Australian Government
Australian Transport Safety Bureau

Signal passed at danger involving passenger train TE43

Between Fortitude Valley and Bowen Hills, Queensland on 24 May 2023

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Acknowledgement of Country and Traditional Owners

The Australian Transport Safety Bureau acknowledges the traditional owners of country throughout Australia, and their continuing connection to land, sea and community. We pay our respects to them and their cultures, and to elders both past and present.

Investigation summary

What happened

On 24 May 2023, a Queensland Rail suburban passenger train (TE43) was operating a scheduled service between Coopers Plains and Ferny Grove in Brisbane, Queensland. After stopping at Fortitude Valley Station platform 2, the driver continued their trip, passing a signal (BS07) that was displaying a yellow aspect (caution indication) at the northern end of the platform. The next signal ahead (CS025) displayed a red aspect (stop indication) due to another train (EM03) that was ahead of a further signal (CS027) and waiting to enter Bowen Hills Station.

Between Fortitude Valley Station and signal CS025, the driver of train TE43 reported that they had a sudden sneezing fit. Approaching signal CS025 at red, the driver acknowledged the in-cab Automatic Warning System alarm and shortly after, realising the signal was at stop, applied emergency braking. Train TE43 passed signal CS025 by about 64 m, stopping prior to signal CS027 and about 296 m behind train EM03.

After train TE43 stopped, the driver contacted the Queensland network control centre to report a signal passed at danger (SPAD). The network control officer subsequently issued an authority for the driver to proceed to Bowen Hills Station, where they were relieved from duty. There were no injuries to passengers or crew, and no damage to either the train or infrastructure.

What the ATSB found

The driver likely experienced a degree of impairment arising from the sneezing reflex, which adversely affected their control of train speed and observance of the signal aspect displayed on signal CS025. Additionally, the multiple automatic warning system (AWS) alerts previously acknowledged by the driver during the trip, possibly in conjunction with the impairment arising from the sneezing fit, likely influenced the driver's action to acknowledge the AWS alarm and not identify the red aspect in signal CS025 until it was too late to prevent passing it.

The ATSB previously identified the AWS provided the same audible alarm and visual indication to a driver on the approach to all restricted indications. The potential for habituation, and the absence of a higher priority alert when approaching a signal displaying a red aspect, reduced the usefulness of the AWS to prevent signals passed at danger (SPADs).

Queensland Rail had a system designed to alert the network control officer of a SPAD event. However, there were inherent constraints in the system, particularly for automatic signals, where an alert would not be provided under certain circumstances. This reduced the opportunity for the network control officer (NCO) to identify and respond to a SPAD.

While the driver recognised the signal was at red and stopped their train in this instance, the critical risk control provided by the NCO intervention was ineffective. This was not considered in the risk assessments that addressed risks to train separation, including SPAD events.

What has been done as a result

Queensland Rail continues to maintain the current risk control arrangements, in conjunction with the AWS functionality, to manage the risk of SPADs while the preferred engineering control of European Train Control System (ETCS) technology is being implemented.

The Queensland Department of Transport and Main Roads has a long-term plan to deploy ETCS throughout the South East Queensland rail network. Deployment is occurring in prioritised sectors and full deployment will take several years. ETCS is currently installed on the Shorncliffe pilot line and is undergoing verification, validation and certification. Bowen Hills Station and surrounding areas were indicated to be included in sectors 2 and 3. Until this occurs, the established risk will remain.

Additionally, Queensland Rail is undertaking a range of SPAD risk management activities, and has advised the ATSB that the current enterprise and operational area risk assessments support the organisation's so far as is reasonably practicable (SFAIRP) position. However, Queensland Rail's current risk registers were not updated following this occurrence and therefore did not assess inherent constraints identified by the ATSB that may lead to risk controls being less effective. Specifically, the ATSB considers the scenario where a SPAD alarm was not generated and the driver did not report the SPAD, had not been considered in the Queensland Rail risk assessments.

The ATSB therefore issued a recommendation that Queensland Rail reviews the risk associated with a SPAD in circumstances where the inherent constraints of the universal traffic control system do not alert the network control officer and the driver does not self-report, and any additional risk controls that may be appropriate for the current signalling system.

Safety message

This investigation highlighted inherent limitations in the effectiveness of the automatic warning system (AWS) to prevent a SPAD event. It also identified that a SPAD alarm may not be presented to NCOs in all circumstances, preventing their active intervention.

These types of limitations should ideally be eliminated and, where that is not possible, the hazards they create should be considered in risk assessments related to SPAD and collision prevention.

Contents

The occurrence

On 24 May 2023, Queensland Rail suburban passenger train TE43 was operating a scheduled service between Coopers Plains and Ferny Grove in Brisbane, Queensland.

At about 0942 local time, as the train approached platform 2 at Fortitude Valley Station, the rail traffic driver (driver) received an alarm from the onboard automatic warning system (AWS) (see the section titled *Automatic warning system information*). This indicated that signal BS07, located at the northern end of platform 2, displayed a caution indication (steady yellow aspect).

The driver acknowledged the AWS alarm and continued into the platform where they stopped the train for passengers, as scheduled. At 0943:31, train TE43 departed platform 2 to continue along the down[1] suburban line towards Bowen Hills Station. Signal BS07 continued to display a steady yellow caution indication. The next 2 signals ahead, CS025 and CS027, displayed a restricted indication (red, 'at danger' aspect).

Ahead of signal CS027, empty suburban passenger train EM03 was stopped at signal ME19, waiting to proceed into platform 2 at Bowen Hills Station. Signal ME19 had changed from a restricted indication to a proceed indication (green aspect), however train EM03 had not yet moved. Train EM03 was travelling in the same direction as train TE43 (Figure 1).

Figure 1: Midsection track layout of down suburban line between Fortitude Valley Station and Bowen Hills Station

The train images superimposed on the aerial view of the track are not their precise location.
Source: Google Earth and Queensland Rail, annotated by the ATSB

After departing Fortitude Valley Station, train TE43 accelerated to 50 km/h, before the driver shut off traction power. The driver later reported that they had a sneezing fit, sometime after departing platform 2.

At 0943:51, as train TE43 traversed a curve in the track, signal CS025 came into the driver's view. As the front of train TE43 passed over the AWS magnet, fixed between the rails about 80 m before signal CS025, the in-cab AWS sounded a continuous audible alarm, indicating that the signal ahead displayed a restricted indication. The driver

[1] Rolling stock movements on the down-rail line travel away from the Central Railway Station (Brisbane).

responded to the alarm by pressing the AWS acknowledgement button, however, they later advised they could not remember doing so.

The driver recalled that just before they passed signal CS025, they recognised the red restricted indication and immediately placed the brake controller into full-service, and then the emergency brake position.

Train TE43 stopped about 64 m past signal CS025, and about 296 m behind train EM03 (Figure 2). The rear of train EM03 was about 92 m ahead of signal CS027, which was also displaying a restricted indication. The driver of TE43 recalled seeing the rear of train EM03 as it started to move.

Figure 2: Approximate stopping locations of train TE43 and train EM03 after train TE43 passed signal CS025 at stop

The train images superimposed on the aerial view of the track are not their precise location.
Source: Google Earth and Queensland Rail, annotated by the ATSB

The driver of TE43 made an emergency radio call to the network controller officer (NCO) to report a signal passed at danger (SPAD). The NCO established details surrounding the SPAD with the driver, then issued an authority for train TE43 to proceed to Bowen Hills Station platform 2, where the driver was relieved from duty.

The NCO did not receive a SPAD visual dialogue box or audible alert for signal CS025 at their workstation.

There were no injuries to passengers or crew, and no damage to either the train or infrastructure.

Context

Driver information

The driver had about 25 years of driving experience and was qualified on the route. They had completed the required maintenance of competency[2] assessments in June 2021 and subsequent on-job observations on 12 April 2022 and 5 March 2023. An audit on safe driving was also completed on the Brisbane suburban network on 11 October 2021.

