Rail Accident Investigation Branch

# Rail Accident Report


## Unsafe movement of a train at Styal station
## 3 May 2023

Report 07/2024
July 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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This report is published by the Rail Accident Investigation Branch, Department for Transport.

# 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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# Unsafe movement of a train at Styal station, 3 May 2023

## Contents

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# Summary


At around 15:26 hrs on Wednesday 3 May 2023, a passenger train operated by Northern Trains Ltd departed from Styal station, Manchester, with five bodyside doors open.

The train involved was a three-car class 323 electric multiple unit. Immediately before the incident, the train had experienced technical difficulties which meant that the driver was unable to release the brakes and take power. As a result of this, Northern Trains Ltd control instructed the driver to isolate safety systems relating to the doors to allow the train to move. The safety isolations did not resolve the issue; however, after further checks, the train became able to move.

The train travelled for approximately 10 seconds with five doors open. Once the train reached 3.1 mph (5 km/h), a safety system caused the open doors to close automatically. No one was hurt in the incident, although people were moving towards the train and a passenger was standing in an open doorway when the train started to move.

The incident occurred because the engineering safeguards on the train to prevent the train from departing with the doors open had been bypassed to try and rectify a fault. The train departed without the driver receiving an indication that the dispatch process was complete and without confirmation that the doors were closed.

The investigation identified that the process used by Northern Trains Ltd for assessing trains before being released into service had permitted the train to be in service with an unidentified intermittent defect. Northern Trains Ltd's processes for authorising the isolation of engineered safeguards on trains in service did not effectively control the risks created by such isolations. Also, Northern Train Ltd's training did not provide the driver with the necessary skills for managing stressful situations.

RAIB has made three recommendations addressed to Northern Trains Ltd. The first seeks to improve the management of the risk of trains being in operational service with known intermittent faults. The second recommendation considers how the operational risk of trains being in service with safety systems isolated is managed. The third recommendation looks to provide operational staff with the skills and strategies to manage out-of-course incidents and stressful situations.

RAIB has also identified a learning point to remind train operators of the importance of complying with operating rules when isolating safety systems.

# 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.

# The incident

## Summary of the incident

3 At around 15:26 hrs on Wednesday 3 May 2023, a passenger train operated by Northern Trains Ltd (Northern) departed from Styal station, Manchester (figure 1) with five of its six bodyside doors open on the platform side of the train.

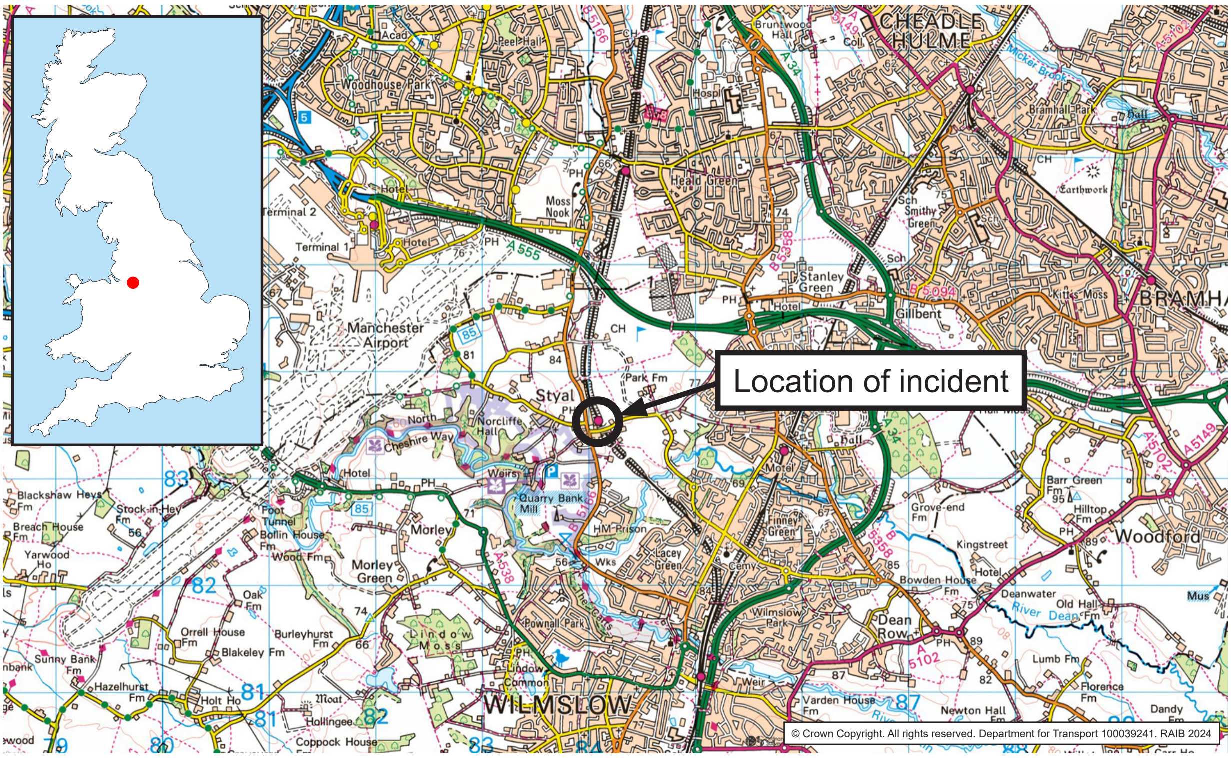


*Figure 1: Extract from Ordnance Survey map showing the location of the incident at Styal.*

4 Immediately before the incident, the train had experienced technical difficulties which meant that the driver was unable to release the brakes and take traction power. As a result of this, Northern Trains control instructed the driver to isolate safety systems relating to the doors to allow the train to move.

5 The train travelled for approximately 10 seconds with five doors open (figure 2). Once the train reached 3.1 mph (5 km/h), a safety system caused the open doors to close automatically. No one was hurt in the incident, although people were moving towards the train and a passenger was standing in an open doorway when the train started to move.

## Context

### Location

6 The incident occurred on platform 1 at Styal station, to the south-east of Manchester Airport. Styal is an unstaffed station managed by Northern. The station sits in a cutting. The only access to both platforms is down access ramps from Station Road. Both platforms at Styal are on a slight curve.

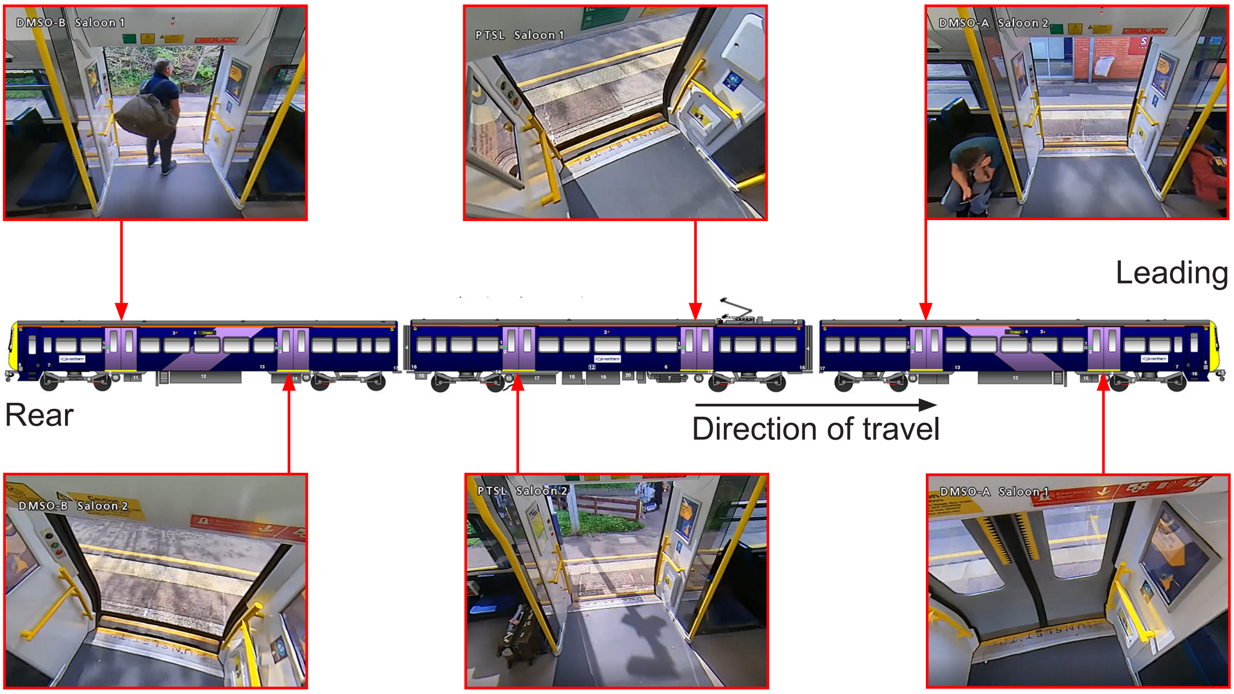


*Figure 2: Images from the internal CCTV showing the status of the train bodyside doors when the train started to move (courtesy of Northern Trains Ltd).*

7 Styal station is located on the Styal line, a loop of two tracks that connect Wilmslow station to Manchester Airport (figure 3). Platform 1 is on the Down Styal line, which is used by trains heading to the airport. The Styal line is electrified using overhead lines energised at 25,000 volts (25 kV).

