Australian Government
Australian Transport Safety Bureau

Signal ME45 passed at danger involving suburban passenger train TP43 and near collision with another suburban passenger train

Bowen Hills, Queensland, on 10 January 2018

ATSB Transport Safety Report
Rail Occurrence Investigation (Systemic)
RO-2018-002
Final – 15 April 2021

Cover photo: Queensland Rail

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Publishing information

Published by: Australian Transport Safety Bureau
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Addendum

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Safety summary

What happened

On 10 January 2018, a Queensland Rail (QR) Citytrain suburban passenger train (TP43) was en route to Brisbane Domestic Airport, Queensland, with a scheduled crew change at Bowen Hills. While the train was stopped at Bowen Hills, the departure signal (ME25) at the northern end of No.2 platform was displaying a yellow aspect, which meant that at that time the next signal (ME45) was displaying a red aspect (stop indication).

After departing the platform, TP43 exceeded its limit of authority by passing signal ME45, which was still displaying a red aspect (stop indication). After receiving a signal passed at danger (SPAD) alarm, the network control officer broadcast an emergency stop command to the driver of TP43. The train was stopped 220 m past signal ME45, and 126 m prior to a conflict point. At the time that TP43 came to a stop, another suburban passenger train had just cleared the conflict point.

What the ATSB found

When approaching signal ME45, the driver of TP43 probably read through to another signal for an adjacent line that was displaying a green aspect, which they incorrectly believed was signal ME45.

The Citytrain rail network was fitted with an automatic warning system (AWS) that provided a driver with an audible and visual alarm when approaching a restricted signal. If the driver did not acknowledge the alarm, the AWS would generate a penalty brake application. Although the driver of TP43 acknowledged the AWS alarm on approach to signal ME45, this was almost certainly an automatic response, and did not result in the driver effectively checking the aspect of the signal. Therefore, the signal's red aspect was not detected.

The AWS provided the same alarm for all restricted signals (that is, double yellow, yellow, flashing yellow and red aspects). The potential for habituation, and the absence of a higher priority alert when approaching a signal displaying a red aspect, reduced the effectiveness of the AWS to prevent SPADs. This placed substantial reliance on procedural or administrative controls to prevent SPADs, which are fundamentally limited in their effectiveness.

The ATSB found that QR's administration of the train driver maintenance of competency (MOC) process provided limited assurance that its Citytrain train drivers met relevant competency requirements. It should be noted that the ATSB is not suggesting that Citytrain drivers were not competent; rather, the application of the process for assessing competency had significant limitations in assuring the drivers' competency. Nevertheless, following this occurrence, the driver of train TP43, who was very experienced, was found not to meet the relevant competency requirements even though their previous MOC assessments showed no indications of any problems.

The ATSB also found that QR's management oversight of the Citytrain driver MOC process did not include planned assurance activities or regular and effective auditing of how the MOC assessments were being conducted, even after there were multiple indications that the process could have been undermined by not being conducted as designed.

In addition to the safety issues associated with the AWS and the MOC process, the ATSB also identified safety issues with QR's implementation of risk triggered commentary driving (RTCD) and the limited use of recorded data to determine driver compliance with key operational rules that had been designed to minimise the risk of SPADs on the Citytrain network.

What has been done as a result

QR has undertaken a range of actions to change the design and implementation of its train driver MOC process, and it has also undertaken a number of oversight activities focussing on the MOC

process. In addition, it has undertaken a range of activities to improve the implementation and consistency of the application of RTCD, and the use of event recorders to monitor driver compliance with key operational rules.

There is limited potential to effectively redesign the AWS to reduce SPAD risk. However, QR is in the process of introducing the European Train Control System (ETCS) in parts of the south-east Queensland network, and this system, where and when it is implemented, will provide more sophisticated engineering controls for detecting potential SPADs and managing their risk.

Safety message

This investigation has highlighted the importance for rail organisations to have an assurance system in place that effectively monitors and reviews processes for maintaining and assessing the competence of rail safety workers. In addition, assurance activities must be suitably designed and implemented as designed, to ensure that they appropriately evaluate the controls that manage risk.

The rate that individual drivers pass a signal at danger is extremely low. Efforts to ensure reliable driver performance are necessary but need to be considered in the context that human error cannot be eliminated entirely. This occurrence has highlighted the importance for suburban passenger rail networks to have sophisticated engineering controls in place to detect potential or actual SPADs and manage their risk.

Even though SPADs are rare events for most drivers, the role of driver performance in minimising the risk of SPADs is obviously still critically important. This investigation provides an opportunity for train drivers to reflect on the need for crosschecking signal information, particularly at locations where there is potential for a signal read-through.

Contents

The occurrence

Overview

On 10 January 2018, Queensland Rail (QR) electric suburban passenger train, designation TP43, was en route from Varsity Lakes to Brisbane Domestic Airport, Queensland. Shortly after departing Bowen Hills station, the train passed signal ME45 while it was displaying a red aspect (or stop indication). The network control officer (NCO) made an emergency call to the driver, who stopped the train.

Events prior to departing Bowen Hills

At about 1036,[1] TP43 approached Bowen Hills station, where a scheduled crew change (driver and guard) was to take place at No.2 platform.

Just prior to the arrival of the train at Bowen Hills, the incoming driver[2] was waiting on the platform. This driver noticed that the departure signal (ME25) at the northern end of No.2 platform was displaying a yellow aspect (Figure 1). To a driver, a yellow aspect is an indication to proceed with caution and expect the next signal to be displaying a red aspect. In this case, the next signal was ME45, located about 390 m beyond the platform.

Figure 1: Signal ME25 showing a yellow aspect as TP43 arrived at Bowen Hills

The image taken from the front-of-train camera as TP43 stopped at Bowen Hills No.2 platform. The signal displayed a yellow aspect, which the driver recalled seeing prior to the arrival of the train.
Source: Queensland Rail annotated by the ATSB

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1 All time references in this report are in local time (Eastern Standard Time).

2 Incoming driver: the driver scheduled to relieve the (outgoing) driver of TP43 on its arrival at Bowen Hills.

At 1036:42, the train arrived at the platform. The outgoing driver[3] activated the door release for passengers and placed the direction controller to neutral and the brake controller to full service in accordance with the QR 'start on yellow' (SOY) procedure. After exiting the driving cab, the outgoing driver had a brief discussion with the incoming driver, but they did not discuss the aspect indication in the departure signal.

At 1036:53, the incoming driver entered the driving cab. The driver recalled being surprised when sitting down as the driver's seat quickly descended to the bottom of its range and jarred their back.

At 1037:04, the guard gave rightaway,[4] indicating that platform duties were complete, and passengers were clear of the train. The driver recalled that this occurred just after they had jarred their back. The driver stated that they elected not to adjust the seat at the platform, as this would take about 10–15 seconds and delay the departure of the train. Instead, the driver chose to continue to the next station (Albion) where they could adjust the seat during the scheduled dwell time at that platform. Although the seat was at its lowest level, the driver's view of the track and signals was not impeded.

At 1037:13, the driver moved the direction controller from neutral to forward, released the brake controller to the off position, and simultaneously pressed the 'door closed' button. At 1037:17, the driver reapplied the train's brake as the door light 'tile' on the driving console had not extinguished, meaning the train doors had not closed.[5]

At 1037:24, the door light tile extinguished, and the driver again released the train brake, applied traction power, and departed the platform. The driver could not recall checking the aspect indication in signal ME25 prior to leaving the platform; they stated that they probably had not checked it due to the distraction associated with the seat. Closed-circuit television (CCTV) footage from the platform showed signal ME25 was displaying a yellow aspect as the train departed.

Events after departing Bowen Hills

At 1037:35, the driver shut off traction effort to the train when it reached the speed board limit of 25 km/h. As the train coasted towards the 30 km/h speed board for a sweeping right curve, the train speed reached 29 km/h. The driver later recalled that, as the train traversed the sweeping right curve, they saw a green aspect in a signal and thought that was signal ME45 (Figure 2). However, CCTV footage from the front-of-train camera showed the aspect in signal ME45 was displaying a red aspect, while signal ME37 (relevant to the adjacent running line) was displaying a green aspect indication.

As the driving cab of the train exited the sweeping right curve, it was 175 m from signal ME45, and from the driving cab there was a clear and unrestricted view of the signal. As the train cleared the neutral section,[6] less than 150 m prior to the signal, the driver applied low traction effort to gradually increase the train's speed.

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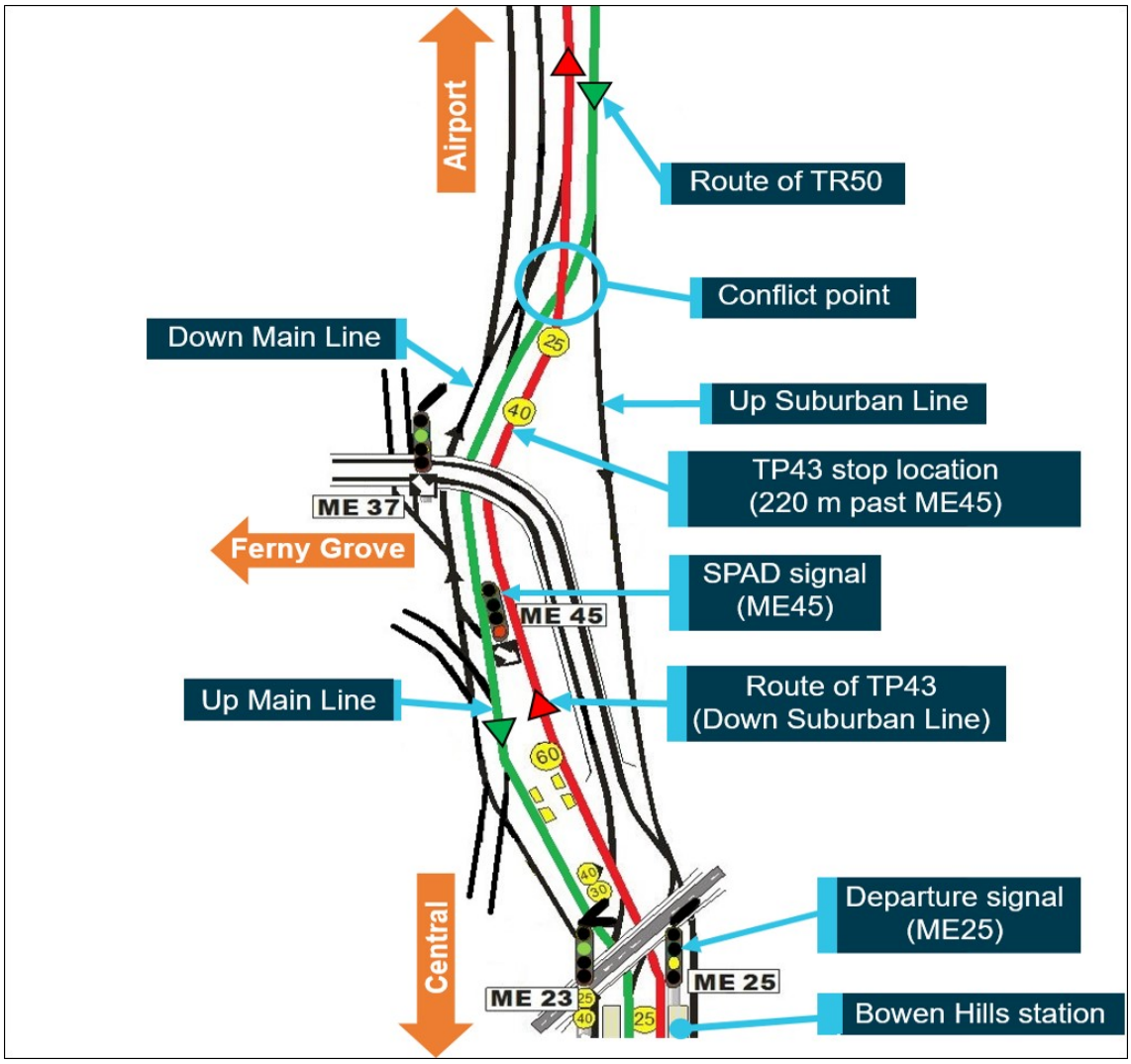
[3] Outgoing driver: the driver who worked the train from Varsity Lakes to Bowen Hills.

[4] The guard is required to check the departure signal is at proceed before giving rightaway (two bells) to the driver, communicating platform duties are complete and rail traffic is ready and authorised to depart.

[5] In normal operation, the door traction interlock system prevented tractive power being available while the doors open tile light was illuminated.

[6] Neutral section: a location within the overhead line equipment consisting of insulators and earthed equipment. It ensured two adjacent electrical sections were kept electrically separated during the passage of the pantograph on an electric train.

Figure 2: Location of signal ME25, signal ME45 and related information



The image shows the route of TP43 (in red) on the down suburban line and the colour light aspects displayed in signals ME25 (yellow) and ME45 (red). It also shows the relevant speed boards (yellow circles) and the potential conflict point with train TR50 on the up main line (in green).
Source: Queensland Rail, annotated by the ATSB

At 1038:04, the leading car of the train passed over the automatic warning system[7] (AWS) magnet for signal ME45, which was located 79.5 m prior to the signal (Figure 3). The in-cab AWS equipment generated an audible and visual alarm, to warn the driver the train was approaching a restricted signal (in this case a stop indication in signal ME45).

At 1038:05, the driver acknowledged the AWS alarm by pressing and releasing the AWS acknowledgement button. In a subsequent interview, the driver could not recall acknowledging the AWS alarm. The train speed at this time was about 30 km/h, which was compliant with the designated speed board.[8]

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7 Automatic warning system: a supervisory system that provides an in-cab alarm when the train passes over a magnet prior to a signal displaying a restricted indication (see *Automatic warning system*).

8 A driver cannot accelerate to the speed posted on a speed board until the rear of the train has passed that speed board. Although the 60 km/h speed board was located prior to the AWS magnet, the driver could not accelerate to 60 km/h until all of the train had passed the 60 km/h speed board.

Figure 3: AWS magnet and signal ME45 displaying a red (stop) aspect

The front-of-train image from TP43 shows the AWS magnet, and signal ME45, which was displaying red aspect (stop) indication. The AWS magnet was located 79.5 m from signal ME45.
Source: Queensland Rail, annotated by the ATSB

Signal passed at danger

At 1038:14, QR's universal traffic control[9] (UTC) system detected that TP43 had exceeded its limit of authority by passing signal ME45. With low traction power still applied, the train speed was about 35 km/h and increasing.

At 1038:17, after a system re-check, the UTC generated a signal passed at danger (SPAD) alarm at QR's rail management centre (RMC), alerting the NCO of the occurrence.

At 1038:26, the NCO first issued an emergency stop command via the train radio to the driver of TP43, followed by additional stop commands. At that point, the train's speed was 41 km/h. The driver commenced braking at 1038:32 and came to a stop at 1038:42, about 126 m short of a crossover[10] that was occupied by another suburban passenger train (TR50) as TP43 was braking to stop (Figure 2).

During the associated communications, the NCO asked the driver; 'just got an alarm to suggest you have passed signal ME45 at danger'. The driver replied by saying:

[9] A system unique to QR that assists network control officers safely route and monitor the movement of trains.
[10] Crossover: a track section used to divert rail traffic from one line to another.

> …halfway off Bowen Hills [referring to the yellow aspect in signal ME25] the next one was green [referring to signal ME45].

These communications support that the driver of TP43 had sighted a green aspect and believed at the time that this green aspect was related to signal ME45.

Context

Rolling stock transport operator information

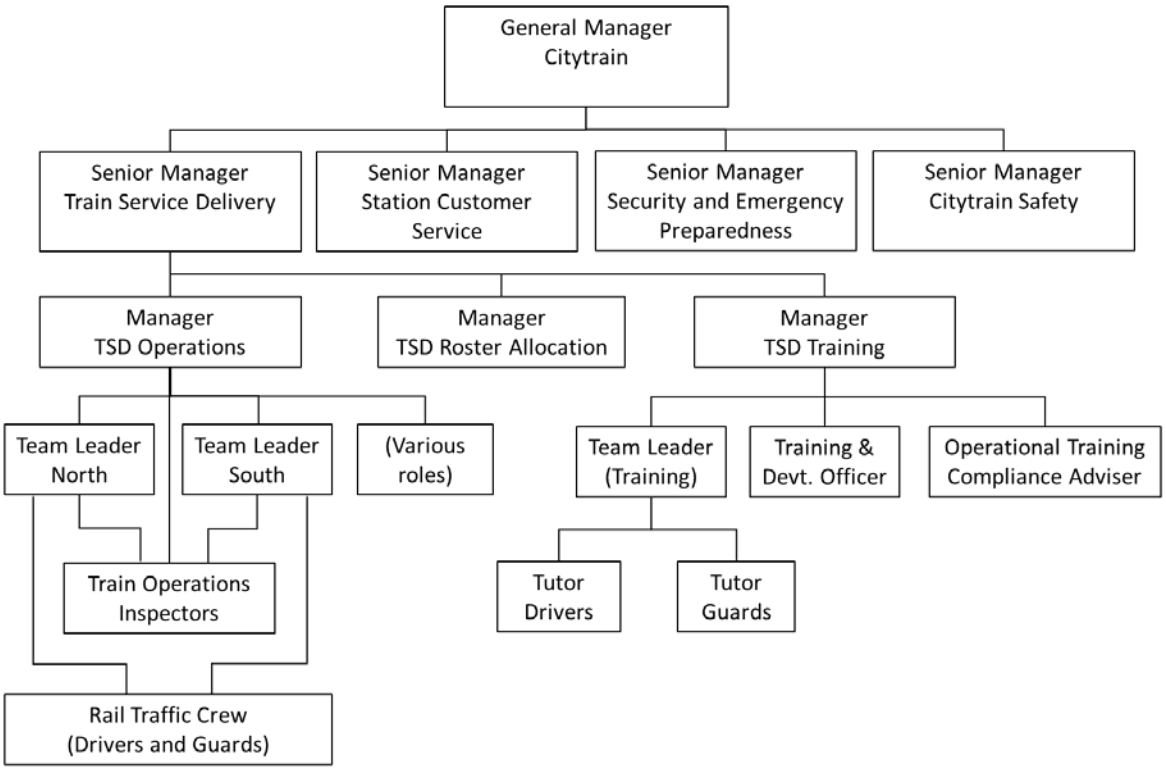
As of 10 January 2018, Brisbane suburban and interurban passenger services were operated under the Citytrain brand of Queensland Rail (QR) (see organisational structure Figure 4). The Citytrain rail network extended south to Varsity Lakes on the Gold Coast, north to the Sunshine Coast, and west to Rosewood.

There were about 240 electric suburban passenger train units that made up the Citytrain fleet. All Citytrain electric suburban trains were crewed by a driver and guard. The train service delivery (TSD) operations section of Citytrain employed about 600 drivers and 500 guards to service more than 7,500 weekly train journeys over the rail network.

The TSD operations section also included 20 train operations inspectors (TOIs), who were experienced train drivers that performed a range of roles, which included providing train crew with technical and non-technical mentoring and coaching, monitoring of on-time running, providing operational support and response to day-to-day operations, and incident investigation. They also conducted competency assessments of train crew for various purposes.

The Citytrain TSD training section had a training manager, support staff, tutor drivers and tutor guards. Tutor drivers were experienced train drivers who were qualified to conduct driver training and assessments. Overall, 49 tutor drivers and 23 tutor guards were employed for training and assessment purposes. The role of the manager was to oversee TSD training and its legislative requirements. The training manager had a small number of support staff to provide administrative assistance and compliance monitoring. As required, the TSD training section received support from QR's learning and development team.

Figure 4: Simplified organisation structure of QR Citytrain



Train information

TP43 was an electric suburban passenger service operated by QR Citytrain and timetabled to travel between Varsity Lakes (Gold Coast) and Brisbane Domestic Airport. The train was on schedule when it arrived at Bowen Hills station at 1036.

TP43 consisted of an interurban multiple unit (IMU168) and a suburban multiple unit (SMU285), with the IMU168 unit leading. Overall, the train was 144 m long and weighed 254.78 t.

The multiple units that worked TP43 operated as designed and there were no reported or recorded faults that influenced their serviceability. Both units were fitted with event recorders and front-of-train cameras. These systems operated effectively during the occurrence sequence, and relevant information from these systems are included in the report where relevant.

Network and signalling information

Train safeworking system and signalling

The train safeworking system in the Brisbane suburban network was remote controlled signalling (RCS). The system included procedures, colour light signals and power operated points, controlled by a local fail-safe interlocking, which was supervised by a universal traffic control (UTC) system located at QR's rail management centre (RMC).

By operating the UTC, network control officers (NCOs) were able to safely route trains over a wide area of railway, aided by safeguards built into the system. These safeguards prevented a signal being cleared if it allowed a conflicting path to be set.

Various indications were displayed on the UTC workstation monitors for the information of the NCO. These indications included the location of all trains, points, signals, and some types of alarms. A signal passed at danger (SPAD) auditory and visual alarm, in most cases, was generated if a train passed a signal displaying a stop indication and in addition, the NCO received a visual alert.

The signalling system within the Brisbane suburban network had intrinsic safeguards to mitigate the risk of SPADs and reduce the potential for train-to-train collisions. This included signal aspect sequencing, which was designed to keep safe separation between trains providing the train driver operated the train according to the aspects displayed in the signals.

In addition, a safety feature known as 'overlap' reduced the risk of a train-to-train collision should a train exceed its limit of authority by passing a stop signal. This feature provided a safety margin distance on the departure side of the signal. The overlap varied in distance depending on factors like maximum track speed.