They underwent a medical assessment (rail category 1 – high-level safety worker) in September 2022 and were considered fit for duty (unconditional). Following the incident, testing of the driver for both drugs and alcohol returned negative results.

After 2 consecutive early morning shifts, the driver signed on for work at 0437, the morning of 24 May 2023. During the shift, they had completed 2 scheduled trips, with a meal break between 0738–0808. They had commenced the incident trip from Cooper Plains at 0910. They reported feeling fully alert at the time of the occurrence. However, about 12 hours later, they tested positive to Coronavirus disease (COVID-19).[3]

Records provided by Queensland Rail (QR) showed that the driver had 2 previous signal passed at danger (SPAD) incidents (2001 and 2019), however these were not considered relevant to the occurrence.

Train information

General

Train TE43 consisted of a 6-car multiple unit (3-car interurban multiple unit [IMU] 181 leading and a 3-car suburban multiple unit [SMU] 295 trailing), with an overall length of about 145 m, and individual car length of 72.4 m. Lead unit IMU181 was fitted with an event recorder and forward-facing CCTV recorder.

Lead unit IMU181 had been modified to decrease the volume of the automatic warning system (AWS) audible beeps at a green proceed indication, and increase the volume for the continuous buzzing alarm at a restricted indication (see the section titled *Previous occurrences).*

Recorded information

Park Road Station to Fortitude Valley Station

A review of data from the event recorder showed that, prior to departing Fortitude Valley Station, the driver operated the train consistent with safe driving procedures (see the section titled *Safe driving procedures*). The driver recalled that from Park Road Station,[4] there was peak congestion, which was normal for the inner-city area at that time of day.

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[2] Maintenance of competency: QR program to ensure driver theory and practical competency. The program ran on a 3-year cycle, with additional on the job observations at 12- and 24-month intervals. In December 2023, the program was changed to verification of competency and added an additional 18-month intervention within the 3-year cycle. This intervention included a safeworking reaccreditation theory assessment, simulator scenario, unit preparation and shunt, and practical on track component, followed by an on-job observation.

[3] The COVID-19 pandemic was a public health emergency of international concern between 30 January 2020 and 5 May 2023.

[4] Park Road Station was located 5 stations prior to Fortitude Valley Station on the down Ferny Grove line.

Recorded data showed that, from Park Road Station, the driver:

- acknowledged 20 AWS alerts for restricted indications
- received 3 AWS alerts for proceed indications, of which they acknowledged one.

Fortitude Valley Station to signal CS025

The event recorder captured the following sequence after TE43 departed Fortitude Valley Station:

- 0943:31 traction power was applied and the train departed platform 2
- 0943:47 traction power was shut off at 50 km/h
- 0943:59 the lead unit IMU181 passed over the on-track AWS magnet (see the section titled *Automatic warning system information*)
- 0944:00 AWS buzzer activated and shortly after the driver pressed the acknowledgment button
- 0944:03 at 50 km/h driver selected full-service brake position
- 0944:07 at 37.5 km/h driver selected emergency brake position
- 0944:15 train TE43 stopped

The driver safety control, also known as 'deadman's system', [5] did not activate at any time during the incident.

Rollingstock brake performance

The recorded braking distance was calculated to be within the expected performance for the rollingstock and the track gradient. No braking issues were recorded in the train fault log on the day of the occurrence. Additionally, the driver of train TE43 did not report anything unusual about the train's handling on the day.

Safe driving procedures

QR procedure MD-11-72 *Train service and delivery* (*TSD) Professional driving – safe driving* outlined rules for train drivers 'to mitigate the incidence of signals passed at danger (SPAD) and other adverse operational safety events'.

The procedure contained general safe driving rules which included:

- 75% speed rule: rail traffic must be travelling at or below 75% of the designated track and/or traction speed at the point of passing a double yellow or single yellow aspect signal.
- 20/20 rule: on the approach to a red aspect signal, the speed of the rail traffic must not exceed 20 km/h at the point of passing over the automatic warning system (AWS) magnet.

The procedure also contained 'safe driver application' rules which included that when starting on a single yellow aspect, the driver must:

- after coming to a stop at a platform, place direction controller to neutral
- apply or maintain the 75% speed rule
- maintain situational awareness and vigilance through scanning, crosschecking and application of, or continued use of RTCD [risk triggered commentary driving] (MD-13-165 TSD *Professional driving - risk triggered commentary driving procedure*)
- When approaching a red aspect signal the procedures included that the driver must:

[5] Driver safety control: a safety feature designed to apply the train's brakes in the event of the driver incapacitation.

- initiate a further positive action, i.e., make a brake application or reduce tractive power depending on track gradient
- maintain situational awareness and vigilance through scanning, crosschecking and application of, or continued use of RTCD (MD-13-165 TSD *Professional driving - risk triggered commentary driving procedure*)
- apply the 20/20 rule

When approaching restricted indications, QR procedure MD-13-165 *TSD Professional driving – risk triggered commentary driving* required drivers to verbalise:

- acknowledgement of the aspect of the restricted signal
- the location and aspect of the next signal
- their intended actions.

On receiving an AWS alert, risk triggered commentary driving (RTCD) was to be applied continuously from the acknowledgement of the audible alarm, until the required actions were complete.

The driver recalled applying RTCD on the morning of the incident, but could not recall if it was applied at Fortitude Valley Station platform 2. The QR internal investigation report found that the driver did not apply RTCD on approach to signal CS025.

Network and signalling information

Train safeworking system and signalling

On the Brisbane suburban network, the train safeworking system utilised remote controlled signalling. The system included signalling infrastructure (signals, points, etc.), which network control officers (NCOs) could interact with using the universal traffic control (UTC) system.

The UTC system displayed a range of indications on the NCO's workstation. These included the location of all trains, points, signals and alarms, such as a SPAD alarm message (see the section titled *Signal passed at danger warning system)*.

Signals on the network were either controlled (operated by the NCO) or automatic (set by the passage of rail traffic). The aspect of a controlled signal was displayed on the NCO's workstation. In contrast, automatic signals were displayed as a yellow icon and their aspect was not shown (Figure 3).

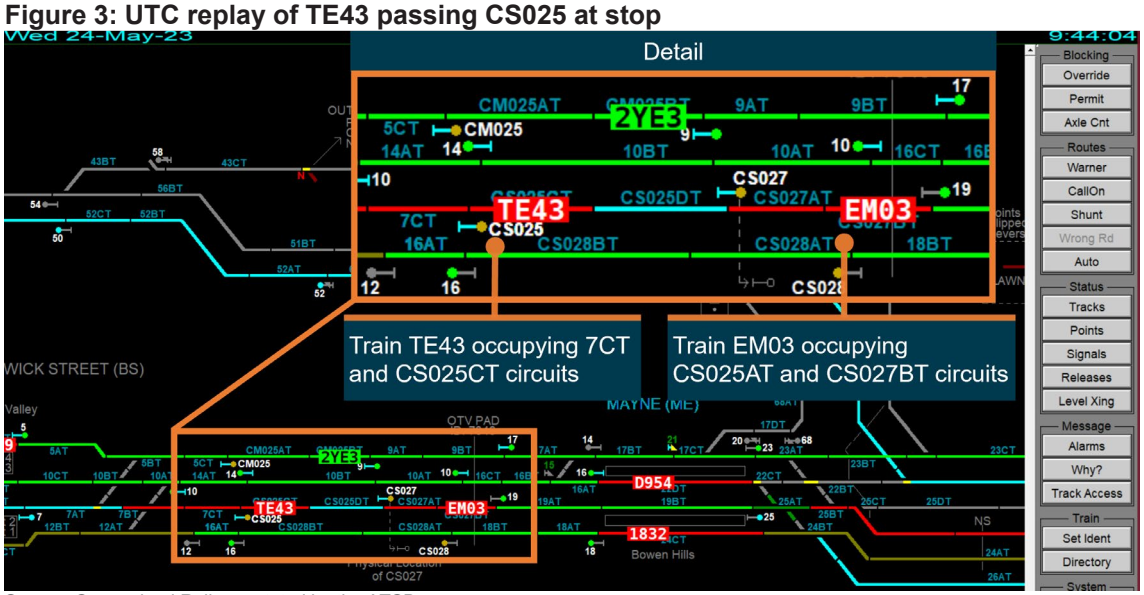
Universal traffic control recorded information

The recorded UTC replay identified the following:

- 0943:50 as train TE43 departed Fortitude Valley Station, the path for train EM03 was set to Bowen Hills Station
- 0943:52 signal ME19 displayed a green proceed indication for train EM03 to enter Bowen Hills Station, as train TE43 approached signal CS025
- 0944:04 train TE43 passed signal CS025 and occupied track circuit CS025CT. Train EM03 was occupying track circuits CS027AT and CS027BT. Train EM03 was likely moving but had not passed signal ME19.