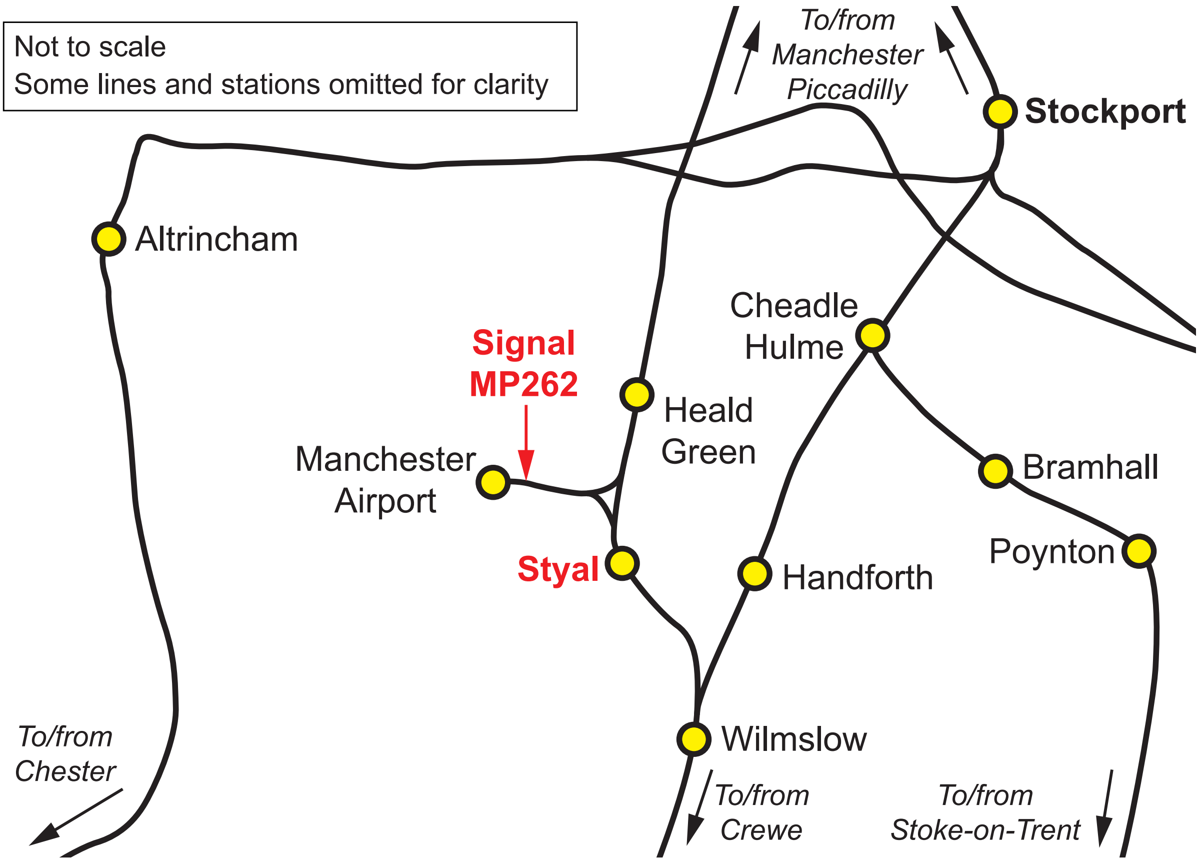


*Figure 3: Rail network showing Styal and surrounding stations.*

## Organisations involved

8 Northern Trains Ltd operated and maintained the train involved. Northern employed the driver, conductor, maintenance controller and duty control manager. Northern leases the train from Porterbrook Leasing Company Limited.

9 Network Rail owns, operates, and maintains the infrastructure, and employed the signallers on duty at the time of the incident.

10 All of the organisations involved freely co-operated with the investigation.

## Train involved

11 The train service involved in the incident was the 14:16 hrs service from Crewe to Manchester Piccadilly (via Manchester Airport), operating as train reporting number 2A89.[1] This service was operated by a class 323 electric multiple unit[2] number 323232.

12 Unit 323232 had been maintained in accordance with Northern's maintenance schedule for this type of train.

## Staff involved

13 The driver, based at Manchester Piccadilly had been driving for Northern for approximately four years, and had worked for three years before that as a conductor. At the time of the incident, the driver's competencies were up to date. The drivers record showed no previous operational incidents.

14 The conductor on the train was also based at Manchester Piccadilly and had worked for Northern for seven months. They had been passed out as competent to work unaccompanied five months before the incident. The role of 'conductor' includes all duties of a train 'guard' as defined in the railway rule book.

15 The maintenance controller had been in the role for four years and was based at Manchester Rail Operating Centre (ROC). Before being a maintenance controller, they had worked for seven years maintaining and repairing diesel trains. At the time of the incident, their competencies were up to date.

16 The signaller, whose competencies were up to date, was based at Manchester Piccadilly Signalling Control Centre, and was employed by Network Rail.

## External circumstances

17 The incident occurred on a warm and dry afternoon, with a temperature around 15°C recorded at Manchester Airport weather station (3 km from the incident location). The sun direction did not create glare for the driver within the cab. There is no evidence that external circumstances played any part in the incident.

[1] An alphanumeric code, known as the 'train reporting number', is allocated to every train operating on Network Rail infrastructure.

[2] An electric multiple unit is a train consisting of one or more vehicles permanently coupled together, operating as a single unit and powered by electricity supplied through overhead line equipment or conductor rails.

# Background information

## Class 323 trains

18 The train, unit 323232, comprised three coaches, individually numbered 64032 (leading at Styal), 72232 (middle), and 65032 (trailing). Coaches 64032 and 65032 are fitted with driving cabs, allowing the train to be driven from either end. Coach 72232 carries much of the train's electrical traction equipment and is also fitted with a toilet for the use of the train's passengers. Each coach has two sets of sliding doors for use by passengers, located one-third and two-thirds along the coach length. Additionally, each cab has an external door on each side of the vehicle, to allow crew access, and an internal door giving access to the passenger saloon from the cab (as can be seen in figure 2).

19 British Rail procured 43 class 323 units which were introduced into service during the early 1990s. Many are currently used on services around the north-west of England, operated by Northern. Class 323 units are also used on suburban services around the West Midlands.

## Door operation and station dispatch

20 In normal circumstances, the passenger doors on Northern class 323 trains are operated by a conductor using the door key switch (DKS). In a class 323 unit, DKS panels are located in the cabs at either end, and by one of the passenger doors in the middle coach. At Styal this was the first set of doors in the direction of travel. On arrival at a station, a conductor will check that the train is correctly positioned in the platform and will then insert a key ('keyed in') to activate the DKS panel at a 'local door' (the platformed door closest to the DKS panel). This energises the door control pushbuttons, enabling passengers to open the doors using the buttons provided at each doorway.

21 When station duties are complete and it is time to dispatch the train, Northern's operating rules require a conductor to check from the local door that the area of the platform close to the train (known as the platform-train interface, or PTI) is clear of people (or objects) who may be in contact with the train or fallen on the tracks. A conductor must also check that there are no obstructions in the doorways before commanding the train's doors to close.

22 The action of commanding the doors to close activates an audible alarm to warn people that the doors are about to close. This alarm continues to sound until the doors have been detected closed. Bodyside indicator lights (small lights on the side of each coach) indicate the status of the doors on each coach. From the local door (which remains open), the conductor monitors the closing doors and that the bodyside door indicator lights are extinguished. As part of the 'train safety check' the conductor will visually confirm that the doors are closed, and that nothing is trapped in the doors.

23 Having checked that it is safe to start the train, the conductor then boards and uses the DKS panel to close the local door from which they are working. The closure of this final door extinguishes the bodyside indicator lights on the coach from which the conductor is working and enables the train to gain door interlock (see paragraph 31). The conductor then uses the panel to sound a buzzer twice in the driving cab, to inform the driver that dispatch has been completed and that the train is ready to start (RTS). The driver responds by sounding the buzzer twice, to confirm they have received the RTS, before then departing from the platform. The conductor remains at the door as the train departs to monitor the platform and act in case of emergency.

24 On Northern's fleet of class 323s a 'doors close' button is provided on the driver's desk in the cab but this is not operational. An indicator showing the status of the door interlock is provided on the driver's desk. However, this is only illuminated if the DKS panel provided in the cab has been activated (keyed in). As the DKS panels in the active driving cab are not used by Northern, this desk door interlock status indicator is not normally illuminated regardless of the status of the door interlock.

## Isolating switches

25 In common with most trains, class 323 units are fitted with isolating switches to enable operators to isolate equipment and safety systems when responding to faults. At Northern, isolating switches can be activated by maintenance engineers within the engineering depot, or when in service, by drivers under explicit authorisation from the duty control manager (DCM).

26 Isolating switches, located on a panel to the far right of the driver's seat, are activated using the driver's key to turn the required switch 90° to the right. The activation of any of the isolation switches will cause the 'safety systems isolated' light on the driver's desk to illuminate as a reminder to the driver that a safety system has been isolated (figure 4). Isolating switches can only be reset by maintenance staff at a depot, or by an engineering technical inspector (ETI).

### Emergency brake isolation switch

27 The emergency brake isolation switch (EBS) on class 323 units enables the train's braking safety systems to be bypassed (RIS-3437-TOM 'Defective On-Train Equipment', issue 3 dated 2022 uses the term 'emergency bypass switch' for the same piece of equipment).

28 The electrical supply for the train's brakes runs from the rear cab, through the train and its safety systems (such as the driver's safety device and emergency brake control) to the front cab. The electrical supply is sometimes known as a 'round train circuit' or 'safety loop'. The system also verifies that sufficient air pressure exists within the brake reservoirs. If these systems are in the correct configuration for safe operation, then the presence of this electrical supply will allow the train's brakes to be released. In contrast, a lack of electrical supply will ensure that the brakes cannot be released if a potentially unsafe condition exists. When activated, the EBS bypasses these functions, giving drivers the ability to move the train if defects exist which may have been preventing the train's brakes from being released.

