Up Fast line through platform 3.

108 When the driver approached P468 signal, they stated that they looked ahead and saw the banner repeater[8] associated with the starter signal on platform 3 which they believed to be displaying a green aspect. Perceiving this green indication would have reinforced their belief that they were going straight through platform 3.

109 The banner repeater signal would display this green indication only when the signal at the end of platform 3 was set to proceed. RAIB analysis of the signalling data recorder shows that this banner repeater signal was not displaying a green aspect but was white and set to repeat the platform 3 signal which was at red. RAIB also reviewed the visibility of the banner repeater signal and found it was not visible until a train had passed P468 signal by around 500 metres, indicating that the driver had an incorrect recollection of the state of the aspect on the platform 3 starter signal.

The signal

110 The control of speed at this diverging junction is reliant on drivers correctly observing and responding to all signal information at up to 800 metres from P468 signal.

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

a. Signalling principles require the diverging route information to be provided at the first readable point to allow drivers to control their trains appropriately (paragraph 112).

[8] A banner repeater is a signal which shows the state of the aspect of the associated signal beyond it, in this case P440 signal on platform 3 (figures 21 and 22).

b. An exemption from the Railway Safety Regulations 1999 meant that overspeed protection was not required at this location (paragraph 119).

Each of these factors is now considered in turn.

Signalling principles

112 Signalling principles require the diverging route information to be provided at the first readable point to allow drivers to control their trains appropriately.

113 Lineside signalling on Network Rail infrastructure does not provide drivers with information relating to the permissible speed of a diverging junction ahead. Signs positioned at diverging junctions indicate where permissible speed changes occur. However, drivers are required to be travelling at the appropriate speed on reaching such changes.

114 The lineside signalling system provides indications to drivers as to which route has been set for their trains, together with a proceed aspect based on the aspect of the signals ahead. Where a diverging route requires a significant reduction in speed, drivers are given sufficient warning to allow them to reduce the speed of their trains before reaching the junction.

115 When colour light signalling was introduced, a signal protecting a diverging junction would be held at red, slowing trains down as the driver obeyed the aspect given by the signal, anticipating the requirement that they may have to stop. As the approaching train slowed to a speed approximating that of the speed of the junction ahead, and if the signal interlocking allowed it, the signal would clear to a proceed aspect and the train could continue at, or around the same speed. However, concern was raised that the improved braking performance of newer trains could permit a driver, who was correctly slowing to obey the protecting signal, to be nevertheless travelling at a higher speed than that permitted for the junction when the signal cleared.

116 Standard Signalling Principle 6 (SSP6), first issued in January 1992, standardised the principle of junction signalling from controlling the speed of an approaching train by restricting the clearing of the protecting signal, to providing the driver with the knowledge of which route has been set at the earliest opportunity and allowing the driver to manage the speed of their train accordingly. This route signalling principle is reliant on the driver correctly interpreting the routing information provided by the signals and using their route knowledge to avoid excessive speed over the junction.

117 Advanced warning of a diverging route can be provided by a flashing yellow signal sequence and this was one of the facilities provided on P468 signal at Peterborough (paragraphs 28 to 33). Drivers reacting to a flashing yellow warning signal sequence cannot confuse a diverging route with the straight-ahead route, as flashing yellow aspects are only displayed when a diverging route is set. Obeying this advanced warning prompts a driver to slow down their train in readiness for the divergence and should also prompt them to look for a route indication on the junction signal. This approach sequence, therefore, provides a driver with two notifications of a divergence, the first from the flashing yellow signal sequence and the second by the route indication itself.

118 However, where a junction signal is approach released from red, as P468 signal was in this incident, there is no advanced warning from flashing yellow aspects given to drivers before the junction signal becomes visible. Therefore, although a driver will still slow the train in anticipation of coming to a stop, correct handling of the train is reliant on that driver observing the route indication at the junction signal. If a driver does not observe the route indicator at the junction signal, then they may be misled into believing the straight-ahead route has been set or have their previous belief that this was the case reinforced (as happened in this incident). A driver may then accelerate their train in accordance with the higher permitted speed for the through route.

The 1999 Railway Safety Regulations

119 An exemption from the Railway Safety Regulations 1999 meant that overspeed protection was not required at this location.

120 The Railway Safety Regulations 1999[9] came into force on 30 January 2000. Regulation 3 originally required railway organisations to fit an appropriate train protection system before 1 January 2004 to mitigate the risks due to trains passing signals at danger and overspeeding at speed restrictions. Following the 1999 Ladbroke Grove accident in which 31 people died,[10] the deadline for fitment of such systems was brought forward to 2003 by the Health and Safety Executive (HSE) which was at that time the safety regulator for the mainline railways in Great Britain.[11]

121 During the mid-1990s the infrastructure managers of the mainline railway in Great Britain (British Rail and subsequently Railtrack) had developed and tested the system which would become TPWS (Train Protection and Warning System). As TPWS was the only system available which could be implemented on the scale required before the compliance date contained in the regulations, fitment of TPWS was rolled out across the mainline rail network in Great Britain.

122 In 2003, Network Rail requested an exemption from the regulations for certain situations.[12] This included permissible speed restrictions at diverging junctions which were equipped with approach release signalling. It listed a number of reasons for its exemption including the design limitations and complexity of using TPWS in these locations. Network Rail also regarded approach release signalling as an effective risk control for trains approaching junctions.

123 HSE granted this exemption. It stated that it agreed with the cost/benefit study submitted by Network Rail, and that any funding was to be spent instead on the fitment of TPWS+, to provide protection against SPADs for trains travelling at higher speeds.

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[9] https://www.legislation.gov.uk/uksi/1999/2244/made.

[10] 'The Ladbroke Grove Rail Inquiry Report', The Rt Hon Lord Cullen PC, HSE, 2001. Available at https://www.railwaysarchive.co.uk/eventsummary.php?eventID=142.

[11] The Railways Act 2005 transferred responsibility for railway-related health and safety matters from HSE to ORR.

[12] https://webarchive.nationalarchives.gov.uk/ukgwa/20130903201608/http://www.rail-reg.gov.uk/server/show/ConWebDoc.8864.

124 The reasons submitted by Network Rail for the exemption only considered the speed of trains on the approach to a junction signal. It did not specifically consider the risk of trains overspeeding once the junction signal was released to show a proceed aspect, as occurred in this incident. Although approach release signalling will, by the action of the driver, reduce the speed of a train on the approach to a signal, there is no further control provided by the signalling system once that signal is showing a clear aspect.

125 Following a previous overspeeding incident at this location in April 2022 (see paragraph 245), a signalling review report produced by Network Rail suggested that it may be beneficial to use TPWS to control overspeed at the junction. This was based on the consideration of the long distance between the signal and the junction and the existing deviation from standards for this signal because of the large speed reduction involved. However, this solution had not been pursued by the time of this second overspeeding incident in May 2023.

126 Following this second incident, Network Rail conducted a workshop with train operators whose services pass over Spital Junction (see paragraph 255). The use of TPWS to reduce the consequences of an overspeed event at this location was considered and rated as requiring further evaluation. It was recognised that this was a novel use of TPWS, which would require significant assurance and would be expensive. It was also noted that it would introduce a precedent which may lead to a national implementation. The actions of the industry since this second incident are discussed further at paragraph 202.

The conspicuity of the signal

127 The conspicuity of the signal's JI, and its level of association with the main aspect, may have reduced the likelihood of the driver observing it.

128 This possible factor arose due to a combination of the following:

a. It is likely that the conspicuity of the JI was less than the main aspect. This is a possible factor (paragraph 129).

b. The JI may not have been sufficiently associated with the signal's main aspect. This is a possible factor (paragraph 146).

Each of these factors is now considered in turn

The conspicuity of the signal's JI

129 It is likely that the conspicuity of the JI was less than the main aspect. This possibly contributed to the driver not observing the route indication.

130 The principle of providing drivers with route information so that they appropriately control the speed of their train is reliant on the driver being given a clear and unambiguous indication of the route that has been set. To achieve this, the route indication and main aspect signals must be readable at a distance from which the driver can correctly interpret the information being provided.

131 At the time of this incident, P468 signal was fitted with a Unipart Dorman Mk1 LED type of JI. Signalling equipment is ranked into different performance categories based on its readability at a defined distance. Railway Group Standard GKRT0031, 'Lineside Signals and Indicators', issue 4 dated February 2002, was current at the time that the Unipart Dorman Mk1 LED JI was commissioned at P468 signal and was still relevant at the time of the incident. To be compliant with GKRT0031, main aspect signals and their associated JIs were required to be readable at 800 metres (875 yards) at speeds up to 125 mph (201 km/h). The standard does not define how the performance criteria of a new product should be met, such as by defining the required light level output. Instead, proposed signal products were assessed by a committee viewing the signal at 800 metres.

132 The type of LED JI provided at P468 signal was assessed for readability as part of its product introduction in 2002. Signals and indicators using LED technology were being developed and tested around that time as a replacement for equipment fitted with conventional filament bulbs. The results of the testing were recorded in 'Readability Test Report OPT/01355'. The associated safety case document AR/TE/EST0008 issue 1 noted that no specification existed at the time and that the optical output of the JI was set to a 'comparable value' to 'BRS SE 154'. BRS SE 154 was a product drawing produced by British Rail which described the housing arrangement of a filament bulb type JI. The arrangement of the bulb and lens module used in this older type of JI was set down in drawing BRS SE 156/1, although this drawing does not include any optical performance specification. The optical test data for the Unipart Dorman Mk1 LED JI referred to within the safety case document is no longer available from the manufacturer.

133 RAIB undertook a survey of the signal beam alignment and light output performance of the JI fitted to P468 signal. It was not possible to accurately determine the light output of the JI on location, or to remove the JI from service for testing, due to the long-lead time required to obtain a replacement. However, Network Rail was able to supply an LED JI of the same type and RAIB commissioned an independent optical consultant to undertake light output testing. The performance of this LED JI was tested and compared with an 'as new' BRS SE 156/1 filament bulb JI module.

134 Filament bulb JIs use four individual light modules meeting BRS SE 156/1 for each route to be indicated. These are arranged around a similar light module, known as the pivot light, which illuminates with all indication positions to give five white lights (figure 23). The Unipart Dorman Mk1 LED JI is similar in design with a pivot light and four LED modules forming each indication. Both types of JI use a cast metal frame to house the light modules and a large backboard to improve contrast to the white light output.

135 The BRS SE 156/1 light module uses a traditional filament bulb and glass lens arrangement to focus the light output towards the driver (figure 24). This produces a focused beam, but because of the long thin horizontally aligned filament used in the SL18 bulb, the intensity of the light output is greater in the horizontal axis than it is in the vertical axis when viewed from the front (figure 26a). In contrast, the Unipart Dorman Mk 1 LED light module uses an array of LEDs mounted at the end of a short tube. This provides improved visibility and reduces problems originating from sunlight reflecting directly on the LED (figure 25). The absence of a filament allows the LED light module to emit light equally in both the horizontal and vertical axis (figure 26b).