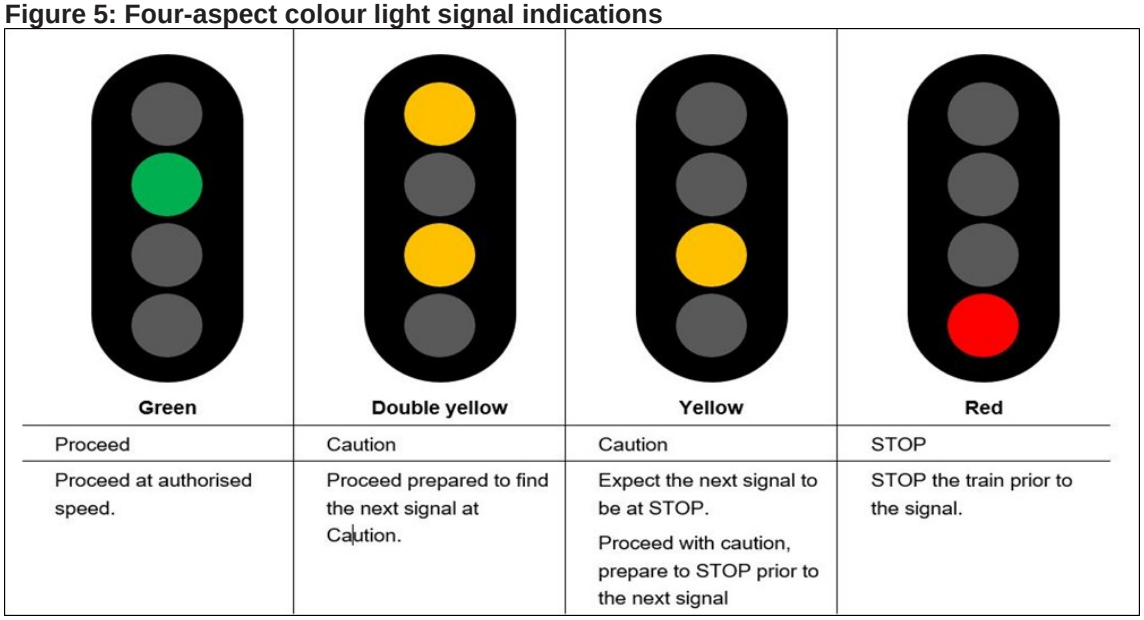
Signal ME45 information

Signal ME45 was a controlled signal operated from QR's RMC. It was located at 3.877 km[11] on the down suburban line between Bowen Hills and Albion stations.

The signal was a four-aspect colour light signal, capable of displaying green, double yellow, yellow or red aspects and was fitted with light emitting diodes (LEDs). Figure 5 provides information about the function of the different aspects. More generally, the term 'proceed' was associated with a signal displaying a green aspect, and the term 'restricted' was used to refer to a signal displaying a double yellow, single yellow, flashing yellow or red aspect.

[11] Distance measured from Roma Street station, Brisbane (0.000 km).

Figure 5: Four-aspect colour light signal indications



Green	Double yellow	Yellow	Red
Proceed	Caution	Caution	STOP
Proceed at authorised speed.	Proceed prepared to find the next signal at Caution.	Expect the next signal to be at STOP. Proceed with caution, prepare to STOP prior to the next signal	STOP the train prior to the signal.

The image shows the indications displayed by a four-aspect colour light signal and their authority. Although not displayed in this image, a flashing yellow aspect meant 'special caution' - proceed to the next STOP signal at a speed not exceeding 40 km/h.
Source: Queensland Rail

On 10 January 2018, during the period leading up to the SPAD occurrence, signal ME45 operated as designed. It was displaying a red aspect (stop) indication because another suburban passenger train (TR50) was occupying a conflicting track section.

According to QR's 2017 signalling statistics, trains that approached signal ME45 encountered a red aspect (or stop indication) 0.9 per cent of the time. The rate was lower in January 2017 (0.5 per cent) relative to other months.

Signal ME45 was located about 390 m north of Bowen Hills station, but could not be seen from the platform due to a sweeping right curve and a road overpass (Figure 2). From the driving cab, the signal could first be sighted from about 230 m but there was restricted viewing due to the overpass pillars and overhead line equipment masts.

Immediately prior to first sighting signal ME45, there was the potential for a driver to 'read-through' to another signal.[12] This occurred when the viewing angle from the driving cab, as a train traversed the sweeping right curve, brought signal ME37 into view momentarily before signal ME45 came into view (Figure 2). Signal ME37 applied to the down main line, two tracks left of the up suburban line.

As trains exited the sweeping right curve and entered the straight section of track (about 175 m from signal ME45), there was clear and unobstructed vision of ME45. This complied with QR's sighting distance requirement of 135 m at this type of location (as outlined in QR standard MD-10-95, *Signalling positioning principles*).

At the time of the occurrence, signal ME37 was displaying a green aspect. The driver of TP43 stated in interview that they sighted a green signal as the train traversed the sweeping right curve, and they subsequently believed this was probably signal ME37 rather than ME45.

Signal ME45 SPAD history

In March 1996, a suburban passenger train (1195) passed signal ME45 which was displaying a stop indication and then collided with a freight train (C760). Although the SPAD generated an alarm in the network control centre, the controller was not in a position to respond to the situation

[12] A read-through occurs when a driver views the incorrect signal (such as a near-by signal on an adjacent track) and accepts the aspect displayed in that signal rather than the target signal, which applies to the path of their train.

and transmit an emergency stop command to the driver of the passenger train. The collision derailed both trains and a number of passengers were injured. The SPAD was attributed to driver inattention/distraction.

Between January 1996 and January 2018 there were 10 SPAD occurrences at signal ME45 , including the collision in March 1996 and the occurrence on 10 January 2018. According to QR records, at least five of the 10 SPAD occurrences happened following a driver changeover at Bowen Hills, which included the 10 January 2018 occurrence.

In June 2013, signal ME45 was classified as a multi-SPAD signal because of two SPAD occurrences within a 3-year period, and it was included on QR's monthly multi-SPAD and blackspot report. QR's SPAD Prevention Working Group assessed it to be high risk because of the high traffic junction the signal protected. Accordingly, the working group requested the QR signal sighting committee conduct a review of signal ME45.

The signal sighting committee completed its review in August 2013. It identified the potential for a 'read-through' scenario with signal ME37. To mitigate the risk, the committee recommended that the incandescent aspects in signal ME45 be upgraded to the brighter LEDs. In addition, it recommended that the stopping mark at Bowen Hills No.2 platform be relocated to a position where drivers had a better view of signal ME25 when their trains were stopped at the platform.

These recommendations were completed by June 2014. In addition to upgrading ME45 to LEDs, the incandescent aspects in signal ME37 were also upgraded to LEDs in accordance with MD-10-95.[13] Signal ME45 was included in QR's April 2016 multi-SPAD and blackspot report, and at that time it was noted: 'Assessment of circumstances has highlighted no obvious engineering solutions. Continue to Monitor'. It was then removed from the monthly report in May 2016.

The current driver route map for the area was last updated in October 2016. It included signal ME45 as a 'Black Spot/Multi SPAD signal'.

Conflict between train TP43 and TR50

The NCO's emergency stop command to the driver of TP43 was initiated at 1038:26, 12 seconds after the train had passed signal ME45 and 9 seconds after the SPAD alarm was generated. In that time, the train had travelled about 130 m. Simultaneously, suburban passenger train TR50 was traversing the crossover from the down main line to up main line (see Figure 2 for conflicting train paths).

The driver of TP43 responded to the emergency call and brought the train to a stop 220 m past signal ME45 and 126 m prior to the conflict point. At the time that TP43 came to a stop (1038:42), TR50 had just cleared the conflict point. The NCO's intervention therefore significantly reduced the risk of a train-to-train collision.

To determine the potential for a collision without the NCO's intervention, the ATSB carried out rudimentary calculations based on known facts, speed board locations and time and distance travelled. It was established that had the driver of TP43 maintained a speed of 41 km/h (the speed at the time of the NCOs emergency stop command) and complied with the designated speed boards, TR50 would have cleared the conflict point about 13 seconds prior to the arrival of TP43, or 90 m clear of the conflict point prior to the arrival of TP43.

Automatic warning system

QR's Citytrain suburban rail network was fitted with an automatic warning system (AWS). According to the QR standard MD-10-119 (*Automatic warning system (AWS) operations manual*), AWS was designed to:

[13] MD-10-05 stated 'Where a new LED signal is positioned near to incandescent signals, with read through or read across potential upgrade these signals to LED aspects.'

- provide an in-cab visible and audible indication of the aspect displayed in the next signal
- prompt and warn the rail traffic driver of a RESTRICTED signal aspect displayed in the next signal
- stop the rail traffic if the rail traffic driver fails to acknowledge the AWS alarm of a RESTRICTED signal aspect

AWS is an advisory system and not a control system.

The setting of rail traffic speed remains with the rail driver, but the AWS is designed to apply the brake when the rail traffic driver does not acknowledge a restrictive aspect…

The system recognised two states:

- clear (the signal aspect was green): inside the driver's cab, the AWS indicator provided a black visual display and an audible sound (a short series of beeps) to indicate the signal aspect was green. The alert was designed to prompt the driver to check the aspect displayed in the signal. No further action was required from the driver.
- restricted (the signal aspect was either double yellow, single yellow, flashing yellow or red): inside the driver's cab, the AWS indicator provided a yellow and black (sunflower) visual display and an audible warning alarm. In response, the driver was required to check the aspect displayed in the signal, and then acknowledge the alarm by pressing and releasing the AWS acknowledge button on the driver's console. If the driver did not acknowledge the alarm within 3 seconds, the AWS would generate a penalty brake application.[14]

The AWS provided the same aural and visual indication for every type of restricted signal (that is, double yellow aspects, single yellow aspect, flashing yellow aspect and red aspect).

The AWS was originally introduced into railway systems in the United Kingdom. The Brisbane suburban rail network commissioned the use of the AWS in 1979 with the introduction of electrification.

The ATSB recently published reports on three SPAD occurrences in the Brisbane suburban network where drivers acknowledged an AWS alarm but did not recognise that the associated signal was displaying a red aspect (RO-2017-010,[15] RO-2017-012[16] and RO-2017-015[17]). In the case of RO-2017-012 and RO-2017-015, the drivers did not recall acknowledging the AWS alert. The same situation also occurred with the SPAD occurrence on 10 January 2018.

Citytrain driving procedures

Safe driving procedures

The QR suburban rail network had limited engineering or technical controls in place to detect potential or actual SPADs and manage their risk (see *Use of engineering-based risk* controls); consequently it heavily relied on front line staff to manage risk through their compliance with procedures.

QR procedure MD-11-72 (*TSD professional driving – Safe driving*) outlined rules for train drivers to apply 'to mitigate the incidence of Signals Passed at Danger (SPAD) and other adverse operational safety events'. The procedure stated:

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[14] The AWS trackside equipment contained a permanent magnet and an electromagnet. If the electromagnet was energised, the system provided a 'clear' indication. If the electromagnet was not energised, the system provided a 'restricted' indication.

[15] ATSB RO-2017-010, *Signal ME45 passed at danger, involving suburban passenger train 1A21, Bowen Hills, Queensland, on 26 August 2017*. Available from www.atsb.gov.au.

[16] ATSB RO-2017-012, *Signal RS57 passed at danger involving suburban passenger train 1W33, Roma Street Station, Queensland on 5 September 2017*. Available from www.atsb.gov.au.

[17] ATSB RO-2017-015, *Signal passed at danger by train 2552, Petrie, Queensland on 12 October 2017*. Available from www.atsb.gov.au.

> Safe Driving focuses on planning, prioritising, communicating and taking appropriate positive actions. The methods of Safe Driving are important defences against the risk of error and are intended to reduce errors and mitigate risk in the event of errors occurring…
>
> The technique shall be incorporated into all aspects of day to day driving, driver training, driver monitoring, assessment, accreditation and reaccreditation programs. The principle of the driving method is based around thinking safety, behaving and acting proactively and positively in all situations which could arise. Safe driving is mandatory.

The procedure included several specific rules to mitigate the risk of SPADs, including the start on yellow (SOY) rule from platforms, procedures for approaching different types of signals, the '75%' rule and the '20 / 20' rule. Other relevant procedures for mitigating the risk of SPADs, such as risk triggered commentary driving (RTCD), were published in other documents.

Start on yellow (SOY)

As applicable to an electric suburban train at a station platform, the SOY rule stated:

> When the platform departure signal is displaying a single yellow / flashing yellow aspect or, where there is no departure signal and the signal prior to the platform was displaying a single yellow / flashing yellow aspect, then the RTD [rail traffic driver] must:
>
> - When stopped at the platform, fully apply the… brakes and place the direction controller… into the neutral position
> - When starting on a yellow / flashing yellow, minimum traction power applied so as not to exceed 75% road speed, maximum 40kph or if a lower speed is indicated the lower speed applies.

The 'starting on a single yellow aspect' rule provided additional details. It stated:

> Scan for the departure signal or check the AWS indicator (where fitted) if there is no departure signal. Confirm signal aspect and location of next signal
>
> Place the direction controller… into forward position
>
> Release the brakes when satisfied all doors are closed (after the door open tile light extinguishes…)
>
> Implement and maintain RTCD, calling signals and actions aloud
>
> Apply and maintain the 75% speed rule
>
> Maintain situation awareness and vigilance through scanning, crosschecking and continued RTCD…

Approaching signals

Procedure MD-11-72 outlined the following procedures for signals indicating red, yellow and green aspects.

> **Approaching a green aspect**
>
> - Confirm signal aspect
> - Check AWS response (where fitted)
> - The train may be operated under normal circumstances…
>
> **Approaching a single yellow aspect**
>
> - Confirm the signal aspect
> - Confirm the signal applies to your track
> - Initiate or maintain RTCD, calling signals and actions aloud
> - Confirm and acknowledge the AWS alarm (where fitted)
> - Apply or maintain the 75% Speed Rule
> - Maintain situation awareness and vigilance through scanning, crosschecking and continued RTCD

- Confirm the location of the next (Red) signal…

Approaching a red aspect

- Confirm the signal aspect
- Confirm the signal applies to your track
- Maintain RTCD, calling signals and actions aloud
- Apply the 20 / 20 rule
- Maintain situation awareness and vigilance through scanning, crosschecking and continued RTCD

  Note: IMU160 / SMU260 class not to exceed 30kph when within150 metres of a red stop signal unless a lower speed is indicated in which case the lower speed applies

Related to approaching a yellow aspect was the 75% rule, which stated:

> A train must be travelling at or below 75% of designated track speed when passing a double yellow / single yellow aspect signal.

Normal driving could be resumed upon sighting and confirming a green aspect.

Related to approaching a red aspect was the 20 / 20 rule, which stated:

> Reduce the speed of the Rail Traffic to pass over the Automatic Warning System (AWS) transponder (Magnet) for a red signal at a speed no great than 20kph. When stopping at a red signal, target at a stopping point 20 metres before the signal.

Risk triggered commentary driving

QR procedure MD-13-165 (*TSD professional driving – risk triggered commentary driving [RTCD]*) outlined QR's requirements for RTCD. It described the technique as follows:

> At a basic level, RTCD involves RTDs acknowledging the aspect of the restricted signal, and intended actions, by speaking aloud. By applying RTCD, RTDs can listen to their thoughts and the subsequent actions they are planning to apply. This allows RTDs to 'sense check' what they should do next.
>
> RTCD is required to be applied continuously from the acknowledgement of the restricted audible alarm on the Automatic Warning System (AWS) until the action that must be taken is actually performed. This is because information may not be retained if the message is not repeated within 10 to 20 seconds.

Procedure MD-13-165 further stated:

> Primarily, RTCD has been developed to manage risks while running on restricted signals. Other applications may include managing adverse conditions, managing operational risks (level crossings, signal in advance cannot be sighted, etc. The application of RTCD:
>
> - encourages RTDs to verbalise the positive actions they will apply
> - helps RTDs manage distractions by keeping the mind focused on operational priorities such as signals, safeworking and train management
> - is to be applied when RTDs are exposed to restricted signal indications, and is recommended for use when exposed to degraded working, fatigue and during other identified operational risk factors
> - assists RTDs to detect and manage threats and prevent errors
> - supports RTDs in minimising SPAD and other operational risks
> - reinforces route competence and maintains optimum cognitive function during times of low workload or potential fatigue

The procedure emphasised that RTCD was not simply announcing the signal. It also provided some examples of suggested word strings. More specifically, it stated:

> RTCD is not just repeating what RTDs see, but also the required action they will need to take to the next signal. Examples are:

- "… Single Yellow located…reduce speed not exceeding 75% of road speed, which is…."
- "Departing on single yellow aspect, not exceeding 75% track speed (50% on IMU160 / SMU260 class) and scanning for next signal which is located…." Target 20kph over AWS Magnet.

The procedure also emphasised the following:

> **It is a mandatory requirement that RTCD be verbalised aloud, including when a second person is in the operating cab, e.g. Train Operations Inspector (TOI), Tutor Driver...**
>
> **It is important to note that the trigger for applying RTCD is the sound of the restricted audible alarm on the AWS.**
>
> **When nominating restricted road speed, the RTD must state the intended speed, e.g. '75% of 100km which is 75 km'…**

Adjusting the driver seat

QR procedure MD-11-282 (*TSD professional driving – Train management train units*) outlined some additional procedures relevant to drivers of electric trains. The procedure for adjusting the driver's seat stated:

> On entering a driving cab, and before moving the train, it is important that the RTD's seat be personally adjusted so that all relevant controls are in comfortable reach and can be operated safety.
>
> …[outgoing] RTC [rail traffic crew] to inform relieving [incoming] RTC the seat may require adjusting…

Rightaway procedures

For a suburban train at a station platform, the guard was required to provide a rightaway signal to the driver when station duties were complete, and all people were clear of the train. In addition, the guard had to ensure that the departure signal was not indicating a red aspect. If these conditions were met, the guard would blow the whistle and provide the rightaway signal to the driver, which was indicated by two bells. The driver was then required to follow the documented steps in procedure MD-11-282:

> After receiving Rightaway and before moving, the RTD shall:
>
> - Check the indication of the departure signal
> - Move the direction controller into the forward position (if not already in the forward position)
> - Press the door closing button
> - Sound the city horn
> - Wait for the 'doors open' tile to extinguish
> - "Scan before you go"
> - Ensure headlight is on (if applicable)

Train driver information

Qualifications and experience

The driver of train TP43 was a permanent full-time employee of QR. The driver's personal records showed that they gained driver qualification in 1983. At the time of the 10 January 2018 SPAD occurrence, the driver was qualified to operate the rolling stock that worked TP43, and route competent to travel over the down suburban line between Bowen Hills and Albion, which included the location of signal ME45. The driver reported having frequently travelled over the route and being familiar with the signal.

According to QR records, the driver was last assessed as competent in line with QR's driver maintenance of competency (MOC) process in February 2017, which was still current at the time of the SPAD.

QR advised that the driver was last involved in a SPAD occurrence in June 2006.

Medical information and recent history

Medical records provided by QR showed that the driver underwent a medical assessment (rail category 1 – high-level safety worker) on 13 February 2017 and was assessed as fit for duty. The fitness certificate was valid for a 12-month period and was still current as of 10 January 2018.

The driver's duty times for the day of the occurrence (10 January 2018) and the previous 4 days are shown in Table 1.

Table 1: Actual duty times for the driver during 6–10 January 2018

Date	Work activity	Duty start	Duty end	Duty time	Time free (off duty)
6 Jan 2018	Day off				
7 Jan 2018	Day off				
8 Jan 2018	Train driving, various routes	0404	1231	8.5 hours	16.5 hours
9 Jan 2018	Train driving, various routes	0500	1400	9.0 hours	14 hours
10 Jan 2018	Train driving, various routes	0357	1320	9.4 hours	

The driver stated that they normally set their alarm at home about 75 minutes prior to sign-on time and they normally obtained 5–6 hours sleep prior to an early start. The driver recalled that their sleep on the night of 9 January (and the previous two nights) was consistent with this normal practice.

On 10 January, the driver signed on for duty at 0357 at Mayne depot, and considered themself fit for work. They conducted some driving duties and then had a rest break (including a meal) at Bowen Hills from 0911 until 1036, the arrival time of train TP43. The driver stated that they felt alert when taking over the train.

Following the SPAD occurrence, the driver undertook a mandatory drug and alcohol test, which produced negative results (that is, no drugs or alcohol detected).

The driver stated that they had nothing on their mind in the period leading up to the SPAD except work-related tasks. They were not in conversation with the guard or using a mobile phone at the time of the occurrence. A review of information on the driver's phone indicated that they were not involved in any phone calls or sending or receiving text messages at the time of the occurrence. The driver reported that they were thinking about 'the route ahead to the airport and where the signals were located'.

Maintenance of competency assessment results

QR train drivers on the Citytrain network were required to complete a MOC assessment every 18 months. The MOC included a written assessment and a practical on-track assessment (see *Citytrain driver maintenance of competency process* for further details about the MOC).

The ATSB requested the driver's most recent MOC assessment (February 2017) as part of the investigation process. While analysing the written assessment, the ATSB identified a number of irregularities. On three separate occasions, questions were answered out of order. For instance, the answer to question No.34 was recorded under question No.31. In addition, answers to questions that required detailed responses matched almost word-for-word with the MOC written assessment marking guide. The driver obtained 97 per cent correct answers on the first attempt and made the necessary corrections, including the answers to questions that were out of order, to attain 100 per cent. No development plan was recorded.