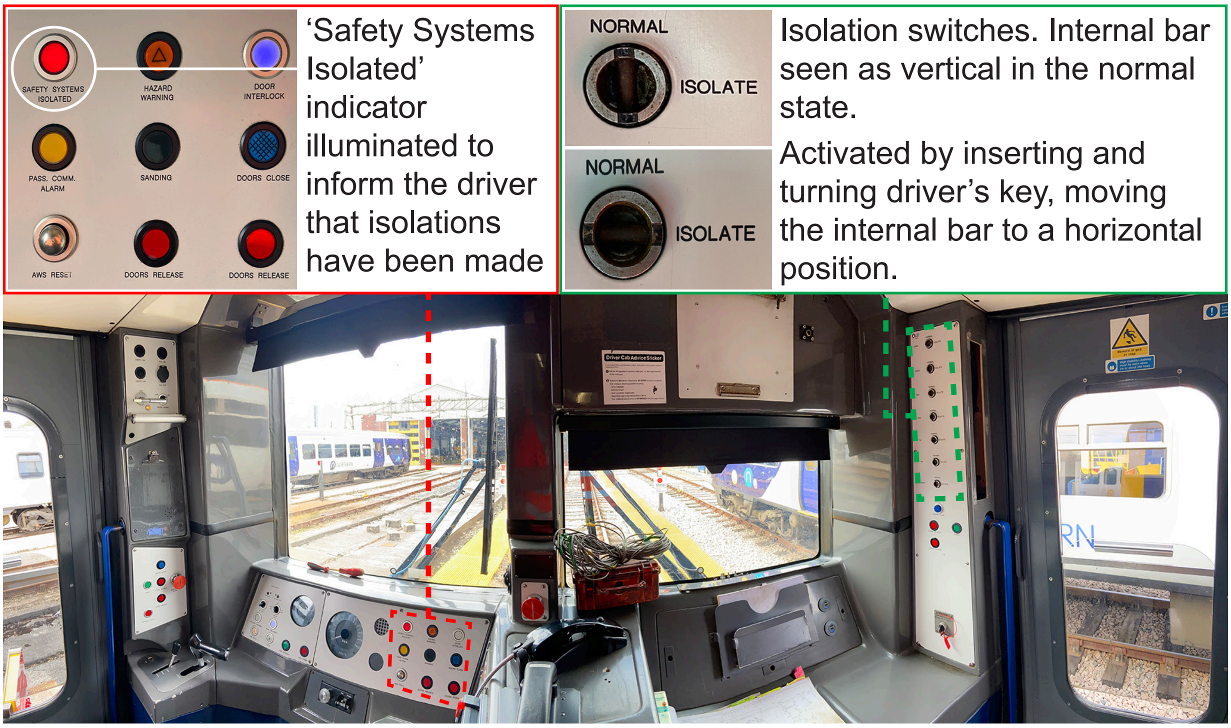


*Figure 4: The location of the 'safety systems isolated' light on the driver's desk and the safety isolation switches within the cab (left to right).*

29 The EBS also disables the brake continuity train-wire. This function is used to prove that trains formed from coupled multiple units are complete. This functionality has not been explored in detail as the incident at Styal involved a single unit.

### Traction interlock switch

30 The traction interlock switch (TIS) enables the door interlock system to be bypassed.

31 The door interlock system is linked to electrical relays within the train and ensures that the train's brakes cannot be released until all of the doors are detected as being closed and locked. Equally, should a door open while the train is moving, the train's brakes would activate. The system also ensures that a driver cannot take traction power to accelerate the train unless all the doors are detected as being closed and locked.

## Low speed relay

32 The low speed relay (LSR) forms part of the door interlock circuit on a class 323. The LSR is energised should the train reach speeds of 3.1 mph (5 km/h) when any of the doors are not closed. The LSR commands any open doors to close when the train reaches this speed and remains operational even when the TIS has been activated.

# The sequence of events

## Events preceding the incident

33 On Wednesday 3 May 2023, the driver returned to work after five consecutive rest days. After signing on for duty at 10:58 hrs, they worked a train service from Manchester Piccadilly to Rose Hill (Marple), worked the return service back to Manchester Piccadilly and then took a scheduled 50-minute-long break.

34 The driver and conductor were both rostered to work unit 323232 from Manchester Piccadilly where it formed train 2K37, the 13:06 hrs service to Crewe via Stockport. This was the first time the driver and conductor had worked together. The service departed from Manchester Piccadilly on time, calling at 12 stations with no reported issues during the journey.

35 Once at Crewe, unit 323232 formed train 2A89, the 14:16 hrs Crewe to Manchester Piccadilly via Manchester Airport service. The driver changed ends, with vehicle 64032 now leading. There were approximately 40 people on board the service on departure from Crewe.

36 The train left Crewe on time, but then experienced a six-minute delay at the first station stop, Sandbach, as it was held by the signaller to allow a delayed express passenger service to take priority. The train then continued on to Holmes Chapel, followed by Alderley Edge.

37 At Alderley Edge station, once the conductor had completed the dispatch procedure, the driver found they were unable to release the brakes. The driver and conductor repeated the action of opening and closing the doors before completing a series of initial fault finding actions, none of which resolved the issue.

38 At the request of the driver, the conductor called Northern's maintenance controller (MC) for assistance, but the line was busy, and they were unable to get through. The driver then decided to try to open and close the doors one more time. The conductor followed the normal dispatch process (paragraph 20) and the driver was able to gain brake release. The train left the station, having been stationary at Alderley Edge station for 11 minutes and 40 seconds.

39 The train continued to Wilmslow where the doors were opened and closed with no issues. The next scheduled station stop was Styal, where the train arrived at platform 1 at 15:01 hrs, 18 minutes behind schedule.

## Events during the incident

40 After approximately 30 seconds at Styal station, the conductor followed the dispatch process and gave the RTS signal to the driver. The driver acknowledged the conductor before attempting to take power. However, the driver was unable to release the train's brakes.

41 On realising that the train was not moving, the conductor moved from the DKS panel in the middle of the train to the rear cab to speak with the driver using the train's internal 'cab-to-cab' phone. The driver advised the conductor that the train's brakes would not release. This was a similar issue to that experienced previously during the station stop at Alderley Edge. The driver asked the conductor to call the MC, enabling the driver to continue fault finding.

42 Figure 5 shows the movements of the conductor and the driver during the period when the train was stationary at Styal station. In the first eight minutes after the attempted departure, the driver remained in the front cab, talking the conductor through initial fault finding actions (while the conductor was waiting to get through to the MC). At the same time, the driver continued to reset the train systems in an attempt to resolve the brake release problem. During the course of this fault-finding, the train's doors were released, meaning that passengers could open doors using the local control buttons.

43 At 15:09 hrs the conductor managed to get through to speak with the MC. The call was made on the conductor's company-issued mobile phone. Due to the poor phone signal, the conductor opened the local door to exit the train and continued the call from the platform. The MC asked a number of questions to find out what actions had already been taken as part of initial fault finding. The conductor, under the MC's instruction, then checked whether a passenger alarm had been pulled in the train's toilet.

44 At 15:10 hrs, while the conductor was speaking with the MC, the driver called the signaller using the train's GSM-R (Global System for Mobile Communications – Railway) cab radio system. The driver explained the problem with the train's brakes and acknowledged that they had a green (proceed) signal. The signal ahead of the train is identified as MP281 and was showing a green aspect throughout the incident. The signaller gave the driver permission to continue to investigate the train's fault from the platform.

45 At the conductor's suggestion, at 15:12 hrs the mobile phone was passed to the driver, at the time in the front cab, to enable them to speak directly with the MC. The conductor then, at the driver's request, proceeded to check all the doors were closed. During the phone conversation, the driver advised the MC of the previous issues with brake release at Alderley Edge (which the MC was previously unaware of), explained the fault finding already completed and confirmed that they had spoken with the signaller.

46 Due to the poor mobile reception, the MC and driver struggled to communicate clearly. At 15:14 hrs, the driver called the MC back using the GSM-R system. The MC acknowledged the location of the driver (as the MC had previously assumed that the driver was in the rear cab), before using a fault finding flow chart to confirm what checks the driver had already done.

47 Under the instruction of the MC, the driver activated two safety isolation switches to try to get the brakes to release. The driver was first asked to activate the EBS (paragraph 27), but this was found to have no effect on the brakes. The MC then sought authorisation from the DCM to activate the TIS (paragraph 30). The MC instructed the driver to activate the TIS, but the driver still could not release the train's brakes.

48 At 15:18 hrs, less than a minute after the TIS was activated, a passenger opened one of the doors in the centre coach to exit the train. Until this point, the train's passenger doors had remained closed following the initial attempted dispatch.

49 Having exhausted the checks on the flow chart (see paragraph 118), the MC asked the driver whether they had checked the miniature circuit breakers (MCB) in the middle of the train. The driver ended the phone call to the MC at 15:18 hrs and met the conductor on the platform. Together they walked towards the rear cab. The driver did not inform the conductor about the safety system isolations, as required by the railway Rule Book (see paragraph 92).

50 For the next five minutes, the conductor remained in the vicinity of the rear cab, while the driver opened the rear passenger door and boarded the train. The driver walked through the length of the train and back and checked the status of MCBs (as suggested by the MC earlier), doors and whether any passenger alarms had been operated. While on the train, the driver talked with the passengers who expressed concern over the delay to the service.

51 During this time, passengers opened two more doors (in the front and middle coaches) in order to exit the train. The driver exited the train by opening a passenger door in the rear vehicle at 15:24 hrs. At this point in time, five of the six bodyside doors (on the platform side of the train) were open. The only passenger doors which remained closed was the first set of doors immediately behind the cab in the leading coach.

52 The driver met the conductor on the platform at 15:25 hrs. Together, they decided to make another attempt to overcome the defect. The conductor started to walk towards the rear cab, before being stopped by the passengers on the platform who had alighted the train. The conductor informed them that they were making a final attempt to overcome the defect and suggested that they boarded the train. The conductor did not expect the train to move at any point as they had not carried out the dispatch procedure.

53 Meanwhile, the driver ran along the platform and returned to the front cab at 15:26 hrs. Within the next 30 seconds, the driver was able to get brake release and apply traction power. Although the conductor was standing on the platform and had not initiated the dispatch process, the driver sent an RTS acknowledgement to the conductor, normally the final step in the train dispatch sequence (see paragraph 105). The train then started to move with five bodyside doors open. The conductor, on the platform, shouted at the passengers on the platform to stand back from the moving train, while running towards the rear cab.

54 The passengers and conductor on the platform observed the five open bodyside doors automatically close as the train departed. This was due to the LSR being activated (paragraph 32) as the train accelerated to 3.1 mph (5 km/h).