Figure 23: Example of a JI.

Figure 24: Bulb and lens module used in filament JIs.

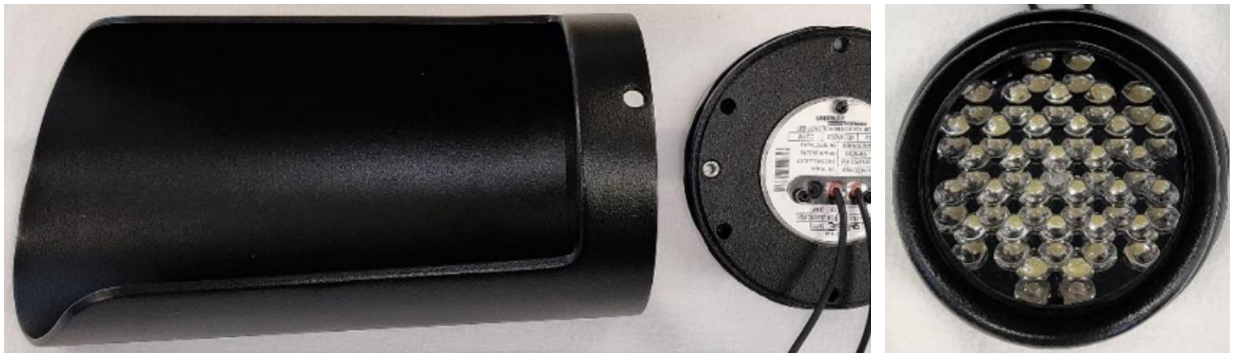

Figure 25: Unipart Dorman Mk1 LED JI module.

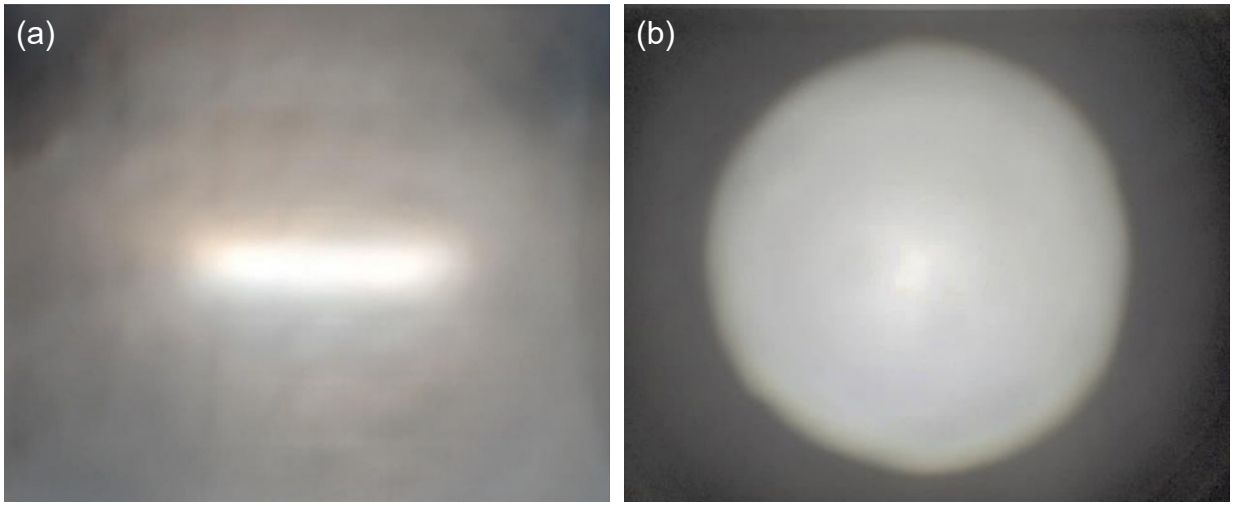

Figure 26: JI projected beam characteristic from filament indicator (a) and LED module (b).

136 The LED JI light modules were found to be at different alignments within the JI housing, ranging between -0.4 and -2.7 degrees error relative to the designed position within the housing. The pivot light was also found to be installed upside down. These issues are likely to be a consequence of the sample JI having been supplied from one of Network Rail's training centres and is unlikely to be representative of the LED JIs in use. To account for the misalignment, the luminous intensity of all modules was tested 'on-axis' and relative to the light module itself, and not to its position within its housing.

137 During testing, the LED JI modules were found to emit a greater luminous intensity when initially illuminated. The luminous intensity reduced as the modules became warmer. Although it is unlikely that the LED JI modules fitted to P468 signal would create sufficient heat to affect the light output during the time they were illuminated for an approaching train, it was necessary to allow the modules to stabilise to enable the testing to take place. When tested, the LED JI pivot light module produced the highest output of 591 cd[13] initially, which reduced to 403 cd once it had stabilised after 40 minutes (figure 28). The other LED JI light modules produced a light output of between 255 cd and 314 cd when stabilised.

138 The measured on-axis luminous intensity of the LED JI modules was significantly lower than the output measured for the BRS SE 156/1 filament bulb module, which was approximately 1,450 cd (figure 27). Although the product acceptance testing verified that an LED JI was readable at the required distance of 800 metres, the testing shows that the output of the LED JI module is significantly lower than the output of the example filament JI module it was intended to replace.

139 It was not possible to assess in-situ the luminous intensity of the JI relative to that of the green main aspect fitted to P468 signal. However, red and green main aspect signals were required by Railtrack Specification RT/E/S/10062, issue 1 dated August 1999, in force when P468 signal was installed, to have a minimum output of 850 cd.

[13] cd, (candela), is the measurement unit of luminous intensity.

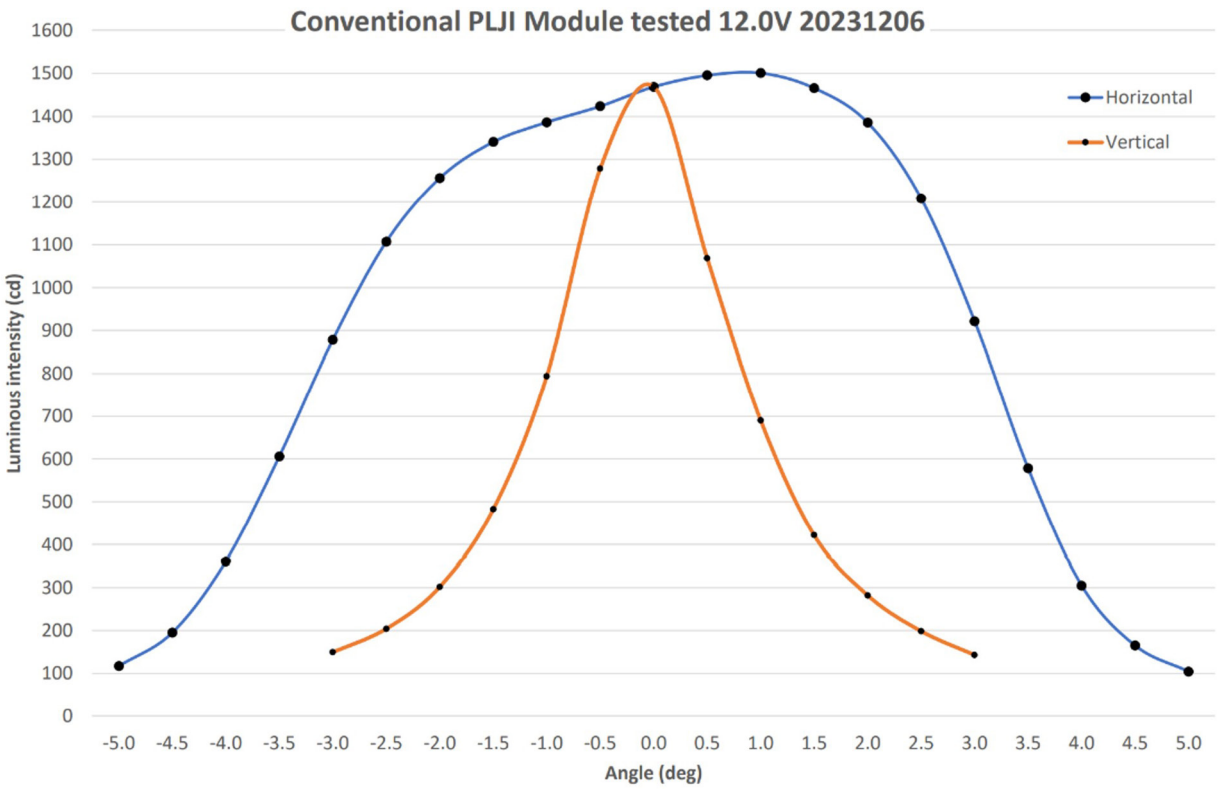

Figure 27: Measured luminous intensity from a filament JI module.

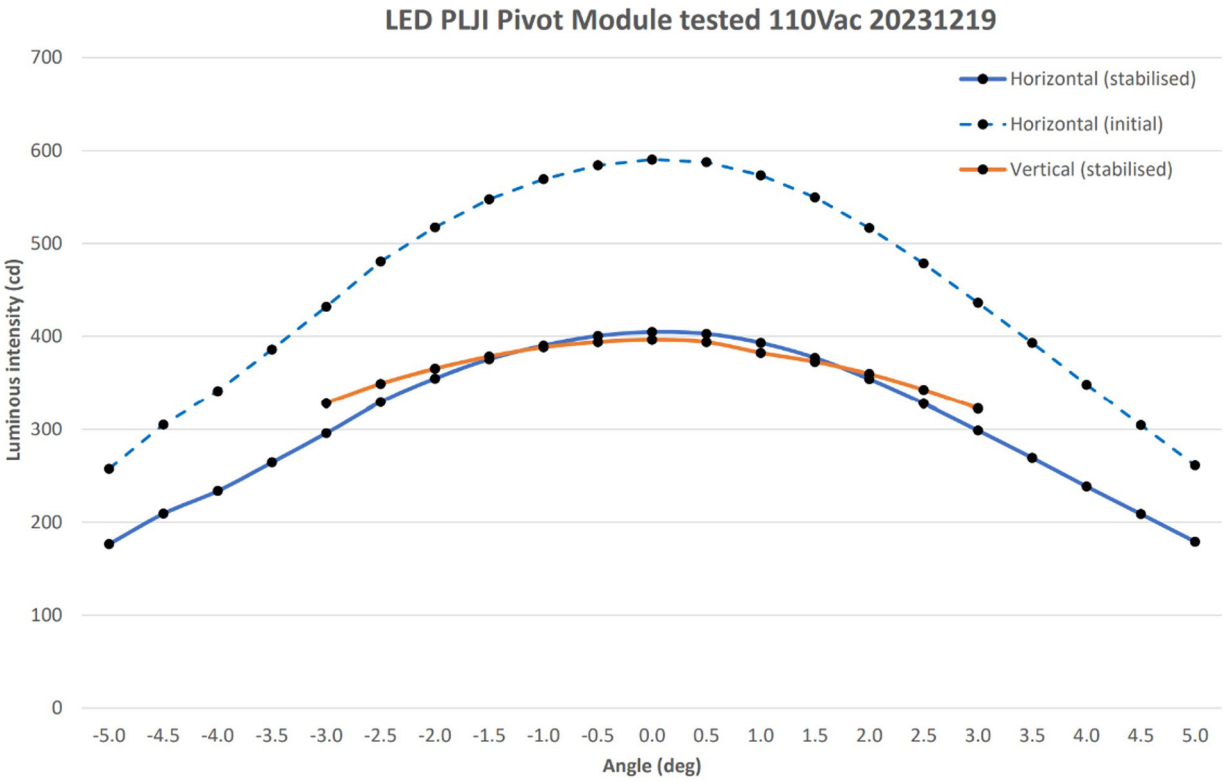

Figure 28: Measured luminous intensity from an LED JI module.