The irregularities identified in the driver's written assessment prompted the ATSB to request all MOC assessments undertaken by the driver since the introduction of the MOC process in 2008. Between 2008 and 2017, the driver participated in six MOC assessments and, on the first attempt,

achieved 100, 100, 100, 98, 99 and 97 per cent respectively on the written assessments. Of the driver's six practical MOC assessments, five recorded perfect results (with no gaps identified in driving performance) and the other recorded near perfect results.

On closer examination, the driver's previous three written MOC assessments prior to 2017 showed similar word-for-word answers compared to the assessor's MOC marking guide. There were also other identified anomalies, such as incorrect answers marked correct.

In addition, anomalies were identified with the driver's performance on elements of risk triggered commentary driving (RTCD) in the MOC assessments. More specifically:

- According to QR training records, the driver of TP43 attended RTCD training in December 2012. The driver could not recall doing this training.
- The written MOC assessment included specific questions in relation to safe driving procedures and RTCD. No problems were noted with the driver's responses to these questions on their three written assessments after 2012 (in 2013, 2014 and 2017). The practical MOC assessments in 2013, 2014 and 2017 included documented evidence of the driver correctly applying RTCD.
- During interview, the driver stated that they were not applying RTCD at the time of the SPAD occurrence. The driver also did not recall RTCD being covered in the MOC, and they did not use RTCD as a normal practice, either during normal driving or when participating in MOC assessments. The driver further stated that they had never called signal indications to others who were travelling in the driving cab and would not have called signals to the assessor while undertaking a practical MOC assessment. According to QR standard MD-10-109 (*Observance of Signals Manual*), calling signals to others in the driving cab was a mandatory requirement.

Operational improvement plan

Following the SPAD occurrence on 10 January 2018, the driver participated in a post-incident on-track observations session that was administered by a train operations inspector (TOI). The purpose of the session was to assess the driver's performance against safe driving procedures and make recommendations towards an operational improvement plan (OIP). Throughout the observation session, the TOI identified and recorded multiple deficiencies with the driver's performance, some of which included:

- not calling signals to the other person in the driving cab
- not using RTCD when travelling on restricted signals
- not applying the start on yellow (SOY) rule at station platforms
- not complying with other safe driving procedures.

In summary, the TOI's report stated the driver:

> … needs to be brought up to speed on RTCD and professional driving…needs to address bad habits … developed in driving style.

The driver was allocated an OIP following the observation session, which involved participating in practical on-track coaching and mentoring sessions. The driver participated in 11 individual coaching and mentoring sessions, which were administered by various TOIs. On each occasion, the TOIs identified deficiencies in many areas of driving performance. With specific relevance to SPAD mitigation procedures, these included:

- not applying the SOY rule on multiple occasions
- not applying the 75% speed rule on approach to restricted signals
- not applying the 20 / 20 rule on approach to a red (stop) signal
- not applying RTCD on multiple occasions.

On the eighth session, the monitoring TOI provided a report on the driver's performance. The report stated the driver:

> …. is making an effort to get things correct. On occasions, [the driver] forgets the order of RTCD, especially when running on a series of restricted signals. [The driver] gets confused and frustrated so by the time … completes the spiel … is almost past the signal…

The report also noted that the driver was having difficulty completing some other driving-related tasks that would routinely be covered during MOC assessments. In addition, it stated the driver:

> …. is an old driver that has been driving the same way for some 32 years…is obviously making an effort to learn all the things required…, however it will take more time and more coaching.

On the eleventh and final session, the same TOI deemed the driver 'not competent' and provided an updated appraisal on the driver's performance. The report stated:

> …driving has greatly improved from last time… [The driver] uses RTCD without prompting although … sometimes still gets the order of things incorrect. [The driver] is a bit slow commencing RTCD so by the time … says all the info … is almost on top of the next signal.

Following this last session, the driver chose (supported by QR management) to relinquish the position of train driver and subsequently took up the position of trainee guard.

Citytrain driver maintenance of competency process

Overview of maintenance of competency process

QR as a rail operator was to ensure that rail safety workers such as drivers were competent. Up until 2008, train drivers were required to undertake re-accreditation training every 3 years to maintain their safeworking accreditation. This involved group training over 5 days in a classroom environment. A TOI administered the training and assessment process.

In 2008, QR replaced the safeworking re-accreditation training program with the driver MOC process. The purpose of the MOC was to assess the skills and knowledge of drivers and identify any performance gaps and (if required) implement remedial action to ensure drivers met the required level of competency. Recently qualified drivers would undertake their first MOC after 12 months, and existing drivers would undertake a MOC assessment every 18 months. Tutor drivers normally administered the driver MOC process, and TOIs were also appropriately qualified to administer the process.

The MOC process involved each driver completing a written assessment (over 1 day) then a practical assessment (over 1 day) with a nominated assessor. The MOC process was undertaken one-on-one; the driver undertook the assessment while the assessor (tutor driver or TOI) administered the activities.

The MOC was initially designed to subject drivers to events, situations, and scenarios that they would rarely encounter under normal operating conditions as well as various regulatory requirements. Over time, the subject material within the written and practical components increased due to findings from investigations, changes to legislation and procedures, and for other operational reasons.

In April 2013, version 2.0 of the MOC was released, which contained significant modifications to the format and content of the MOC assessment. The format then remained basically the same up to and including version 8.1 (July 2016), with minor changes in versions associated with changes in terminology, updates to legislation or procedures, or similar reasons.

In September 2017 (version 9.0), the MOC was reviewed and updated in line with the *Rail Safety National Law* and regulatory requirements, and various other modifications were made. This involved changing the wording of several questions.

In 2018, QR used the MOC assessment for existing drivers to upgrade their train driving qualifications to a Certificate IV. In 2018, 252 (current) Citytrain drivers progressed from Certificate III in train driving to Certificate IV in train driving as a result of the successful completion of their written and practical MOC assessments.

Written MOC assessment

Version 2.0 of the written MOC assessment contained about 300 questions and covered a range of topics. In general, the questions related to train operations, signals, safeworking, responding to various emergency and abnormal situations and a variety of general safety topics. It also included a number of scenarios. The structure and format of the assessment questions varied. Some questions required selection of the correct answer from a list, where others required short answers, and some required a more detailed response.

Since version 2.0, the instructions for the written MOC assessment was contained in the written paper itself (used by the participant) and the associated marking guide (used by the assessor). The instructions stated that if the driver was unsuccessful in more than 10 per cent of the questions, they would be entitled to one retest (of the whole written assessment), which had to be completed on another day. If they were unsuccessful in some questions (but less than 10 per cent), the participant was required to research the correct answers and then make corrections, with the participant writing the correct answers in red pen on the paper.

The participant had to achieve 100 per cent on the written assessment before advancing to the on-track practical component.

The assessors' written MOC marking guide provided further instructions for the assessors. As of May 2014, the marking guide's instructions stated:[18]

> The Participant is to complete all written questions without assistance... Assessors are only required to assist where the Participant requires further clarification of the questions.
>
> If the Participant appears to struggle with writing responses, or self-identifies Language, Literacy and Numeracy (LLN) issues, the Assessor is to offer assistance where possible.
>
> This can be done by reading each question, writing down the Participant's answers, reading back the answers and asking the Participant to confirm response.

In addition, the marking guide provided generic answers to questions as required and more detailed answers to questions that required a specific answer. Overall, the purpose of the marking guide was to aid the assessors throughout the assessment process and to provide guidance when marking a participant's written responses.

In September 2017, the instructions in the written MOC paper and marking guide were supplemented by instruction MD-17-406 (*Rail traffic driver maintenance of competency assessment process*). This instruction stated that for the written MOC, the participant was to complete the assessment in blue pen, the assessor was to use black pen and any corrections (by the participant) were to be undertaken in red pen. The instruction also included the following:

> Under no circumstances is a learner [participant] to view or be provided access to the marking guides…
>
> During [written] assessment if the learner requests assistance the assessor may provide guidance but must not provide answers or breach the code of conduct.

Similar guidance was provided to tutors in a series of emails in 2016–2017 (see *2016 investigations into conduct of MOCs* and *2017 correspondence to tutors*).

Practical MOC assessment

The practical MOC assessment involved a holistic assessment of the drivers' on-track performance. This included observing a suite of activities including train management, safe driving, route knowledge, train preparation, train testing, shunting, and train amalgamation and division. It also included a train simulator component that assessed unusual scenarios and

[18] The same instructions (with minor variations in some terms) had been in the marking guide since version 2.0 (April 2013).

emergency situations. In addition, the drivers were assessed on their ability to apply risk mitigation controls to manage the risks associated with the work environment.

The assessors were required to collect and record both direct and indirect evidence while they observed a driver's on-track performance. Where observations about a specific aspect were not possible, due to unavailability or safety issues, an appropriate question or scenario was to be provided to the driver and written in the evidence section of the assessment report, complete with the answer supplied by the driver.

Following the assessment, and once all the evidence was evaluated, the assessor made a judgement on whether the driver was competent or not yet competent. If the driver was assessed as competent, they would return to normal duties. However, if they were assessed as not yet competent, relevant management personnel were advised accordingly.

If a driver was deemed not yet competent in either the written or practical components of the MOC assessment, the assessor was required to complete a development plan for the driver documenting any outstanding performance or acknowledgement gaps.

Training and assessment qualifications

QR was an enterprise registered training organisation (RTO), which meant it could deliver internal training and assessment to provide national qualifications to its drivers and guards.

Assessors, who administered training and assessment for QR, had to have vocational competencies at least to the level being delivered and assessed, and hold current industry skills relevant to the training and assessment being provided. In addition, they had to have current knowledge and skills in vocational training and assessment, which included holding a certificate IV in training and assessment.

The QR specification MD-13-591 (*Registered training organisation – Governance and administration*) stated that:

> The aim of assessment is to determine whether the learner [participant] has achieved the learning outcomes. Therefore, the completed assessment is evidence a person has the skills and knowledge that match the requirements associated with the learning course. It is very important that assessment evidence is clear and complete to the extent to be admissible in a court of law.
>
> Assessments in Queensland Rail have been developed to follow the 'Principles of Assessment' and 'Rules of Evidence' and to ensure trainers and assessors can easily follow these principles and rules.
>
> **Principles of Assessment:**
>
> - Validity – that the assessment assesses what it claims to assess
> - Reliability – that the assessment instruments will be able to be used consistently and have clearly defined marking guides
> - Fairness – that the assessment process has clear and easily understood information for the learner, and that the learner has the opportunity to identify when he/she is ready to be assessed
> - Flexibility – that the learner's individual needs are considered.
>
> **Rules of Evidence:**
>
> - Validity – the evidence gathered through assessment clearly aligns to whatever the assessment is supposed to assess and supports the assessor's decision on competency
> - Sufficiency – the evidence gathered shows how all aspects of competency were assessed
> - Currency – the evidence demonstrates the learner's current level of skills and knowledge
> - Authenticity – the evidence is, or relates to the learner's own demonstration of skills and knowledge.

Tutor drivers conducted the training for trainee drivers as well as administered the 12-month MOC assessments for recent drivers[19] and the 18-month MOC assessments for existing drivers.[20] As trainers and assessors, tutor drivers possessed the relevant vocational competencies and qualifications to administer training and assessment for Citytrain drivers. The tutors were members of QR's accredited trainer and assessor association (ATAA), which assisted QR in meeting its learning needs and obligations as an enterprise RTO.

The ATAA framework set out the expectations of the assessors who delivered training and assessment outcomes for nationally recognised training. The ATAA provided a framework that underpinned the registration requirements of the RTO and set benchmarks for training and assessment delivery.

With the introduction of the revised driver MOC (version 9.0) in September 2017, a formal instruction MD-17-406 (*Rail Traffic Driver Maintenance of Competency Assessment Process*) was issued to tutor drivers. The instruction contained expanded requirements and guidance on the MOC process, supplementing the information already contained in the MOC materials and marking guides. The instruction was accompanied by formal training for all tutor drivers and TOIs who delivered MOC assessments. The training provided information on how to gather and record evidence associated with the on-track practical component of the MOC and how to administer the written MOC assessment.

Review of drivers' MOC assessments and results

Due to the discrepancies identified with the 10 January 2018 SPAD driver's MOC results, the ATSB requested additional MOC assessments for analysis. This included MOC assessments for a sample of drivers who had experienced SPADs, all the MOC assessments undertaken in November 2017 and a small sample of MOC assessments undertaken in June 2018.

The majority of the MOCs provided by QR were from 2017–18. Most of the MOC assessments were administered by tutor drivers, with a few conducted by TOIs. The ATSB conducted a detailed analysis of 38 of these MOCs undertaken on existing drivers.

The results of the written MOC assessments ranged between 95–100 per cent on their first attempt, with all drivers successfully achieving competency after corrections.

A detailed examination of the written MOC assessments showed widespread irregularities or anomalies with nearly all of the assessments analysed. These included:

- almost all cases with word-for-word or almost identical answers to that of the assessor's MOC marking guide for questions requiring a detailed response
- three cases where answers to questions were out of order on the assessment paper (that is, a correct answer was provided but written next to the wrong question)
- five cases of an obvious spelling error in the assessor's MOC marking guide being reproduced by drivers in their written response (that is, the incorrect word 'collusion' being used instead of the correct word 'collision')[21]
- several cases where answers that were incorrect (compared to the marking guide) were marked correct by the assessors.

The analysis of the on-track practical MOC assessments also indicated potential concerns regarding the integrity of the process. Almost all of the assessments reviewed showed perfect results, with a few showing negligible gaps in driving performances. In addition, the assessors

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[19] Recent driver: new driver with less than 2 years' driving experience.

[20] Existing driver: drivers with more than 2 years' driving experience.

[21] This incorrect answer was included in the assessor's marking guide for written MOC assessments from version 7.0 (March 2015) to version 8.1 (July 2016). The next version of the MOC (version 9.0, September 2017) did not include the associated question.

generally recorded minimal contextual evidence on which to base assessment decisions for justifying their appraisal of a driver's on-track performance.

None of the MOC assessments in the analysed sample showed performance, skills, or knowledge gaps on completion, and therefore there were no recorded development plans for the drivers.

The ATSB also conducted a brief analysis of a number of other MOCs, which appeared to be consistent with those from the sample that was analysed in detail.

MOC results of drivers with SPAD performance issues

During the period 2015–2018, there were eight Citytrain drivers who either were demoted, had their employment terminated or took a voluntary reduction from the role of driver to guard because of multiple SPAD occurrences. This count did not include the driver involved in the 10 January 2018 SPAD occurrence.

Two of the eight drivers were recent drivers, with just over 12 months experience after spending more than 1 year in the trainee driver training program. The other six existing drivers had various years of experience. One of the existing drivers had been involved in eight SPAD occurrences between 1999 and 2016, and one of the recent drivers was involved in three SPAD occurrences in less than 12 months.

At the request of the ATSB (and in addition to previous driver MOC assessment requests), QR provided the most recent MOC assessments undertaken by each of the eight drivers (prior to their SPAD occurrence). However, QR could not locate one of the driver's written MOC assessments, but the driver's on-track practical assessment was available.[22]

A review of their written MOC assessments showed results ranging from 95–100 per cent on their first attempts, with all the drivers achieving competency after corrections. Overall, the MOCs were similar in nature to the other samples analysed by the ATSB. There were many multiple word-for-word answers on questions requiring a detailed response that were close or identical to that of the assessor's MOC marking guide. In addition, seven of the eight drivers recorded faultless on-track practical assessments. All drivers progressed through the MOC process as competent. None of the eight drivers had any details recorded in development plans.

After their most recent SPAD occurrences, three of the eight drivers participated in individual OIPs and subsequent coaching and mentoring sessions. According to QR documentation, these drivers were assessed as not competent on multiple occasions due to numerous issues. These findings were inconsistent with the results recorded in their MOC assessments prior to their recent SPAD occurrence, and notably similar to the assessment findings of the driver involved in the SPAD occurrence at signal ME45 on 10 January 2018.

Processes to monitor knowledge and performance gaps

Although the driver MOC assessment had a formal section (MOC assessment report) for the assessor to record knowledge or performance gaps, this section was rarely populated. The ATSB's analysis of driver MOC assessments did not identify any assessment where the assessor recorded knowledge or performance gaps.

In about 2008, Citytrain TSD developed a compliance monitoring database. The database provided a section for assessors to comment on a driver's MOC assessment or monitoring session and include information regarding future areas of focus or record development plans based on the results of the driver's monitoring session or MOC. An assessor could then review these comments prior to conducting the next assessment on that driver.

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[22] The *Transport (Rail Safety) Act 2010* and its supporting regulation, current at the time, required rail operators to keep records of competence for rail safety workers. QR's own recordkeeping management requirements provided direction on maintaining records for rail safety workers.

In August 2014, QR conducted a second line assurance activity (audit) that examined aspects related to SPAD controls. The audit noted that the TSD compliance monitoring database had been abolished, therefore TOIs were unable to review focus areas identified in previous monitoring sessions prior to undertaking a new session.

At the time of the 2014 audit, TSD management advised the auditor that each monitoring session was conducted as if the driver was competent. Any identified issues in the previous session would be corrected by coaching, until the driver was considered competent. The audit report noted that TOIs on occasions communicated driver performance issues verbally or by email to other assessors, as they were no longer able to review focus areas in the database. The audit report did not specifically discuss the use of the database for MOC sessions.

In 2019 QR advised the ATSB that the compliance monitoring database 'was decommissioned by previous Queensland Rail management about 5 years before and information from the database is no longer accessible'.

Management oversight of the maintenance of competency process

Overview of risk management and assurance processes

QR had documented standards and procedures for risk management and assurance. The standard MD-11-1338 (*Risk management*) stated:

> Risk management embodies an organisational culture of prudent risk-taking within Queensland Rail. It is the process of identifying, assessing and responding to risks, and communicating the outcomes of these processes to the appropriate parties in a timely manner…
>
> Risk management is a responsibility of all and should be considered as part of how Queensland Rail does business. Managing risk effectively requires people at all levels in the organisation to have specific accountabilities, authorities, delegations and appropriate competence to establish, apply and maintain the risk management framework as a basis for good decision making. It is important to have complete and current risk information available as this information assists in ensuring informed decisions around both strategic direction and operational objectives.
>
> Risk management is not a stand-alone discipline and requires integration with existing business processes such as business planning, assurance and Internal Audit, in order to provide the greatest benefits…
>
> For risk management to be effective, controls must be regularly monitored and reviewed. Controls must be monitored to ensure that they continue to perform as intended and continue to modify the risk in the manner and to the extent assumed in the risk assessment.

In the section on monitoring and reviewing, the standard stated:

> Assurance is a process that provides a level of confidence that objectives are achieved within an acceptable level of risk.
>
> Assurance is a planned and deliberate activity, should be continuous and dynamic and primarily conducted by those with day-to-day responsibility for the relevant risk management activity.
>
> All managers are responsible for ensuring that controls are designed to address risks. The design of risk controls will involve considering and recording when, by what means and how control and assurance activities take place…
>
> Queensland Rail applies three levels of assurance to ensure there is an appropriate balance between control and assurance activities refer to the Assurance Standard MD-16-24 and Assurance Procedure MD-12-27.

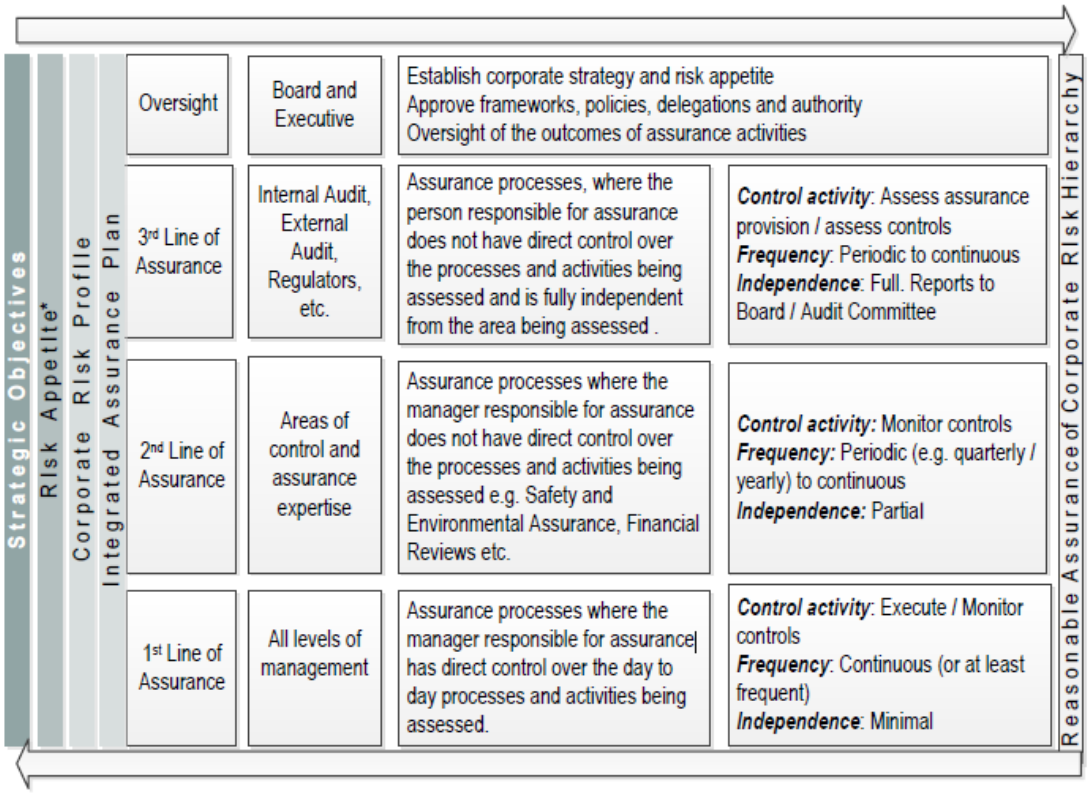
QR standard MD-16-24 (*Assurance*) expanded on the monitor and review concepts. It stated that in order for risk management to be effective, QR should comply with a set of assurance principles, which included:

- Assurance is an integral part of all organisational processes. Assurance is not a stand-alone activity that is separate from the main activities and processes of the organisation.