Figure 3 shows the UTC replay of the track section between Fortitude Valley Station and Bowen Hills Station after the SPAD. Of note, no SPAD warning dialogue box was displayed (see the section titled *Signal passed at danger warning system*).

Figure 3: UTC replay of TE43 passing CS025 at stop



Source: Queensland Rail, annotated by the ATSB

Automatic warning system information

QR's suburban network was fitted with an automatic warning system (AWS). This system consisted of an in-field magnet on the track and a magnetic receiver linked to a warning system on the rollingstock.

QR Standard MD-10-119 *Automatic warning system (AWS) operations manual* noted that the AWS was designed to:

- 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.

This procedure also stated:

> AWS is an advisory system and not a control system. The setting of rail traffic speed remains with the rail traffic driver. The AWS is designed to apply the brake when the rail traffic driver cannot or does not acknowledge a RESTRICTED signal aspect…

When the train's magnetic receiver passed over the in-field magnet on approach to a signal, the AWS would provide a different alert to the driver for proceed or restricted indications:

- proceed indication: the AWS indicator would display a black visual and sound a short series of beeps. Acknowledgment of the clear to proceed indication was not required by the driver.
- restricted indication: the AWS indicator would display the same yellow and black 'sunflower' visual display for both caution and stop indications and sound a louder, continuous buzzing alarm. The driver was required to cancel the alarm by pressing and releasing the acknowledgment button. If the AWS alarm was not acknowledged after 3 seconds, a penalty brake application would occur.

On approach to signals BS07 and CS025, the AWS provided a 'sunflower' visual display and a continuous buzzing alarm, which were both cancelled by the driver using the acknowledgement button. During interview, the driver advised that they could not recall

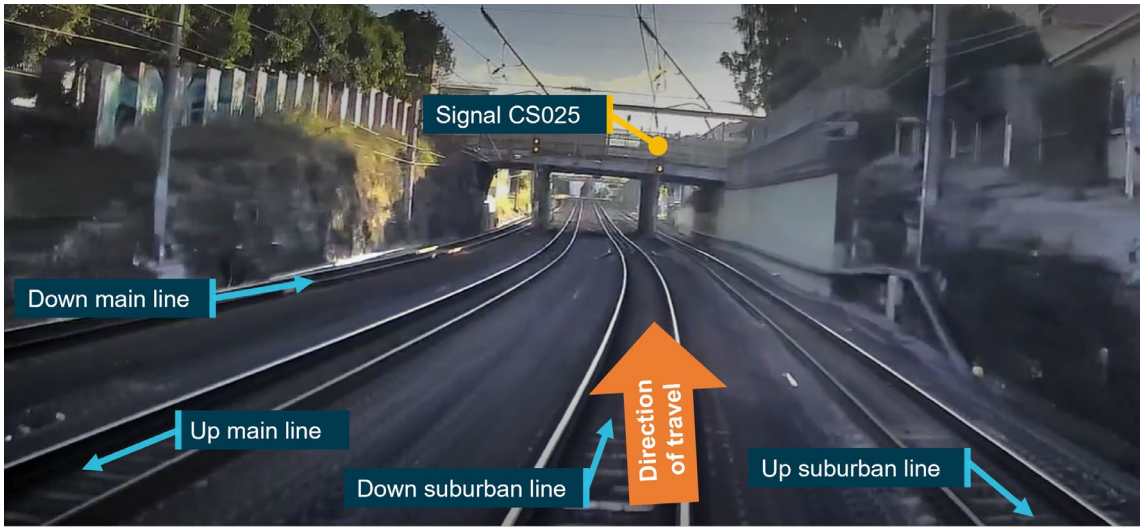
acknowledging the AWS for signal CS025, and they could not remember if they were first alerted to the red aspect by the AWS alarm, or visual observation of the signal.

Previous ATSB investigations have identified instances where train drivers have acknowledged the AWS alarm for a red aspect, and subsequently passed the signal at danger (see the section titled *Previous occurrences*).

Signal CS025

Signal CS025 was a 4-aspect[6] automatic signal located at the 2.545 km mark on the down suburban line, mid-section between Fortitude Valley Station and Bowen Hills Station (Figure 4). On approach to signal CS025, the mainline speed for this track section was 60 km/h.

Figure 4: Approach to signal CS025 along down suburban line towards Bowen Hills Station

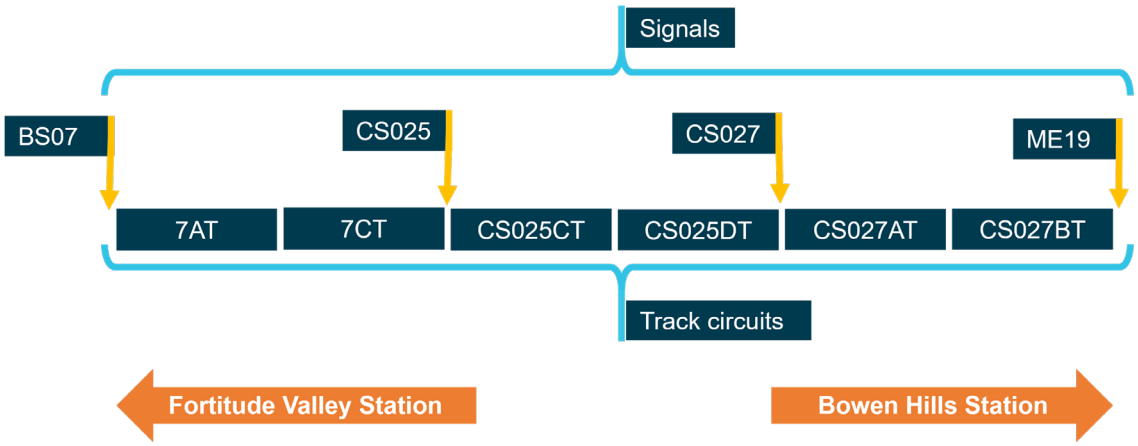


Note that this image shows CS025 with a caution steady yellow aspect.
Source: Queensland Rail, annotated by the ATSB

There were 2 track circuits between signal CS025 and the next signal CS027 (CS025CT and CS025DT) (Figure 5). Signal CS025 would display a stop indication when either track circuit CS025CT or CS025DT was detected as occupied. Additionally, if track circuit CS027AT was occupied, after CS025CT and CS025DT had cleared, CS025 would also display a stop indication.

[6] 4-aspect signalling: A system of colour light signalling which provides red, yellow, double yellow and green aspects in a manner that normally provides the first caution at least 2 signals before a signal at red.