The alignment of the JI

140 Although both P468 signal's main aspect and its associated JI were visible from a distance of up to 800 metres, RAIB undertook a detailed survey of P468 signal to determine the beam alignment of both the main aspect and JI, relative to approaching trains. This included a topographic survey of the Up Fast line and relative alignment of the main signal and JI units.

141 Testing of the filament and LED JI modules found that the filament module produced a higher peak luminous intensity (paragraphs 136 to 138). This was significantly reduced as the viewing angle increased, especially in the vertical axis. In contrast, LED modules produced a much lower peak luminous intensity output but were less sensitive to viewing angle. This meant they produced an output much closer to the peak luminous intensity as the viewing angle increases away from the projected beam axis.

142 When a beam drawn from the green aspect and JI of P468 signal is overlaid on the topographical survey of the Up Fast line, the centre line of the green main aspect was found to be pointing down towards the track, and the JI pointing upwards (figure 29). This downwards alignment of the main aspect is in line with signal sighting guidance to aim the main signal towards driver's eye level at the AWS magnet associated with the signal. Figure 30 places an approaching train at 100 metres (110 yards) from P468 signal. At this distance, the centre of the green aspect beam is to the left and at a height approximating that of a driver's eye line. In contrast, the top of the windscreen of an approaching train is approximately 5 degrees below the centre of the beam projected by the JI.

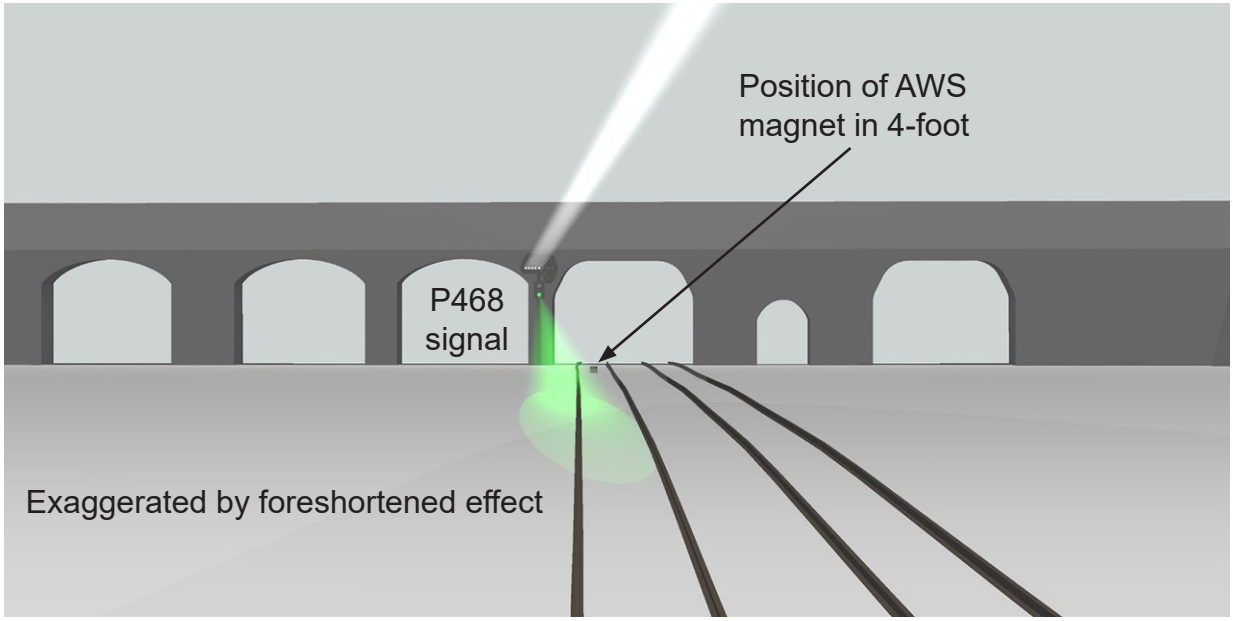

Figure 29: Alignment of green aspect and JI when viewed at 800 metres from P468 signal.

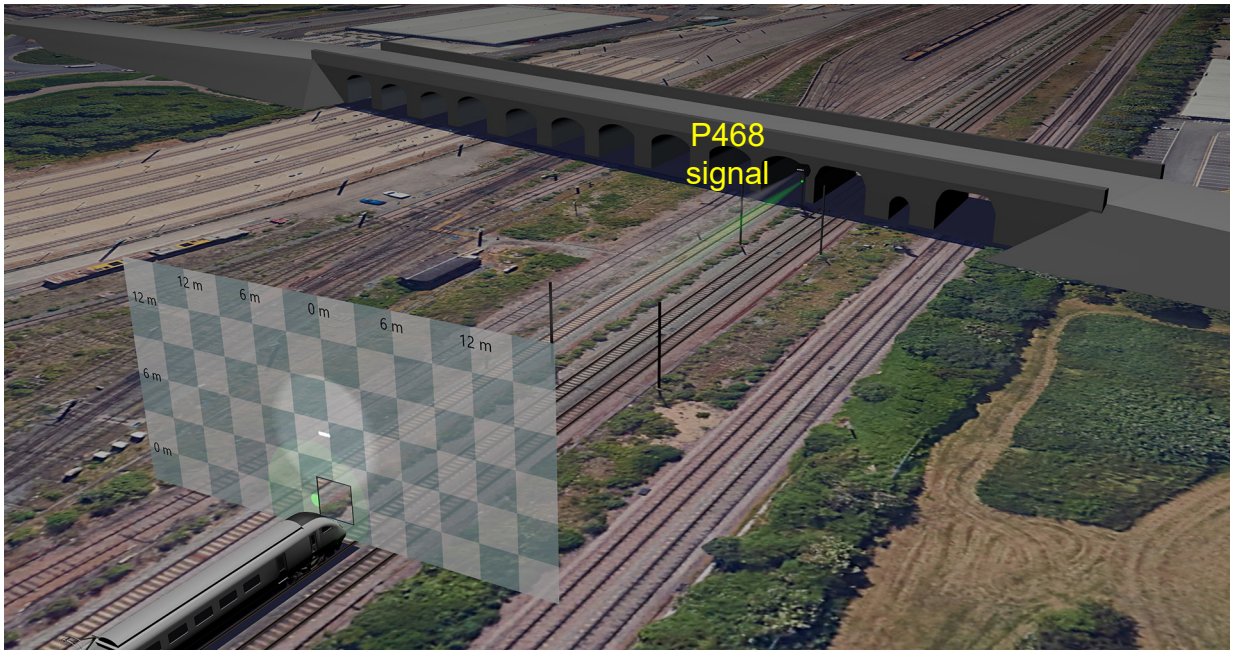

Figure 30: Illustration of beams projected from green aspect and JI onto a virtual grid of 3x3 metre squares positioned 100 metres from P468 signal.

143 When these beams are projected to 800 metres (875 yards) from P468 signal, the centre of the green aspect beam remains closer to the driver's eye level, although below the windscreen level of an approaching train. However, the centre of the JI is much further from the driver's eye line (figure 31).

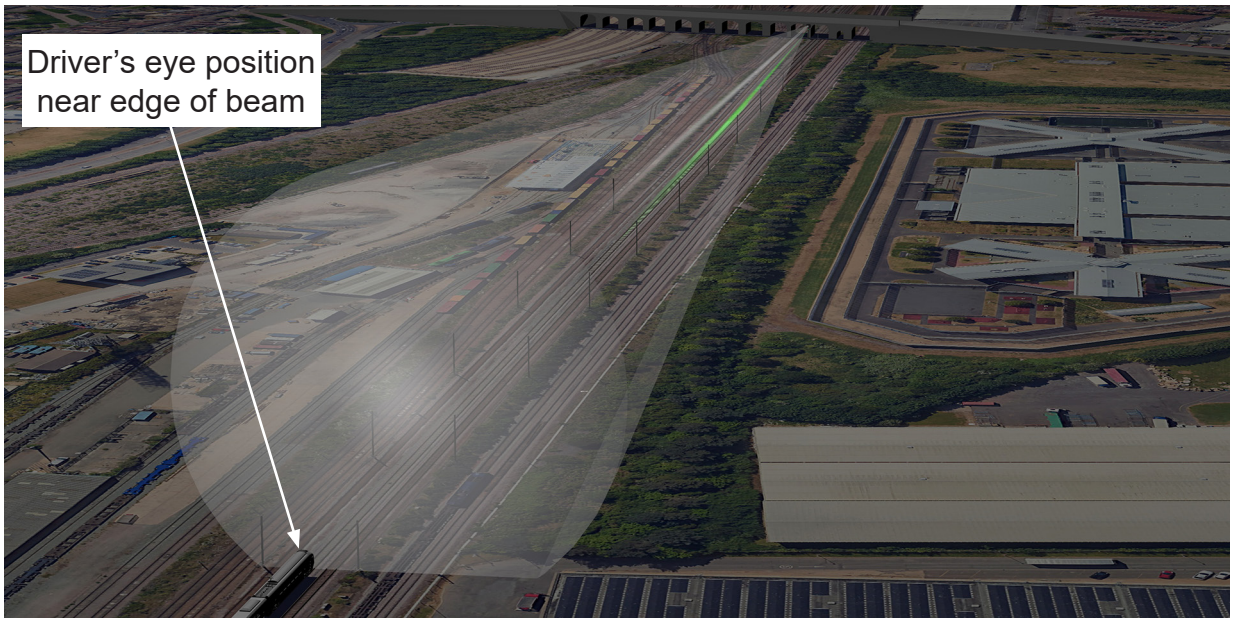

Figure 31: Illustration of the JI beam projected by a 5-degree cone out to a distance of 800 metres.