- Assurance is risk-based. Assurance should be weighted to risk and control effectiveness. The importance of this is highlighted by following an integrated risk and assurance approach. Ultimately assurance is part of risk management…
- Assurance activities are aimed at obtaining reasonable assurance, rather than absolute assurance over Queensland Rail internal performance of controls.
- Assurance is systematic, structured and timely. A systematic, timely and structured approach to assurance contributes to efficiency and to consistent, comparable and reliable results…
- Assurance is a continuous process that facilitates unceasing improvement. It consists of assurance providers and management incorporating consistent and systematic processes in their day-to-day activities to monitor and assess control effectiveness…
- Assurance activities are interdependent and inter-related. All previous and planned assurance activities form an integrated whole and contribute to the application of the Three Lines of Defence Assurance Model.

The three lines of defence model was summarised in a diagram, as shown in Figure 6.

Figure 6: QR's three lines of defence assurance model



Source: Queensland Rail

The procedure MD-12-27 (*Assurance*) stated that:

> First line assurance activities are essential management activities that shall be incorporated into existing business processes and systems when they are being designed and updated as the processes and systems are being implemented.
>
> The general objective of first line assurance activities is to verify that the controls are operating effectively and as intended. The scope and complexity of each management assurance activity are determined based upon a sound understanding of the risk and controls, control effectiveness and risk tolerances. The time and resources to be allocated shall be commensurate to the level of risk.
>
> Where practicable or required by legal and regulatory compliance obligations, first line assurance planning will be undertaken. First line assurance planning focuses on the risks and controls each Leader has accountability and / or responsibility for and applies to different Leader...

With regard to second and third line activities, the assurance procedure stated:

> An integrated assurance plan focussing on second and third line assurance providers must be consolidated and reviewed annually (Risk, Insurance and Compliance) through an assurance mapping exercise to provide a holistic view of all assurance activities in relation to the corporate risk hierarchy.

The assurance procedure also stated that the planning of second and third line activities would be based on many matters. These included:

- The relevant Key Operating Risks (KOR) and Event Risks (ER) of the Corporate Risk Hierarchy, their linked risks and key controls and the risk tolerance levels.
- Findings, conclusions and status of actions from previous management reviews.
- Findings, conclusions and status of actions from previous second line and third line assurance activities (including investigations) impacting the risks and controls.
- Assurance activities performed by other managers with the Group, Function and other Functions…

A review of the Citytrain TSD master assurance schedules[23] between 2012 and 10 January 2018 identified numerous scheduled assurance activities. Some of these activities examined MOC assessments, with this examination generally limited to assuring management that drivers had completed the MOC process within the timeframe allocated.

During the investigation, QR was asked to provide copies of all reviews, audits, assessments or investigations conducted into the MOC or the MOC process between 2012 and 2018. In addition, a review activity in 2011, which provided information on the MOC process, was also requested. Relevant activities are presented in the following sections in chronological order.

2011 SPAD management study (independent review)

In 2011, QR contracted a consultancy firm to undertake an independent review of SPAD events in the Roma Street rail precinct of Brisbane. As part of its activities, the review evaluated the Citytrain driver MOC process. The report submitted to QR stated:

> It is recognised by both the train service delivery (TSD) …. and the train crew that this assessment [MOC] process is deficient…
>
> Drivers feel that this test is impossible to fail, probably because any deficiencies identified by the [assessor] early in the assessment process are developed (hopefully) to a competent level within the MOC process… Drivers also view it as a paper-filling exercise rather than skill assessment and maintenance.
>
> Both drivers and TMIOs [assessors] raised the questionnaire [written assessment] as an issue. The same questionnaire is used at each assessment, which means a large area of their knowledge is never retested. This is certainly contrary to best practice, which recommends the use of a (large) pool of questions from which a questionnaire containing a set number of questions is randomly generated.

The review recorded that historically drivers were required to re-train every 3 years to maintain their safeworking reaccreditation, and were taken off driving duties and rostered to classroom training to facilitate this process. Drivers felt the previous process was much more effective at maintaining and assessing their skill and knowledge levels.

The review outlined many recommendations. Relating to the driver competency assessment processes, recommendations included:

- consider how to implement best a practice competency management system
- review the effectiveness of coaching training for tutor drivers

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[23] The yearly TSD master assurance schedule recorded proposed dates for 1st, 2nd and 3rd line assurance activities throughout the financial year.

- consider how assessment questionnaires can be less predictable and examine broader areas of drivers' knowledge.

According to the report, QR advised that there were plans under development within the compliance office to evaluate and validate the assessment tools and to update the assessment process. 'This will be become a 5 day, off-road reskilling and assessment process based on adult learning principles and making full use of the simulator'. As far as could be determined, minimal (if any) changes were made to the MOC process following this review.

2014 audit of SPAD prevention measures

In May 2014, a second line assurance activity examining SPAD prevention strategies included an examination of the extent to which current drivers had completed a MOC and also met relevant route competency requirements. No problems were identified.

2015 investigation into distribution of written MOC marking guide

In October 2014, a QR driver who had obtained a copy of the 'driver maintenance of competency (MOC) written assessment marking guide' emailed the document to several other drivers and another person they thought was a driver. The latter recipient, however, was a member of the public who resided in New South Wales. In January 2015, that person advised QR that the document held questions and answers to an assessment.

Initially, QR referred this matter to the Queensland Crime and Corruption Commission (CCC) for investigation. QR's correspondence to the CCC suggested concern as it was possible that some 300 drivers may have had access to the document, but the precise number, at that time, was unknown. The correspondence stated that:

> … in distributing/viewing the Marking Guide could have resulted in a number of Locomotive Drivers being deemed competent who may not be competent. This means there may be Locomotive Drivers undertaking driving duties without sufficient training or understanding, which is a significant risk to the safety of passengers travelling with Queensland Rail.

After evaluating the material, the CCC referred the matter back to QR for investigation. In early February 2015, QR convened an investigation into this matter. The investigation determined that the drivers who had obtained the marking guide were using it as a 'study guide' and there was no evidence that they used the document during their MOC assessments. However, correspondence associated with the QR investigation indicated that some staff had previously been caught using a mobile phone during the MOC process which had images of answers.

In April 2015, the internal investigation identified deficiencies with QR's processes relating to security of information and document security classification and, as such, issued the following recommendations:

- The marking guide should be reclassified from 'official' to 'confidential'.
- The 'audience' category in the marking guide should be amended from 'All rail traffic crew recent employees' [TSD Employees] to 'Tutor Driver / Assessors'.

It should be noted that the 'audience' category in the assessor's marking guide was changed to 'tutor drivers' in September 2017 (version 9.0) in accordance with the recommendation. However, the classification from 'official' to 'confidential' was not changed. There were considerations to change the MOC questions and process, however this did not occur and did not form part of the recommendations.

2015 audit of competency accreditation and SPAD management controls

In May 2015, a second line assurance activity examined QR's driver competency accreditation program (to ensure drivers were appropriately trained and accredited), as well as the effectiveness of SPAD investigation processes and the processes for post-SPAD management of drivers.

In terms of training and MOC processes, the audit reviewed documentation associated with six trainee drivers, six recent drivers and six existing drivers. Although various inconsistencies with the monitoring of recent drivers were noted (compared to stated requirements or 'best practice'), they had all completed a MOC within 18 months of graduation as required. The six existing drivers also had completed a MOC within the previous 18 months as required.

2015 audit of the MOC process

In November 2015, a second line assurance activity was conducted into the train crew MOC process. The purpose of the activity was to determine if TSD was compliant with protocols related to the:

- completion of the train crew MOC prior to the due date
- removal of the relevant train crew qualification if the MOC was not completed by the due date
- implementation of a performance plan for train crew who were unsuccessful in their attempt at the MOC.

The audit reviewed 34 driver and 34 guard MOC assessments. It identified that all assessments were conducted within the relevant timeframes except for two drivers and two guards who were on leave when their MOC assessments were due. The audit recorded that the qualifications of both drivers were removed and reinstated after completing the assessment. However, the required process was not completely followed for the two guards.

The audit noted that none of the drivers or guards had been found to be 'not yet competent' through the MOC process. Four drivers (and 10 guards) had documented development plans whereas 12 other drivers (and two guards) had gaps identified by the auditor that were not documented in a development plan. The auditor also noted that of the 14 crew that had development plans, none of the MOCs had complied with the requirement to have the driver or guard undertake the unsuccessful questions on a separate day to the original assessment. In addition, most of the associated MOCs did not have the relevant answers corrected in red pen, which was also a compliance requirement.

During the audit process, the auditor identified that some answers to questions within the written MOC assessment matched word-for-word with the answers documented in the assessor's MOC marking guide. To confirm this finding, the auditor chose at random a question from each MOC assessment (driver and guard) that required a lengthy response. The auditor then checked the responses provided by the participants against the answers in the relevant marking guides. The auditor found that 14 of the drivers (41 per cent) and 13 of the guards (38 per cent) provided an answer that matched word-for-word with the answer in the assessor's marking guide. The extent to which the other responses were substantially similar was not noted.

As this finding was outside the scope of the audit, the auditor recorded it as an observation rather than a finding. The audit report, including two recommendations about other matters, was forwarded to the relevant TSD managers.

2016 advice to tutors

In January 2016, the TSD training manager determined that written correspondence was necessary to notify tutor drivers about accountabilities when undertaking training and assessment. After consulting with senior management, the training manager's resultant email to the tutor drivers stated:

> In the context of our business group, examples of unacceptable behaviours include, (but are not limited to):
>
> - Providing crews with marking guides to assist them in completing written or practical assessments
> - Signing crews off in a set competency or qualification without conducting adequate assessment activities

- Intentionally arriving late and/or leaving early for rostered activities, without prior approval

Please note that any examples of the above behaviours will be considered a breach of code of conduct obligations…

The email was re-forwarded to tutor drivers by a team leader in June 2016, in association with a reminder about attendance requirements.

2016 investigations into conduct of MOCs

On 23 August 2016, a TSD manager reported an incident to the QR human resources (HR) section relating to a driver who was allegedly in possession of the assessor's MOC marking guide while undertaking a written MOC assessment. The tutor driver administering the assessment was not in the room with the driver at the time. After interviewing the driver and the tutor driver involved, the manager who witnessed the event cancelled the driver's MOC and referred the matter to HR for investigation.

In early September 2016, a TSD compliance officer, conducting a 'front-line' audit process, identified a guard's written MOC assessment with word-for-word answers to that of the assessor's MOC marking guide. This was reported to a manager who subsequently referred the matter to TSD senior management and HR. The manager noted that the tutor guard involved in the MOC assessment stated that their procedure was to:

> …engage the participant in discourse over the subject matter, and when the individual articulated a correct response, …read the answer in the MOC to ensure a 'word perfect' response.

The manager concluded that the tutor needed retraining, and that:

> In response to this incident, I have instigated an immediate change to the written MOC assessment and marking guide, and will be releasing an urgent communication to all tutor staff notifying them of their responsibilities in conducting assessments with qualified staff.

On 23 September 2016, correspondence was sent to the tutor group advising that identified word-for-word responses from written MOC marking guides had been identified in train crew assessments.

Also in September 2016, the HR investigation into the 23 August 2016 event concluded that the tutor had left the marking guide with the driver, and noted that a number of the driver's answers were word-for-word matches with the marking guide. It recommended that the tutor driver be provided a 'communication of expectations' in regards to their obligations as a tutor driver.

The HR investigation also concluded that no outcome should be issued to the driver because:

- We have not substantiated that the driver used the assessor's marking guide during his MOC assessment. The evidence is based on one witness account, which essentially is one person's word against the other.
- Management have disclosed that any other employee's MOC assessment would also be word for word…
- We have identified that there are clear issues with the process and how the MOC assessments are conducted generally. Specifically, each tutor requires different levels of information and at times tutors will read out the answer for the driver or guard who is undertaking the assessment.
- The business has not implemented the recommendations that were made last year [2015] following a similar case.

In terms of the third dot point, the HR officer later clarified with the training manager that some tutors required a high level of detail and others only required a few words for an answer. In addition, some tutors allowed the driver/guard to verbally give an answer and then, if that was close enough to the answer in the marking guide, allow the driver/guard to note down the answer from the guide.

In terms of the second dot point, the ATSB was subsequently advised that this comment was based on meetings with train crew management, which led the HR officer to form a view that it was common practice for tutors to verbally verify answers and then, once answers had been provided, to let the drivers copy the answer from the marking guide.

Following further correspondence within QR, the HR section made the following recommendations to TSD in December 2016:

- Review the entire Maintenance of Competency training process and determine if the current process is the best and most suitable way to train our drivers and guards.
- Develop clear instructions for Tutor Drivers and Guards on how to undertake the process.
- Send out a clear communication to all Tutors, Guards and Drivers on what is expected during the entire assessment process and potential outcomes should the process be breached.
- Ensure all Tutors are trained correctly and consistently in how to undertake the MOC assessment process.

As noted in *Citytrain driver maintenance of competency process*, in September 2017 version 9.0 of the MOC included rewording of several questions, and a written instruction (MD-17-406) was issued to supplement the instructions in the MOC paper and marking guide. However, a review of relevant documentation identified no significant changes to the MOC process prior to the 10 January 2018 SPAD occurrence at ME45.

2017 correspondence to tutors

In 2017, a manager sent a series of emails to tutors regarding maintaining the security of assessment materials.

In February 2017, an email stated that:

> Maintaining the integrity of TSD training is critical to ensure that only those trainees who are deemed as competent by a qualified Assessor become qualified drivers and guards for Queensland Rail.
>
> An important part of this obligation is ensuring the security of assessment materials.
>
> Please ensure you:
>
> - Do not share assessment materials with those who are not a uthorised…
> - Ensure assessment materials are secure at all times.
>
> Please be reminded of our obligations under the Queensland Rail code of conduct…

In June 2017, another email with the same content and additional dot points was disseminated to the tutor group. These included:

- Do not leave materials on desks, in communal areas or anywhere a trainee may access…
- Marking guides are for Tutors ONLY and must never be provided to a trainee.

Another email in June 2017 noted that security of assessment materials had been tightened ‘as concerns have been raised that these resources may have been provided to people outside of the TSD training area’.

Instruction MD-17-406 (*Rail Traffic Driver Maintenance of Competency Assessment Process*), issued to tutor drivers in September 2017, included the following statements:

> Under no circumstances is a learner [participant] to view or be provided access to the marking guide…
>
> During the assessment if the learner requests assistance the assessor may provide guidance but must not provide answers or breach the code of conduct.

Additional information related to the MOC process

Regulatory oversight activities

Prior to 30 June 2017, the Department of Transport and Main Roads (DTMR) was the Queensland rail regulator.[24] Its function, in part, was to ensure accredited rail transport operators[25] had the competence and capacity to carry out particular railway operations safely. To facilitate this outcome, DTMR evaluated rail compliance through audits and compliance inspections.

Between June 2012 and June 2017, DTMR directed a number of regulatory audits / compliance inspections relevant to QR's (Citytrain) driver maintenance of competency process:

- In May 2012, DTMR conducted an audit to determine compliance of QR's safeworking and maintenance of competency training for Citytrain drivers in the Brisbane suburban area.
- During July–September 2013, DTMR facilitated a compliance inspection to determine if Brisbane-based category one driver route competence was assessed against competency element 14 (direction of travel) for all tracks relating to MD-10-199 *Safeworking Training*.
- Between December 2016 and June 2017, DTMR conducted an audit to determine if the requirements contained in QR's safety management system were being adhered to for ensuring the competence of rail safety workers who carried out rail safety work was assessed and recorded with the focus on 32 TSD Citytrain trainee drivers who were currently progressing through the assessment of the competence process.

A review of the findings recorded only minor discrepancies with the Citytrain driver MOC process and nothing that related to assessment irregularities.

Although DTMR recorded that rail traffic crew competency for QR as an important aspect of operational risk, there was no specific audit or oversight activity that examined in detail the integrity of the MOC process.

Commission of Inquiry into train crewing practices

In the course of this investigation, the ATSB reviewed the findings from the *Queensland Rail Train Crewing Practices Commission of Inquiry* initiated in November 2016, with the final report completed in January 2017. The independent inquiry was initiated by the Queensland Government as a result of Citytrain train crew shortages and subsequent suburban train cancellations with the introduction of the Redcliffe rail corridor.

One of the relevant underlying issues the inquiry identified for the reduction in qualified train drivers was 'Management decisions to reduce training staff and halt driver training intakes between February 2014 and February 2015'. The report also noted that the shortfall between supply and demand of drivers was not widely understood in the organisation, partly associated with the TSD team being 'focussed on short-term operations' and it did not 'sufficiently recognise or escalate longer-term issues'.

In addition, the report noted that in 2012–13 QR initiated a voluntary redundancy program, which resulted in eight tutor drivers and 10 TOIs leaving the organisation, and that 'reductions in training programs and tutors was a contributing factor to the undersupply of train crew'. The inquiry also identified that QR had significant challenges with the implementation of risk management processes, in particular in relation to each of the three lines of defence.

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[24] In July 2017, responsibility for the oversight of Queensland rail transport operators was transferred to the Office of the National Rail Safety Regulator (ONRSR).

[25] Collectively, rolling stock operators and rail infrastructure managers are referred to as rail transport operators.

Additional information from training managers

The ATSB interviewed several personnel who served in the role of TSD training manager or provided specialist support to the manager during the period from 2015 to 2018. These personnel all stated that the driver MOC was an assessment designed to appraise the drivers' skills and knowledge in accordance with enterprise, legislative and regulatory requirements. They further stated that the assessor's MOC marking guide highlighted the fact that it was an assessment. In addition, correspondence, in the form of multiple emails relayed to the tutor group, emphasised that the MOC was an assessment not a coaching session.

All of the managers interviewed stated that the TSD training section was short-staffed in their time as manager, which presented challenges due to the high number of drivers, guards, trainees and tutors in TSD.

From late 2013 until June 2015, there was no training manager in TSD. The responsibilities of the training manager were merged with those of the manager TSD operations during this period. In June 2015, a training manager was appointed to the role. This manager stated that at that time there were only three support staff in the training team: a compliance officer, training officer and a team leader.

The manager also recalled that their initial task was to correct legacy issues resulting from the absence of a training manager. Initially, the focus was on responding to regulatory requirements such as expired train crew competencies, derogations near to elapse and 'issues that were broken'. In addition, there was a need to increase the driver and guard numbers due to identified crew shortages in Citytrain. This limited the availability of training staff to undertake assurance audits.

However, the manager recalled utilising staff to undertake periodic compliance checks on the train crew MOC process. They noted that on at least one occasion, a compliance officer noted that answers to questions in a written MOC assessment were word-for-word with the assessor's MOC marking guide (see *2016 investigations into conduct of MOCs*).

Additional information from tutor drivers

The ATSB interviewed nine Citytrain tutor drivers, all of which had at least 7 years' experience as a tutor. Many of these tutors stated that they believed the MOC was and/or should be a process to ensure that, at the end of the assessment, the driver was competent. However, some noted that in recent times management had deemed that it was an assessment of competency rather than a process to maintain competency. Some tutors also noted that drivers were not provided time or specific guidance material to prepare for a MOC, and therefore treating the process as only an assessment was an unrealistic expectation.

There was significant variation amongst the tutors with regard to how the driver MOC process was administered, particularly in terms of the written assessment. Two of the tutors indicated that they would verbally read the question to the driver then discuss it with the driver before the driver wrote their answer. Others indicated that the driver would read and answer the questions in writing on their own, with the tutor either waiting in the same room or just outside, providing assistance as required. However, the amount of this assistance appeared to vary significantly, with some tutors saying that they would only help the driver by rephrasing the question to make it clearer, whereas others indicated they would also discuss scenarios and/or use a whiteboard to provide information to help the driver understand what the question was 'looking for'. None of the tutors stated that they provided the marking guide to the drivers or provided the actual answers to any of the questions.

All of the tutors advised that drivers would need assistance with some of the questions. Some indicated that this was because the content of the questions was information that was rarely encountered in the drivers' day-to-day work. Although several tutors noted that a number of the

questions were not relevant to the role of a train driver, some of these tutors noted that this problem had been addressed in a recent version of the MOC.

Most of the tutors also noted that some of the questions were worded ambiguously, causing difficulty for the drivers in identifying the correct response. It was further noted that the ordering of questions was sometimes misleading, resulting in drivers being confused as to the intent of some questions. Some tutors reported having provided feedback about poorly worded questions, but this feedback was rarely responded to, which deterred them from further reporting suggested changes. Correspondence regarding the MOC reviewed by the ATSB included examples where tutors provided concerns regarding MOC questions and feedback was provided to the tutors.

None of the tutors interviewed stated that they had conducted a MOC in which the driver was found to be 'not yet competent', with some indicating that they had always managed to coach the driver up to the required standard. Many of the tutors noted that they were dealing with qualified drivers who already knew the information required, but just needed some assistance with understanding the intent of the questions. The tutors advised that the duration of the MOC assessment would vary depending on the driver and other factors, and that fitting it within 2 days was often difficult but usually achieved, with some MOCs requiring a 3rd day.