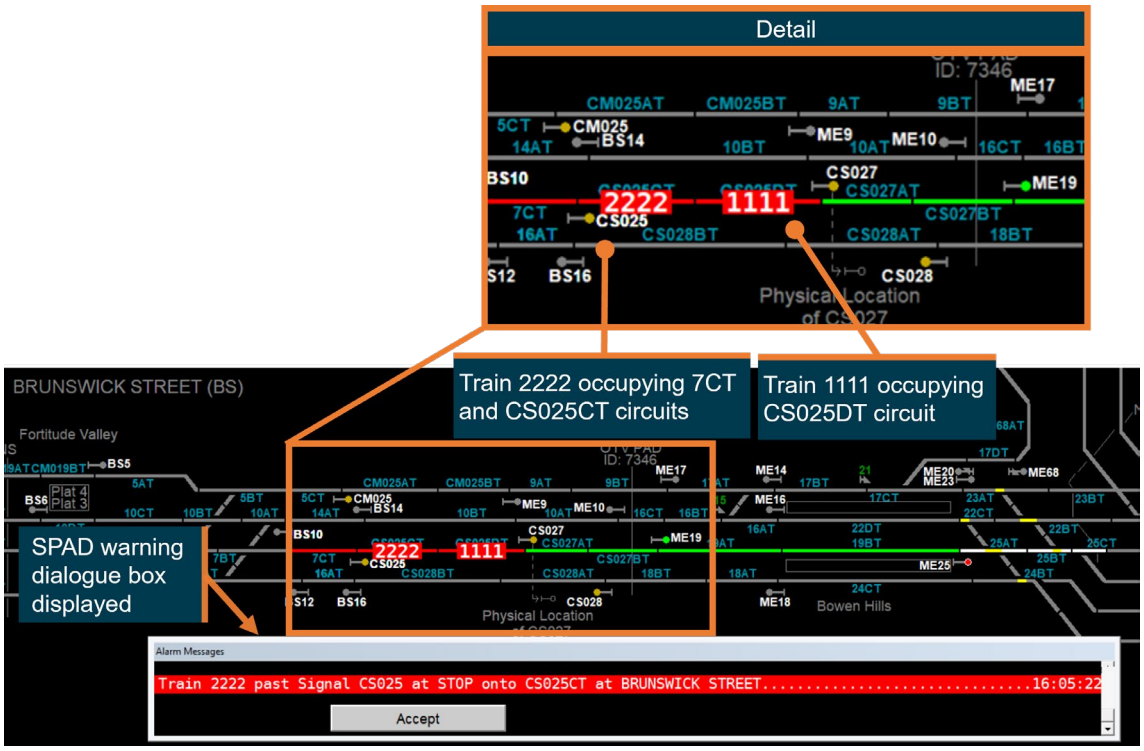
Figure 5: Track circuits between signal BS07 and ME19 on the down suburban line towards Bowen Hills Station



Source: ATSB, based on signalling arrangement maps and diagrams - not to scale

QR confirmed via simulation that the UTC system would generate a SPAD alarm, and display a SPAD message indication on the NCO's workstation for signal CS025, if track circuit CS025DT was occupied by another train ahead when signal CS025 was passed at stop (Figure 6). In this simulation track circuit CS027AT, ahead of signal CS027, was unoccupied.

Figure 6: UTC simulation of train passing CS025 at stop



Source: Queensland Rail, annotated by the ATSB

QR identified that there had been no SPADs recorded at signal CS025 since 2010, and the signal complied with the sighting distance requirements described in QR Standard MD-10-95 *Signalling positioning principles*.

Signal passed at danger (SPAD) warning system

The SPAD warning system consisted of an audible 3-beep alert tone and a red text dialogue box that appeared on the NCO's workstation (Figure 6).

The QR manual MD-14-37 *Network control manual* outlined different UTC alarm messages that would be provided to warn the NCO of threats to safeworking. The NCO was required to immediately respond to these messages, unless they assessed that doing so had the potential to increase the hazard.

UTC SPAD alarm messages were identified as of critical importance, with the highest response requirement by the NCO. The NCO was to:

> Investigate cause. Make emergency call to stop offending train. If other trains are present, call all trains in the area(s) to stop. Assess if rail traffic driver is fit to continue, move train to position of safety.

QR procedure MD-11-42 *Signal passed at danger* – module EP1-13 reflected the above required response by the NCO following receipt of a SPAD alarm.

In this instance, the NCO did not receive a SPAD alarm and was first alerted to the SPAD of train TE43 by the driver's emergency radio call.

Signal passed at danger alarm generation principles

The QR manual SR105 *SPAD Alarm generation principles* defined the criteria used by the UTC system to determine if a SPAD alarm message would be displayed to the NCO.

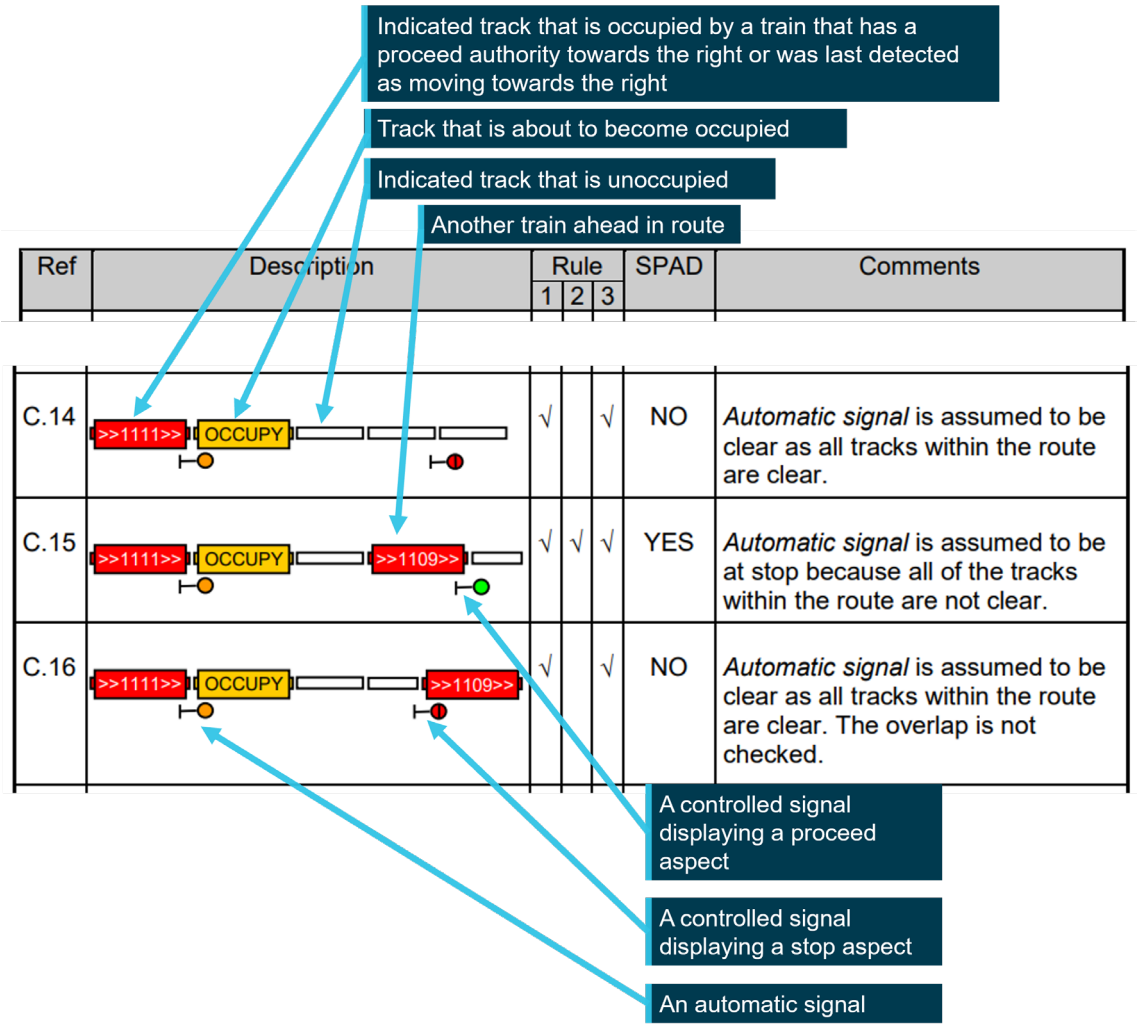
Section 6.1 of the manual stated:

> The UTC Controller Workstation shall generate a 'Train passed signal at stop' alarm if all of the following rules are met:
>
> Rule 1 The first track beyond a Limit of authority (LOA)[7] becomes occupied.
>
> Rule 2 There is no train on a track adjacent to the newly occupied track with a proceed authority onto this newly occupied track.
>
> Rule 3 There are one or more trains that can step onto the newly occupied track from an adjacent track which has an LOA facing towards the newly occupied track.