144 It is likely, therefore, that the conspicuity of the route indication was reduced compared to that of the green main aspect because:

- the JI had a lower luminous intensity (paragraphs 133 to 139).
- the centre of the JI beam, where luminous intensity is highest, was further from driver's eye line (paragraphs 140 to 143).

145 It is unknown what, if any, contribution the likely lower conspicuity of the JI had towards the driver not seeing the route indication when observing the green aspect of P468 signal on 4 May 2023. This combined with the fact that the driver did not look for the JI at the point when the main aspect changed from red to green (paragraph 83) makes this a possible factor.

Association of JI with main aspect

146 The JI may not have been sufficiently associated with the signal's main aspect. This is a possible factor.

147 During product acceptance trials for the Unipart Dorman Mk1 LED JI (paragraph 131), a committee was convened to view an example of the proposed JI which had been fitted to a two-aperture LED signal head. This was similar to the type installed at P468 signal but did not include indications for positions 2, 3, 5 and 6. During these trials, some members of the committee reported a disassociation between the JI at the top of the signal structure and the green main aspect at the bottom. Although not assessed during the trials, this disassociation effect will be increased when, as was the case with P468 signal, the JI included a position 3 or 6 indication. This is a consequence of needing to raise the whole JI unit to provide the necessary space for the lower quadrant indications, so increasing the distance above the main aspect head. Guidance in Rail Industry Standard RIS-0737-CCS states that the distance between the upper main aspect and the JI pivot light should be a minimum of 550 mm, with no maximum distance given. RAIB measured this distance on P468 signal and found it to be 1001 mm.

148 One consideration during the acceptance process was the need to avoid the bright ring of light, or corona, projected around the main aspect from obscuring other indications at night. This was found to be a particular problem with the LED main aspect modules tested. Consequently, it was considered not possible to reduce the separation between the JI and main aspects.

149 For a train driver, their field of view will be centred towards a point ahead of the train which is further away the faster the train is travelling. The eyes of a driver approaching a bridge, such as that adjacent to P468 signal, will naturally look along the track furthest ahead and through the portal. This is supported by the driver stating that, after seeing and responding to the green main aspect, they were looking towards the banner repeater (paragraph 108).

150 P468 signal is positioned against the dark background of a road bridge. This would provide a good contrast for the signal indications, improving conspicuity when compared to a similar signal viewed against a lighter background such as the sky. However, this also creates a difficulty for approaching drivers in recognising the shape of the signal ahead if the black boarding, which is provided to give a contrasting border to the indications, is itself against a dark background. Camouflaging the overall profile of a signal removes the recognisable signal shape and visual cue that would prompt a driver to scan across the full signal and look for route indications.

151 When viewing P468 signal from a distance, the vertical separation between the JI and main aspect is unlikely to influence a driver's ability to observe both the JI and main aspect. However, the effects of the JI being towards the periphery of the field of vision when looking through the bridge portal, the distance of the JI relative to the main aspect and the camouflaged signal profile may combine to increase the likelihood of a driver only observing the main aspect and not the route indication. This uncertainty combined with the fact that the driver did not look for the JI at the point when the main aspect changed from red to green (paragraph 106) makes this a possible factor.

The signalling layout and configuration at Spital Junction

152 The distance between the location at which the driver observed the main aspect and the diverging junction was sufficient to accelerate the train to an unsafe speed.

153 The features that make this junction subject to significant overspeeding risk is the distance between the point at which a green aspect can be given by P468 signal and the signal itself, the distance from the signal to the junction, the low maximum permissible speed of the divergence, and the acceleration capability of some of the trains used on the route.

154 Train 1A64 reached the divergence at the junction when travelling at 66 mph (106 km/h). RAIB has not conducted dynamic analysis to assess how close the train came to derailment. This is because this incident took place at a speed 10 mph (16 km/h) lower (although with a different type of train) than the train speed seen in the incident in April 2022[14] in which the train passed through Spital Junction close to a speed which would have resulted in it overturning.

155 Junction signals are placed as close as possible to the junction they protect and not more than 800 metres away from the point of divergence (for P468 signal, this requirement was in accordance with Railway Group Standard GKRT0045, which was in force at the relevant time). This reduces the risk of drivers mishandling their train as a consequence of forgetting the route they are to take or having to travel for long periods at a reduced speed to comply with the upcoming junction speed.

156 P468 signal is located about 700 metres from the point of divergence to platforms 1 and 2. Moving P468 signal closer to the point of divergence would be challenging to the line of sight required because of the presence of the bridge where the signal is currently located, as well as another bridge over the railway about 600 metres beyond it. Also, by changing the location of P468 signal, it could potentially impact on the placement of other signals over many miles further back along the Up Fast line, to ensure that they are spaced to maintain the correct distances needed for train braking.

[14] https://www.gov.uk/raib-reports/report-06-slash-2023-train-overspeeding-at-spital-junction.

157 Train 1A64 was approximately 750 metres from P468 signal, travelling at 16 mph (26 km/h), when the OTDR indicates that the driver reacted to the main aspect displaying a green main aspect, with full power being applied when it was around 680 metres from the signal, around 11 seconds later (paragraph 63). The train was able to reach 66 mph (106 km/h) by the time it reached the divergence. This is typical of the rapid acceleration available to modern rolling stock. Although the driver of train 1A64 did not immediately apply power as soon as the signal displayed a readable green main aspect (paragraph 63) they could have done. This would have been at a distance close to 800 metres from P468 signal.

158 P468 signal is located 700 metres from the junction, so the total distance travelled over which the train accelerated on approach to the junction was approximately 1,450 metres. This, and the acceleration performance of the train, made it possible for the train to reach 66 mph (106 km/h) at the junction. Had the driver applied full power as soon as the signal changed to display a clear aspect, the total distance would have been close to 1,500 metres and (assuming the train continued to accelerate) the speed would therefore have been greater.

159 The junction itself is in an area of very restricted space. The effect of this on the layout of the junction is that relatively low radius turnouts are necessary towards the diverging routes. Low radius turnouts have a low permitted maximum speed, such as the 30 mph (50 km/h) reducing to 25 mph (40 km/h) involved in this incident. Increasing the speed over the junction from the Up Fast to the Up Slow lines would require remodelling the track at the north end of the station. Increasing the maximum permissible speed of the divergence was proposed and considered in 2014 when the signal's operation was changed. This is discussed further in paragraph 192.

Identification of underlying factors

Skills and strategies to manage risk

160 Grand Central had not provided all its drivers with the necessary skills or additional strategies to manage the risk at this signal. This is a possible underlying factor.

161 The driver stated that they were aware of the risks at this signal, and in their role as a driver mentor they would warn other drivers about the risks posed by the possible diverging route at this junction. Other Grand Central employees have described this junction as a ''trap'', and one that they are aware could be a potential overspeed risk. Nonetheless, it was found during this investigation that this signal had not been included in Grand Central's route risk assessment (RAIB considers this omission to be observational; see paragraph 219).

162 Grand Central has historically only employed experienced drivers, so their training involved learning the routes, passing their rolling stock assessment, and then being placed with a driver mentor for approximately three months. This entails a mentor sitting with the driver in the cab to develop their driving skills through one-to-one driving time. After this initial training period, drivers had been given two rostered days per year for ongoing training which was predominantly classroom based. This has recently been increased to eight days and there are plans to include the use of simulators, as well as other training methods, in the future.

163 All drivers are issued with a professional train driving handbook as part of their company induction. The purpose of this document is to offer guidance to drivers on how they should perform tasks before, during, and after duty with the aim to reduce the risk of operational incidents.

164 Non-technical skills (NTS) are noted as a core principle in Grand Central's professional train driving handbook. NTS are defined by RSSB as the social, cognitive and personal skills that can enhance the way staff carry out technical skills, tasks and procedures. However, Grand Central drivers are currently only trained reactively in NTS, for example, where a driver has had a previous incident or has been placed on an individual development plan.

165 Following this incident, the driver of train 1A64 was invited to take part in a psychological assessment, conducted by an external company. This assessment was designed to identify any NTS weaknesses that may have contributed to the incident and to assess any strengths that could be built on. An individual plan was then developed. This detailed additional strategies that could be used by the driver to help with areas identified in the assessment, and to keep them safe when driving. The driver has since stated that this assessment has prompted them to look back at the incident at Spital Junction. In doing so the driver has recognised that they were driving on "autopilot" on the day of the incident and were not checking signals with the same rigour that they normally would.

166 One technique which is widely trained and used by drivers to manage risk while driving is risk triggered commentary. This uses the process of verbal commentary and repeating back the potential risk ahead and the actions the driver needs to take, before reaffirming them, which acts as a check. The technique needs the early identification of a potential risk to trigger it. The driver has stated that they did sometimes use risk triggered commentary when driving, but due to the expectation of going straight ahead and then seeing the green main aspect at P468 signal, they did not perceive that there was a risk on this occasion. Other strategies may have assisted in this instance (such as those mentioned in RSSB's underload toolbox[15]) and the driver noted that they have been using some of the strategies that they learned as a result of their post-incident external assessment, with positive results. It is possible, therefore, that effective integration of these strategies into driver training and development programmes before the incident might have helped the driver to avoid it.

167 Guidance from the Office of Rail and Road (ORR, the safety authority for railways in Great Britain) on developing and maintaining staff competence advocates that the development of NTS should be integrated into the wider competence management system and that it should not be seen as a substitute for good system design. In addition, research suggests that NTS training is more effective when delivered through a range of methods including classroom-based and simulation-based training or real-life exercises, as well as development activities outside of the classroom, like coaching and feedback discussions. These activities should be ongoing, and form part of a company's driver competence management system.

[15] https://www.rssb.co.uk/en/safety-and-health/improving-safety-health-and-wellbeing/understanding-human-factors/the-underload-toolbox.

Assessment of overspeeding risk

168 Neither Network Rail nor the East Coast Main Line train operators effectively controlled the risk of overspeeding at this junction both at the time the signal's operation was changed in 2014 and following the previous incident in 2022.

The assessment of risk when the signal's operation was changed in 2014

169 In 2012, Network Rail consulted with the operators of passenger and freight trains on its proposal to add the flashing yellow aspect sequence controls to P468 signal considering that it required a deviation from standards (paragraph 44). The issue to be addressed, as stated in the meeting minutes, was that P468 signal, in its then operational state of being approach released from red, was leading to trains having to accelerate towards, and then braking in advance of the diverging junction. The stated benefit of the proposed change was an improvement in journey time performance by a reduction of up to 90 seconds for trains travelling from the Up Fast to the Up Slow lines.