Additional information from drivers

During the course of this investigation and other recent investigations, the ATSB interviewed a number of drivers about training and assessment and the MOC process. Most of the drivers interviewed stated that they were not provided with the assessor's written MOC marking guide when completing the written assessment. They advised that they were coached or assisted (to various degrees) in answering some of the questions by the assessor.

Some drivers noted that some of the questions were poorly written, which made them difficult to answer. Another common complaint was that in most cases a MOC assessment was scheduled at short notice, which meant there was no time to study for the assessment.

A trainee driver stated that, while under assessment conditions, the assessor would vacate the room and leave the assessor's marking guide in clear view of the participants. The trainee driver further stated that in their experience it was the culture within TSD to be provided with answers to assessment questions or be assisted in some way. The trainee driver stated that, when they were working as a guard, on two occasions the assessor's MOC marking guide was made available to them during a MOC assessment. They also recalled being directed to rephrase the answers to questions when completing the written assessment, so the answers were not word-for-word with the assessor's marking guide. In addition, they were instructed to get some answers wrong in order to disguise audit attention.

One experienced driver who was interviewed stated that during their last MOC assessment they were provided with the assessor's written MOC marking guide at the start of the assessment and told to use it if required. The driver stated that 50 per cent of the time they referred to the marking guide to answer the questions. The driver indicated that 'no driver would pass the MOC assessment in its current form' without assistance. The driver further suggested that some of the questions in the written MOC assessment were not applicable to a driver's role and questioned their relevance.

Implementation of risk triggered commentary driving (RTCD)

Introduction of RTCD

In 2005, Arriva Trains Wales, a rail operator in the UK, and railway consultancy business Halcrow developed risk triggered commentary driving (RTCD) after Arriva experienced a significant number of SPAD occurrences.

In 2008–09, Queensland Rail (QR) introduced RTCD for Citytrain train service delivery (TSD) drivers with assistance from Halcrow. Initially, RTCD was recommended as a self-regulated tool,

which allowed drivers to personalise and/or individualise their verbal rehearsals and allow flexibility on its application. However, after a sharp increase in the number of SPAD occurrences midway through 2011, TSD management mandated the application of RTCD. Other business functions within QR that had implemented RTCD continued using it as a recommended (but not mandatory) technique.

The ATSB requested documentation and supporting evidence from QR on how it facilitated the management of change with the decision to mandate RTCD within Citytrain TSD. In response, QR was not able to provide documentation to demonstrate that a risk management approach was followed in accordance with its internal management of change process. There was also no documented evidence available to establish if literature reviews, risk assessments or consultation with stakeholders was considered or undertaken as part of the change process.

2013 review of RTCD application

In mid-2013, relevant QR executive management sponsored a working group to review SPAD controls due to over-represented SPAD numbers in the Brisbane inner-city. RTCD was one aspect examined by the SPAD Prevention Working Group.

In November 2013, the working group produced a recommendation paper. The paper noted that QR Citytrain was the only Australian passenger rail operator to have mandated the use of RTCD for its drivers. In addition, the paper noted there was no conclusive evidence to determine the efficacy of mandating RTCD. The working group conducted literature reviews and consulted with subject matter experts on the topic, which culminated in a recommendation paper.

The working group presented the 'RTCD review recommendation paper' to Citytrain senior management. The paper reviewed relevant literature relating to the technique and how it was applied, with the focus on whether the technique should be mandated. It noted that, under the model proposed by Halcrow, RTCD was based on the following principles:

- RTCD is recommended, but not mandatory, using a system where the driver speaks the aspect of the signal/indication/hazard and the specific action that needs to be taken.
- If the driver does not want to speak the instructions recommend that the driver uses a technique that is acceptable to them – such as quietly "muttering" this to themselves or silently repeating it back.
- It is applied during situations which introduce increased risk – such as driving on restricted signals, departing a platform on restricted signals and the signal ahead cannot be seen, when certain degraded conditions apply; and
- Other essential tasks required of the driver will take priority over RTCD in certain circumstances (e.g. answering the emergency intercom, completing Safeworking forms, and other high workload situations).

The review paper also noted there 'was no empirical study identified that researched the application of RTCD in the rail environment'. It also noted that there were no studies in any industry that either recommended or advised against mandating verbalisation or RTCD.

The paper referred to a 2008 fact sheet produced by the UK Rail Safety and Standards Board (RSSB). The fact sheet stated that the RSSB human factors team noted that using RTCD had both positive and negative effects for drivers:

- Benefits included providing a tool to help them evaluate their next actions and helping them remain alert and able to remember key information.
- Negative aspects included the potential for excessive workload and distraction from driving, particularly when drivers were learning the technique or having difficulty articulating what they are thinking, and sustained use leading to the technique being applied automatically without drivers thinking about what was said.

The RSSB fact sheet stated that RTCD could be of great benefit to some drivers, but also noted it should be stopped under high workload conditions or if a driver felt that it was 'taking away from their driving performance'.

The SPAD Prevention Working Group's review paper also stated that:

- Stakeholders advised the current RTCD training materials and delivery are inadequate and require immediate review.
- It was suggested that training inconsistencies [variations on the training delivery of RTCD] are likely due to personal preferences regarding risk from individual instructors [tutor drivers], which confuses the end users [drivers].

Two of the paper's recommendations included:

> 3. Based on RTCD literature, industry research and application, the use of RTCD should be highly recommended to RTDs as one effective risk management control, but its application not be mandated…
>
> 4. …. Queensland Rail (suggested lead – TSD with Learning and Development input) review the current procedures and training materials for RTCD and delivery of training for Rail Traffic Drivers to ensure it aligns with the agreed definition and is appropriate for the function.

Appendix 'A' of the review paper provided minutes from a review meeting. The minutes noted there was currently no means to effectively monitor the use of RTCD in driver only operations. They also stated that participants had different views about whether the technique should be mandatory, but that all agreed there were problems with consistency in the understanding, delivery and assessment of RTCD.

Appendix 'B' of the review paper allowed stakeholders to provide their comments in relation to the recommendations. Human factors specialists involved in the review agreed that RTCD was a helpful tool for drivers to manage risk, but they opposed the mandatory application of RTCD. One HF specialist indicated that their resistance to the mandatory application was based on the impacts of workload.

Representatives from Citytrain TSD training stated that no strong evidence had been presented against mandating the technique and the technique should remain mandatory. TSD compliance personnel noted that most SPADs involved problems with situational awareness and RTCD was designed to help situational awareness. They also noted that post SPAD briefings with drivers had shown that no SPAD had occurred while a driver was using the technique, although this claim was subsequently disputed and some examples were provided of SPADs that had occurred with drivers reporting they had been using the technique.

Following the review, Citytrain senior management decided to maintain RTCD as a mandatory technique.

August 2015 audit that examined RTCD

In August 2015, QR conducted a second line assurance activity to determine the effectiveness of the implementation and monitoring, by Citytrain, of the 75% rule and RTCD.

The auditor documented the following observations regarding RTCD:

> Discussions with two tutor drivers and review of comments in monitoring records indicate that the application of RTCD is inconsistent; while calling the signal [aspect] is complied with, calling the [drivers] action is inconsistently applied and reinforced. The two tutor drivers advised their understanding was that it was only compulsory to verbalise RTCD when a second person was in the cab. Inconsistent application of RTCD by trainers and assessors does not meet mandatory requirements outlined in the TSD Professional Driving – RTCD instruction…
>
> Review of monitoring materials and discussions with TOIs indicate inconsistent enforcement of RTCD with each employing different levels of compliance and record keeping…

The auditor also recorded irregularities with the effectiveness of the change management process with the updated release of MD-13-165 (*TSD Professional Driving – Risk Triggered Commentary Driving*, version 1.0, July 2013). As TSD management had mandated the application of RTCD, there was a requirement to communicate the procedure to drivers, trainers, monitoring officers and assessors with a consistent framework for the understanding, delivery, application and assessment of RTCD. In addition, the auditor noted that a review of monitoring documents and discussions with tutor drivers and TOIs had identified a variance in the comprehension of RTCD requirements, indicating communications had not been effective.

The auditor also noted limitations with the MOC written assessment questions related to RTCD, with no questions emphasising the importance of calling the required action as well as the signal, and one question potentially indicating that RTCD was only required if a second person was in the cab.[26]

The auditor noted there was no method of verifying compliance with RTCD. However, during post-SPAD interviews with drivers involved in 13 SPADs, none reported using RTCD at the time of the SPAD.

The assurance activity report concluded there was inconsistent understanding of RTCD mandatory requirements across rail traffic crew, and it recommended:

> Distribute clear, concise communication to all Rail Traffic Crew [drivers, tutor drivers and TOIs] regarding mandatory requirements of Risk Triggered Commentary Driving to eliminate current inconsistencies and misunderstanding.

Interviews with tutor drivers and drivers regarding RTCD

Following the SPAD occurrence on 10 January 2018, the ATSB interviewed a sample of tutor drivers and drivers about their understanding of RTCD and how it was applied.

During the interviews, the following information emerged:

- There was wide variation amongst interviewees as to the purpose of RTCD, although most understood it to be an attempt to improve awareness of hazards and risks.
- A number of interviewees reported a belief that 'internal' RTCD was sufficient for experienced drivers; that is talking the hazards and risks as well as actions non-verbally to themselves rather than speaking them aloud as documented in the procedure.
- There was confusion in relation to the mandatory application of RTCD. Most of the interviewees understood that it was mandatory for all risks identified by the driver to be spoken aloud, not just for restricted signals as documented in the procedure.
- A number of interviewees confused RTCD with cross calling all signals when there was more than one person in the driving cab.[27]
- Knowledge of the verbal phrasing and order of the phrasing of RTCD requirements was inconsistent within the interview group. Some believed there were mandatory phrases that a driver must use, while others reported that it did not matter about the phrase or order as long as the key information was verbalised.
- The interviews indicated there was a widespread misunderstanding of the requirements of RTCD amongst drivers and tutor drivers. One tutor driver reported having copied the appropriate passages from the RTCD procedure and using this to assist in discussions with numerous colleagues who misunderstood the practice.

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[26] The question asked what a driver must do, in regards to RTCD, if someone else was in the cab. The model answer in the assessment guide was 'RTCD must be verbalised when a second person is in the cab'. This question was replaced in the September 2017 version of the MOC.

[27] Cross calling signals in a cab when there was more than one driver in the cab was a QR procedural requirement in accordance with the observance of signals. It was a specific requirement that was independent of the RTCD technique.

In addition, a driver who had recently completed driver training advised that there was a lack of standardisation within the tutor driver group on the delivery of RTCD. Some tutors required the driver to verbally call all signals, hazards, speed boards, level crossings and speed reductions while continuing to recall and repeat new information as it developed. Other tutor drivers wanted the verbal recall (word phrasing) of information in a particular way, while others were not so particular.

The recent driver stated that, after being in the driver-training program for more than 12 months, they had only recently learnt that RTCD was only mandatory when encountering restricted signals. They mentioned that this was not emphasised in driver training. The recent driver also recalled the case of a trainee driver who went straight past a platform because they were so busy using RTCD and calling the road[28] they forgot to stop.

Additional information

The QR investigation report into the 10 January 2018 SPAD at signal ME45, noted that the analysis of SPAD occurrences during 2017 found that RTCD was not utilised in at least 67 per cent of the occurrences. The report also noted that not all investigation reports had noted whether or not RTCD was being used. In addition, the report noted that there were currently no methods available for monitoring compliance with RTCD when drivers were alone in the cab.

SPAD risk management processes

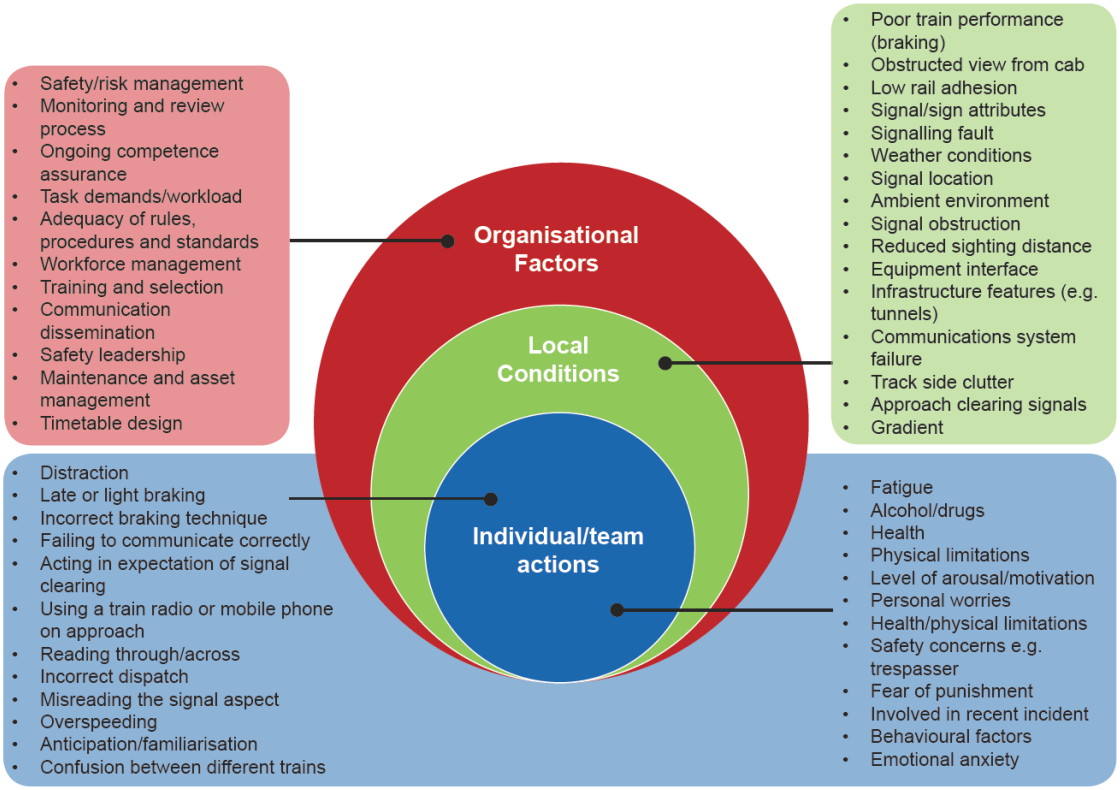
General information

The occurrence of SPADs is a significant, ongoing problem for most rolling stock operators. Although most SPADs result in negligible safety consequences, a small proportion result in collisions, derailments or other accidents with significant adverse consequences.

A wide variety of factors can contribute to SPADs, as indicated in Figure 7, taken from the Rail Industry Safety and Standards Board (RISSB) *SPAD Risk Management Guideline*.

[28] Track and signal information and relevant threats that the driver may identify as a risk.

Figure 7: Types of factors that can contribute to SPADs



Source: RISSB SPAD Risk Management Guideline

In order to minimise the risk of SPAD occurrences, it is widely recognised that a rolling stock operator needs to utilise a range of processes and controls as part of an overall SPAD risk management framework.

Queensland Rail (QR) had been actively monitoring and managing the risk of SPAD occurrences for many years using a variety of processes, controls, and programs. In addition to its other risk management and assurance processes, it had specified requirements in its *SPAD Risk Management Standard* (MD-10-89), *SPAD Risk Management Procedure* (MD-13-362), *TSD SPAD Risk Management Instruction* (MD-13-446), and a variety of other associated documents.

More specifically, QR's processes and controls for managing the risk of SPAD occurrences included (but were not limited to):

- ensuring signals and related infrastructure met relevant design requirements
- ensuring drivers were provided with relevant training and met relevant competency requirements
- reporting, recording and investigation of SPADs
- reviewing any signals and related infrastructure that has been involved in a SPAD
- post SPAD management of drivers involved in a SPAD
- analysis and classification of SPAD information
- communication of SPAD information and lessons learned.

SPAD prevention activities were also developed, facilitated and promoted by various cross-sectional groups within QR. For example, in March 2013, the SPAD Prevention Common Outcome Group was initiated to direct and deliver progressive improvement in the management of SPADs. Prior to this time, the SPAD Prevention Working Group performed a similar role. In October 2017, QR convened the SPAD Prevention Taskforce.

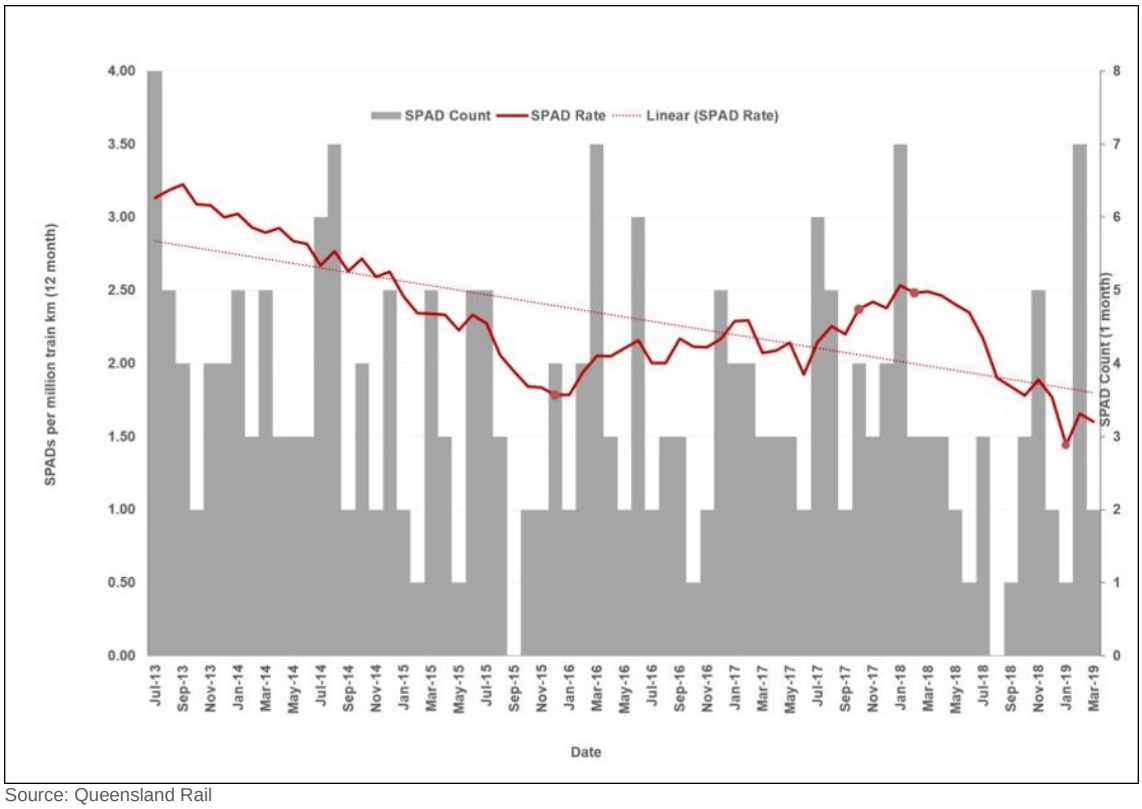
SPAD management activities were subject to first line and second line assurance activities on a regular basis.

Overview of QR SPAD statistics

In the period from July 2012 to March 2019, QR recorded 287 SPADs. This equated to an average SPAD rate of 42.5 SPADs per year (or 3.5 per month). Most (75 per cent) of these occurred within the Citytrain rail network.

For all of QR, during the financial years 2015–16, 2016–17 and 2017–18, there were 40, 35 and 43 SPAD occurrences, respectively. As shown in Figure 8, the SPADs per million train kilometres trendline decreased over the period from July 2012 to March 2019. For the years 2015–16, 2016–17 and 2017–18, it was 2.16, 1.93 and 2.35 SPADs per million train kilometres, respectively. For Citytrain, the rates were similar, with 2.11 SPADs per million train kilometres over the 2 years 2016–18.

Figure 8: QR SPADs and SPADs per million train kilometres from July 2012 to March 2019



Source: Queensland Rail

For all of QR, the annual rate of red signals approached per SPAD[29] for 2015–16, 2016–17 and 2017–18 was 31,700, 34,900 and 26,800, respectively. For Citytrain, the rates were similar, with 31,000 red signals approached per SPAD over the 2 years 2016–18.

For all of QR, during the period from July 2012 to March 2019, there were:

- 154 driver misjudged SPADs (that is, the driver attempted to stop the train but failed to stop before passing the signal)
- 93 completely missed SPADs (that is, no attempt was made to bring the train to a stop before the signal and the train proceeded into the next section or block without the necessary

[29] A red signal approached was recorded when the signal was displaying a red aspect when the train passed the previous signal. In some cases, the signal would have changed prior to the train reaching the signal. Therefore, it is likely that the number of red signals approached per SPAD was lower than the figures indicated.

authority; the driver did not realise the train had passed the signal until they were notified by train control or a more serious event occurred)

- 13 starting against signal SPADs (that is, a stationary train started at and proceeded beyond the signal)
- 27 other SPADs (that is, any authority exceeded that is not classifiable under one of the above subcategories).

QR considers 'completely missed' and 'start against signal' as the most significant SPADs, as generally the drivers involved have acknowledged the AWS alarm immediately prior to passing the red (stop) signal and continued to operate the train unaware it had exceeded its limit of authority. These two SPAD categories were associated with 106 occurrences, which represents about 37 per cent of the total SPADs during the period from June 2012 to March 2019. For Citytrain over the same period, the rate was similar (34 per cent).

Use of engineering controls

Because most (but not all) SPADs involve driver errors, it is widely agreed that various types of engineering or technical controls are usually the most effective in preventing SPADs, reducing the likelihood of SPADs and/or minimising the consequences of SPADs.

QR advised that engineering controls on the Citytrain network to reduce the risk of SPADs included the design of the signals themselves, signal aspect sequencing (and the cues that provides to the driver), overlaps, track design and routing. In addition, other risk controls to reduce the exposure to potential SPADs included timetabling.