To illustrate the application of the rules, several scenarios were included in the appendices of the manual (Figure 7).

[7] Limit of authority (LOA): The limit of authority may be defined by a sign, a signal capable of displaying a STOP indication, or a specific kilometrage point on a line. It defines the location to which rail traffic may travel under a Proceed Authority or the limits of a work on track authority.

Figure 7: Extract from appendices of SR105 signal passed at danger alarm generation principles manual



Source: Queensland Rail, annotated by the ATSB

The examples showed:

- For C.14, all the track circuits between the automatic signal and the next signal were unoccupied. The automatic signal was assumed to be displaying a proceed indication. When train 1111 passed the automatic signal to occupy the track ahead, no SPAD alarm would be generated.
- For C.15, a track circuit between the automatic signal and the next signal is occupied by train 1109. The automatic signal was assumed to be displaying a stop indication. When train 1111 passed the automatic signal to occupy the track ahead, a SPAD alarm would be generated.
- For C.16, a track circuit ahead of the next signal is occupied by train 1109. The automatic signal was assumed to be displaying a proceed indication. When train 1111 passed the automatic signal to occupy the track ahead, no SPAD alarm would be generated.

Additionally, Section 6.8.1 of the manual noted that:

> – Automatic signals are not indicated, and therefore UTC is unaware of whether the signal has a proceed aspect or not. So that SPAD alarms can be generated for automatic signals, UTC will

assume that an automatic signal has a proceed aspect when all of the tracks up to the next signal are all clear. The tracks in the overlap[8] (if any) will not be checked.

Section 7 also noted further limitations:

> If the replacement track[9] of a signal is already occupied (e.g. by another train, gang or track fault), then a train passing the signal will not be able to be detected, and therefore a SPAD alarm will not be generated.
>
> Due to the possibility of timing issues,[10] the overlap of an automatic signal (if any) will not be checked when determining whether an automatic signal is clear. Consequently, if the overlap of an automatic signal is occupied, then a SPAD alarm will not be generated if a train passes the automatic signal.

Overview of Queensland Rail SPAD risk management

QR maintained a suite of risk registers that identified hazards and related risk controls. The enterprise risk register identified several key risks and controls related to SPAD events including the following:

- …SEQ [South East Queensland] Operations failing to adequately prevent a rollingstock collision (train to train, train to vehicle, train to person), potentially resulting in one or more fatalities
- …rail traffic separation or route integrity not being maintained on the mainline resulting in train to train, train to person, train to infrastructure, train to object collision or derailment

These risks were last reviewed on 22 September 2021. Risk controls included:

- ongoing SPAD prevention strategies/programs/campaigns
- focus groups designed to prevent SPADs
- maintenance of worker competencies
- assurance activities
- safeworking audits
- the application of the UTC system.

The effectiveness of the respective controls was assessed as ‘substantially effective’ with the hierarchical level primarily identified as ‘administrative’. For each of the risk controls above, the risk score following implementation of the controls was assessed as ‘medium’. The justification for the risk score was respectively:

- Controls at this level are administrative. Where appropriate GM’s [General Managers] registers identify higher levels of controls where the control owner has accountability/responsibility of the control.
- No higher-level engineering control is currently available to control this risk. Until ETCS [Level 2][11] is fully implemented across the QR SEQ network this safety risk is being controlled by

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[8] Overlap: The overlap of a signal is an extension of a track circuit beyond a stop signal to provide a margin of safety beyond that signal. The overlap must be unoccupied and free of opposing signal locking before the signal is permitted to show a proceed aspect

[9] Replacement track: track sections that are after the entry signal

[10] In-built time delays within the UTC/interlocking software implemented to prevent the possibility of spurious SPAD alarms.

[11] European Train Control System (ETCS) Level 2: an engineering level control for the mitigation of SPADs, comprised of a 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.

> administrative/people control (active supervision) which is inherently partially effective in the absence of the higher engineering control (ETCS).

The TSD Operations SEQ Risk register – *Risk 3 Train to train collision* included the risk description: 'risk of train-to-train collision resulting in injury or death as a result of a SPAD event'.

Risk controls included:

- rail traffic crew training
- safe driving techniques
- risk triggered commentary driving (RTCD)
- application of the SPAD risk management standard (MD-10-89)
- SPAD risk management procedure (MD-13-362)
- SPAD risk management instruction (MD-13-446).

Again, the effectiveness of the controls was assessed as 'substantially effective' and the hierarchical level as 'administrative'. The residual risk score was assessed as 'medium'. The justification for the risk score was:

> Higher order controls are in place but owned by other business areas (e.g. Engineering: Level Crossing protection systems, signalling system & UTC). TSD Operations therefore has not identified any further higher order controls available for implementation by our functional area.

Additionally, a pilot bowtie analysis for QR operations was developed on 1 September 2021. This was intended as an information aid for QR's safety management system, including the enterprise and operational area risk registers. The bowtie analysis identified risk controls and highlighted those assessed as critical risk controls[12] associated with the prevention of human factors-related SPADs, including driver distraction. Risk controls listed in the bowtie included:

- Safeworking training standards (MD-10-199) – critical risk control
- TSD Professional driving followed by drivers (MD-11-72)
- Train safety systems (AWS, ATP, DTC)[13] (MD-10-218) – critical risk control
- Automated train protection remove and replace with train safety systems
- QNRP network rules and procedures (MD-12-189)
- Safety in yards (MD-10-175)
- DTC Alarms in cabs
- UTC SPAD alarm triggering emergency response procedure
- NCO emergency response to SPAD alarm to stop train
- Potential control: Train control radio for emergency comms with driver (workers on track do not have radio)
- Observe signal approach warning (MD-10-109) – critical control
- Risk triggered commentary driving (RTCD) (MD-13-165)

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[12] Critical risk controls in the Queensland Rail risk management framework were related to engineering controls. The remaining controls, although operationally critical were administrative controls.

[13] Refers to automatic warning system (AWS), automatic train protection (ATP) and direct train control (DTC) used across the whole Queensland Rail network.

- Potential control: Rail resource management human factors framework training and competency (RTC and NCO)
- Potential control: ETCS controls train in event of incapacitation

UTC SPAD alarms and the NCO's emergency response to a SPAD alarm were listed as risk controls in the bowtie analysis. QR did not consider them as critical risk controls, as they were partially effective administrative controls. In contrast, train safety systems (including AWS) were considered a critical risk control.

The QR standard MD-10-89 *SPAD Risk Management* ranked the severity of a SPAD incident to the application of risk controls, based on the Office of the National Rail Safety Regulator (ONRSR) Reporting requirements for notifiable occurrences guideline. Where the rollingstock stopped more than 50 m from the rear of the train ahead by the actions of the driver alone, the severity was ranked as 'minor' due to 'significant escalation of SPAD required before incident could occur'. Additionally, where the rollingstock stopped more than 50 m from rear of the train ahead by the actions of the NCO, the severity was also ranked as 'minor' due to 'significant escalation of SPAD required before incident could occur'.

In contrast, where the rollingstock stopped less than or equal to 50 m from the rear of the train ahead by the actions of NCO, the severity was ranked as 'significant' due to 'potential incident prevented by recovery action'.

QR confirmed that training and toolbox talks for NCOs included information about SPAD alarm warning messages not being presented under certain circumstances.

QR advised that the effectiveness of the recovery action provided by the NCO (including the effectiveness of the SPAD alarm warning system), were not risk assessed by QR business or functional areas.

The QR internal investigation report for this incident did not identify the absence of the SPAD alarm activation for signal CS025.