170 The train operating companies involved were asked to consider the risk to drivers of introducing the flashing yellow aspect signal controls. Their collective response was that, by 2012, drivers no longer considered flashing aspects to be solely for high-speed junctions and their use for lower speed junctions was more prevalent. It is also recorded that drivers would use their route knowledge to drive appropriately. Other issues were discussed including the positioning of the PSWI AWS magnet (paragraph 40) and the location at which the signal would revert to its approach released from red controls. All parties involved were accepting of the change proposal.

171 The final deviation certificate, signed off in February 2014 superseded previous versions, the first being in May 2013. The certificates stated the reasons for the proposed alternative operation of P468 signal and the impacts of the changes.

172 A qualitative risk assessment was made in support of the application for the deviation. This considered the risk of a SPAD event at P468 signal and its associated signals. It focused on the risk of drivers anticipating that P468 signal would change to a proceed aspect by the time they reached it. The assessment concluded that the SPAD risk at P468 signal due to errors of anticipation was reduced and that the signals' controls and TPWS were provided to manage this risk.

173 However, this assessment did not consider the risk of overspeeding at the junction once the junction signal had cleared, and control of that risk was reliant upon drivers seeing and responding to a signal supported by their route knowledge.

Reliance on flashing aspects as a risk control

174 Flashing aspects are provided to give drivers advanced warning that a diverging route has been set ahead of their trains (paragraph 94).

175 All three versions of the deviation certificates state:

> '*The flashing aspect sequence will reduce the risk of trains accelerating towards the divergence after receiving a delayed aspect release on the junction signal, as (the) majority of diverging trains will be signalled with the flashing aspects rather than MAR*.' [MAR, main aspect release from red].

176 By 2014, Peterborough station had been remodelled to increase its capacity (paragraph 43). Before its completion, 34% of passenger trains timetabled on the Up Fast line were diverted to (the now) platform 1 and 18% to (the now) platform 2, via the divergence. The remaining trains (48%) passed through Peterborough on the Up Fast line (before the current platform 3 was added). This means, at that time, approximately half of all trains were likely signalled over the divergence at the junction. It is not known how many of these trains would have received flashing aspects, had they been fitted. It may have been a majority, as stated in the deviation certificates, based upon the number of train services and their stopping patterns. However, Network Rail has not been able to provide any evidence that a numerical assessment had been conducted to support this statement.

177 Since the capacity improvement scheme, train service patterns have changed significantly. The working timetable for 2022 shows that only 3% of trains approaching on the Up Fast line were timetabled to the Up Slow line via the current platform 1, with none timetabled into the current platform 2. The remaining 97% stayed on the Up Fast line, either passing straight through, or stopping at platform 3.

178 A comparison of the working timetables of 2012 and 2022 shows that by 2022 there had been an increase in the number of trains timetabled to travel on the Up Fast line between Stoke Junction, to the north of Peterborough, and Peterborough station of over 12% (99 trains per day in 2022, compared with 88 trains in 2012).

179 Grand Central told RAIB that its drivers had estimated that only 1 in 40 journeys of train service 1A64 were given flashing aspects on the approach to Spital Junction. LNER conducted a poll, to which 89 of its drivers responded, and found that 49% had rarely or never encountered flashing aspects at this location when being diverted from the Up Fast to the Up Slow lines, with 30% of drivers receiving them only some of the time; this is approximately equivalent to half of the journeys on which their trains were diverted.

180 The increase in train services and the change in their operating patterns has led to an increase in the number of southbound trains slowing down, stopping at, and starting their journeys from Peterborough station. This means that the separation between trains has reduced, leading to an increase in trains approaching under restrictive signal aspects. This, in turn, has led to a reduced likelihood that a train will approach with flashing aspects being presented when routed to the divergence.

181 One of the conditions stated on the deviation certificate is:

> '*The holder of the certificate is responsible for checking that the original assumptions and conclusions contained in the deviation certificate remain valid whenever any material changes occur. If the conditions of the deviation certificate change, the deviation will no longer be valid. In these circumstances, the holder of the deviation certificate may consider applying for a new deviation*.'

182 Network Rail could not say how much reliance it had put on the statement regarding the proportion of trains that would approach with flashing aspects as a risk mitigator. Neither had it provided any evidence that it had undertaken a reassessment of the effectiveness of flashing aspects, in consideration of the changes in train operations seen at Peterborough since 2014.

Change in the duration of the signal release track circuit timer

183 Because of the conditions present when train 1A64 approached it, P468 signal was operating on the principle of approach release from red (paragraph 38). This was the configuration it would have been in before approach release from yellow controls were introduced in 2014. The only difference between this previous configuration and that in place at the time of the incident was the release of the signal by occupation of the timer track circuit (paragraph 31). This had previously been 20 seconds and was now 10 seconds. The difference of 10 seconds was stated as contributing to the performance benefits which were cited in the deviation application which was made so that flashing yellow aspect sequence controls for the routes from P468 signal could be added (paragraph 44).

184 If the timer's duration had been maintained at 20 seconds, and the same conditions had existed as at the time of the incident, then train 1A64 would have been around 70 metres closer to P468 signal when it changed to green, possibly making the JI more conspicuous to the driver when it illuminated. However, even if the duration of this timer had been increased, marginally different conditions, such as a slower approach speed of train 1A64, could have resulted in the signal's status changing when a train was at the same distance from it as in this incident. Therefore, it is not possible to say what effect, if any, this timing change would have had on the driver's expectations of which route the train was taking.

185 The additional 10 seconds, and this small reduction in distance over which the train would have accelerated, would have led to train 1A64 travelling over the junction at a slightly lower speed had all other conditions been the same. However, in different circumstances, the driver might have applied full power to the train sooner and a greater speed would have been reached, which was the case in the previous overspeeding incident at this location.

Provision of the AWS for the PSWI

186 AWS is mostly fitted on the approach to signals to give an audible warning that the signal being approached is not displaying a green aspect. Research by RSSB[16] has shown that extending the use of AWS for hazards such as speed restrictions can result in drivers receiving multiple and persistent AWS warnings on a journey. In turn, this can lead to drivers anticipating the warning and cancelling it in a routine manner, without necessarily associating it with the specific hazard.

187 The deviation certificates state that:

> '*Provision of PSWI with AWS arrangement is considered to adequately manage the overspeed risk at the junction, and assist with driver route knowledge as to what speed the flashing sequence relates*'.

188 The use of flashing aspects on the approach gives drivers, should they encounter them, advanced warning that the route ahead is set for the divergence. In this case, the AWS warning approaching the PSWI complements the flashing aspects given, reminding drivers of the maximum permissible speed for the junction divergence.

[16] RSSB (2004). Driver reliability with extended AWS. Project T021 Summary Report.

189 The original deviation certificate in 2013 stated that the AWS warning associated with the PSWI was proposed to be suppressed for all routes other than that for the divergence. The temporary deviation certificate issued in December 2013, before the final version, stated that although this had been considered, it was not possible due to engineering constraints related to the operation of associated signals.

190 Therefore, all drivers approaching this junction on restrictive aspects (paragraph 55) receive this AWS warning even if the train subsequently remains on the Up Fast line and is not routed over the divergence. In its existing arrangement, it is not specific as a warning that a diverging route has been set ahead of the train. A driver receiving the AWS warning for the PSWI in isolation (without the flashing aspects) and before P468 signal becomes visible, such as the driver in this incident, may not therefore associate the AWS warning with the PSWI. This could lead to it being acknowledged, by the driver cancelling the warning, but not regarded as relevant.

191 Network Rail has provided no evidence that the effectiveness of the AWS warning associated with the PSWI when flashing aspects are not given to drivers was considered as part of the assessment process when creating the deviation, or since service conditions have changed.

Increasing the diverging junction speed

192 All versions of the deviation certificates state that future switch and crossing renewal was planned to include improvements allowing the turnout speeds to be raised to at least 40 mph (64 km/h). They state that provision of the flashing aspects would require minimal signalling alterations when that was delivered. Although it further states that the cost of renewing the points to allow a greater diverging speed would significantly exceed any safety benefit, Network Rail was unable to provide any documentation to support the statement that a cost-benefit analysis, or similar, had been conducted. Neither could it say how much reliance it had placed on this planned upgrade to mitigate the risk and consequence of overspeeding at this junction, nor provide any documentation relating to the stated proposal to increase the speed of the diverging junction.

193 Network Rail told RAIB that a switch and crossing renewal was planned for January 2024 (week 43, 2023-2024), but this only involved a like-for-like renewal of the points; remodelling the area to give an increased divergence speed has not been considered.

Actions following the previous incident in April 2022 and before the May 2023 incident

Actions by Network Rail

194 Following the previous overspeeding incident at this location on 17 April 2022 (see paragraph 245) Network Rail undertook a signalling review of the operation of P468 signal. This included its controls, and the AWS and TPWS arrangements provided at the junction. The assessment was based upon the relevant signalling standards applicable at the time P468 signal was commissioned and consideration of current standards and good practice. No issues of concern were found.

195 Network Rail also undertook a desktop signal sighting exercise which included a check for any obscuration of P468 signal, as well as the reading time and minimum reading distance required. The review was undertaken by viewing site images, including those taken from an adjacent line and the forward-facing CCTV footage from the train involved in that incident. The assessment of readability used a photograph taken at 600 metres from the signal and confirmed that the signal was readable at that distance. The assessment concluded that the signal is likely readable up to its maximum distance of 800 metres.

196 The review found that P468 signal had not formally had its sighting assessed since 1990. The sighting form from that time did not contain information such as minimum sighting distance times, or detailed alignment, as would be required for more recent installations and their assessments.

197 The review made a recommendation to undertake a site visit to assess the signal's alignment. Network Rail has stated that a check on the alignment of P468 signal was performed in 2022 by the local maintenance team. However, RAIB observes that the signal sighting documentation held for P468 signal does not include any reference to an on-site check of the readability and alignment, including of the JI, following the previous incident.

198 The report stated that it may be possible to move the inhibition point for the flashing aspects closer to the signal to give a greater opportunity for the route to be set ahead of the train so that the driver receives flashing aspects on the approach. It also stated that as its flashing aspect controls were outside of the ranges stated in standards (because of the deviation), it may benefit from having a TPWS fitment beyond the signal to mitigate the hazard of overspeeding towards the divergence. Neither of these options had been pursued by the time the second incident occurred in May 2023.

Actions by the relevant train operators

199 At the time of the publication of the RAIB report into the April 2022 overspeeding incident, Lumo, the train operator involved in that incident, had reported its subsequent actions. This included retraining and reassessing the driver, updating its route risk assessment document, enhancing its route learning briefing document and briefing the particular risks to its drivers.

200 Since publication of this report, ORR has updated RAIB on the progress of the recommendations made within it. These are discussed in paragraph 240.