The Citytrain network also included engineering controls that provided various alerting functions to minimise the risk of SPADs. These included the automatic warning system (AWS), which provided various advisory information to drivers on their approach to a signal (*Automatic warning system*).

In addition, although QR's universal train control (UTC) system did not prevent SPAD occurrences, in most cases the system provided a SPAD alarm at the network control officer's (NCO's) workstation if a train passed a 'controlled'[30] signal. Therefore, the system had the potential to mitigate the consequences of a SPAD occurrence by the NCO broadcasting an emergency stop command to the driver (as was the case with the 10 January 2018 SPAD at signal ME45). However, 'non-controlled'[31] signals located on the QR suburban rail network did not generate a SPAD alarm on the UTC system.

There are also other engineering controls available that can play a more active role in detecting potential or actual SPADs and managing their risk. Some examples of such systems used by other Australian infrastructure and rolling stock managers include:

- Automatic train protection (ATP): involves the installation of technology on the trains themselves and the tracks (trackside). The ATP technology transmits information from the trackside equipment to the train that supervises train speed, target speed, and enforces braking when necessary to prevent derailments and SPAD occurrences.
- Signal train stops: a train stop system involves a trip cock on the vehicle and a trip arm located trackside which, directly initiates an emergency brake application from the trip cock coming into contact with the trip arm. The trip arm is located adjacent to the signal, and the lever arm elevates when the signal is displaying a red aspect and returns horizontal when the signal clears.

As noted by the RISSB *SPAD Risk Management Guideline*:

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[30] Controlled signals: a signal that is, or may be, controlled or operated by a network control officer. They normally display a red aspect.

[31] Non-controlled signals work by the detection of traffic over track circuiting and they are not normally manually controlled.

> Reducing the SPAD consequence can dramatically reduce overall risk and largely involves the use of technical solutions, such as Automatic Train Protection (ATP), positive train control or other enhanced train separation. Ultimately, these are the most effective means of reducing SPAD risk, however, it is recognised that they may not provide the optimum solution because:
>
> - Technical solutions often come at a high cost – the balance of costs and benefits need to be considered to determine the best use of resources;
> - Problems with interoperability – systems may not be compatible or standardised between RTOs [rail transport operators] or across the rolling stock fleet. Many networks carry mixed traffic including metropolitan passenger trains, regional passenger trains and freight trains, each with their own type of rolling stock and train protection systems. There are additional problems of interoperability given the variation in network rules across state boundaries;
> - Compatibility with legacy systems – rail infrastructure can vary greatly even across the same network. This may be due to variance in asset age and/or variability in adopted standards;
> - Potential for de-skilling – some technical solutions may reduce the efficiency of route knowledge or inadvertently impact the manner in which routes are navigated.

Although QR had considered introducing ATP on the Citytrain network at various times, it had not been introduced prior to the 10 January 2018 SPAD occurrence.

In 2016, the Queensland Government agreed to fund the introduction of the European Train Control System (ECTS). A 'Building Queensland' cost benefit analysis summary released in May 2016 stated:

> In February 2016, the Queensland Government requested that Building Queensland lead the development of a Business Case for the European Train Control System (ETCS) – Inner City project, in conjunction with the Department of Transport and Main Roads and Queensland Rail.
>
> The ETCS – Inner City Project delivers a complete overhaul of the inner-city rail signalling and communications system with new, state-of-the-art equipment.
>
> ETCS Level 2 is a new generation of train protection and control for the rail network in SEQ, providing automated train protection and communications-based signalling.
>
> Geographically, the scope of the project has been identified as the area of the network between Northgate and Milton stations. This area encompasses the key area of the network through which all trains must pass, and includes Roma Street, Central, Fortitude Valley and Bowen Hills stations.
>
> Lineside signals would be progressively removed from the network as they would no longer be required. To support ETCS L2, the project replaces and upgrades a number of existing signalling and telecommunications systems that are nearing end-of-life and are due for replacement.

Monitoring of driver performance

Introduction

In addition to the use of the maintenance of competency (MOC) assessments for existing drivers, QR also had a number of other planned and unplanned methods to monitor driver compliance with procedures and rules to minimise the risk of SPADs.

In-cab performance monitoring

An observation of the Citytrain TSD master assurance schedule (July 2013 to June 2016) showed evidence of planned monthly first line assurance activities where TOIs were scheduled to conduct compliance audits on driver performance. However, there was no evidence to determine the extent these activities were conducted as planned. The assurance schedule for July 2017 to June 2018 showed no planned evidence of such line assurance activities.

Recent driver monitoring

Recent driver monitoring was another method used by QR Citytrain to assess driver compliance. This involved a TOI riding with and observing the driver's performance and providing feedback at specified intervals.

QR originally introduced this process due to the over representation of SPAD occurrences by drivers with less than 2 years' driving experience. Initially, these monitoring sessions were scheduled at the 1, 3, 6, 9,12,15,18 and 24-month intervals after driver qualification was gained. However, an internal audit in May 2015 identified anomalies with this process where monitoring sessions occurred outside of the specified times and on some occasions did not occur at all. The practitioner undertaking the audit was advised by Citytrain management that:

> …the requirements set out in the abovementioned monitoring program are an example of 'best practice' and are 'nice to have' but they are not mandated. Therefore, drivers who are delayed in obtaining their milestone monitoring are not deemed 'incompetent' and this does not have any impact on our safety accreditation with the regulator.

In April 2016, Citytrain TSD management revised the recent driver monitoring schedules and changed them to 2, 6, 12, 18 and 24-month intervals after the initial driver qualification was gained.

Post SPAD coaching and mentoring sessions

Following a SPAD occurrence, a TOI evaluated the involved driver's on-track performance and documented areas for improvement. Normally this would be followed up with detailed coaching and mentoring sessions, also administered by a TOI. The results of the coaching and mentoring sessions were recorded in a database for retrieval as required.

Use of event recorder data

The RISSB *SPAD Risk Management Guideline* included guidance regarding 'good practice' relating to various SPAD management processes. Under a section on developing and maintaining staff competence, it stated:

> Include, within the assessment cycle, programmed assessment events such as practical rides, unannounced monitoring through, for example, on-train data recorder analysis, random monitoring of safety critical communications, monitoring from stations and yards, monitoring using CCTV etc

QR personnel reported that, prior to the 10 January 2018 SPAD occurrence at ME45, event recorders were not systematically used to evaluate driver compliance against rules and procedures, other than when investigating specific incidents and for a planned project to analyse driver behaviour in 2015. That 2015 project involved the comprehensive analysis of driver behaviour by the use of event recorders and front-of-train CCTV. To ensure the validly of the analysis, the event recorder and CCTV were calibrated for the purpose of accuracy. This enabled the analyst to see what the driver was viewing while the event recorder displayed inputs generated by the actions of the driver.

Although this was a protracted undertaking, this process provided the organisation with a comprehensive understanding of driver behaviour, risk exposure and the benefit of knowing the data was reliable if required for strategic use. In addition, the data could also be used to crosscheck other evidence gained from audits and assurance activities to form the basis for good strategic decision-making. It also provided a benchmark to evaluate future safety performance if strategic initiatives were introduced after the initial data collection.

Although the outcome of the project was well received by QR, there was no proposal to maintain the analysis of driver behaviour through the examination of event recorders.

QR advised the ATSB that it had not subsequently introduced any other program to review event recorder data to monitor driver performance prior to the 10 January 2018 SPAD. However, the SPAD Prevention Taskforce established in 2017 identified the use of proactive event recorder analysis as one of its critical SPAD prevention initiatives. After a period of planning, baseline data collection commenced in April 2018.

QR personnel involved in the analysis advised that the data collection was based on four SPAD mitigation rules (*Citytrain driving procedures*):

- 75% rule
- ‘start on yellow’ (SOY) rule
- stopped at red rule
- 20 / 20 rule.

As of March 2019, QR was still collecting baseline data. Data for the periods from September 2018 to March 2019 indicated compliance rates as follows:

- 87 per cent for the 75% rule
- 55 per cent for the SOY rule
- 92 per cent for the stopped at red rule
- 99 per cent for the 20 / 20 rule.

QR personnel advised that the data collection process did not use front-of-train CCTV footage as part of the analysis. Accordingly, there were assumptions made regarding some aspects of these analyses (in terms of what signal aspects a driver was exposed to in some cases).

Safety analysis

Introduction

Soon after departing Bowen Hills station, suburban passenger train TP43 was approaching signal ME45 on the down suburban line. The signal was displaying a red aspect (or stop indication), but the train continued past the signal, gradually accelerating.

There were no problems associated with the operation of the train or the serviceability of the train, and the signal functioned as designed. The immediate reason for the signal passed at danger (SPAD) was that the driver perceived the signal was displaying a green aspect and drove according to that belief.

Such a 'completely missed' SPAD can have very serious consequences as there were limited risk controls or defences in place on the Queensland Rail (QR) Citytrain rail network to recover from the situation. In this case, the network control officer (NCO) promptly responded to the SPAD alarm and alerted the driver of TP43, who stopped the train. Had the NCO not issued the stop instruction, there was potential for a collision with another suburban train.

The safety analysis will initially discuss the most likely factors that contributed to the driver's misperception of the signal. It will then discuss some of the key risk controls that QR had in place to minimise the risk of such SPADs. In particular, the analysis will discuss:

- the automatic warning system (AWS)
- risk triggered commentary driving (RTCD)
- the maintenance of competency (MOC) process
- the oversight of the MOC process
- other means of monitoring driver performance.

Potential factors associated with the SPAD

Overview

Train driving is a specialised task that is acquired through comprehensive training; it involves conducting routine, frequently practiced tasks in a largely automatic manner (at a skill-based level) with occasional conscious checks on performance. In addition, it relies on well-developed safeworking and route knowledge, particularly the location of signals and the sequence in which they function. Instead of simply responding to each signal in isolation (as is largely the case with road vehicle drivers), train drivers are required to anticipate the state of future signals based on the signal aspect indications of the preceding signals and other relevant information.

As stated by Stanton and Walker (2011):

> Assuming that the individual has the correct route knowledge for operating the train, their schema will enable them to anticipate events (such as the signals and signs they expect to see and routes they expect to take), search for confirmatory evidence (such as looking at the signal aspect, trackside objects, routing information, speed indicators and notes), direct a course of action (such as braking and accelerating) and continually check that the outcome is as expected (such as the slowing down or the speeding up of the train).

Accordingly, most of the driver errors associated with SPADs occur at the skill-based level of performance, and such errors are generally known as slips or lapses (Reason 1990). As noted by a recent UK Rail Safety and Standards Board (RSSB) report (Gibson 2016):

> The dominant driver error types that are causal or contributory to SPADs can be grouped together as slips or lapses, and are cases where the driver had the correct intention, but their performance based on that intention did not go as planned (for example forgetting to implement routine signal observation tasks or misperceiving signal aspects). These slips or lapses are primarily related to observing and

> acting on caution and stop aspects and are causal or contributory in 70% of SPAD incidents. Key mechanisms underpinning these errors include attention (for example distraction) and expectation (for example, a caution signal is perceived to be green rather than at caution because it is usually at green in the driver's experience).

In this case, the driver misperceived signal ME45 to be displaying a green aspect as the train traversed the sweeping right curve prior to the signal. When traversing the curve, the driver would have first sighted signal ME37 (which was displaying a green aspect) just before sighting signal ME45 (which was displaying a red aspect). Therefore, based on the available evidence, the driver probably read through to the other signal (ME37) and mistook it for ME45, and subsequently assessed that ME45 was displaying a green aspect.

Expectancy

Expectations are based on past experience and other sources of information. They strongly influence where a person will search for information and what they will search for (Wickens and McCarley 2008), and they also influence the perception of information (Wickens and others 2013). In simple terms, people are more likely to see what they expect to see, and less likely to see what they do not expect to see.

Exactly what the driver was expecting when the train departed Bowen Hills and on approach to signal ME45 could not be determined, as the manner in which a train is driven after departing Bowen Hills is not significantly different when the departure signal is at yellow compared to when it is at green. However, a read-through error when approaching signal ME45 (and assessing the signal to be green) would be consistent with the driver expecting that signal ME45 was not displaying a red aspect.

In this case, the driver of TP43 was very familiar with the route, and statistics provided by QR showed that drivers rarely (less than 1 per cent of the time) encountered a red aspect at signal ME45. This context would generally create an expectation, in the absence of other information, that the signal would not normally be displaying a red aspect.

Prior to boarding the train, the driver noted that the departure signal (ME25) was displaying a yellow aspect. This meant that, at that time, signal ME45 would have been displaying a red aspect, and the driver should have expected that signal ME45 would be at red. It is also noted that, when contacted by the NCO after passing ME45, the driver was able to recall that the departure signal was at yellow. However, their ability to recall that signal after being stopped by a controller does not necessarily mean they had a high level of awareness of that signal (and therefore the likely status of ME45) when approaching ME45.

A number of factors could have reduced the driver's awareness of the status of the departure signal, and affected their expectancy of the status of signal ME45 when approaching that signal:

- The signal aspect of ME25 was not discussed during the changeover with the outgoing driver.
- After boarding the train, the driver's attention was distracted due to problems with their seat (see also next section).
- The driver could not recall checking or sighting the departure signal after boarding the train, and they reported they probably did not check the signal. Based on the available information, it would appear very unlikely that the driver did check the signal.
- The driver did not apply risk triggered commentary driving (RTCD) as a general practice, or specifically on this occasion, in response to the restricted signal prior to departing Bowen Hills.
- Drivers often encounter situations where the signals ahead of a train stopped at a platform upgrades prior to them leaving the platform. Similarly, as noted by Punzet and others (2018), 'In some situations and under certain conditions, a strong route knowledge can be detrimental as it can lead to habituation and incorrect assumptions. For example, if a signal in a particular location is often or always on amber (indicating the next signal may be on red), but the next signal is actually green by the time the train approaches it, a train driver may become

habituated to the fact that the second signal is always green and so may assume it is green on every approach.'

- At least five of the 10 SPAD occurrences at signal ME45 since 1996 involved drivers who had just boarded the train following a changeover at Bowen Hills. During this period, it is likely that significantly more than half the trains passing through signal ME45 did not have a driver change at Bowen Hills. Therefore, this data indicates that the process of boarding a train may increase the likelihood of a driver not fully recognising the significance of a yellow departure signal, and other expectancies may have more influence on their performance than the status of the departure signal.
- Drivers who board a train at Bowen Hills when signal ME45 is displaying a red aspect only receive cues from signal ME25 (displaying a yellow aspect), whereas drivers that do not change at Bowen Hills would receive a double yellow aspect at the signal prior to ME25 as well as the yellow aspect in ME25.

Based on the available evidence, the ATSB concluded that the driver was probably not expecting to see a red aspect when approaching ME45, even though they had identified that the departure signal was displaying a yellow aspect prior to boarding the train.

The driver had opportunities to maintain or reinforce their awareness of the status of the departure signal prior to departing the station and on approach to signal ME45. In particular, not consciously checking the departure signal, either before or after receiving the 'rightaway' from the guard, removed a critically important opportunity. However, the extent that this action by itself would have prevented the subsequent error could not be determined, due to the number of other potential factors involved.

Distraction

Research has shown that distraction or diverted attention involving the driver is commonly associated with SPADs (Naweed and Rainbird 2013). Distractions can arise from task-related activities (both inside and outside the locomotive cab), activities unrelated to the task or internal thoughts (Regan and others 2011).

In this case, the primary potential distraction the driver experienced after boarding the train was the seat descending to its lowest position. Associated with this distraction, it is very likely that the driver did not check/sight signal ME25 prior to departing the station.

The driver reported that they did not adjust the seat's position prior to departing the station, or during the approach to signal ME45, instead intending to fix the adjustment at the next station. Regardless of whether the driver was attempting to adjust the seat after departing the station, there was still the significant potential for distraction associated with a jarred back and being in an unusually low seating position during this period.

After exiting the sweeping right curve, the driver would have had 175 m of clear unobstructed view of signal ME45. During the 25–27 seconds it took to travel this distance, the driver did not detect that the signal was displaying a red aspect. The extent to which the driver looked at the signal during this period could not be determined. However, if the driver had already decided that the signal was displaying a green aspect, they may not have noticed the red aspect even if they looked at the signal. A substantial body of research has shown that when a person's attention is focussed on another task, they often do not detect an unexpected object or event, even sometimes when it is salient and the person is looking directly at it (Chabris and Simons 2010). In this case, in addition to aspects associated with the seat, the driver's attention would have been focussed, at least to some extent, on the signals after ME45.

Summary

The investigation considered a variety of other explanations for why the driver perceived the signal aspect of ME45 to be green. However, there was no evidence to indicate the driver had a medical

or vision problem, and there was no indication that sun glare or other factors were affecting the visibility of the signal.

Other than the seat, there appeared to be no other sources of distraction. Some research has indicated that time pressure associated with dwell times at stations can be a source of distraction for drivers (Naweed 2013). In this case, the driver indicated that they would rather not fix the problem with the seat at Bowen Hills and extend the station dwell time. Instead they chose to adjust the seat at the next station (Albion) during that station dwell time, therefore not delaying the train. However, there was insufficient evidence to conclude that concerns regarding on-time running was affecting the driver's attention.

On the day of the SPAD, the driver had commenced a third early start shift in succession. However, there was sufficient rest opportunity between shifts for the driver to be fit for duty and they had a significant rest break just prior to boarding the train. There was no indication that the SPAD resulted from a delayed response time or not sighting a signal at all, which would be more likely associated with fatigue. Overall, there was insufficient evidence to conclude that the driver was experiencing a significant level of fatigue at the time of the SPAD.

Due to the skill-based nature of train driving, it is not always possible for drivers to have a full recollection of events and their thought processes, and therefore it is not always possible to determine the immediate reasons why a SPAD occurred. In this case, when approaching signal ME45, the driver probably read through to another signal displaying a green aspect, which they misidentified as signal ME45. Expectancies of the usual indications of ME45 and distraction associated with the seat position probably contributed to this error and the driver's ability to detect this error.

Effectiveness of the automatic warning system

The Citytrain network had an automatic warning system (AWS) in place to provide drivers with a visual indication and aural alarm if an upcoming signal aspect applicable to the path of the train was 'restricted' (that is, any colour other than green).

In this case, the driver of TP43 promptly responded to the aural alarm for signal ME45 by acknowledging the AWS reset button, but they did not recall doing so. The alarm also appeared to have no influence on the driver's misperception that the signal was displaying a green aspect. The extent to which the AWS resulted in the driver checking the signal indication could not be determined, but as previously noted any such check may not have been effective depending on the driver's focus of attention and expectancy at the time.

Although the AWS reduces the likelihood of SPADs in some situations, it is widely acknowledged that its design is fundamentally limited, and it does not eliminate SPADs. More specifically, because the system provides the same visual and aural alarm for all restricted signals (including those with a double yellow, yellow, flashing yellow or red aspect), the significance of approaching a red aspect (stop) indication is substantially diminished.

Research has indicated that a significant number of drivers in many rail networks have reported that they have 'automatically' acknowledged the AWS alarm at a restricted signal (McLeod and others 2005, Naweed and others 2015). That is, they have acknowledged the alarm without recognising that it had occurred. This is known to occur in situations where drivers frequently encounter restricted signals with yellow or double yellow aspects. Some research has shown that at times drivers respond so fast to an AWS alert that it appears to be done proactively in anticipation of the alert rather than reactively in response to the alert (Stanton and Walker 2011).

The inner-city part of Citytrain's network runs at near full capacity during peak periods, with trains closely following other trains. This means that drivers frequently encounter restricted signals. For that reason, it is understandable how drivers can become conditioned to cancelling the AWS alarm as a habitual, automatic and/or reflexive reaction.

With almost all ‘completely missed’ SPAD occurrences, the drivers have automatically responded and cancelled the AWS alarm without recognising the situation. In many cases, the drivers have not even been aware that they have cancelled the alarm, therefore nullifying the driver-signal relationship. This was almost certainly the case with the 10 January SPAD occurrence, and a significant number of other SPAD occurrences on the Citytrain network.

In summary, the AWS was not a highly effective risk control because it provided the same audible alarm and visual indication on the approach to all restricted signals. The potential for habituation and the absence of a higher priority alert when approaching a red aspect (stop indication) reduced the effectiveness of the AWS to prevent SPADs.

The Citytrain network had various engineering controls in place to reduce the potential likelihood of a SPAD (such as track design, signal design or signal aspect sequencing) or reduce the consequences of a SPAD (such as overlaps). However, there were limited engineering controls in place to detect potential or actual SPADs and manage their risk. Citytrain had SPAD alarms within its universal traffic control (UTC) system that provided an alert if a train passed a signal displaying a red aspect, but this only applied to controlled signals. Such a system also required the NCO to interpret the situation and then issue an emergency stop command to the driver, a process that involved a short time delay and would not always be successful.

Given the limitations of the AWS and UTC SPAD alarms, Citytrain had to place substantially more reliance on driver performance and associated administrative controls to minimise the risk of SPADs compared to rail networks that had additional or more sophisticated engineering controls in place to detect potential or actual SPADs and manage their risk. Accordingly, Citytrain had specified operational procedures and rules for drivers to use to minimise the risk of SPADs. In addition, it had introduced a range of processes and controls to maximise the use of these rules, such as training its drivers, routinely assessing driver performance (using the maintenance of competency process), implementing risk triggered commentary driving, investigating SPADs, and assessing and managing the performance of drivers involved in a SPAD .