Previous occurrences

The ATSB has investigated several occurrences that identified the important role of active intervention by the NCO to prevent a further reduction in safety margins once a SPAD had occurred. These investigations all showed that it was possible for the driver to completely miss a signal.

RO-2017-010 Signal ME45 passed at danger, involving suburban passenger train 1A21, Bowen Hills, Queensland, on 26 August 2017[14]

Train 1A21 passed controlled signal ME45 at the northern end of Platform 2 Bowen Hills, and an alarm activated at the QR Rail Management Centre at Mayne. The network control officer overseeing that particular area, broadcast an emergency radio message calling for the driver of 1A21 to stop. Due possibly to distraction, the driver did not apply the applicable procedures relevant to the restricted indication displayed at signal ME25 prior to departing the platform, therefore missing vital information concerning the aspect status of signal ME45. The driver's attention was likely focussed on peripheral trackside

[14] RO-2017-010 Signal ME45 passed at danger, involving suburban passenger train 1A21, Bowen Hills, Queensland, on 26 August 2017 https://www.atsb.gov.au/publications/investigation_reports/2017/rair/ro-2017-010

activity as the train approached signal ME45, distracting him from the primary task of observing signal indications.

RO-2018-002 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[15]

Train TP43 passed controlled signal ME45 at the northern end of Platform 2 Bowen Hills, and an alarm activated at the QR Rail Management Centre at Mayne. After receiving a 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.

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.

During the investigation, the ATSB identified a safety issue with the AWS (Safety Issue RO-2018-002-SI-03).[16] This was due to the potential for habituation, and the absence of a higher priority alert when approaching a signal displaying a red aspect, which reduced the effectiveness of the AWS to prevent SPADs.

QR advised the ATSB of safety action taken, including:

> …conducting a whole fleet 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, with input from the Principal Human Factors Advisor and Principal Electrical Engineer. The estimated project completion was 30 December 2023.
>
> …projected introduction of the European Train Control System (ETCS) into the Citytrain network as a safety action to manage the risk of SPADs. 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.

On 15 April 2021, the safety issue was closed as partially addressed:

> 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.

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15 RO-2018-002 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 https://www.atsb.gov.au/publications/investigation_reports/2018/rair/ro-2018-002

16 RO-2018-002-SI-03 Design of the automatic warning system (AWS) https://www.atsb.gov.au/safety-issues/RO-2018-002-SI-03

Safety analysis

Introduction

After departing Fortitude Valley Station on the down suburban line, suburban passenger train TE43 passed signal CS025 that was displaying a red stop indication by about 64 m. There were no technical issues associated with the rollingstock, and the signalling system functioned as designed.

The safety analysis will discuss:

- the immediate reason for the signal passed at danger (SPAD)
- the habituation of acknowledging the automatic warning system (AWS)
- alarms for SPAD occurrences not being displayed to the network control officer (NCO) by the universal traffic control (UTC)
- the effectiveness of current recovery risk controls for signal passed at danger (SPAD) events in risk assessments.

Driver performance

On departure from Fortitude Valley Station platform 2, a steady yellow aspect was displayed on signal BS07. Application of the safe driving procedures meant the driver was required to travel at a speed not exceeding 45 km/h (75% speed rule) and maintain situational awareness and vigilance through cross checking and the use of risk triggered commentary driving.

Approaching the next signal (CS025) displaying a red, ‘at danger’ aspect, the driver was required to initiate further positive action to slow the train. If the signal remained at stop, the driver was to further reduce speed to not exceed 20 km/h as the train traversed the AWS magnet (20/20 rule). The driver would then receive, and acknowledge, the AWS alarm before stopping 20 m prior to the signal.

In this instance, after passing BS07, the driver accelerated train TE43 to 50 km/h before removing traction power and coasting. There was no braking or reduction of train speed as TE45 rounded the curve on the approach to signal CS025. Additionally, there was no reduction in speed as TE43 approached and then traversed the AWS magnet. The first brake application and reduction in train speed occurred just prior to passing signal CS025.

A review of the onboard recorded data found that prior to Fortitude Valley Station, the driver generally reduced train speed in accordance with the safe driving procedures, as they approached and passed each restricted indication. Additionally, the driver also placed the direction controller in neutral at the platform in accordance with the safe driving procedure. The only recorded occasion during the trip where the driver had not applied the speed reduction occurred after the departure from platform 2 at Fortitude Valley Station.

The driver reported that, after departure from platform 2, they experienced a sudden sneezing fit. Additionally, they were diagnosed with COVID-19 about 12 hours after the occurrence. They also stated that although they did acknowledge the AWS alarm approaching CS025, they could not recall if it was a conscious or reflex response to the alarm.

Sneezing is a symptom that may be observed in individuals presenting with COVID-19 or other acute respiratory infections (Australian Centre for Disease Control, 2024). Such a prolonged sneezing reflex, or fit of sneezing while operating a train, could affect the driver's capacity to effectively control the train during a critical phase approaching a restricted indication, and impair their ability to detect and react to stimuli.

The ATSB concluded that, although the driver was aware the departure signal (BS07) displayed a restrictive indication showing the signal ahead (CS025) was at stop, they likely experienced a degree of impairment arising from the sneezing reflex, which adversely affected the driver's control of train speed and observance of the signal aspect.

Contributing factor

The sneezing fit between signal BS07 and signal CS025 reported by the driver likely impeded their control of the train and observance of the red aspect displayed in CS025. Train TE43 subsequently passed signal CS025 at stop by about 64 m.

Automatic warning system

During the trip between Park Road Station and Fortitude Valley Station, the driver promptly acknowledged multiple AWS alarms (continuous buzzers) from restricted indications, and on one occasion an AWS alert (short series of beeps) from a proceed indication, which the driver was not required to acknowledge. Approaching signal CS025, the driver again acknowledged the AWS alarm for the restricted indication promptly, although they could not remember doing so.

ATSB investigation report RO-2018-002 discussed the effectiveness of AWS alarms, noting that although they reduced the likelihood of SPADs in some situations, the design was fundamentally limited and would not eliminate SPADs. The report also highlighted research indicating a significant number of drivers in many rail networks had reported 'automatically' acknowledging an AWS alarm at a restricted signal without recognising it had occurred, particularly in situations where drivers repeatedly encountered signals displaying restricted indications. The report also noted with drivers encountering an increased frequency of restricted indications, they could become conditioned to cancelling the AWS alarm as a habitual or reflex reaction.

In this instance, the driver recalled that from Park Road Station, the suburban network was operating at near peak capacity. This meant that the driver received and acknowledged many AWS alarms to restricted indications along with proceed indications. This, possibly in conjunction with the impairment arising from the sneezing fit, likely influenced the driver's action to acknowledge the AWS alarm and not identify the red aspect until it was too late to prevent passing it.

Contributing factor

There were frequent automatic warning system (AWS) alarms presented to the driver between Park Road Station and Fortitude Valley Station due to traffic congestion. This likely influenced the driver's reaction in acknowledging the AWS alert on approach to signal CS025, which cancelled the train's automatic brake application, while not recognising the red aspect.

ATSB investigation RO-2018-002 identified the AWS alarm was also not an effective risk control because it provided the same visual and aural alarm for all restricted indications and that substantially diminished the significance of approaching a stop indication (red aspect). Queensland Rail (QR) undertook several safety actions, including changing the auditory volume of the AWS for restricted indications versus proceed indications. Although this action provided a degree of improvement, it did not differentiate a red aspect from other restricted indications (double yellow, yellow, flashing yellow aspects).

The AWS was the primary engineering risk control used by QR in the suburban network to reduce the likelihood of, or to mitigate the consequences of a SPAD event. However, the AWS system was vulnerable to human error as drivers could acknowledge the alarm and cancel the automated application of a brake penalty, without necessarily considering the next signal ahead was at stop.