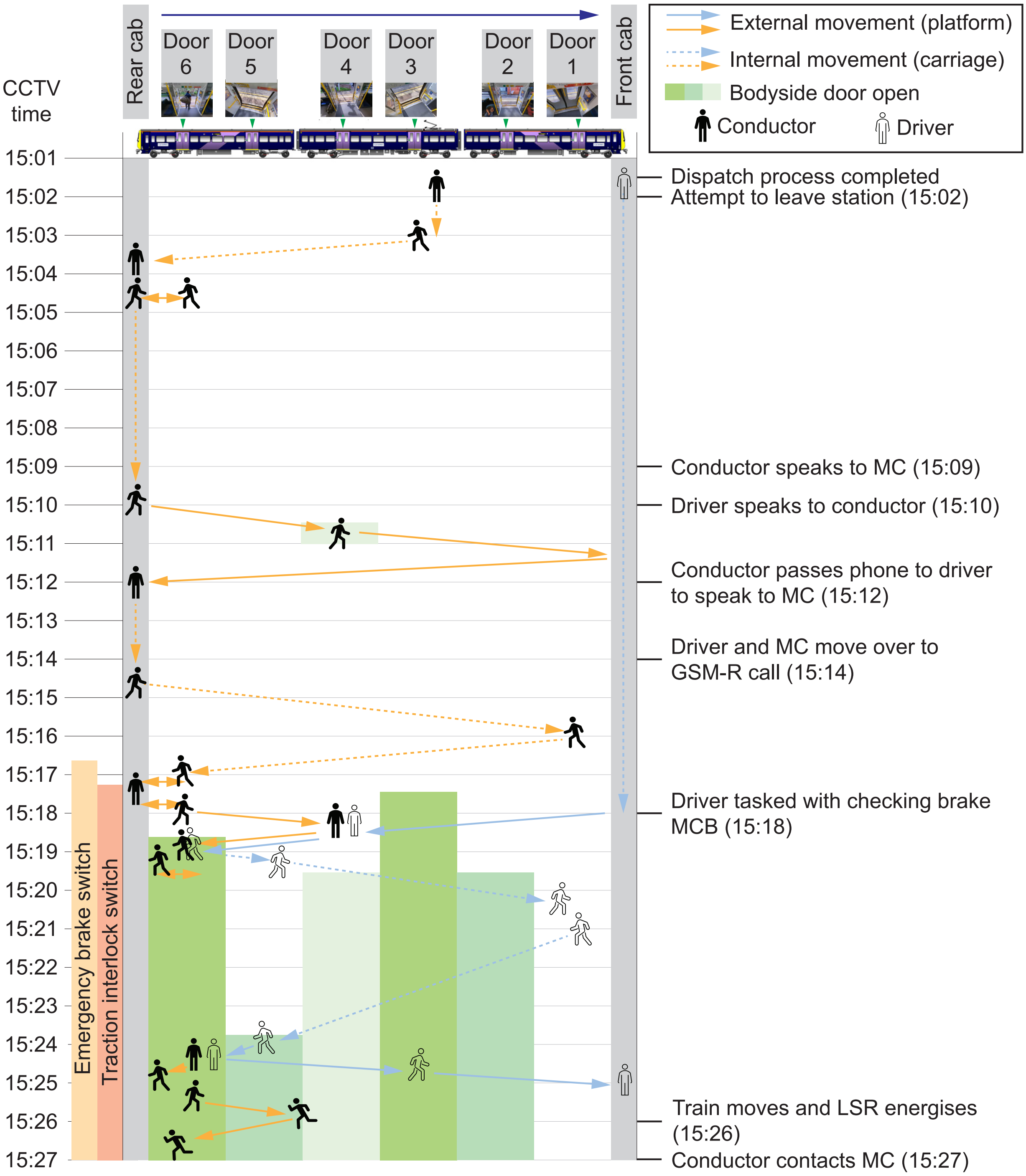


*Figure 5: The movements of the driver and conductor during the 25 minutes train 2A89 was at Styal station.*

## Events following the incident

55 The conductor alerted Northern Trains Control through the MC, who in turn notified the signaller. The signaller stopped train 2A89 at MP262 signal, the last signal before Manchester Airport. While stopped at the signal, the driver was asked to confirm that all the doors on the train were closed and that the conductor was on board. The driver confirmed this to the signaller. The train was then signalled to proceed into platform 4 at Manchester Airport, a terminal station. Train 2A89 arrived at Manchester Airport station 42 minutes late at 15:34 hrs.

56 On arrival at Manchester Airport, the train's doors did not open. The driver walked to the rear cab to investigate why this was. On entry to the rear cab, the driver realised that the conductor was not on board the train.

57 Train 2A89 was terminated at Manchester Airport due to the incident. It was later taken, empty and out of service, to Allerton depot (Liverpool) for post-incident testing. The passengers and conductor had to wait for the next scheduled train service at Styal station, which conveyed them to Manchester Airport.

58 After the incident, Northern tested the driver and conductor for the presence of non-medical drugs and alcohol. The driver and conductor tested clear for both.

# Analysis

## Identification of the immediate cause

**59 Train 2A89 departed from Styal station with multiple bodyside doors open.**

60 On arrival at Styal station, the doors were opened by the conductor to allow passengers to leave and join the train. The conductor then completed the dispatch procedure, closing all doors and informing the driver that the train was ready to depart.

61 Brake release issues with the train meant the driver was unable to move the train. Train 2A89 subsequently stood at Styal station for approximately 25 minutes. During this time, five passenger bodyside doors were reopened following the initial dispatch procedure. Closed-circuit television (CCTV) shows that two doors were opened by the driver while fault finding, and three doors were opened by passengers leaving the train.

62 The conductor was not given an opportunity to close the doors and repeat the dispatch procedure as the train departed unexpectedly, leaving them on the platform. The isolation of the safety systems meant that the train driver was able to release the brakes and take traction power despite five bodyside doors being open. This is evidenced by forward-facing CCTV, on-train data recorder (OTDR) data and witness evidence.

## Identification of causal factors

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

a. Engineered safeguards on the train had been isolated by the traincrew in an attempt to overcome a fault (paragraph 64).

b. Train 2A89 departed from Styal station in an unsafe condition (paragraph 82).

Each of these factors is now considered in turn.

### Safety isolations

**64 Engineered safeguards on the train had been isolated by the traincrew in an attempt to overcome a fault.**

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

a. The train was in service with a known fault that maintainers had not been able to identify and resolve (paragraph 66).

b. Northern's control function instructed the traincrew to isolate engineered safeguards on the train (paragraph 75).

Each of these factors is now considered in turn.

*Defect history*

**66 The train was in service with a known fault that maintainers had not been able to identify and resolve.**

67 Unit 323232 experienced a brake release issue 10 days before the incident at Styal station. On 24 April 2023, while in passenger service, the driver of the unit was unable to release the train's brakes at a station following door operation. The driver reset the train's systems and the fault self-rectified, enabling the driver to release the brakes.

68 Northern's train maintenance staff based at Allerton depot examined the unit in response to the incident on 24 April. A series of standard door tests were carried out, OTDR data was examined, and the unit's history was reviewed in the fleet database (see paragraph 108). The depot could not recreate or identify the fault and was therefore unable to resolve it. The reported fault and the fault finding conducted by the depot were recorded in the database as 'no fault found' before unit 323232 was released back into passenger service.

69 The incidents at Alderley Edge and at Styal occurred on 3 May 2023. Like the previous event on 24 April, the driver was unable to release the brakes at a station platform, and again the fault seemed to have self-rectified. The 24 April reoccurrences, in additional to the operational incident, heightened the level of investigation by Northern.

70 The subsequent investigation was escalated to be overseen by senior depot staff and the depot technical co-ordinator (DTC). The DTC was able to provide technical guidance to the depot ETIs who carried out the fault finding and testing. A detailed and thorough test was conducted of every door on the unit. However, Northern was unable to recreate or identify the fault and therefore to resolve it.

71 Northern has identified, through technical monitoring, a reliability issue on 17 electrical relays within the class 323 unit control system. In response to this, a project was proceeding to replace these relays as part of scheduled maintenance, or when a fault is attributed to any of the identified relays. Although Northern could not directly attribute the brake release faults seen on unit 323232 to this reliability issue, all 17 relays were replaced on the unit following the incident as a precautionary measure, as part of the relay replacement project.

72 The DTC reviewed all the work, and the reported fault and the fault finding conducted by the depot were again recorded in the fleet database. They also linked the case with the earlier unresolved brake release incident during April. On 11 May 2023, the unit was released back into passenger traffic as no fault found, initially with an ETI riding on board the unit to provide support should the fault reoccur.

73 Two weeks later, 25 May 2023, while shunting in Stockport sidings, the driver of unit 323232 was unable to get brake release. The driver contacted the MC who talked them through initial fault finding and sent an ETI to attend the train. The fault had occurred while the driver was changing cab ends (a process which did not require train doors to be opened). This enabled the ETI to identify that the fault was specific to one cab end (coach 64032, the cab in use during the incident at Styal) and did not lie within the door or brake system, but within the cab-specific brake control system. The fault self-rectified and the train was moved to Allerton depot.

74 Although the fault could not be recreated at the depot, with the investigation now focussed on the cab-specific electrical control circuits for the brake control system, maintenance staff were able to identify the cause of the fault. This was an intermittent brake fault affecting only the driving cab of coach 64032 which was caused by intermittent high resistance across either a brake supply relay (BSR) contact or at least one of two emergency relay (ER) contacts. A detailed explanation of the fault is provided in appendix C. The technicians replaced both the BSR and ER relays and the train returned to service. Northern advised RAIB that this appears to have cured the defect, as no further related failures were reported.

*Responding to faults in service*

**75 Northern's control function instructed the traincrew to isolate engineered safeguards on the train.**

76 Northern's control room for the western side of its network is within Network Rail's Manchester ROC. On the day of the incident, the MC on duty was located next to the DCM.

77 The conductor of train 2A89 contacted the MC using their work-issued mobile phone (paragraph 43). The MC continued the conversation with the driver on the conductor's mobile and then on GSM-R. Initially, the driver led the conversation with the MC, before the MC sought confirmation that the driver had spoken with the signaller and asked them to return to their cab. This was based on the MC's assumption (because the driver was using the conductor's mobile phone) that the driver was with the conductor in the rear cab. The driver at this point told the MC that they were already in the front cab. The MC sought no other confirmation of which cab the fault finding had taken place in. Due to the nature of the fault only affecting the leading cab (see appendix C), brake release would have been gained from the rear cab had an attempt been made to do so.

78 The MC confirmed which checks the driver had already done before concluding that they needed to activate safety isolation switches, but then deliberated whether to activate the TIS (paragraph 30) or the EBS (paragraph 27). The MC instructed the driver to activate the EBS and then the TIS (paragraph 47), but neither had any effect on brake release due to the nature of the fault. However, isolating safety systems meant that the train was no longer protected from moving while in a potentially unsafe condition, such as with the passenger doors open (paragraph 31).