201 Shortly after the previous incident in 2022 and before this latest incident, Grand Central issued a briefing notice to its drivers, including the driver involved in this incident, regarding the risks at this signal. Actions taken by Grand Central since this second incident are in paragraph 257.

Management of overspeeding risk

202 Network Rail does not control the risk of overspeeding at locations where there is a long distance between the approach released protecting signal and the junction itself, once a proceed aspect has been given to drivers.

203 Although approach release, as fitted at P468 signal, alerts drivers to reduce train speed, it relies on route knowledge, observation of signal aspects and correct handling of the train. Network Rail does not have an engineered solution to mitigate the risk or minimise the outcome of an overspeeding event in such circumstances.

European Train Control System

204 TPWS was adopted originally as an interim train protection measure (paragraph 121) until the implementation in the UK of the European Train Control System (ETCS), part of the European Rail Traffic Management System (ERTMS).

205 ETCS provides supervision of train movements, with an on-board computer continuously calculating the maximum permitted speed the train can travel at to allow it to brake safely before the end of its movement authority. It operates by communicating with trackside beacons (at lower ETCS levels) or a central communications hub (at higher ETCS levels) and informs train drivers of the speeds that their trains can travel at, with the permitted speed being displayed in the driver's cab. In the event a driver does not respond to the speed shown in the cab, the system will automatically control the train's speed. Within higher levels of ETCS, lineside signals can be removed so that there are none for the driver to observe.

206 The 2001 Uff/Cullen joint inquiry into train protection systems[17] recommended that this system should be operational on UK high speed lines by 2010. Although a level 2 ETCS system became operational on the Cambrian line in 2011, and level 2 ETCS systems became operational on the Thameslink Core line in March 2018, and Heathrow branch of the Elizabeth line in 2020, it has otherwise taken a significant time to develop and implement these systems across the rest of the mainline rail network in Great Britain. Older automatic train protection systems introduced by British Rail in the 1980s have also in some cases become obsolete during this period and are being gradually withdrawn from service and replaced with later versions of TPWS, with exemptions from the regulations being granted by ORR.

207 In RAIB's report into the overspeed incident at Fletton Junction near Peterborough published in August 2016 (see paragraph 243), Network Rail reported that ETCS was due to be commissioned on lines between King's Cross and Peterborough in 2022. RAIB has since been informed that its first use on the East Coast Main Line will be between London and Peterborough and will not become operational until 2029.

208 In consideration of these timescales, and the existing limited application of ETCS to the mainline rail network in Great Britain, RAIB made recommendation 2 in its investigation report on the 2022 overspeeding incident. This was made with the intention of reducing the risk of overspeeding at junctions fitted with approach controls.

[17] The Joint Inquiry Into Train Protection Systems, Health and Safety Executive, 2001.

UK rail industry train protection strategy

209 The Train Protection Strategy Group (TPSG)[18] is a subgroup of the GB rail industry's vehicle/train control and communication system interface committee. This group is facilitated by RSSB and has members who represent rail industry stakeholders including train operators, rolling stock and rail infrastructure managers and owners. This group develops and monitors the train protection strategy, which is owned by RSSB, and reviews the application and use of existing train protection systems.

210 The purpose of the strategy is to mitigate so far as is reasonably practicable the risk from train derailment or collision by using enhancements to train protection systems. This includes consideration of their suitability, effectiveness, cost and performance benefits. The strategy recognises that these enhancements are considered in the light of the migration of the GB mainline railway towards the implementation of ETCS.

211 The previous strategy was published in 2017 and has been regularly updated. Since then, there have been several notable SPAD and overspeeding incidents. TPSG recognised that although these events were not frequent, they were of a potential high consequence.

212 In December 2023, RSSB issued a consultation draft of an update to its strategy to industry members. The draft started by highlighting 28 overspeeding events which have occurred since 2016, including 10 which had been investigated by RAIB. The draft acknowledges the benefit of TPWS in reducing the consequence of SPAD events and some overspeeding incidents. It also recognised that the usefulness of TPWS is limited as it does not cover all permanent speed restrictions (PSRs), including lower speed turnouts.

213 At the time of publication of this report, the draft strategy is in a period of consultation and review.

The Office of Rail and Road's final determination for control period 7

214 In October 2023, ORR published its final determination document[19] following its periodic review before the start of control period 7 (CP7) which covers the forthcoming five years from April 2024. A periodic review is one of the processes ORR uses in its role as an economic regulator to request Network Rail to be accountable for the delivery of its plans. For each control period, Network Rail produces its strategic business plan, based upon its priorities. The final determination sets out what Network Rail needs to achieve over the forthcoming control period. The review covers the requirements for spending, performance, efficiency, sustainability and health and safety. As part of this review, ORR published a supporting document to its final determination (PR23) relating to health and safety.[20]

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[18] https://www.rssb.co.uk/about-rssb/groups-and-committees/technical-strategy/system-interface-committee-chairs/vehicle-train-control-and-communications/train-protection-strategy-group.

[19] https://www.orr.gov.uk/monitoring-regulation/rail/networks/network-rail/price-controls/pr23/final-determination.

[20] https://www.orr.gov.uk/sites/default/files/2023-10/13-pr23-final-determination-supporting-document-health-and-safety_0.pdf.

215 The supporting document to PR23 stated the priority areas which Network Rail was required to develop to achieve the CP7 delivery plan, one of which was to address train overspeeding events. It recognised that TPWS had '*frailties*' with respect to preventing these incidents and the slow deployment of ETCS.

216 ORR commented that Network Rail's plans to develop and implement a system to control train speeds in the period before ETCS becomes available had changed. ORR also noted that '*Work undertaken by the industry Train Protection Strategy Group highlighted that advances in technological development means that there was the possibility of a new train protection solution that would be reasonably practicable and reduce risk more quickly than the implementation of ETCS'.*

217 During control period 6 (CP6), running for five years up to April 2024, Network Rail had been working on a programme known as OTTO (optimising train track operations). This programme was created to explore the opportunities for developing new solutions and build a business case. Towards the end of CP6, Network Rail considered this programme as too complex, and with high-risk development activities associated with adapting existing technologies. It decided that it would not be taken forward in the same form as it had been originally intended. Network Rail acknowledged the findings of the TPSG that current train protection systems may no longer reduce the risk to so far as is reasonably practicable (SFAIRP) and that the industry should consider the potential benefits of new technology. Network Rail stated that '*it does recognise however that there may be potential solutions available that are reasonably practicable, and reduce risk to SFAIRP, and that facilitates the transition to ETCS over time.'* It further stated that some elements of the previous programme will be taken forward.

218 ORR's response to Network Rail was that its '*present proposals are vague'* and that '*This is disappointing in such an important area of risk control'.* It stated that it would be a top priority for ORR to see firmer funded proposals in Network Rail's delivery plan for CP7. It further stated that it was seeking a plan with milestones to deliver outcomes focused on addressing gaps in current provision, obsolescence challenges, and securing value-for-money technology that complements or replaces existing train control systems. Network Rail has since provided further information to RAIB on its proposals (see paragraph 256).

Observations

Route risk assessments

219 Grand Central had not identified the risks associated with P468 signal in its route risk assessment.

220 Although Grand Central was aware of the previous incident in April 2022, it had not updated its route risk assessments to include P468 signal, or multiple route signals with a similar risk of overspeeding by the time of the incident in May 2023. The version of their risk assessment current at the time of this incident was dated February 2021.

221 RAIB's investigation has considered the incident driver's route knowledge. Despite these route risk assessments not being updated, the Grand Central driver involved in this incident had many years of driving trains, which had built up their experience and route knowledge. They were aware of the risks at this location and had been briefed following the 2022 incident. Additionally, in their mentor role, they had also briefed trainee drivers on this issue (paragraph 161). For this reason, RAIB considers that the status of the route risk assessment was not a causal factor in this incident.

Managing driver performance

222 Grand Central was not managing the development plans for the driver in accordance with its own processes.

223 RAIB's investigation has considered the processes used by Grand Central to manage the driver's competence and found that Grand Central was not following its own competence management processes. However, this is not considered to be a causal factor in this incident.

224 The driver joined Grand Central in 2013, and, since being deemed competent in March 2014, has successfully completed all their competency assessments since that time as part of the competency management system for drivers. The driver's last driving assessment was completed on 23 January 2023 with a satisfactory outcome of '*no items for review*'. Their last rules assessment (referred to internally as the interim rules summary) was completed on 26 January 2023 which also recorded '*no items for review'*.

225 Grand Central uses individual development and support (IDS) plans to assist drivers who have been involved in driving incidents. The purpose of these plans is to create further opportunities to mentor and support drivers who have had incidents to get back to driving safely. The length and content of these plans depend on the type of incident and the number of incidents over a set period, but generally consist of formal driving assessments (FDAs) and route reviews, in addition to the existing assessment detailed in the competence management system.

226 The driver was involved in four incidents between July 2016 and November 2017. These consisted of an emergency brake application, an unauthorised train movement, non-cancellation of an AWS warning, and an unsolicited emergency brake application due to not reacting to a PSR. The last of these led to a long-term IDS plan for the driver, which was due to span two years, and consisted of one-to-one sessions with driver managers and additional FDAs.

227 The driver was then involved in another incident, a wrong side door release, in January 2019, which fell within the two-year IDS plan timeframe already in place. This led to the driver being away from the workplace for four months and triggered a medium-term IDS plan (one-year duration). The plan, put in place by the company's operations standards manager, consisted of a four-day reintroduction to the workplace course after returning to work and four FDAs over the 12-month period. The IDS was due to be completed by June 2020, but due to the COVID-19 pandemic (during which Grand Central train operations were suspended) and the retirement of the operations standards manager, this plan was never officially signed off as completed. During this investigation, RAIB identified that there were other IDS plans put in place for other drivers around this time that were also not signed off as complete, meaning the drivers involved were still technically on these plans.

228 When new drivers join the company, they are appointed a mentor. To become a mentor, Grand Central's policy states that applicants must have been driving for at least three years and should not be on an incomplete IDS plan. The training to become a mentor consists of a two-day course and mentors receive a pay uplift for taking on the additional role. Mentors would typically have one mentee for around three months. In 2021, the driver was appointed as a driver mentor, but was still technically on an IDS plan which does not comply with the company's policy for becoming a mentor.

The management of LED signal degradation

229 Network Rail's reliability centred maintenance regime does not include a means to effectively manage degradation of LED JI modules.

230 The introduction of LED technology for lineside signals and indicators removed the need for the routine filament bulb replacement necessary to maintain conventional signalling. However, routine bulb replacement does allow any degradation of the signal light output to be reset with the fitment of a new bulb and provides the opportunity to clean the signal lenses at the same time.

231 LED modules do not require replacement to the same frequency as a filament bulb, but the light output does slowly degrade while the LED array is illuminated. Unipart Dorman anticipated this degradation and produced a light measuring tool, as LED signals were becoming more common on the network. This tool was intended to assist maintenance staff in the identification of LED modules approaching the end of their service life which, at the time, was estimated to be around five to eight years of continuous service.