This risk control was less effective than systems like Automatic Train Protection or European Train Control Systems (ETCS), that offered a higher level of automation, such as automatic initiation of a penalty brake application following a SPAD event. In 2021, QR advised that, in addition to improvements to the AWS, work was being undertaken with suppliers to determine an ETCS Level 2 implementation schedule for parts of the QR rail network in South-East Queensland. As of May 2023, the project had progressed to testing ETCS technology on the Shorncliffe Line with compatible rollingstock, but had not been commissioned into operational service.

Contributing factor

The automatic warning system (AWS) provided the same audible alarm and visual indication to a driver on the approach to all restricted indications. 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 usefulness. (Safety issue)

Signal passed at danger warning

The UTC signal passed at danger (SPAD) warning functionality was designed to generate a SPAD alarm on the network control officer's workstation if a train passed a signal aspect displaying a stop indication. However, inherent constraints within the UTC system meant that under certain situations, although an automatic signal displayed a stop indication, no alarm was generated if a SPAD occurred.[17]

In this instance, automatic signal CS025 was displaying a red stop indication when passed by train TE43, and no SPAD alarm was generated at the NCO's workstation. The track circuit ahead of the next signal CS027 was occupied by train EM03, the reason signal CS025 was at stop. However, signal CS025 was assumed by the UTC to be displaying a proceed indication as the 2 track circuits in between were clear.

[17] This is contrary to previous ATSB investigations, which incorrectly reported that 'non-controlled' (automatic) signals located on the QR suburban rail network did not generate a SPAD alarm on the UTC system under any circumstances. See https://www.atsb.gov.au/publications/investigation_reports/2018/rair/ro-2018-002

The SPAD alarm generation principles were designed to not check the track ahead of the next signal, to avoid timing issues associated with the operation of the UTC system. This design, while solving a technical problem, prevented notification of certain SPAD events to the NCO. It also compromised the effectiveness of the recovery action provided by the active intervention of the NCO in making an emergency call to the driver to stop their train.

The signal after CS025 (CS027) ahead of train TE43 was also at stop, and the red aspect, coupled with the associated AWS warning, provided protection to the rear of train EM03. However, if the driver had not stopped after passing signal CS025, and continued passed CS027, with EM03 still occupying the track immediately ahead of the signal (CS027AT), again no SPAD alarm would have been produced on the NCO's workstation. This was also due to a design limitation in function, as the replacement track circuit to signal CS027 (CS025AT) was already occupied by EM03, and the UTC was unable to detect a change in state of the track circuit from unoccupied to occupied.

Other factor that increased risk

The universal traffic control (UTC) system did not present a signal passed at danger (SPAD) alarm for signal CS025 to the network control officer, because the conditions required for the UTC to display the alarm were not met. Consequently, mitigation of the safety risk relied on the driver recognising the SPAD and stopping the train.

In this occurrence, the driver of train TE43 recognised that signal CS025 was at stop just before they passed it, stopped the train and made an emergency broadcast, initiating the NCO's response. Fortunately the inherent constraint resulting in the absence of a SPAD alarm and associated risk mitigation from active intervention by the NCO had no effect on the consequence of this occurrence. However, if the driver had completely missed signal CS025, then automatically acknowledged the next AWS warning and continued past signal CS027 (i.e., multiple SPAD), a SPAD alarm would again not have been generated, if the replacement track was still occupied by train ahead EM03.

Other finding

The driver of train TE43 recognised signal CS025 was at stop just before they passed it, applied emergency braking and made an emergency radio call to network control. The signal after CS025 (CS027) ahead of train TE43 was also at stop. This red aspect, coupled with the associated automatic warning system activation, provided protection to the rear of train EM03. However, if train TE43 had passed signal CS027 with train EM03 occupying the replacement track, a SPAD alarm would also not have been generated by the universal traffic control system.

Risk management of signal passed at danger

QR knew of conditions that would prevent a signal passed at danger (SPAD) alarm being provided to the NCO following a SPAD event. These conditions were noted in SR105 – *SPAD Alarm generation principles* manual, which included specific limitations applicable to automatic signals.

In this instance, the NCO became aware of the SPAD at signal CS025 after the driver had stopped their train and only because the driver made an emergency call. QR Network control manual identified the signal passed at danger alarm as a critically important control to mitigate the risk from SPADs. Additionally, the QR standard *MD-10-89 SPAD Risk Management* noted the actions of the NCO as a factor that reduced the severity of SPAD incidents once they occurred. The absence of a SPAD alarm message to an NCO, would prevent them from taking any recovery action.

Additionally, QR had developed a bow tie analysis to assess the risk of a SPAD due to driver distraction. All of the risk controls listed were contingent on the driver performing the correct action, which while they were distracted was unlikely to be effective. The bowtie analysis did identify 'UTC SPAD alarm triggering emergency response procedure' and 'NCO emergency response to SPAD alarm to stop train' as risk controls. However, it did not recognise that the NCO taking action was dependent up on a SPAD alarm being generated, and the UTC SPAD alarm was not specifically identified as critical risk control.

QR had also undertaken both enterprise and operational area risk assessments that addressed risks to train separation, including SPAD events. The risk assessments did not assess the effectiveness of the recovery action provided by the NCO or consider the SPAD alarm warning limitations inherent to the UTC system. Risk assessments conducted in operational areas referenced other QR functional areas, however these also did not assess the risk further.

The risk control of active intervention by the NCO in response to a SPAD was an administrative control and was not defined as a critical risk control. This was because it could not guarantee all trains in the area would stop. However, previous ATSB investigations noted NCOs had an important role in preventing further reduction in safety margins, once a SPAD had occurred. In other SPAD scenarios where a signal was completely missed by a driver and not self-reported, the system was reliant upon the NCO receiving and responding to a SPAD alarm (which will not always occur) to prompt the driver to stop the train.

Other factor that increased risk

The signal passed at danger (SPAD) alarm for CS025 did not alert the network control officer when train TE43 passed the signal at stop. This was due to inherent constraints of the universal traffic control system, which was not considered in the way Queensland Rail managed the risk of SPADs. (Safety issue)

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 the signal passed at danger involving passenger train TE43 between Fortitude Valley and Bowen Hills, Queensland on 24 May 2023.

Contributing factors

- The sneezing fit between signal BS07 and signal CS025 reported by the driver likely impeded their control of the train and observance of the red aspect displayed in CS025. Train TE43 subsequently passed signal CS025 at stop by about 64 m.
- There were frequent automatic warning system (AWS) alarms presented to the driver between Park Road Station and Fortitude Valley Station due to traffic congestion. This likely influenced the driver's reaction in acknowledging the AWS alert on approach to signal CS025, which cancelled the train's automatic brake application, while not recognising the red aspect.
- **The automatic warning system (AWS) provided the same audible alarm and visual indication to a driver on the approach to all restricted indications. 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 usefulness.** (Safety issue)

Other factors that increased risk

- The universal traffic control (UTC) system did not present a signal passed at danger (SPAD) alarm for signal CS025 to the network control officer, because the conditions required for the UTC to display the alarm were not met. Consequently, mitigation of the safety risk relied on the driver recognising the SPAD and stopping the train.
- **The signal passed at danger (SPAD) alarm for CS025 did not alert the network control officer when train TE43 passed the signal at stop. This was due to**

inherent constraints of the universal traffic control system, which was not considered in the way Queensland Rail managed the risk of SPADs. (Safety issue)

Other finding

- The driver of train TE43 recognised signal CS025 was at stop just before they passed it, applied emergency braking and made an emergency radio call to network control. The signal after CS025 (CS027) ahead of train TE43 was also at stop. This red aspect, coupled with the associated automatic warning system activation, provided protection to the rear of train EM03. However, if train TE43 had passed signal CS027 with train EM03 occupying the replacement track, a SPAD alarm would also not have been generated by the universal traffic control system.

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 are invited to provide submissions to this draft report. As part of that process, each organisation is asked to communicate what safety actions, if any, they have carried out or are planning to carry out in relation to each safety issue relevant to their organisation.

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

Automatic warning system alert limitations

The automatic warning system (AWS) provided the same audible alarm and visual indication to a driver on the approach to all restricted indications. 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 usefulness.