79 Because of the potential risks involved, safety isolations must be undertaken in accordance with the requirements of the Rule Book (see paragraph 87). The MC was not trained in the relevant provisions of the Rule Book. They therefore had to seek authority for safety isolations from the DCM, who had been trained in the relevant operating rules. While on the call with the driver, the MC turned to the DCM to let them know that they needed to activate the TIS to try and get the train moving. Authorisation was given verbally by the DCM to do this. After receiving authorisation from the DCM, the MC instructed the driver to activate the TIS, after which the driver still could not get the train's brakes to release.

80 In normal circumstances isolating the TIS is the last stage of fault finding; although it removes the function of some safety systems, isolating the TIS does normally enable a vehicle to move. However, in this case, even though the TIS had been activated, the train's brakes still would not release. Therefore, the driver and MC were both faced with an out-of-course situation for which there was no written guidance.

81 As the train still would not move, the MC tasked the driver with checking the brake MCB in the middle of the train. The driver agreed and said they would check the MCB and call the MC back. The call then ended. There was no further communication between the driver and the MC while train 2A89 remained at Styal station.

### Train dispatch

**82 Train 2A89 departed from Styal station in an unsafe condition.**

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

a. The driver moved the train without dispatch authorisation from the conductor (paragraph 84).

b. The driver was unaware that the doors remained open (paragraph 95).

Each of these factors is now considered in turn.

#### *Dispatch authorisation*

**84 The driver moved the train without dispatch authorisation from the conductor.**

85 After obtaining brake release, the driver of train 2A89 sounded the buzzer twice before taking power and departing Styal station (paragraph 53). At this point, the conductor was still on the platform and was therefore not given the opportunity to perform the dispatch procedure, including giving the RTS to the driver. The driver's decision-making is discussed from paragraph 96.

86 Because the normal running of the train had been affected by a defect, and because safety systems had been isolated, the Rule Book also required the driver of train 2A89 to receive additional authorisations before departing Styal station. These are detailed in GERT8000 The Rule Book[3] Module TW5 'Preparation and movement of trains: Defective or isolated vehicles and on-train equipment', issue dated 11 September 2022, was in force at the time of the incident.

87 The Rule Book details the communication structure that is to be followed when a defect is identified. This requirement comes from the National Technical Specification Notice (NTSN) for Operation & Traffic Management (OPE)[4] which specifies the need for the infrastructure manager and railway undertaking to have processes in place to immediately inform each other of any situation that will impede the normal running of a train.

[3] Railway Group Standard GE/RT8000 The Rule Book contains direct instructions and operational rules for the mainline railway, various modules as noted in text. Copies of Railway Group Standards, Rail Industry Guidance Notes, and Rail Industry Standards can be obtained from the Rail Safety and Standards Board (RSSB) www.rssb.co.uk.

[4] National Technical Specification Notice for Operation & Traffic Management (OPE NTSN). This was formerly the Technical Specification for Interoperability for Operation & Traffic Management. Available from www.gov.uk.

88 Guidance on implementing the OPE NTSN is detailed in GOGN3615 ‘Rail Industry Guidance Note for the Operation and Traffic Management Technical Specification for Interoperability’, issue 2 dated September 2017, and section 1 of Rule Book Module TW5. These outline the required communications process as:

a. The driver advises the signaller of the issue.

b. The signaller informs Network Rail operations control.

c. Operations control tell the signaller what instructions are to be given to the driver.

d. The signaller passes these instructions to the driver.

89 Although not a Rule Book requirement, it also forms part of control room instructions for Network Rail operations control to inform the train operator’s control to enable them to make a decision based on the Defective On-Train Equipment (DOTE) and contingency plans which can be fed back to Network Rail operations control. Rail Industry Standard RIS-3437-TOM (paragraph 27) is aligned with Module TW5 and is intended to help railway undertakings meet the requirements of the OPE NTSN.

90 Should a driver receive instructions directly from the train operating company’s control (as was the case in the incident at Styal station), then the driver will tell the signaller, who then informs Network Rail operations control. The driver must await instruction from the signaller before moving the train. The driver at Styal station did not inform the signaller that they had activated the EBS or the TIS on train 2A89.

91 When the TIS is activated, the door interlock is no longer operational (paragraph 30). As such, the Rule Book requires that all the doors on both sides of the train must be checked to be securely closed by the driver before activating the TIS. Checking the state of the doors before activating the TIS provides confirmation that the inability to gain traction interlock is the result of some defect preventing the interlock functioning, rather than a door remaining open.

92 Once the TIS has been activated, it is the responsibility[5] of the driver to tell the signaller and the conductor that this has been done. The driver should not move the train until instructed to do so by the signaller and should detrain passengers at the first suitable station, in addition to carrying out any other instructions given. The conductor is also required to physically check all doors on both sides of the train are closed before the train moves, and to be positioned in the rear cab. This process should be repeated for each occasion that the doors are released.

93 On 3 May, the driver of train 2A89 did not inform the signaller that they had activated the EBS or the TIS following the instructions from the MC. In addition, train 2A89 was moved without the conductor confirming that all doors were closed.

[5] As stated in the rule book Module TW5 (issue 12) ‘Preparation and movement of trains: Defective or isolated vehicles and on-train equipment’.

94 The driver met the conductor on the platform twice after activating the EBS[6] and the TIS (paragraph 49) and did not inform the conductor that the EBS and the TIS had been activated on either occasion. Witness evidence suggests that there were two likely reasons for this omission. Firstly, the driver knew that the conductor was newly qualified (paragraph 14) and so was taking on more responsibility for fault finding and managing the situation to support the conductor. Similar behaviour was also seen earlier at Alderley Edge where the driver took on more responsibility for initial fault finding. The second reason is that the driver was focused on the task of getting the train moving and was possibly therefore less likely to process recently gained information (see paragraph 98).

*Driver's awareness*

**95 The driver was unaware that the doors remained open.**

96 The conductor normally closes the train's doors as part of the dispatch process (paragraph 20). On returning to the cab at Styal station, the driver had no communication with the conductor, but nevertheless sounded the buzzer twice before the train departed (paragraph 53). This suggests that they regarded the dispatch process as complete and that the train was safe to move, despite neither being the case in reality.

97 When the driver left the conductor on the platform and returned to the front cab, they passed five sets of open doors. However, the last set of passenger doors they would have seen before boarding the train via the cab door were closed, (paragraph 51) and had remained closed throughout the extended stop at Styal station. This, combined with a number of other influencing factors, may have impacted the driver's awareness of the actual status of the train's doors.

98 Humans are constantly assessing the situation they are in, taking in new information from the environment, and using existing knowledge and prior experiences to make decisions. The 'working memory' holds the information used for cognitive function. In dynamic situations that are evolving and changing quickly a person relies heavily on their working memory to process information. Working memory has a limited capacity and, if the situation is stressful, or unfamiliar, or the person is focused on one particular task, then the ability to process new information becomes diminished.

99 This is supported by Cooper et al[7] who identified that as situations become more demanding skilled performance as an output decreases. The ability to maintain awareness of a situation, as one of the main precursors to decision-making, can degrade with stress and be affected by interruptions and distractions, and can impose a heavy load on the working memory, specifically when dealing with out-of-course situations.

[6] Additional Rule Book requirements exist for EBS activations, as there is an operational risk around units coupled together becoming uncoupled. As train 2A89 was formed of a single class 323 unit, these requirements did not apply.

[7] Simon Cooper, Joanne Porter & Linda Peach (2014) Measuring situation awareness in emergency setting: a systematic review of tools and outcomes, Open Access Emergency Medicine, 1-7, DOI: 10.2147/OAEM.S53679.

100 Confronted with a reoccurring fault, the driver in this case had to form an assessment of the changing situation, involving many different aspects of the train, the passengers, and their working environment. Trying to release the train’s brakes became the driver’s main goal, and all the information that they were taking in and processing at the time would have been used by the driver to try and achieve that.

101 The driver’s main goal was further underpinned with objectives relating to personal and professional pride and wanting to resolve the situation successfully. The train was already running late on arrival at Styal station, which also increased the perceived pressure on the driver, as did making a conscious effort to try to reduce the stress being passed to the newly qualified conductor. Being asked by the MC to perform another task (paragraph 49) further narrowed the driver’s comprehension of the wider situation, and the significance of critical elements (such as doors being open as they passed them on the platform, and the EBS and the TIS being activated) may have become lost.

102 Three years before the incident, the driver had experienced a brake issue in service, where they were required to apply safety isolations. They were supported by an experienced conductor on the service concerned and followed Northern’s operational processes without any safety issues. This suggests that the driver had the skills, knowledge, and training on that occasion to successfully address the matter. However, in contrast, the isolation of safety systems at Styal on 3 May did not rectify the train’s fault. The train did not respond to safety isolations as expected, or as previously experienced by the driver.

103 The driver is required by the Rule Book (paragraph 92) to inform the conductor that safety isolations have been activated, but this was not done. Instead, the driver’s thoughts were focused on their intent to terminate the train at Manchester Airport due to the repeated concern of the impact of the faulty train blocking the Styal line for other trains and the inconvenience for the passengers.

104 The driver’s previous experience may have predisposed them to perceive the information they were receiving in a set way and possibly created an expectation in their mind that they would be able to resolve the fault, having done so before.

105 Repeated experiences within an environment can therefore build expectation and create preconceptions about future events. Despite not receiving the RTS, the driver gave “*two buzzers*” to the conductor as that was part of their expected dispatch process. The driver’s response to the signaller to confirm that the conductor was on board and the train doors were closed (paragraph 55) was given without hesitation, and is a strong indication of their state of awareness of the situation and their focus on resolving the train’s brake fault.

106 The complexity of the system the driver was operating can be identified by the numerous tasks they performed in repetitively resetting and checking systems to try and rectify the fault. Within these tasks, the driver had to analyse the changing situation and assess the changing environment to identify the information on which to determine their course of action. In parallel to this, additional complexity was introduced by the MC giving the driver further tasks.

## Identification of underlying factors

### The operation of trains in service with unresolved faults

**107 Northern's processes for assessing train faults did not provide assurance that the risk of trains becoming defective in service was sufficiently considered. This is a possible underlying factor.**

108 The fleet database is used to record all reported faults experienced during train operation, identified defects, work undertaken and the maintenance status of each unit. When a train comes into a maintenance depot with a reported fault, the fleet database is used to enable technicians to view the history of the unit and identify previous, linked, repeat faults to aid investigation (paragraph 72).