232 The instructions accompanying the light measuring tool specify that LED modules should be replaced when the light output reaches 60% of the original factory reading, which is noted on the equipment being tested. However, Network Rail's maintenance processes did not include use of this measuring tool, which has now been withdrawn from service. RAIB's independent optical consultant explained that the distance at which output readings are measured by the tool would not provide consistent results and so the output degradation could not be effectively managed with this tool.

233 Network Rail maintains the signalling infrastructure in accordance with its company standards; those relevant to LED signal output degradation and current at the time of the incident were:

- NR/L3/SIG/10661, 'Signalling Maintenance Task Intervals', issue 23 dated 4 June 2022, which defines the default maintenance task intervals.
- NR/L3/SIG/10663, 'Signalling Maintenance Specifications (SMS)', issue 16 dated 4 March 2023, which is split into several parts which describe the maintenance tasks to be undertaken including NR/SMS/Part/C-SG10 relating to LED main colour light signals and NR/SMS/Part/C-SG15 which relates to LED JIs.
- NR/L3/SIG/10665, 'Reliability Centred Maintenance of Signalling Equipment', issue 22 dated 4 June 2022, which describes the alternative maintenance task periodicity where reliability centred maintenance has been adopted.

234 The default maintenance specified for LED main signals relevant to light output required the lens to be checked externally for cleanliness and lens damage as part of service task 'A'. The standard specifies a normal interval of 91 days and maximum of 364 days for this task. The signal head should also be checked internally for deterioration, contamination, and water ingress annually as part of service task 'B'. The LED modules are required to be replaced as part of the 'Periodical Task'. The normal interval between the periodical task intervention is 12 years, with the maximum given as 9999 days.

235 The default maintenance of an LED JI is very similar to that of the main aspect LED signal, although service task A has a maximum interval of 91 days, and not the maximum one-year interval given for a main signal. In contrast, the periodical task interval for the replacement of the LED modules is ten years for both the normal and maximum interval.

236 In the late 2000s, to make maintenance more efficient, Network Rail introduced 'Reliability Centred Maintenance of Signalling Equipment' (RoSE). This included a revised interval and maintenance task schedule for signalling equipment. For main aspect signals, section 9.6 of the standard replaces the A and B services with a single 'R1' service. The R1 service is very similar to the A and B services it replaces, but the interval is set to four years. The RoSE service regime requires the module replacement as part of the periodical task scheduling to continue.

237 The RoSE regime for a Unipart Dorman LED JI replaces the A and B services with a single 10-year interval 'R1' service. However, unlike the main aspect maintenance interval, the JI RoSE regime does not include a time-based requirement to replace the LED modules. Under RoSE, replacement would occur only if the unit was renewed for a reason other than routine maintenance, or the indication had degraded to such an extent that drivers made a report to the signaller.

238 It is unlikely that the JI associated with P468 signal had degraded sufficiently to reduce the conspicuity of the route indication because of a significant loss of luminous intensity. Although the JI had been installed in 2006, the route indication is used only when a route is set into platform 1 and the train is approaching the signal. RAIB has calculated that this route indication would have been illuminated for around 0.9 years of that time and therefore would only have degraded a small amount from its original state. However, the conspicuity of route indication can be important (paragraph 118) and JI initial luminous intensity may be lower than that of a main aspect (paragraph 133). The RoSE maintenance regime may, over a long period of time, allow such a disparity to increase.

Previous occurrences of a similar character

239 RAIB investigated a derailment at Bletchley Junction which occurred on 3 February 2012 (RAIB report 24/2012). This accident was a result of overspeeding, because the train driver did not immediately observe and register what was being displayed by a signal's route indicator. The locomotive travelled over the junction, which had a maximum speed limit of 15 mph (24 km/h), at 65 mph (105 km/h), resulting in it derailing. RAIB concluded that the driver's belief that they were continuing straight ahead overcame the fact that the signal, indicating a diverging route, was clearly visible to them.

240 The report made a recommendation to the train operator to review its route knowledge training and assessment process to control the risk from drivers exceeding permissible speeds at diverging junctions. The recommendation asked the operator to consider the need to reinforce the knowledge by driving over the routes concerned, cab simulation, video-based scenario training, or other suitable techniques, and the required frequency of each. The recommendation also stated that this may apply to other train operators.

241 The report also made a recommendation to Network Rail, in conjunction with train operators, to assess the risk from overspeeding at junctions taking consideration of:

a. the locations where the speed of the diverging route is significantly lower than the approach speed

b. the type of traction and its acceleration capability

c. the locations where the signals are fitted with standard alphanumeric route indicators (an indicator that displays instructions to drivers using letters and/or numbers).

242 ORR responded to RAIB regarding this recommendation. ORR initially stated that Network Rail had carried out a detailed assessment for the southern end of the West Coast Main Line and had concluded that the results did not justify repeating this approach for the whole network. Follow-up by ORR led to Network Rail concluding that there were no reasonably practicable solutions at locations with similar characteristics to Bletchley. Further questioning by ORR led to Network Rail undertaking a peer-review workshop. Subsequently, all junction signals have been subject to detailed assessments using its signal overrun assessment toolset (SORAT). Bletchley Junction has since been remodelled and in February 2020 ORR reported that Network Rail had taken the recommendation into consideration and taken action to implement it.

243 RAIB investigated an overspeed incident at Fletton Junction near Peterborough on 11 September 2015 (RAIB report 14/2016). This caused the passenger carriages to lurch sideways resulting in minor injuries to three members of staff and one passenger. The train travelled over the junctions at 51 mph (82 km/h) and the track layout had a permitted speed of 25 mph (40 km/h).

244 The investigation concluded that it was likely that the train driver had forgotten about the presence of the speed restriction because they were distracted and fatigued due to issues related to their family. The investigation found that lineside signs and in-cab warnings may have contributed to them not responding appropriately as they approached the speed restriction. There were also no engineered controls to prevent the overspeeding. RAIB made a recommendation to both Network Rail and the train operator to identify locations where there is a greater-than-usual risk that a driver may be unaware of a speed restriction.

245 RAIB investigated a similar overspeeding incident at the same location which occurred on 17 April 2022, involving a Lumo train service from Newcastle to London King's Cross (RAIB report 06/2023). This train also passed over the three sets of points at Spital Junction at excessive speed. Data from the train's OTDR indicated that the points had been traversed at a speed of 76 mph (122 km/h).

246 In this incident, the speed of the train over the junction resulted in sudden sideways movements of the vehicles leading to some passengers being thrown from their seats and luggage falling from the overhead storage, causing some passengers to receive minor injuries. Although the train did not derail, and no damage was caused, post-incident analysis indicated that the train was close to a speed that would have led to it overturning, and it was likely that some of the wheels of the vehicles lifted off the rails.

247 RAIB made four recommendations in the report published on 10 July 2023. The current progress by the industry on these is stated in paragraph 252.

Summary of conclusions

Immediate cause

248 Train 1A64 passed over the junction at excessive speed because the driver had controlled the speed appropriately for the through route rather than the slower, diverging route (paragraph 74).

Causal factors

249 The causal factors were:

a. The driver did not react appropriately to the JI at P468 signal (paragraph 82). This causal factor arose due to a combination of the following:

   i. The driver had formed an expectation that the train would be routed straight ahead (paragraph 88, **Recommendation 1**).

   ii. The advanced warnings provided as part of the signalling system (flashing aspects and the AWS for the PSWI) were ineffective as a warning to the driver of the diverging route ahead (paragraph 93, no recommendation).

   iii. The driver only reacted to the main aspect and did not actively check for the JI (paragraph 105, **Recommendation 1**).

b. The control of speed at this diverging junction is reliant on drivers correctly observing and responding to all signal information at up to 800 metres from P468 signal (paragraph 110). This causal factor arose due to a combination of the following:

   i. Signalling principles require the diverging route information to be provided at the first readable point to allow drivers to control their trains appropriately (paragraph 112, no recommendation).

   ii. An exemption from the Railway Safety Regulations 1999 meant that overspeed protection was not required at this location (paragraph 119, No recommendation).

c. The conspicuity of the signal's JI, and its level of association with the main aspect, may have reduced the likelihood of the driver observing it (paragraph 127). This possible causal factor arose due to a combination of the following:

   i. It is likely that the conspicuity of the JI was less than the main aspect. This is a possible factor (paragraph 129, **Recommendation 3**).

   ii. The JI may not have been sufficiently associated with the signal's main aspect. This is a possible factor (paragraph 146, **Recommendation 3**).

d. The distance between the location at which the driver observed the main aspect and the diverging junction was sufficient to accelerate the train to an unsafe speed (paragraph 152, no recommendation).

Underlying factors

250 The underlying factors were:

a. Grand Central had not provided all its drivers with the necessary skills or additional strategies to manage the risk at this signal. This is a possible underlying factor (paragraph 160, **Recommendation 1**).

b. Neither Network Rail nor the East Coast Main Line train operators effectively controlled the risk of overspeeding at this junction both at the time the signal's operation was changed in 2014 and following the previous incident in 2022 (paragraph 168, **Recommendation 2**).

c. Network Rail does not control the risk of overspeeding at locations where there is a long distance between the approach released protecting signal and the junction itself, once a proceed aspect has been given to drivers (paragraph 202, no recommendation).

Observations

251 The observations were:

a. Grand Central had not identified the risks associated with P468 signal in its route risk assessment (paragraph 219, **Learning point 1**).

b. Grand Central was not managing the development plans for the driver in accordance with its own processes (paragraph 222, **Learning point 2**).

c. Network Rail's reliability centred maintenance regime does not include a means to effectively manage degradation of LED JI modules (paragraph 229, **Recommendation 4**).

Previous RAIB recommendations relevant to this investigation

Recommendations that are currently being implemented

Incident at Spital Junction, Peterborough RAIB report 06/2023, Recommendations 1, 2 and 3

252 The following recommendations, which were made by RAIB as a result of its investigation into the previous incident at Spital Junction in April 2022, have relevance to this investigation. So as to avoid duplication, they are not remade in this report. However, shown below is a recap of their wording and an account of their current status.

Recommendation 1

The intent of this recommendation is to reduce the risk of Lumo drivers overspeeding at diverging junctions where there is a significant reduction in maximum permitted speeds.

Lumo (East Coast Trains Limited) should review, and amend as necessary, its route risk assessment process to ensure that it considers junctions where there is a potential for a greater risk of overspeeding (such as where there is a large distance between the point where a driver is given a clear aspect and the junction and/or where there is a large speed differential between the main and diverging routes).