Although procedural and administrative risk controls will always be necessary, it is important to recognise that the use of such controls will always be fundamentally limited in their effectiveness compared to well-designed engineering controls for detecting potential or actual SPADs and managing their risk (see also *Other processes for monitoring compliance with operational rules*). The future implementation of the European Train Control System (ECTS) to the Citytrain network should play a significant role in managing SPAD risk at locations where it is fitted.

Implementation of risk triggered commentary driving (RTCD)

To assist with reducing the frequency of SPADs, QR introduced risk triggered commentary driving (RTCD) in 2008–2009, and subsequently Citytrain made it a mandatory requirement for its drivers in 2011 for situations where they were approaching a restricted signal. The justification for RTCD was to reduce driver distraction/inattention by getting drivers to speak aloud the signal aspect and their required actions while travelling on restricted signals.

In this case, the driver of TP43 reported that they did not apply RTCD. If the driver had applied RTCD in accordance with the operator’s procedures when departing Bowen Hills (starting on a yellow aspect), it is possible this may have facilitated an expectation that signal ME45 would be displaying a red aspect. However, the extent that this would have overcome other expectations is unclear. In addition, having (incorrectly) perceived signal ME45 was displaying a green aspect, there was no requirement for the driver to continue RTCD. Overall, it is difficult to conclude that in this case applying RTCD would have prevented the SPAD.

The application of RTCD when approaching a restricted signal will potentially have benefits for many drivers in many situations. However, there were some problems with the way the technique was implemented within Citytrain that limited its potential effectiveness. These problems included:

- The technique was made mandatory (for restricted signals) in Citytrain without any explicit acknowledgement that its application in some cases actually increased risk. Human factors specialists in the UK Rail Standards and Safety Board and QR noted that in high workload situations the use of the technique would be problematic.
- Unfortunately, in the rail environment there has been very little formal research that has examined RTCD. Although research into road vehicle drivers has shown some benefits with using different forms of verbal commentary (Young and others 2014), research has also shown that producing a verbal commentary can decrease concurrent hazard perception in road vehicle drivers (Young and others 2017) and adversely affect the performance of airline pilots in high workload situations (Earl and others 2017). Potential problems with workload and distraction when using the technique in high workload situations were also raised by human factors specialists external to and within QR prior to the Citytrain decision to mandate the technique. Not clearly recognising and managing such limitations when implementing RTCD increased the likelihood that the technique would not be perceived as useful by drivers.
- The changes implemented in 2011 did not effectively ensure that tutor drivers, and therefore drivers, had a consistent understanding of when the technique was required to be used and how it should be applied. The SPAD Prevention Working Group in 2013 and a QR audit report in 2015 noted this problem. This problem was also evident in late 2018 when the ATSB interviewed a sample of tutor drivers and drivers. In general, there appeared to be a common belief that RTCD was mandatory under all conditions (rather than just for restricted signals). Such beliefs would likely lead to reduced perceptions of its practicability or usefulness and detract from its application when it was most relevant.
- There was limited information to confirm that the practical on-track MOC assessments were effectively being used to assess driver competence and/or compliance with the RTCD procedure. The driver involved in the 10 January 2018 SPAD reported that they did not use RTCD, including during MOC assessments, yet no problems were identified with their RTCD performance during multiple MOC assessments.
- Other than actually observing a driver apply RTCD during a practical MOC assessment or an in-cab monitoring activity, there was no formal method to establish if the technique was actually being applied on a routine basis. Conducting observations of its use is problematic, as it may not reflect normal operations. However, some form of anonymous or de-identified survey of drivers could have been undertaken to assess reported usage of the technique and perceptions of its usefulness. Without some form of measurement, QR and Citytrain had a limited understanding of the technique's usage rate or effectiveness.
- During SPAD investigations, QR had asked drivers whether they were applying RTCD at the time of the SPAD, and in most cases the drivers reported it was not being used. Although such a result could be interpreted as indicating the technique was effective (if it was being used), any firm conclusions about effectiveness would be tenuous without having data about how often the technique was actually being used correctly. The data from SPAD investigations may simply be indicating that the technique was rarely being used in general.

In summary, based on the available evidence, Citytrain did not implement RTCD in a manner likely to maximise its potential benefits and minimise its potential limitations or risks. This was mainly due to change management limitations associated with introducing the technique as a mandatory risk control, limited processes in place to evaluate its utilisation and effectiveness, and ineffective risk management associated with not detecting and rectifying identifiable shortfalls with some drivers' understanding of the technique and how it should be applied.

Application of the maintenance of competency process

Train drivers perform a safety-critical role, both in terms of minimising the risk of SPADs but also in terms of minimising the risk of many other types of safety-related occurrences. Therefore, a train driver's performance needs to be systematically assessed at regular intervals to ensure they are competent to perform their role. This is also a regulatory requirement.

Accordingly, QR had invested significant resources into designing its MOC process to ensure it assessed a wide range of knowledge and skills required by its drivers. In addition, it was investing significant resources into administering MOC assessments, by allocating a tutor driver to conduct a 2-day MOC assessment with each driver every 18 months.

Even though significant resources had been applied to the design and administration of QR's Citytrain driver MOC process, the ATSB's review of a number of MOC assessments and related evidence identified a number of anomalies or limitations. These included:

- There was evidence that, at least on some occasions, drivers had access to a copy of the assessor's written MOC marking guide when completing the written MOC assessment. This was stated in some reports from witnesses and drivers. It was also indicated by the way answers were presented in some written MOC assessments, with word-for-word answers from the marking guide. This included a spelling error in the assessor's marking guide which was reproduced in some of the drivers' MOC assessments, and also answers to questions written out of order.
- There were numerous other occasions when answers requiring a detailed response in the written MOC assessment matched word-for-word the answers from the assessor's marking guide. The extent to which this occurred was inconsistent with how a sample of tutors described their process for administering the written MOC assessment, with most saying that the drivers would write down their initial answer first before being provided the answer from the marking guide.
- It is likely that at least in some cases drivers were providing their initial answers to the written MOC questions verbally, and then tutors provided the correct answer from the marking guide for the driver to write down, resulting in word-for-word answers. This practice was inconsistent with the MOC instructions and the general rules of evidence for assessments (in terms of authenticity).
- The guidance material for assessors and Citytrain training managers stated that the MOC was an assessment of competency; however many of the tutor drivers who administered MOC assessments suggested it should be considered more as an opportunity to train or coach drivers. In other words, many tutor drivers regarded the MOC as a means to ensure competency rather than a means of assessing competency. Despite various communications from management to the tutors in 2016–2017, it did not appear that these different perspectives were effectively resolved, with many written MOC assessments appearing to involve significant coaching.
- There were significant variations in how tutors were administering the MOC. Although some variation is natural when dealing with a large pool of assessors and a long assessment process, significant variation appeared to create the potential for some tutors to use their judgement to shortcut the assessment process for some items if they did not believe the items were important.
- Based on the available documentation, drivers were achieving very high levels of success on all the assessments, with very few indications of areas where initial responses or performance could be improved. Such results were unrealistic for such a large written assessment. Such results also meant that topics that drivers had some difficulty with were not being formally noted in development plans, or for identifying areas of focus for future assessment.
- There was no systematic process for recording questions that drivers were having difficulty with across all the MOC assessments. This limited the potential for Citytrain to identify and evaluate questions to see if they needed rewording or if broader education or communication strategies were required across the driver cohort.
- The driver involved in the 10 January 2018 SPAD achieved perfect or near-perfect results in their previous written and practical MOC assessments prior to the SPAD. However, the results of the driver's post-SPAD coaching and mentoring sessions indicated that they had developed some driving habits over an extended period that were inconsistent with Citytrain procedures

and guidance. It was very likely the non-compliance issues had become characteristic and well entrenched, as the driver had difficulty readjusting to QR's driving procedures even with the aid of 11 coaching and mentoring sessions. This pattern was consistent with a driver who was learning the required procedures and techniques, rather than a driver who had recorded near faultless written and practical MOC results over a period of 10 years. A similar pattern was subsequently identified with three other experienced drivers who had been involved in SPAD occurrences.

- As noted in the previous section, the driver involved in the 10 January 2018 SPAD reported that they did not use RTCD, yet no problems were identified with their RTCD performance during multiple MOC written and practical assessments.
- All of the drivers' on-track practical MOC assessments analysed by the ATSB showed faultless or near perfect results. It is not likely that these results could have been achieved by all. The on-track practical MOC assessment was performed over an entire day, which encompassed a wide range of activities that provided many hundreds of opportunities for error. It is reasonable to expect that tutor drivers noted errors or other problems in many if not most of these MOC assessments, and potentially discussed these with the drivers, but no details were recorded in the MOC assessments.

Overall, these limitations resulted in a situation where Citytrain's administration of the MOC process provided limited assurance that the drivers who undertook the MOC assessments met relevant competency requirements. Many of the driver MOC assessments were being completed in a manner that was inconsistent with the specified instructions. In such cases where there are routine deviations from a defined procedure or process, it becomes difficult for those involved to determine what aspects of the specified instructions are essential or important.

It should be noted that the ATSB is not suggesting that QR's Citytrain drivers were not competent; rather, the application of the process for assessing competency had significant limitations in assuring the drivers' competency. It is very likely that most of the Citytrain drivers possessed the skills, knowledge and aptitude to demonstrate competency at the time the assessments were conducted. However, the limitations with the process meant that some drivers would be assessed as competent when they could not meet all the relevant requirements. As indicated above, this was found to have occurred on multiple occasions.

In the case of the driver involved in the 10 January 2018 SPAD, it is apparent that the MOC assessments administered prior to the SPAD were not effective in identifying problems with the driver's knowledge and skills that probably existed at the times those assessments were conducted. However, based on the available evidence, the ATSB was unable to conclude that the main limitations in the driver's ongoing performance, identified after the SPAD, were related to the specific actions involved in the SPAD occurrence sequence. Nevertheless, the problems associated with the administration of the MOC process across the driver cohort was a significant safety issue with the potential to contribute to other safety occurrences.

It is likely that the limitations in the MOC process evolved due to a combination of many factors. The high number of questions (up to 300) in the written MOC assessment placed pressure on both the drivers undertaking the assessment and the tutor drivers administering the assessment. This was exacerbated by the absence of a dedicated period of retraining prior to the administration of a written MOC, and limited, tailored guidance material for drivers to review prior to undertaking the assessment. There were also perceptions that a number of the questions on the written MOC were not relevant the drivers' role, although the ATSB's review of the MOC assessments indicated that the majority of the MOC questions had relevance. In addition, there was limited oversight of the tutors within TSD training due to the nature of the organisational structure and the nature of the one-on-one assessments of the drivers.

Overall, these types of factors contributed to the differences in perception about the purpose of the MOC process and/or how it should be administered between those who designed the MOC and the training managers compared to the tutor drivers and drivers. In addition, the ATSB noted that

there was significant pressure on the Citytrain TSD training section during the years prior to 2018 associated with ensuring that sufficient numbers of new drivers were trained, at the same time that the MOCs for existing drivers were being conducted.

Oversight of the maintenance of competency process

Regardless of the exact reasons for it, there was a significant problem occurring with the administration of driver MOC assessments and the overall level of assurance being provided by the MOC process. Accordingly, the ATSB examined the extent to which QR and Citytrain had identified and was attempting to assess and address the problem.

The MOC was a necessary and important component of QR's safety management system and obviously a very important risk control used by QR to manage risk. In addition, the MOC was particularly important in Citytrain's management of SPADs, given the suburban network was carrying a large number of passengers with limited engineering controls in place to detect potential or actual SPADs and manage their risk, and there were limited processes in place to monitor driver compliance with SPAD management procedures (see next section).

Overall, QR had a defined structure and process for risk management, which included various policies, standards and procedures and incorporated three lines (or levels) of assurance. The process identified risks and planned second line and third line assurance activities accordingly, with first line assurance activities being conducted at the local level by relevant personnel.

In the case of the MOC, there were planned second line assurance activities that examined the MOC process. However, these activities focussed on determining the extent to which MOCs were being conducted at the required time intervals. Given the formal requirements associated with conducting MOCs at 18-month intervals, this focus was understandable. There was minimal focus on examining how the MOCs were being conducted, and it would be reasonable to expect that many transport operators would not have identified a need to focus assurance activities on how their competency processes were being conducted.

Nevertheless, through a second line assurance activity conducted in November 2015, it was identified that a high percentage of driver and guard written MOC assessments contained answers matching word-for-word with the assessor's marking guide, and this was raised as an observation in the auditor's report. Similarly, a first line assurance activity undertaken in 2016 within TSD training identified a case of a tutor's MOC containing word-for-word answers, and this activity was conducted soon after a manager observed a driver undertaking a written MOC assessment with a copy of the marking guide, and a number of that driver's responses contained word-for-word answers. QR's Human Resources (HR) section also encountered the problem in another investigation in 2015, and at that time were advised by TSD management that word-for-word answers from the marking guide would be common.

In response to some of these identified problems, TSD managers sent out a series of reminder emails to tutors regarding the importance of ensuring marking guides were secure and not able to be accessed by drivers or guards undertaking MOC assessments. In addition, a written instruction for the MOC process was developed in September 2017, which expanded on guidance already contained within the written MOC assessment and the associated marking guide.

Although these interventions occurred, at no stage did QR or Citytrain ever seek to conduct a more detailed audit or review of the situation to determine the extent of the problem or the underlying reasons for the problem, or whether the problem was still ongoing after the interventions. When the ATSB reviewed a sample of written MOC assessments from November 2017, and a smaller sample in June 2018, the problems associated with word-for-word answers were still evident. Problems with individual development plans in the MOC process were also identified in a November 2015 audit, but as far as could be determined, were not revisited in subsequent assurance activities.

It is acknowledged that during the period leading up to the 10 January 2018 SPAD occurrence, the TSD training section was under significant pressure with its requirements for training new drivers as well as administering MOCs for existing drivers. Nevertheless, given the significance of the MOC as a risk control, and the nature of the problems previously identified, further assurance activities were warranted.

In summary, the driver MOC process was a necessary and very important risk control within Citytrain. However, QR's management oversight of the Citytrain driver maintenance of competency (MOC) process did not include planned assurance activities or regular and effective auditing of how the MOCs were being conducted, even after there were multiple indications that the process was not being administered as designed.

Other processes for monitoring compliance with operational rules

QR Citytrain carried a large number of passengers each year and, as already discussed, it had limited engineering controls in place to detect potential or actual SPADs and manage their risk . Accordingly, Citytrain placed a heavier reliance on driver performance to minimise the risk of SPADs compared to rail networks that had additional or more sophisticated engineering controls.

However, although SPADs are somewhat frequent events in terms of the number of occurrences per year on a rail network, they are rare events in terms of the number of times they occur per driver. For example, an independent review of SPADs commission by QR in 2014 noted that on the Citytrain network each driver would average about 2.2 SPADs in a 40-year career (or about one SPAD every 18 years).

In addition, SPADs are also rare events in terms of the number of red aspects encountered. For example, in the UK rail context, the UK RSSB (Gibson 2016) estimated that the rate of SPADs was one per 25,000 approaches to a red aspect. It also noted that this level of performance was approaching the currently understood limits of human reliability for such tasks. Although it is problematic comparing SPAD performance between different networks, it appeared that Citytrain's SPAD performance was at about these levels (averaging about one SPAD per 31,000 approaches to a red aspect during the period from July 2016 to June 2018).

Given such statistics and the inherent nature of human performance, it is not possible to eliminate SPADs by focussing on driver performance. Nevertheless, a rolling stock operator needs to continually review and enhance its processes and controls to improve and/or at least maintain its SPAD performance levels.

As part of such activities, it is considered good practice for a rolling stock operator to collect and analyse information about normal operations in order to understand the level of compliance with relevant rules and procedures, and to best target further efforts for improving driver performance. QR had some processes in place for monitoring driver performance. These included the MOC for existing drivers, a program for monitoring recent drivers, and occasional in-cab monitoring of drivers. However, with such processes, drivers know they are being assessed, and may perform differently to their normal operations. In addition, sample sizes may not be sufficient to understand the true nature of driver performance on a network and the factors that may be influencing driver performance.

In contrast, a best-practice process of monitoring driver compliance with relevant rules and procedures would involve reviewing event recorder data from normal operations. Although QR had trialled such a process in 2015, this was not continued.

In summary, prior to the SPAD occurrence on 10 January 2018, QR did not routinely and systematically analyse recorded data to determine driver compliance with key operational rules that had been designed to minimise the risk of SPADs. As such, its ability to effectively target interventions to continually improve driver performance or identify problems with particular locations or other factors, on the Citytrain network was limited.

It is noted that QR started considering another process for reviewing event recorder data in late 2017, which commenced collecting baseline data in April 2018. Until more sophisticated engineering controls to detect potential or actual SPADs and manage their risk can be introduced on the Citytrain network, such a process is essential to better target future interventions to improve driver performance.

Last line of defence

In March 1996, a suburban passenger train and a freight train collided after the suburban train exceeded its limit of authority by passing signal ME45 while it displayed a red aspect (stop indication). As the suburban train passed ME45, the signalling system generated a SPAD alarm in the network control centre, warning the network control officer (NCO) that the train had exceed its authority. However, at that time the NCO was not in a position to respond to the situation by transmitting an emergency stop command to the driver of the suburban train. Therefore, the final opportunity to prevent the train-to-train collision was lost.

The 10 January 2018 SPAD at ME45 has similarities to the March 1996 SPAD and subsequent train-to-train collision. In both cases, the drivers passed signal ME45 unaware it was displaying a stop indication, and in both cases there was an opposing train movement.

However, on 10 January 2018, the NCO observed the SPAD alarm and issued a stop command to the driver, and the driver stopped the train prior to reaching the conflict point. Although the two trains would not have collided had they continued at their expected speeds, this occurrence has highlighted the potential consequences of a SPAD and the importance of having an effective series of risk controls in place to minimise the likelihood of a SPAD and maximise the ability to detect and manage potential or actual SPADs before adverse consequences can occur.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

Safety issues are highlighted in bold to emphasise their importance. A safety issue is a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to TP43 passing signal ME45 without authority resulting in a near miss with suburban passenger train TR50 near Bowen Hills, Queensland on 10 January 2018.

Contributing factors

- Approaching the first signal (ME45, displaying a red aspect) after departing from Bowen Hills, the driver probably read through to another signal for an adjacent line that was displaying a green aspect, which they incorrectly believed was signal ME45.
- Although the driver of train TP43 acknowledged the automatic warning system audible alarm, this was almost certainly an automatic response that did not result in an effective check of signal ME45's aspect indication, resulting in the signal's red aspect not being detected.
- **The automatic warning system (AWS) provided the same audible alarm and visual indication to a driver on the approach to all restricted signals (that is, double yellow, yellow, flashing yellow and red aspects). The potential for habituation, and the absence of a higher priority alert when approaching a signal displaying a red aspect, reduced the effectiveness of the AWS to prevent signals passed at danger (SPADs). This placed substantial reliance on procedural or administrative controls to prevent SPADs, which are fundamentally limited in their effectiveness.** (Safety issue)

Other factors that increased risk

- Although the driver of TP43 had observed the departure signal (ME25) displaying a yellow aspect before boarding the train at Bowen Hills, it is very likely they did not check the signal again, either before or after receiving the 'rightaway' from the guard. This removed a critically important opportunity to reinforce their awareness of the status of the departure signal, and the likely status of the next signal (ME45).
- **After mandating the use of risk triggered commentary driving (in 2011) to mitigate the risk of signals passed at danger, Queensland Rail Citytrain did not provide the necessary support to its trainers, assessors and drivers to effectively maximise the potential benefits of the technique and minimise the potential limitations or risks associated with the technique.** (Safety issue)
- **Queensland Rail's administration of the maintenance of competency (MOC) assessment process provided limited assurance that its Citytrain train drivers met relevant competency requirements.** (Safety issue)

- **Queensland Rail's management oversight of the Citytrain driver maintenance of competency (MOC) process did not include planned assurance activities or regular and effective auditing of how the MOC assessments were being conducted, even after there were multiple indications that the process was not being conducted as designed.** (Safety issue)
- **Prior to the signal passed at danger (SPAD) occurrence in January 2018, Queensland Rail did not routinely and systematically analyse recorded data to determine driver compliance with key operational rules that had been designed to minimise the risk of SPADs.** (Safety issue)

Other findings

- After the universal traffic control system generated a SPAD alarm, the network control officer broadcast an emergency stop command to the driver of TP43 to stop their train.

Safety issues and actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the rail industry, the ATSB may issue a formal safety recommendation or safety advisory notice as part of the final report.

All of the directly involved parties were provided with a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions are provided separately on the ATSB website, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website as further information about safety action comes to hand.

Train driver maintenance of competency assurance

Safety issue description

Queensland Rail's administration of the maintenance of competency (MOC) assessment process provided limited assurance that its Citytrain train drivers met relevant competency requirements.

Issue number:	RO-2018-002-SI-01
Issue owner:	Queensland Rail
Transport function:	Rail: Passenger - metropolitan
Issue release date:	27 February 2019
Current issue status:	Closed - Addressed
Issue status justification:	The ATSB is satisfied that the actions undertaken by Queensland Rail to change the MOC process will reduce the risk of this safety issue.

Proactive safety action taken by Queensland Rail[32]

Action number:	RO-2019-002-NSA-049
Action organisation:	Queensland Rail
Action date:	27 February 2019
Action status:	Closed

The Queensland Rail (QR) internal safety investigation into the 10 January 2018 SPAD occurrence at signal ME45 was completed in February 2018. The report included the following conclusions related to the driver maintenance of competency (MOC) process:

- There is no requirement for the assessor to observe an RTD [driver] performing the complete Start on Yellow Procedure during MOC practical assessment and the current written assessment markers guide does not contain all the requirements for the Start on Yellow procedure.