109 Repeat defects receive a higher level of fault finding involving the ETIs and senior expertise of the DTC. If a fault remains unidentified it is recorded as no fault found. It is then decided, based on the nature of the fault and considering factors such as implications on performance, safety and recovery, whether the unit will remain in the depot or whether it will be released back into passenger traffic.

110 Northern's processes to categorise faults are undocumented and rely on individual professional judgement. The classification into safety or performance-related faults occurs at depot level:

a. Safety-related defects import a greater risk and as such are never returned to traffic with deferred work or as no fault found. This means that nothing with a safety risk is permitted to leave the depot. The classification of a safety-related defect having a technical safety risk or risk to passengers is down to the judgment of maintenance staff at the depot. If the nature of the fault is covered by Northern's DOTE procedure and/or the Rule Book, then the DCM will be consulted for the final decision to release the unit.

b. Performance-related defects which, if experienced in service, would cause delays but would not themselves create an unsafe situation. The final decision to return such a unit to traffic is made by the depot Production Team and Team Leader. They review the information available (such as the fleet database and technician's repair sheets) and make the decision based on their professional skills, knowledge and experience.

111 The final decision to return a unit to traffic (or not) is made during conference calls. Northern holds two such conference calls every night (at 22:00 hrs and 02:00 hrs) to discuss the fleet and make decisions regarding individual units. This will determine what units will be available for service during the following day. These calls are led by the MCs from both Manchester and York[8] ROCs and include the depot engineering supervisors. For safety defects, the DCM has final authorisation, and the further expertise of the engineering function on-call team can be accessed if required.

112 During the telephone conference, the status of each unit is reported by the depot, with the addition of reviewing operational logs from Monday to Friday for reports of incidents and faults that hold repeat concerns for operational staff. For each unit, it is decided whether they are:

a. to remain on depot for further fault finding, examination or maintenance

[8] The MC for the eastern side of Northern's train operation is based in York ROC.

b. to be sent out with an ETI riding on board the unit should the fault reoccur

c. to be released into service.

113 A unit declared as no fault found may be considered as within category b or c above. During the year before the incident at Styal, 10% of reported faults on Northern's class 323 trains could not be diagnosed or rectified, and hence were released back into service as no fault found.

114 Northern's process addresses faults that are safety-related separately to those perceived to purely impact performance, thereby informally creating a dynamic assessment of risk. This process restricts trains with unidentified safety faults from leaving the depot. There is also a process for performance-related unidentified faults to be peer-reviewed based on available data combined with skills, knowledge and experience of the staff on the conference call. However, Northern does not have a formalised risk assessment for managing the risk of returning a unit as no fault found back into traffic. The decisions made during the calls detailed above are not documented in a manner which provides assurance as to the consistency of approach.

115 Should a fault classified as performance-related reoccur in passenger service, the risk is imported onto the operational staff who must then manage a potentially difficult out-of-course situation. This may result in them being subject to interruptions and distractions (such as were seen in this incident) which affect their performance. Northern provided no evidence which demonstrated that it considered the potentially increased risks which may be posed by releasing a train which had been designated as 'no fault found' back into service.

### Controlling risk arising from safety system isolations

**116 Northern's processes for authorising the isolation of engineered safeguards on trains in service did not effectively control the risks created by such isolations.**

117 MCs have a series of fault guides and flow charts to aid in their response to faults across the 10 different types of train that Northern operates. Once MCs have received their initial training, their competence is assessed as part of a two-year cycle. The use of the fault guides and flow charts is included within the competency assessment.

118 Northern's Competence Assessment of Maintenance Controllers (document reference SMSP 5.19, issue 3 dated August 2016) references four such flow charts, one of which is the 'Unable to Release Brakes Flowchart' (figure 6). The MC used this flow chart when responding to the brake release fault at Styal station. The flow chart is generic across all fleets, and contains actions that are specific to diesel engines, which would not have been relevant to the class 323s, which are electric units. The last action offered by the flow chart is to activate the EBS.

119 The TIS is not referenced in the flow chart as an option, nor does the flowchart provide any support to the MC regarding the related Rule Book requirements (paragraph 85) following the activation of the EBS. This means that the flow chart does not guide the MC to seek authorisation or inform the DCM (paragraph 79), and it does not offer any further support or direction should the fault not be rectified by the end of the flow chart.

## 10.5. *Appendix 5: Unable to Release Brakes Flowchart*

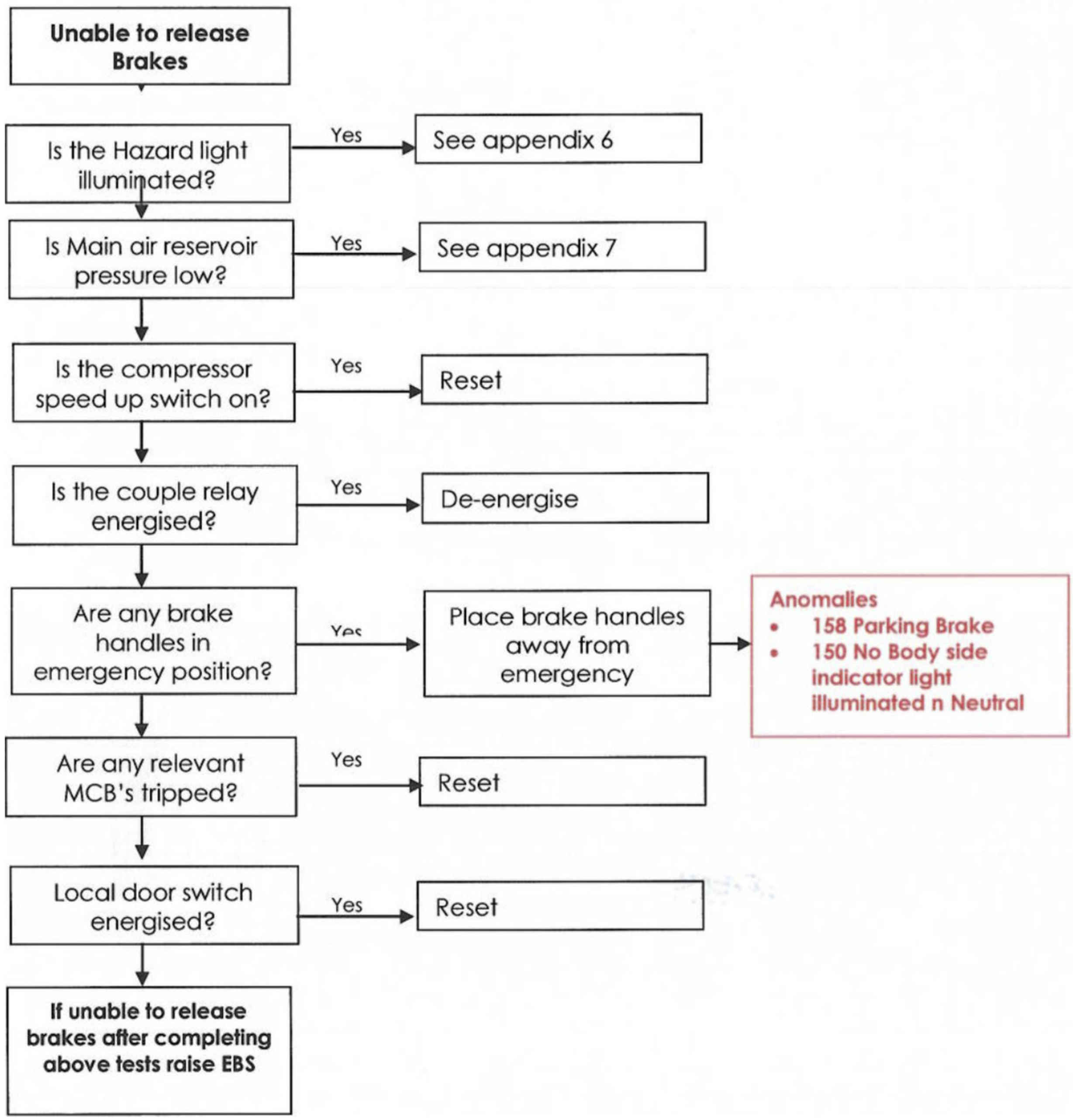


*Figure 6: 'Unable to Release Brakes Flowchart' issued to Northern MCs.*

120 Drivers are provided with the 'Form B Poor Brake/TIS/EBS Report Form' (SMSP 1.01-B, issue 12). The form collates basic information (about the train, route driven, fault as experienced), acting as a record of the event and asks a series of questions to be answered before the EBS or the TIS are operated. The form implies that the activation of safety isolations is the decision of the driver, whereas such an action should be led and authorised by staff in control, such as the MC and the DCM. Equally, it does not refer to any Rule Book requirements that need to be followed as a result of such isolations.

121 This is probably because the activation of safety isolations was historically instigated by drivers and the form was originally created to ensure that the wider operations and maintenance functions were aware of such activations.

122 Drivers are expected to carry the form in paper copy (they are not issued with electronic devices), and then to send the completed copy by fax or scanned as an email attachment to the DCM. This means that the DCM will receive the form some time after its completion. The DCM will link the received form B to the control log for that incident. After the incident at Styal station, Northern briefed drivers on the need to carry form B.

123 The driver did not complete a form B at Styal station and neither the MC nor the DCM asked the driver to do so. The driver did not recall the form after the incident, although RAIB found that they had completed a previous version of the form when they had activated the TIS three years before. The MC was also not aware of form B. The DCM had seen the form before, having received them (although rarely) via email or fax.

124 The need to appropriately manage the safety risks arising from isolating on-train safety systems is detailed within the Rule Book (paragraph 89). Northern's DOTE process (paragraph 110a) details its expected response to defective equipment and isolated systems on board a train, whether they be identified/activated within passenger service or when starting the journey. For the activation of the TIS, the DOTE plan references the need to comply with Rule Book module TW5.

125 The process of seeking authorisation from the DCM creates a communication hierarchy intended to ensure that someone with an overarching view of the incident and knowledge of the Rule Book is taking the lead on decisions with safety implications. The conversation held between the MC and the DCM during the incident at Styal station was informal and brief and held as a side conversation while the MC was talking with the driver.

126 The Rail Safety and Standards Board (RSSB)[9] describes spoken safety-critical communications as '*a crucial factor in helping deliver a safe operational railway'*. The MCs within Northern Trains Control are not trained in safety-critical communications, despite the nature of their role being to communicate with drivers and lead them through train faults. This role is not simply to aid drivers rectifying the faults, but to calmly lead and support drivers. A review of the recorded conversation between the driver and the MC during the incident at Styal showed that it fell short of expected good practice for safety-critical communications.