Based on this revised risk assessment, Lumo should review the control measures in place intended to ensure that the risk from drivers exceeding permissible speeds at diverging junctions is adequately mitigated. This review should include consideration of the professional knowledge, training and assessment of its train drivers. Lumo should implement any changes necessary to mitigate the risk of overspeeding at junctions (paragraph 202b.i, 203a). This recommendation may also apply to other train operators.

Recommendation 2

The intent of this recommendation is for Network Rail to work with operators of trains to assess the risks of trains overspeeding at junctions fitted with approach controls.

Network Rail should:

a) Identify junctions fitted with approach controls where the risk from overspeeding could lead to derailment, injuries or damage (paragraphs 202c and 203b).

b) Share this information with the operators of trains which use the identified junctions to facilitate a collective reassessment of the risk of trains overspeeding at those junctions. This assessment should consider, among other factors, the acceleration capability of the rolling stock using the junctions, the degree of overspeed and the potential consequences.

Recommendation 3

The intent of this recommendation is to reduce the risk of trains overspeeding at junctions by considering appropriate mitigation measures.

Based on the findings of the assessments undertaken as part of Recommendation 2, Network Rail, in conjunction with train operators, should jointly consider and implement risk mitigation measures at the junctions identified where the risk from overspeeding could lead to derailment, overturning or damage. Such risk mitigation measures could include:

a) technical means (such as additional protection by signalling configuration changes) and/or the use of new technology (such as in-cab information systems to better inform drivers)

b) operational considerations (such as reinforcing driver awareness, changes to service patterns and/or how signallers regulate trains at these junctions).

253 On 28 March 2024, ORR informed RAIB that recommendation 1, which required Lumo, the train operator involved in that incident, to review and amend its route risk assessment process to reduce the risk of overspeeding at junctions, had been passed on to all train and freight operators. ORR reported that both Lumo and Grand Central have considered the recommendation and are taking actions to close it. The current status of this recommendation as reported by ORR is that it is 'Open'.

254 On 28 March 2024, ORR informed RAIB that Network Rail had stated on 5 March 2024 that it had created an action plan in collaboration with RSSB to address both recommendations 2 and 3. The current status of both of these recommendations as reported by ORR is 'Insufficient response'.

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

255 Following the second overspeeding incident in May 2023, RAIB issued Urgent Safety Advice (appendix C) to Network Rail and transport undertakings that operate trains on the East Coast Main Line through Peterborough station. This advice alerted them that suitable arrangements may not be in place to mitigate the risk of trains travelling southbound through Spital Junction at excessive speeds when signalled from the Up Fast line onto the Up Slow lines at Peterborough station. Duty holders were advised that they should take immediate steps, either operationally, or by technical means, to mitigate this risk.

256 Network Rail has advised RAIB that, since this second overspeeding incident, it has:

a. Applied a temporary approach control change to restrict P468 signal to only display a single yellow aspect when a route is set which requires the JI to be illuminated. Network Rail informed RAIB that this had been commissioned as a permanent modification on 4 May 2024.

b. Held a workshop with the train operators on that route to generate options to minimise recurrences. This included the measure taken above, the use of TPWS beyond the signal and upgrading the junction to permit higher speeds.

c. Allocated £18.3m to the Speed Management Programme (SMP) within CP7 in order to develop a 'minimum viable solution' to provide accurate and timely speed information to the driver's cab. While the SMP is not developing an alternative onboard signalling control system, its objective is to enable timely and accurate speed information to be provided within the driver's cab. This will be, where possible, via existing onboard systems such as the Driver Advisory System (DAS). The programme is not funded to deliver the deployment of such a system. The speed restriction manager element of this programme is planned to support the long-term deployment plan delivering ETCS across the network.

257 Grand Central has advised RAIB that since this incident it has:

a. retrained and reassessed the driver, who is now back on driving duty

b. issued a safety operational notice to its drivers to highlight the importance of actively looking for all parts of a signal

c. discussed with drivers the factors which contributed to both overspeeding incidents

d. reviewed and updated its route risk assessments (paragraph 253)

e. begun addressing the management of its driver development plans in accordance with its own processes (paragraph 222).

Recommendations and learning points

Recommendations

258 The following recommendations are made:[21]

1 *The intent of this recommendation is to reduce the risk of Grand Central's train operations by providing its drivers with additional skills to manage the approaches to signals controlling multiple routes.*

Grand Central should review, and amend as necessary, its training and competence management processes to provide all its drivers with the necessary skills and strategies to manage the risk encountered at signals which may show different aspects to those usually encountered (paragraphs 249a.i, 249a.iii and 250a).

2 *The intent of this recommendation is to improve the quality and the follow-up of incident investigations carried out by the industry which involve risks that need to be managed between industry parties, so that safety lessons can be learnt and shared in an open manner and cross-interface risks be more effectively managed.*

Network Rail, working with transport undertakings using its infrastructure, should review the processes by which they identify, share and implement safety learning from accidents and incidents that involve risks which need to be managed by more than one party. This review should consider legal requirements, including the duty of co-operation, good practice, such as that contained in Rail Industry Standard, RIS-3119-TOM 'Accident and Incident Investigation', RIS-3704-TOM, 'Managing Train Accident Risk Arising from Infrastructure Assets and Train Operations' and safety learning from other industries.

The review should also consider how those risks are equitably shared and appropriately controlled between Network Rail and the different organisations using its infrastructure.

Following this review, Network Rail should develop a timebound plan to make any appropriate changes identified to standards, processes and its organisational structure (paragraph 250b).

[21] 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 (Incident 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.

3 *The intent of this recommendation is to minimise the possibility of drivers not correctly reading signals by ensuring that the conspicuity of the necessary elements of junction indicator signals is optimised.*

The Rail Safety and Standards Board should review the specifications for the procurement of signal aspects stated within Rail Industry Standard RIS-0737-CCS and Railway Group Standard GKRT0057. This should include consideration of vertical separation and relative brightness of main aspects and junction indicators to understand the effects on conspicuity of the complete signal at distances up to which a signal is required to be readable. The Rail Safety and Standards Board should then consult with industry on the findings of this review and, if appropriate, update the relevant standards which will be used by industry in its specifications for the procurement of signal equipment (paragraph 249c.i and 249c.ii).

4 *The intent of this recommendation is to manage the risk of a driver not seeing a route indication because of the gradual reduction in light output of LED modules over time.*

Network Rail should review its current arrangements for maintenance and replacement of LED indicators used for signalling purposes considering the expected degradation in performance that is predicted to occur over time. This review should identify how this degradation will be managed to prevent the reduction in output reaching a point where its readability to approaching drivers may be affected to an unacceptable degree. Network Rail should then implement any necessary improvements to the arrangements that have been identified as part of this review (paragraph 251c).

This recommendation may also apply to other railway infrastructure managers.

Learning points

259 RAIB has identified the following important learning points:[22]

1 Transport undertakings are reminded of the importance of route risk assessments including signals which may show multiple routes and/or display signals to drivers which are not usually encountered, and which have a risk of overspeeding (paragraph 251a).

2 Transport undertakings are reminded of the importance of managing the competence development plans for safety-critical staff effectively and in accordance with their own processes (paragraph 251b).

260 The following learning point was made following observations during the investigation into the previous incident in 2022 (RAIB report 06/2023). This is of relevance to this subsequent incident.

Drivers should be aware of the need to maintain alertness approaching junction signals so all the information the signal provides is acted upon. Drivers should not make assumptions about the route set ahead based on commonly set routes and their previous experience.

[22] 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

Appendices

Appendix A - Glossary of abbreviations and acronyms

AWS	Automatic warning system
CCTV	Closed-circuit television
CP6	Control period 6
CP7	Control period 7
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
FDA	Formal driving assessment
HSE	Health and Safety Executive
IDS	Individual development and support
JI	Junction indicator
LED	Light emitting diode
LNER	London North Eastern Railway
NTS	Non-technical skills
ORR	Office of Rail and Road
OTDR	On-train data recorder
PSR	Permanent speed restriction
PSWI	Permissible speed warning indicator
RAIB	Rail Accident Investigation Branch
RoSE	Reliability Centred Maintenance of Signalling Equipment
RSSB	Rail Safety and Standards Board
SMP	Speed Management Programme
SPAD	Signal passed at danger
SSP6	Standard Signalling Principle 6
TPSG	Train Protection Strategy Group
TPWS	Train Protection and Warning System

Appendix B - Investigation details

RAIB used the following sources of evidence in this investigation:

- information provided by witnesses
- information taken from the train's OTDR
- CCTV recordings taken from the station
- site photographs and measurements
- voice communication records
- weather reports and observations at the site
- information from Network Rail's signalling data records
- documents and records provided by Grand Central and Network Rail
- an optical consultant report commissioned by RAIB
- a review of previous RAIB investigations that had relevance to this incident.

Appendix C - Extract from RAIB urgent safety advice

Urgent Safety Advice 02/2023: Overspeeding through Spital Junction

Published 25 May 2023

1. Safety issue

Suitable arrangements may not be in place to mitigate the risk of trains travelling southbound through Spital Junction at excessive speeds when signalled from the Up Fast line onto the Up Slow lines at Peterborough station.

P468 signal, which controls this junction, is located 700 metres on the approach to the point of divergence. The signal is fitted with a position light junction indicator informing drivers of their signalled route. Under certain circumstances, the signal clears from red as a train approaches when a diverging route is set. The maximum permitted speed through the diverging junction is initially 30 mph (48 km/h), before reducing further to 25 mph (40 km/h).

Drivers who rarely experience being routed towards the slow lines when approaching Peterborough station from the north, and whose trains are not scheduled to stop at the station, may develop an expectation that their train will remain on the Up Fast line and miss some of the information provided at P468 signal when their train is being signalled onto the diverging route.

In these circumstances the distance from which a proceed aspect on P468 signal can be seen by approaching trains, and the distance from the signal to the junction, is sufficient to result in some trains being able to accelerate to speeds which could lead to derailment by overturning when passing through the junction.

2. Safety advice

Duty holders should take immediate steps, either operationally, or by technical means, to mitigate this risk.

3. Issued to:

Network Rail and transport undertakings who operate trains on the East Coast Main Line through Peterborough station.

4. Background

On 17 April 2022, the driver of a Lumo service from Newcastle to London King's Cross did not observe and react to the junction indicator on P468 signal which showed that the train was being signalled towards the slow lines at Spital Junction. Believing that his train was going to stay on the Up Fast line, he accelerated the train towards the junction and passed over it at 76 mph (122 km/h) instead of the 30 mph (48 km/h) maximum permitted speed.

On 4 May 2023, the driver of a Grand Central service from Sunderland to London King's Cross did not observe and react to the junction indicator on P468 signal which showed that the train was being signalled towards the slow lines at Spital Junction. Believing that his train was to stay on the Up Fast line, he accelerated his train towards the junction and passed over it at 65 mph (105 km/h).

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