[32] This final ATSB report provides a more detailed version of the safety action provided by QR as of February 2019 than was released in the ATSB's interim report.

- Although the Relief RTD was deemed competent in his use and knowledge of RTCD during his Maintenance of Competency Assessment the Relief RTD stated during interview that he routinely does not use RTCD.

The report also included the following internal recommendation (with a due date of 30 November 2018):

> Manager Train Services Delivery Training to lead a multidisciplinary review of the Rail Traffic Driver Maintenance of Competency Assessment Process to include (not exclusively) content, assessment methods, trainer/assessors and security of training materials, and produce an action plan to address any outcomes of the review.

The ATSB briefed Queensland Rail senior management about the MOC process safety issue in June 2018 and August 2018, and the ATSB formally advised QR about the safety issue in September 2018.

On 19 October 2018, QR responded to the safety issue with the following information:

> Queensland Rail senior management has not identified a systemic MOC issue. Historically Queensland Rail has identified individual code of conduct failings and has untaken HR investigations in relation to these issues…
>
> Specifically in relation to the SPAD at ME45 on 10 January 2018, the [QR internal] safety investigation Identified inconsistencies with the marking and assessment process for the route competency of the driver involved and recommended "Manager Train Services Delivery Training to lead a multidisciplinary review of the Rail Traffic Driver Maintenance of Competency Assessment Process to include (not exclusively) content, assessment methods, trainer/assessors and security of training materials, and produce an action plan to address any outcomes of the review" with an initial target completion date of 30 November 2018…
>
> Following identification of the issue, QR has ensured the safety of its operations, so far as is reasonably practicable, including by actively managing any identified MOC non-compliance and monitoring information regarding the operation of rolling stock to confirm driver competency.

In relation to the multidisciplinary review, QR stated that it would continue for a further 12 months for various reasons, including:

> The existing Rail Traffic Crew MOC was designed to meet legislative requirements outlined in the Rail Safety National Law (Queensland) Act 2017, Subdivision 8 Competence and identification of rail safety workers, and Subdivision 10 Accreditation.
>
> The Rail Safety National Law requires Rail Traffic Crew to hold the appropriate competencies in order to fulfil their role. Queensland Rail has been given a two year transitional period to comply with these changes, ending June 2019.
>
> As such, the outcomes of the multidisciplinary review will not be able to be implemented until the end of this transitional period.

QR also advised:

> While this multidisciplinary review is being conducted, safety actions undertaken include:
>
> - Comprehensive review of completed MOCs to ensure quality
> - Monitoring of train journey data on an ongoing basis, with over 4000 reviews completed to date to verify actual driver compliance with requirements and competency
> - Active management on any identified non-compliance with the support of the People and Culture function. This has recently resulted in disciplinary action...
>
> Further to these safety actions undertaken, Queensland Rail has implemented a Tutor Leadership program that is currently in the process of being rolled out to all Tutor Drivers and Tutor Guards. Consisting of four Modules, the program seeks to strengthen the Tutor's understanding and demonstration of Leadership, Management, Training and Assessment…
>
> Further to this ongoing review, the Manager TSD Training undertook a review of MOCs to ensure that all drivers on the Network hold a current MOC…

On 27 February 2019, the ATSB released an interim report into its investigation of the 10 January 2018 SPAD. In February 2019, QR advised the ATSB that it had completed a multidisciplinary review of driver training (including the MOC). A working party was convened on 7 January 2019 to identify key initiatives to improve current rail traffic crew training practices, and these new initiatives commenced introduction from late January 2019.

In February 2019, QR also stated:

> From April 2019, [QR] will transition to a revised theory assessment as part of the MoC process, with updated questions and content which will be administered through a classroom-based group setting, rather than on an individual basis wherever practical. This is in line with contemporary adult learning practices and the process adopted by many other rail operators in undertaking MoC assessments.
>
> The MoC process is only one component of [QR's] comprehensive assurance process for existing drivers, with regular analysis conducted of train event recorders… to identify and manage driver behaviours, in addition to on-track assessments by driver supervisors [see also safety issue RO-2018-002-SI-005].

Proactive safety action taken by Queensland Rail

Action number:	RO-2019-002-NSA-054
Action organisation:	Queensland Rail
Action status:	Closed

In March 2021, QR advised the ATSB that the MOC process had been reviewed and updated, which included 'Changes made to the questions and test methodology to ensure that critical requirements are tested and that the assessments assessed correctly'. More specifically, it advised:

> In 2019 the TSD Training Team undertook a review of the current Monitoring of Competence (MOC) process for all Rail Traffic Crew (RTC), both in SEQ [south-east Queensland] and Regional. The MOC process was overhauled to ensure that it was current with best learning practice.
>
> This included transitioning to a multiple choice based approach and reducing the volume of questions to ensure only understanding of critical information was being confirmed.
>
> Two different theory papers were created to help ensure RTC did not know which test paper they would be taking, and a first line assurance process was created that involves an independent TSD Training Admin Officer monitoring the theory component as well as selecting which paper is allocated to the RTC.
>
> In December 2020 SEQ RTC MOC [was moved to] Summative to Cloud Assess, thus removing the risk of questions being marked incorrectly.

QR further advised that:

> Cloud Assess is an online learning assessment system. Queensland Rail has moved the theory components of the MoC and Summative assessments to this system which enables auto-marking of the multiple-choice questions, thus mitigating the chances of an answer being marked incorrectly.

Oversight of the train driver maintenance of competency process

Safety issue description

Queensland Rail's management oversight of the Citytrain driver maintenance of competency (MOC) process did not include planned assurance activities or regular and effective auditing of how the MOC assessments were being conducted, even after there were multiple indications that the process was not being conducted as designed.

Issue number:	RO-2018-002-SI-02
Issue owner:	Queensland Rail
Transport function:	Rail: Passenger - metropolitan

Current issue status:	Closed – Adequately addressed
Issue status justification:	The ATSB acknowledges the significant increase in assurance activities undertaken by Queensland Rail in this area and is satisfied that, if such activities continue to be undertaken, the risk of the safety issue will be reduced.

Proactive safety action taken by Queensland Rail

Action number:	RO-2019-002-NSA-053
Action organisation:	Queensland Rail
Action status:	Closed

In March 2021, Queensland Rail (QR) advised the ATSB that 'robust assurance had been put in place to provide oversight' of the maintenance of competency (MOC) process, with 'continuous review and periodic external audits scheduled'. More specifically, QR advised:

> In October 2018, Queensland Rail completed a quality review of written maintenance of competency assessments: Q1 2018-19 1 July - 30 September 2018. 181 Written Maintenance of Competency (MoC) Assessments were reviewed.
>
> In December 2018, Queensland Rail completed a quality review of written maintenance of competency assessments: Q2 2018-19 1 October - 30 November 2018. 173 Written Maintenance of Competency (MoC) Assessments were reviewed.
>
> In February 2019, Queensland Rail completed a quality review of written maintenance of competency assessments: 1 December 2018 – 31 January 2019. 189 Written Maintenance of Competency (MoC) Assessments were completed.
>
> In June 2020, Queensland Rail undertook an assurance activity to determine the adequacy and effectiveness of:
>
> - Train Service Delivery's (TSD) new Rail Traffic Crew (RTC) Monitoring Lifecyle Procedure MD-19-235
> - Assess Compliance with SEMS training requirements eg Rail Safety Workers (RSW) Competency (Safeworking Training Standard MD-10-199)
> - Risk Trigger Commentary Driving (SEQ Train Drivers) TSD Professional Driving – Risk Triggered Commentary Driving MD-13-165)
> - The adequacy of any related 1st line assurance activities.
>
> Outcomes from the assurance activity confirmed:
>
> - In September 2019, the MD-19-235 TSD Rail Traffic Crew Monitoring Lifecycle Procedure was formally issued to clearly set out the amendments to the MOC process. MOC assessments were moved to a three-year cycle and included observations in-between assessments at the 12 and 24 month mark.
> - TSD Training issue a weekly MOC Compliance Report that is provided to TSD Management and Training Managers. The report includes SEQ 12/24 Months Observation completed, tracking of all RTC MOC due dates, SEQ MOC Assurance Checks and Expired MOCs. The Regional TSD team also maintain a MOC register tracker for when the Drivers 12/24 Month Observations and MOCs are due.
> - Processes were put in place from July 2020 in the Manager Regional TSD SEMS Planner to review a sample of MOCs and Observation effectiveness once a quarter as first line assurance.
> - Processes were put in place from August 2020 for SEQ TSD to complete 1st line assurance on TSD MoC both theory and practical, that occurs each month on at least 5% of MoC completed that month.

Design of the automatic warning system (AWS)

Safety issue description

The automatic warning system (AWS) provided the same audible alarm and visual indication to a driver on the approach to all restricted signals (that is, double yellow, yellow, flashing yellow and red aspects). The potential for habituation, and the absence of a higher priority alert when approaching a signal displaying a red aspect, reduced the effectiveness of the AWS to prevent signals passed at danger (SPADs). This placed substantial reliance on procedural or administrative controls to prevent SPADs, which are fundamentally limited in their effectiveness.

Issue number:	RO-2018-002-SI-03
Issue owner:	Queensland Rail
Transport function:	Rail: Passenger - metropolitan
Current issue status:	Closed – Partially addressed
Issue status justification:	The ATSB notes the safety action to change the auditory volume of the AWS for restricted signals verses green signals, but believes that this will not have a significant impact in reducing the risk of the safety issue as it does not help differentiate red signals from other restricted signals. The ATSB also appreciates that there would be substantial difficulty in redesigning the AWS to provide a clear distinction between the alerts that occur in response to signals with a red aspect compared to other restricted signals. However, the ATSB welcomes the safety action to introduce the European Train Control System (ETCS) and believes that this system will reduce the risk of SPADs where and when it is implemented.

Proactive safety action taken by Queensland Rail

Action number:	RO-2019-002-NSA-050
Action organisation:	Queensland Rail
Action status:	Closed

The Queensland Rail (QR) internal safety investigation into the 10 January 2018 SPAD occurrence at signal ME45 was completed in February 2018. The report included the following conclusions related to the automatic warning system (AWS):

- It is likely the RTD [driver] unconsciously acknowledged the AWS restricted indication
- If the AWS had prompted the Relief RTD to apply the train brake it is likely that the train would have stopped in advance or just past signal ME45.

The report also included the following safety actions that had already been initiated relating to AWS:[33]

> Principal Human Factors Adviser to review available data to analyse RTD response to AWS audible indications and reaction times on both green and restricted signals.
>
> Principal Electrical Engineer – Operating Assets to facilitate the decrease in volume of the AWS audible indication at a proceed signal aspect (green) and increase the volume of the AWS audible indication at a restricted signal aspect (double yellow, yellow, flashing yellow or red).

In addition, the report also included the projected introduction of the European Train Control System (ETCS) into the Citytrain network as a safety action to manage the risk of SPADs:

> The [ECTS] project has reached the stage where expressions of interest from market leaders to partner with Queensland Rail to implement the new technology have been called.

[33] These actions were initiated following QR's internal investigation into a SPAD that occurred at Roma Street in September 2017 (see also ATSB report RO-2017-012).

> The system encompasses automatic braking and enhanced control systems which will enable trains to safely travel closer together through the monitoring of the speed and position of trains and ensuring they stay within designated speed limits. This will positively impact on SPAD frequency.

In April 2019, the Queensland Government announced that the ETCS works package would be delivered by Hitachi Rail STS. As the future operator, Queensland Rail would be responsible for successfully integrating the cross-river rail project and ETCS Level 2 project into its rail network.

In March 2021, QR advised the ATSB of the following update regarding its the project to decrease in volume of the AWS audible indication at a proceed signal aspect (green) and increase the volume of the AWS audible indication at a restricted signal aspect:

> [Following the initial internal recommendation] An action plan was drawn up for the whole fleet.
>
> Responsibility for completion and progress of the project is being tracked utilising GRC action MA-3108 with an estimated completion date of 30/12/2023.

In relation to other action, QR advised:

> In addition to improvements to the AWS system, Queensland Rail is currently working with project sponsor TMR, the Cross River Rail Delivery Authority and supplier Hitachi STS to determine an ETCS Level 2 implementation schedule for parts of the Queensland Rail network in South East Queensland. The design phase of the project has commenced.
>
> ETCS Level 2 will provide an engineering level control for the mitigation of SPADs or exceedance of authority risk, where implemented. The system includes a Driver Machine Interface which displays maximum permitted speed and the distance to the applicable limit of authority (LOA) to the Rail Traffic Driver. Where the system detects that the rail traffic is exceeding the required braking curve to an LOA, warnings and if necessary, a brake intervention is automatically initiated. The braking curve and any required brake intervention are configured to prevent the rail traffic reaching a point of conflict where a collision with other rail traffic might otherwise occur.

Implementation of risk triggered commentary driving (RTCD)

Safety issue description

After mandating the use of risk triggered commentary driving (in 2011) to mitigate the risk of signals passed at danger, Queensland Rail Citytrain did not provide the necessary support to its trainers, assessors and drivers to effectively maximise the potential benefits of the technique and minimise the potential limitations or risks associated with the technique.

Issue number:	RO-2018-002-SI-04
Issue owner:	Queensland Rail
Transport function:	Rail: Passenger - metropolitan
Current issue status:	Closed – Adequately addressed
Issue status justification:	The ATSB notes the safety action already undertaken and being undertaken to clarify the requirements of RTCD and facilitate more consistent application of the technique, and to simplify some of the recommended word strings. The ATSB still has concerns regarding potential problems with the mandatory nature of the technique in all situations. However, overall the ATSB is satisfied that the safety action undertaken and being undertaken will reduce the risk of this safety issue.

Proactive safety action taken by Queensland Rail

Action number:	RO-2019-002-NSA-051
Action organisation:	Queensland Rail
Action status:	Closed

The Queensland Rail (QR) internal safety investigation into the 10 January 2018 SPAD occurrence at signal ME45 was completed in February 2018. The report included the following conclusions related to risk triggered commentary driving (RTCD):

> There [is] currently no methods available for the monitoring of RTD's compliance with RTCD requirements when alone in the driving cab.
>
> Although the Relief RTD was deemed competent in his use and knowledge of RTCD during his Maintenance of Competency Assessment the Relief RTD stated during interview that he routinely does not use RTCD.

The report also included the following internal recommendation (with a due date of 30 November 2018):

> Manager Train Services Delivery Training to lead a multidisciplinary review of Risk Triggered Commentary Driving to include (not exclusively) benchmarking, RTD consultation and feedback on the use of RTCD, training materials and methods, the use of RTCD as a training tool and methods to measure ongoing compliance, and produce an action plan to address any outcomes of the review.

In March 2021, QR advised the ATSB that the requirements for RTCD techniques were reviewed and updated to provide clarity on requirements. More specifically, it advised:

> In December 2019, the review of Risk Triggered Commentary Driving was completed and MD-13-165 TSD Professional Driving – Risk Triggered Commentary Procedure was subsequently updated in May 2020.
>
> An Important Operational Notice from Senior Manager TSD was emailed to all SEQ RTC on the 13 May 2020 detailing the new changes to Risk Triggered Commentary Driving (RTCD). These changes include:
>
> - Amended verbalisation examples to reflect updated RTCD requirements
> - Expanded RTCD trigger dot points, e.g. when observing "Check AWS" signs/signal distance marker signs
> - RTCD mandatory requirements (2.3) now specifically includes incorporating the status of level/pedestrian crossings; encountering temporary speed restrictions (TSRs); and upon sighting restricted signals in non AWS territory into RTCD verbalisation requirements
> - A new section (2.4) containing illustrated examples of using RTCD.
>
> An indicative video example demonstrating the updated RTCD was placed on Traincrew SPAD Management Site to demonstrate the updated RTCD on the Ferny Grove Line.
>
> The 12/24 Month Observations from the MOC cycle will be used as an opportunity to identify any RTC lacking the proper understanding of RTCD requirements by:
>
> - Providing immediate feedback and/or coaching where minor re-calibration is required.
> - Directing RTD to RTCD DVD and associated guidance materials
> - Arranging for further in-depth RTCD coaching where significant gaps persist.
>
> TSD are currently in the process of recalibrating the Tutor Drivers to ensure there is consistency in the way Trainee RTD are being taught RTCD. They have also published a revision checklist for the Trainees to use prior to them submitting the Summative Assessment.

Use of event recorders to monitor driver performance

Safety issue description

Prior to the signal passed at danger (SPAD) occurrence in January 2018, Queensland Rail did not routinely and systematically analyse recorded data to determine driver compliance with key operational rules that had been designed to minimise the risk of SPADs.

Issue number:	RO-2018-002-SI-05
Issue owner:	Queensland Rail

Transport function:	Rail: Passenger - metropolitan
Current issue status:	Closed – Adequately addressed
Issue status justification:	The ATSB acknowledges the significant increase in activity that Queensland Rail (QR) has undertaken in this area since 2017. Although the ATSB notes that there are some limitations with the data for measuring compliance rates with some SPAD mitigation rules, the ATSB is satisfied that the action undertaken by QR has reduced the risk of this safety issue, and that the risk of this safety issue would be further reduced with the introduction of automatic event recorder analytics software.

Proactive safety action taken by Queensland Rail

Action number:	RO-2019-002-NSA-052
Action organisation:	Queensland Rail
Action status:	Closed

As stated in the ATSB investigation report, in October 2017 Queensland Rail (QR) established a SPAD Prevention Taskforce. QR advised that the taskforce 'brought together key employees from across Queensland Rail to deliver a comprehensive SPAD strategy and a broad range of new safety controls focused on human factors, driver behaviour and increased level of engagement with our staff'.

The taskforce identified the use of proactive event recorder analysis as one of its critical SPAD prevention initiatives. After a period of planning, baseline data collection commenced in April 2018. The data collection was based on four SPAD mitigation rules (*Citytrain driving procedures*):

- 75% rule
- 'start on yellow' (SOY) rule
- stopped at red rule
- 20 / 20 rule.

In February 2019, QR advised that:

> A proactive review program is in place that analyses the train event recorders of key SPAD avoidance driving methodologies:
>
> - Lead indicator that provides visibility of driving behaviours across the organization
> - Enables direct and timely feedback to drivers on driving behaviour/technique.

As of March 2019, QR was still collecting baseline data.

In March 2021, QR advised of the following update regarding its safety action on this topic:

> QR has put in place proactive monitoring of event recorders within excess of 16000 reviews completed. This provides detailed insights to support coaching and mentoring to train crew and information to improve training.
>
> QR … also completes in-cab monitoring in respect to the required driving methodologies across the network. Coaching and skill development is provided where necessary. QR is currently exploring the feasibility of implementing an automatic event recorder analytics software service as part of our SPAD Prevention strategy.

Safety action not associated with an identified safety issue

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Additional safety action by Queensland Rail

The Queensland Rail (QR) internal safety investigation into the 10 January 2018 SPAD occurrence at signal ME45 was completed in February 2018. The report included the following safety action that had been initiated relating to signal ME45:

> Rail Safety Specialist to lead a systemic and comprehensive review of the effectiveness of current Signal Passed at Danger (SPAD) risk controls specific to signal ME45 including but not limited to:
>
> - Analyse the timetabling and routing of services that traverse the signal and the crossovers and diamonds beyond the signal
> - Investigate potential initiatives to reduce risk specifically at this signal including signalling, interlocking, UTC, approach signage and timetabling.
> - Use the 'Hierarchy of Control' model to identify and inform appropriate recommendations in establishing safety measures that would prevent or minimise the risk of SPAD events occurring at signal ME45 thus reducing the risk of collision.

In February 2019, Queensland Rail (QR) advised the ATSB that an engineering solution had been identified for signal ME45 to significantly reduce the possibility of collision risk due to a signal passed at danger (SPAD). In March 2021, QR also advised the following regarding signal ME45:

> In order to minimise the risks associated with trains passing signal ME45 at danger, 290 and 291 points (the conflict point past signal ME45) are now required to be set in the normal position before signals ME23 and ME25 will clear and allow trains to approach signal ME45.
>
> This significantly reduces the risk of a SPAD occurring due to 'read through' and the risk of a train-to-train collision. There have been no further SPADs at signal ME45 since this intervention.

Following earlier advice in June 2018, in March 2021 QR also advised:

> Following the incident and subsequent on-track observation session, the driver was allocated an Operational Improvement Plan (OIP). On the eleventh and final practical on-track coaching and mentoring session, the Relief Driver was deemed 'not competent' having not met the required Professional Driving standards.
>
> The Relief Driver chose (supported by QR management) to relinquish the position of train driver and subsequently took up the position of Trainee Guard.

General details

Occurrence details

Date and time:	10 January 2018 – 1036 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	Signal passed at danger (SPAD)	
Location:	Bowen Hills: 3.877 km north of Brisbane, Queensland	
	Latitude: 27 26.708' S	Longitude: 153 2.260' E

Train details

Track operator:	Queensland Rail	
Train operator:	Queensland Rail	
Train number:	TP43	
Type of operation:	Suburban passenger	
Departure:	Varsity Lakes	
Destination:	Brisbane Domestic Airport	
Persons on board:	Crew – 2	Passengers – Unknown
Injuries:	Crew – Nil	Passengers – Nil
Damage:	None	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Queensland Rail
- the driver of train TP43
- a range of Queensland Rail personnel
- event recorders and CCTV footage from TP43
- the Department of Transport and Main Roads (Queensland).

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Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- the driver of TP43
- Queensland Rail
- the Office of the Rail Safety Regulator (ONRSR).

Submissions were received from Queensland Rail and ONRSR. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.