127 Equally, a driver has communication responsibilities. The 'Northern Rule Book and Northern Operations Handbook'[10] details Northern's expectations regarding communication between the driver, signaller and the MC during train failure. It recommends that drivers do not wait more than five minutes to contact the MC and signaller. During the prolonged stop at Alderley Edge (paragraph 38), the driver did not contact the MC or signaller within this time window.

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[9] The Rail Safety and Standards Board is a not-for-profit company owned by major industry stakeholders. It is the independent safety, standards and research body for the Great Britain's rail network.

[10] Northern drivers are issued with the 'Northern Rule Book and Northern Operations Handbook', which contains the operational requirements adopted by Northern.

### *Degraded dispatch*

128 To ensure compliance, Rule Book requirements are expected to be transferred to operating companies' operational processes, procedures and risk assessments; this includes train dispatch. RSSB refers to dispatch plans as being a comprehensive account of dispatch procedures informed by risk assessment (including PTI risk assessment) and developed to include the Rule Book (module SS1).

129 Northern's dispatch process (paragraph 20) is supported by its 'Conductor Line of Route Risk Assessment'. The risk assessment highlights risks that have been identified as being specific to Styal station, breaking them down into:

a. unique information (dispatching from the centre of the train to improve sighting of the PTI due to the curved platform, exceptional railhead conditions, risk of icy platforms)

b. PTI (curved platform requiring safety announcements, signal sighting)

c. customer service/other information (accessibility information, unstaffed station, known poor mobile reception affecting communications, assembly points).

130 Rail Industry Standard RIS-3703-TOM 'Passenger Train Dispatch and Platform Safety Measures', issue 5 dated September 2022, sets out the requirements and guidance for train operating companies to manage the behaviour of passengers at the PTI through the passenger train dispatch processes. Section 3.6 defines the degraded dispatch modes that shall form part of a risk assessment as '*any train dispatch modes that are to be introduced at short notice (for example, due to staff illness or equipment failure)*'. It specifies that procedures should include methods of dispatch in degraded operations and emergencies to ensure safety and enhance resilience. RIS-3703-TOM cites examples of different modes of train dispatch, stating that a risk assessment process '*should be used to help determine the modes of dispatch to be adopted during degraded operations*'. Examples considered include equipment failures that could affect train dispatch.

131 At Styal, the train suffered equipment failures which meant that a degraded dispatch process should have been enacted. However, no such process is defined within Northern's dispatch plan for Styal, or for any other station.

132 RIS-3703-TOM details the importance of pre-determining effective methods of working to effectively respond to degraded situations in a safe and consistent manner. Without assessing the risks imported by such foreseeable events, the methodology for managing such risks cannot be established, briefed and trained. Northern's risk assessment for Styal station does not cover degraded dispatch.

### Training for stressful situations

**133 Northern's training did not provide the driver with the necessary skills for managing stressful situations.**

134 Northern's train drivers are trained and assessed on the train types and routes they are licenced to drive, relevant elements of the Rule Book and Northern's own processes and procedures. Northern has a competence management process in place for drivers, which covers specific technical skills and knowledge. In addition to the technical skills needed to operate a train safely, it is important that drivers are able to manage out-of-course situations successfully. One potential strategy for achieving this is training in non-technical skills (NTS).

135 NTS are the social, cognitive and personal skills that can influence the way that individuals undertake tasks.[11] When managing pressured, stressful, out-of-course situations within a safety-critical environment, an awareness of NTS can mitigate against risk, improve decision-making and enhance interactions with others. Although knowledge of NTS can improve and potentially heighten the responses of operational staff, like any control measure, they cannot completely eliminate the risk.

136 RSSB has written guidance for the railway industry on integrating NTS into the driver role. The resources refer to developing and establishing NTS within safety-critical roles and continuing to measure and monitor its efficacy. Northern was one of the pilot train operators, publishing its strategy to identify why and how NTS were going to be integrated in the RSSB document 'A Good Practice Guide to Integrating Non-Technical Skills into Rail Safety Critical Roles' (2016) (figure 7). The published strategy twice refers to embedding NTS principles into the competence management system.

137 NTS cannot be delivered in isolation and need to be embedded through personal development, allowing skills to be practised and learning reinforced. The RSSB guidance suggests that NTS can be embedded through assessment and measurement, including practical exercises such as the use of simulations or similar training aids. Further industry guidance exists on measuring NTS as part of performance measurement (using NTS mapping to evaluate technical task performance), and competence standards (observing pre-identified behavioural markers).

138 When NTS training was introduced by Northern, it was embedded within the initial training for safety-critical roles across the organisation such as drivers, conductors, and dispatchers. All members of senior operational management, including driver trainer managers, driver instructors and operational standards managers, also receive specific training on NTS through attending an external course and are then responsible for delivering NTS training and briefs to operational staff. MCs are not designated as safety-critical staff and therefore do not receive NTS training.

139 When Northern introduced NTS, it was included within the initial driver training and also reflected in the operational handbook. It was this training which was provided to the driver involved in the incident at Styal, being delivered during the driver's initial training approximately four years before the incident (paragraph 13). Since that time, Northern's delivery of NTS training has been developed and enhanced. Although this is reflected in changes to the operational handbook, there is no process for updating the training for existing drivers. This resulted in varying levels of knowledge and awareness of NTS within front line operational staff, depending on when staff received their initial training. Northern do not have a process for embedding NTS within the skill set of existing operational staff although the external NTS course has also been used as a development tool for staff who have been in an incident.

[11] RSSB defines non-technical skills as the 'social, cognitive and personal skills that can enhance the way you or your staff carry out technical skills, tasks and procedures'. Available from www.rssb.co.uk.

*Northern Rail recognised integration was a medium- to long-term programme and created an integration strategy to help the company understand why and how NTS was going to be integrated.*

*The strategy covered:*

1. *Statement of commitment, by senior managers, to embed the principles of non-technical skills and human factors into the competence management system.*
2. *A summary of NTS and their key benefits.*
3. *Description of how NTS will contribute to the development of a positive and just safety culture.*
4. *Description of the phased approach to be taken (the road map). This included:*

- *Awareness raising through, for example, safety briefing days, training of relevant staff, and discussion of incidents where NTS played a part and the use of NTS terminology and markers.*
- *A programme of refresher briefings and/or on the job coaching for experienced staff to maintain awareness.*
- *Setting NTS into standards of competence.*
- *Incorporating NTS into selection criteria.*
- *NTS training for managers, drivers, conductors, and other safety critical staff.*
- *A process for discussing NTS as part of the formal assessment process. Northern Rail stated that it would not be possible for a member of staff to fail their assessment based on NTS performance alone.*
- *Mechanisms for evaluating progress made, for example through staff feedback, the success of remedial action plans containing NTS, and the number of safety of the line incidents over time.*

*Figure 7: Extract from 'A Good Practice Guide to Integrating Non-Technical Skills into Rail Safety Critical Roles'.*

140 The Northern Rule Book and Northern Operations Handbook for drivers encompasses both the technical and non-technical skills needed to undertake the job role. Although Module 1 forms part of the initial driver training, it is not mandatory and therefore does not form part of the formal competency cycle. This means that once taught, drivers are not assessed or measured on their knowledge and understanding.

# Summary of conclusions

## Immediate cause

141 Train 2A89 departed from Styal station with multiple bodyside doors open (paragraph 59).

## Causal factors

142 The causal factors were:

a. Engineered safeguards on the train had been isolated by the traincrew in an attempt to overcome a fault (paragraph 64). This causal factor arose due to a combination of the following:

   i. The train was in service with a known fault that maintainers had not been able to identify and resolve (paragraph 66).

   ii. Northern’s control function instructed the traincrew to isolate engineered safeguards on the train (paragraph 75).

b. Train 2A89 departed from Styal station in an unsafe condition (paragraph 82). This causal factor arose due to a combination of the following:

   i. The driver moved the train without dispatch authorisation from the conductor (paragraph 84).

   ii. The driver was unaware that the doors remained open (paragraph 95).

## Underlying factors

143 The underlying factors were:

a. Northern’s processes for assessing train defects did not provide assurance that the risk of trains becoming defective in service was sufficiently considered. This is a possible underlying factor (paragraph 107, **Recommendation 1**).

b. Northern’s processes for authorising the isolation of engineered safeguards on trains in service did not effectively control the risks created by such system isolations (paragraph 116, **Recommendation 2**).

c. Northern’s training did not provide the driver with the necessary skills for managing stressful situations (paragraph 133, **Recommendation 3**).

# Previous RAIB recommendations relevant to this investigation

144 The following recommendations, which were made by RAIB as a result of previous investigations, have relevance to this investigation.

Peckham Rye

145 At 18:46 hrs on Tuesday 7 November 2017, a London Overground service from Dalston Junction to Battersea Park, operated by Arriva Rail London, came to a stand shortly before reaching Peckham Rye station (RAIB report 16/2018). A faulty component on the train had caused the brakes to apply, and the driver was unable to release them. There were about 450 passengers on the train. The train driver used GSM-R to speak with the service controller, train technicians, and the signaller.

146 Following these conversations, the driver (with a member of staff from Peckham Rye station) began to evacuate the passengers from the driver's cab at the front of the train. This involved passengers climbing down vertical steps to ground level, very close to the live electric conductor rail and walking along the side of the line for about 30 metres to Peckham Rye station. Soon afterwards, an operations manager from Govia Thameslink Rail realised what was happening and immediately instructed the driver to stop the evacuation and requested that they contact the signaller and company's controller for further instructions. The driver, with further advice from control, isolated various train safety systems and was eventually able to release the brakes and move the train into Peckham Rye station for all the remaining passengers to leave the train normally. No one was hurt in the incident.

147 The incident occurred because the driver initiated the detrainment of passengers without the traction current being switched off, due to a misunderstanding between the driver and control room staff about the actual location of the stranded train. The train driver and the signaller did not reach a clear understanding about the actions that were required to safely detrain the passengers. The delay caused unrest among the passengers on the train and contributed to stress and task overload of the driver, which affected their decision-making. The driver's experience and skills did not enable them to cope with these demands, and Network Rail did not effectively implement its own procedures for managing an incident involving a stranded train.

148 One of the RAIB recommendations was for Arriva Rail London to review and improve its training, procedures, control room environment and equipment to enable controllers and train drivers to deal effectively with out-of-course scenarios involving stranded trains. The recommendation included consideration of the use of simulators and table-top exercises, and applicability to other train operators.

Finchley Road

149 Shortly after 09:00 hrs on Saturday 1 September 2018, a London Underground Jubilee line train travelled between Finchley Road and West Hampstead stations with 10 passenger doors open (RAIB report 06/2019). The train, with approximately 30 passengers on board, reached a maximum speed of 39 mph (62 km/h) during the 56 second journey between the two stations. No one fell out of the train, and nobody was injured.

150 When the train stopped at Finchley Road station, some of the doors on the train opened without being commanded to do so by the train operator. While dealing with the door issue, the train operator triggered a switch, deactivating the door interlock circuit. The operator did not notice that some doors remained open when departing from Finchley Road station and travelling to West Hampstead. The train operator’s actions were probably influenced by numerous factors including a sudden increase in workload (dealing with faults under time pressure), which they were possibly not prepared for through their training. The train also did not provide an audible warning to the train operator that the door interlock circuit had been bypassed.

151 Of the four recommendations made by RAIB addressed to London Underground, one was to equip its train operators with the skills, knowledge and information needed to identify and respond appropriately to faults affecting their trains. It included consideration of the use of train simulators to practise fault finding, as well as the provision of documentation, such as quick reference guides, to help train operators transition effectively from a low workload scenario to an unexpected high workload scenario when there is an unusual occurrence.

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

152 Northern has reviewed the status of safety-critical communication training and competency within its control room, aiming to deliver more effective support and safety-critical communications with traincrew. Since the incident, all MCs and DCMs have been through RSSB's safety-critical communications course. MCs and DCMs will also be required to complete the course within their subsequent competence cycle, and this will be referenced in competence assessments. Safety-critical communications are reviewed during competency assessments, sample monitored as part of Northern's safety assurance processes, and when any requests are made for voice recordings.

153 The brake release fault finding flow chart (paragraph 118) used by MCs is being reviewed. Northern is currently developing a specification for creating an electronic decision-making tool that will direct the MC to the information they need. The project is being led by Northern's engineering team with the aim for it to be introduced at the end of 2024.

154 After reviewing the decision-making responsibilities and authorities in its control room, Northern has confirmed that the DCM remains the right person to hold overall responsibility. It identified that the role of the DCM is to generate a pause in the event and to provide a holistic view to provide an overall sense check and ensure clarity. Further to this, DCMs have been briefed on their responsibilities and to ensure that they are assertive in leading conversations and taking the lead in developing situations. This included a session organised with Northern's head of operational standards, where the importance of their role and being assertive was a critical focus.

155 Northern has improved the control room logging standards to better reflect the importance of the instructions contained in its DOTE being communicated to the driver. Northern is introducing new logging software in 2024 which it believes will allow for more consistency and audit. Northern has identified that on occasions, if the DCM role was uncovered, the logging process was not as robust. This has prompted a full review and rewrite of this process involving Northern's head of control and resource planning and head of operational standards which is nearing completion.

156 After the incident at Styal station, the competence of the driver was reviewed. No further development in the driver's operational knowledge and experience was identified, and it was decided that they would benefit from further NTS training as part of their driver competency development plan. After the training, which covered performance influencing factors (PIFs) and NTS, the driver wrote an explanation of the benefit of the training in the context of the incident they had experienced.

157 The Northern Rulebook and Northern Operations Handbook has been reissued after the incident at Styal station. Module 1 includes a section on NTS, which now also details PIFs. PIFs describe any condition, whether related to an individual, job role or organisation, that influences a person's performance. They can affect the way information is processed, and therefore how decisions are made. As such, PIFs can be seen as integral to improving performance and increasing safety as they underpin both existing technical skills/knowledge and NTS.

# Recommendations and learning point

## Recommendations

158 The following recommendations are made:[12]

1 *The intent of this recommendation is to improve the management of risk resulting from the operation of trains in service with known faults.*

Northern Trains Ltd should establish a system to provide risk-based guidance regarding decisions to return trains into service with unresolved faults. This system should include specific criteria that will allow staff to differentiate between safety-critical and performance-critical defects and should also allow staff to record the basis on which trains have been released into traffic with known defects (paragraph 143a).

2 *The intent of this recommendation is to manage the risk of safety isolations when applied to trains in passenger service.*

Northern Trains Ltd should undertake a risk-based review of the operating rules and procedures used to manage safety system isolations while trains are in passenger service. This review should consider how such isolations may affect dispatch as well as any related requirements for training, decision support aids and safety-critical communications.

Northern Trains Ltd should develop a timebound programme to make any appropriate changes identified to operating rules, policies and procedures (paragraph 143b).

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

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

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

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

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

3 *The intent of this recommendation is to provide train drivers and relevant operational staff with the necessary skills and strategies to effectively manage out-of-course situations.*

Northern Trains Ltd, building on the work that has already started in this area, should embed non-technical skills training into the ongoing competency monitoring of drivers. It should also review how it maintains and reinforces knowledge and confidence of its staff in dealing with out-of-course events and similar stressful situations. This review should consider the requirements of operational roles and look at methods such as simulations and exercises.

Northern Trains Ltd should develop a timebound programme to make any appropriate changes to on-going training, competency management and briefing arrangements.

This recommendation may apply to other transport undertakings (paragraph 143c).

## Learning point

159 RAIB has identified the following important learning point:[13]

1 Traincrew are reminded of the importance of complying with the requirements of the Rule Book particularly in situations where it is necessary to isolate engineering safeguards on trains, particularly as such isolations increase the reliance on individuals complying with rules and procedures to ensure safety.

[13] '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

| | |
|---|---|
| BDR | Brake demand relay |
| BSR | Brake supply relay |
| CCTV | Closed-circuit television |
| DCM | Duty control manager |
| DKS | Door key switch |
| DOTE | Defective On-Train Equipment |
| DTC | Depot technical co-ordinator |
| EBS | Emergency brake isolation switch |
| ER | Emergency relay |
| ERR | Emergency repeat relay |
| ETI | Engineering technical inspector |
| GSM-R | Global System for Mobile Communication - Railway |
| LSR | Low speed relay |
| MC | Maintenance controller |
| MCB | Miniature circuit breakers |
| NTS | Non-technical skills |
| OTDR | On-train data recorder |
| PBS | Power brake switch |
| PIFs | Performance influencing factors |
| PTI | Platform-train interface |
| RAIB | Rail Accident Investigation Branch |
| ROC | Railway Operating Centre |
| RSSB | The Rail Safety and Standards Board |
| RTS | Ready to start |
| TIS | Traction interlock switch |

## 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 train 2A89
- voice communication recordings
- site photographs
- weather reports
- a report detailing relevant activity on the driver’s mobile device
- the driver’s rosters, driving history, competence and medical records
- RAIB tests conducted on a class 323 unit at Allerton depot
- a review of previous reported incidents related to unit 323232
- Northern’s documentary evidence relating to rules and operating instructions, planning, processes and procedures, competency management and briefing and training
- a review of relevant research literature, railway standards, procedures and guidance
- a review of previous RAIB investigations that had relevance to this incident.

## Appendix C - Detailed description of the fault

C1. Within each driving cab there is a combined power brake switch (PBS). This is a handle used by the driver to adjust the amount of traction power taken by the train across four power steps, or to apply the train's brakes through three brake steps. The PBS also has an emergency brake position, plus an off position where neither power is taken nor the brakes applied. The PBS therefore enables the driver to increase or decrease speed as required. The PBS has 18 electrical contacts, which are open or closed depending on the position of the PBS. These contacts are wired into the train's electrical control circuits so that it provides the required response depending on what PBS position the driver has selected.

C2. Within the cab, the driver uses a switch to control which direction the train will move if traction is demanded. This switch has four positions: 'Off', 'Reverse', 'Neutral' or 'Forward'. The direction switch also has 18 electrical contacts that are wired into the train's electrical control circuits, which not only command which direction the train should go but also interface with other functions on the train that need to know this information (for example, the driver's vigilance device is only active if the forward or reverse positions are selected).

C3. When setting off in a forward direction, the driver first moves the direction switch to forward. To take power, the driver next moves the PBS from a brake step position, through the off position, to release the train's brakes, then through to a traction position to take power. The train's brakes and the amount of braking applied is controlled by the states of two brake demand relays (BDR), known as BDR1 and BDR2. Moving the PBS to the off position, or through to a power step position, opens PBS contact 13 which causes relay BDR1 to be de-energised. It also closes PBS contact 14 which causes relay BRD2 to be energised. This combination of relay BDR1 being de-energised and relay BDR2 being energised is the state that allows the train's brakes to be released.

C4. For relay BDR2 to be energised, as well as the PBS being in the required position, it also needs contact 5 of the BSR relay to be closed and both contacts 1 and 4 of the emergency relay (ER) to be closed. If any of these three relay contacts remain in an open state, the BDR2 relay will remain de-energised, which will prevent the brakes from being released.

C5. If the PBS is moved to its emergency position, this will cause both PBS contacts 13 and 14 to be open. It will also cause PBS contacts 10 and 11 to open which in turn causes the ER and the emergency repeat relay (ERR) to be de-energised (the coils for both relays are wired in parallel). When the ERR is de-energised, contact 1 is opened which in turn prevents the BSR relay from being energised. If the driver then moves the PBS handle back and forth between the off and emergency positions, this action will cause the ER, ERR and BSR relays to cycle between being energised or de-energised. Similarly, the contacts of these relays in the circuit for BDR2 relay will cycle between being open or closed.

C6. Northern's technicians deduced that a contact on either the ER or BSR relays was preventing the BDR2 relay from being energised. This was most likely due to a contact having a high resistance when it was closed, which caused a voltage drop in the circuit. This voltage drop lowered the voltage subsequently seen at the BDR2 relay coil and was sufficient to prevent the relay from energising.

C7. The self-rectification of the fault, that finally allowed the driver to release the train's brakes, was probably due to the driver moving the PBS between off and emergency positions. The repeated opening and closing of the ERR and BSR relay contacts changed the electrical resistance across the high resistance contact and finally provided a voltage at the BDR2 relay coil that allowed it to energise, releasing the brakes.

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



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