Issue number:	RO-2023-004-SI-02
Issue owner:	Queensland Rail
Transport function:	Rail: Passenger – metropolitan
Current issue status:	Closed – not addressed
Issue status justification:	While Queensland Rail has taken actions in relation to the prevention of signal passed at danger occurrences, these actions do not address the identified issue. However, given the substantial difficulty in widespread modification of the AWS technology to distinguish between the alerts that occur in response to signals with a red aspect compared to other restricted signals, and noting the system will be in place for many years to come, the safety issue will be closed as not addressed. The ATSB notes that safety action taken in response to safety issue RO-2023-004-SI-01 provides an opportunity to assess if the controls in place are appropriate to address the continued risk posed by this issue.

Response by Queensland Rail

On 11 April 2025, Queensland Rail reported to the ATSB that it has taken the following safety initiatives to address the issue of potential habituation and the lack of higher

priority alert tone/volume for red signals in automatic warning systems (AWS), which can reduce their effectiveness in preventing signal passed at danger (SPADs):

- Progressive implementation and rollout of European Train Control System (ETCS). At present ETCS is being implemented on the Queensland Rail's Shorncliffe Pilot line undergoing verification, validation and certification. ETCS rollout is in the design phase for other parts of QR Network.
- Auditory volume of AWS for restricted signals versus green signals have been adjusted for better auditory discrimination, which is consistent with the approach taken by other jurisdictions nationally and globally.
- Queensland Rail operation’s area has implemented comprehensive and enhanced driver training focusing on driver route knowledge of track gradients, adhesion levels, and train braking characteristics to help drivers make better judgements about when to start braking in relation to signal aspects.
- Improved accident investigation and analysis, route and signal design management through the Signal Sighting Committee assessment.
- Exploration of advanced driver rostering through the use of the Fatigue Assessment Tool by InterDynamics to consider improvements.
- Active participation in development groups for The Rail Industry Safety and Standards Board (RISSB). This includes the Rail Vigilance Timing Cycles Code of Practice and Australian Standard AS 7475 Management of SPADs and Proceed Authority Exceeded Events.
- Reviewing Risk Triggered Commentary Driving (RTCD) standard and related training to explicitly include the AWS Restricted alarm as a ‘risk trigger’ to commence RTCD.
- Embedding non-technical skills of situational awareness, decision-making and threat and error management in the verification of competency process.

Update of project by Department of Transport and Main Roads

On 10 April 2025, the ATSB requested Queensland Department of Transport and Main Roads (TMR), as the project sponsor of ETCS Level 2 program, provide information on the anticipated implementation schedule of the program for the Queensland Rail network.

On 28 April 2025, TMR responded that there is a long-term plan to deploy ETCS throughout the entirety of the South East Queensland (SEQ) rail network. Deployment is occurring in stages and full deployment will take many decades. Numerous factors are considered to determine which stages are to be prioritised. Operationalisation of ETCS requires the SEQ rail network to be sectorised, with Sector 1 being the priority. Sector 1 is the north-south corridor joining the Gold Coast and Sunshine Coast through the Brisbane CBD.

Cross River Rail (CRR) (twin tunnels under the Brisbane River, exiting in the vicinity of Exhibition on the northside and Dutton Park on the southside) is the first ETCS deployment funded and currently under construction. CRR also deploys ETCS overland from the southern tunnel portal to Moorooka Station, plus the Shorncliffe Pilot Line from Nudgee to Shorncliffe. The Shorncliffe Pilot Line is anticipated to be in revenue service by the end of 2025. The sections between Beenleigh and Varsity Lakes are also in delivery and are expected to be in revenue service by the end of 2026. Further sections have been funded but are not yet in delivery including a new spur line, the Direct

Sunshine Coast Rail Line (Beerwah to Birtinya), Elimbah to Beerwah, and Kuraby to Beenleigh.

Although yet to be funded, the sections from Moorooka to Kuraby, and from Elimbah to Northgate are in planning with the desire to have virtually the entirety of Sector 1 (coast to coast) in revenue service by 2032. Subsequent deployments are anticipated but not yet in planning, with Sector 2 (from Ipswich to Shorncliffe) the likely next sector for ETCS deployment based upon the volume of services on that line.

The TMR response identified priority sectors of the SEQ network planned for ETCS Level 2 implementation. Bowen Hill Station and surrounding areas were in sector 2 (Shorncliffe, Domestic Airport, Doomben, Springfield, Rosewood lines) and sector 3 (Ferny Grove and Cleveland line).

ATSB comment

The ATSB notes the response by Queensland Rail and the actions taken in relation to the prevention of signal passed at danger occurrences. While welcome, these actions do not address the identified issue.

However, the ATSB also acknowledges the substantial difficulty in widespread modification of the AWS technology to distinguish between the alerts that occur in response to signals with a red aspect compared to other restricted signals. Additionally, Queensland Rail is reliant upon the implementation of ETCS Level 2 across the South East Queensland network to replace AWS technology, which will take many years.

As such, the safety issue will be closed as not addressed.

While that means that the risk associated with the identified constraint of the AWS remains, safety action taken in response to safety issue RO-2023-004-SI-01 provides an opportunity to mitigate both issues.

Signals passed at danger risk management

The signal passed at danger (SPAD) alarm for CS025 did not alert the network control officer when train TE43 passed the signal at stop. This was due to inherent constraints of the universal traffic control system, which was not considered in the way Queensland Rail managed the risk of SPADs.

Issue number:	RO-2023-004-SI-01
Issue owner:	Queensland Rail
Transport function:	Rail: Passenger – metropolitan
Current issue status:	Open – Safety action pending
Issue status justification:	Queensland Rail provided extracts from its risk registers to manage SPAD events dated in 2021. These registers had not been updated since the occurrence and did not assess inherent universal traffic control system conditions that may lead to risk controls being ineffective.

Response by Queensland Rail

On 11 April 2025, Queensland Rail (QR) acknowledged that there were known circumstances in which Universal Traffic Control (UTC) may not generate a SPAD alarm at all signal locations on the QR Network.

QR identified that there were approximately 241 signal locations, approximately 5% of coloured light automatic signals throughout the network where SPAD detection, via a UTC system alarm, may not always trigger following a SPAD occurrence. Additionally, in the last 4 years, there have been 3 occasions of a SPAD at an automatic signal, of which all were self-reported from the driver to the network control officer (NCO) in accordance with their training. QR noted that this training ensured that alternative risk minimisation controls were available and suitable beyond automated alarms so far as is reasonably practicable (SFAIRP).

QR further noted that the NCO's intervention following a SPAD was operationally critical, however it advised that it did not meet the threshold of a critical risk control under its risk management framework. It stated that the current risk assessments supported the organisation's SFAIRP risk management position for SPAD management.

In response to the safety issue, QR provided the ATSB with a list of safety actions from the SPAD Prevention Taskforce that was established in 2017.

It advised that the following safety controls and initiatives had been implemented which focused on:

- human factors and driver behaviour
- increased supervision and engagement with drivers
- improved SPAD awareness through toolbox talks and one-on-one engagement with drivers.

Infrastructure improvements initiatives to improve train handling:

- upgrading LED aspects of signals to improve signal sighting
- relocating stopping markers for better line of sight
- installing additional warning signals, countdown markers, route arrows
- modern technology implementation and progressive rollout of ETCS.

QR noted that while these actions represent a reasonable approach to SPAD management, QR along with the other participants in the rail industry, continue to face challenges in fully addressing the limitations of legacy systems, such as AWS, in preventing SPADs. The development and implementation of more advanced automatic safety systems such as European Train Control System (ETCS) remains a strongly preferred option for further improving rail safety and long-term interoperability.

Additionally, QR provided an extract of the risk register reviewed on 22 September 2021 conducted by the Discipline Head Rollingstock. This included a SFAIRP justification that introduction of ETCS would reduce the risk score when implemented. It also listed 'Application of UTC' as a substantially effective risk control. QR noted that the assessment included risk controls that were both partially and substantially effective, and they identified the risk of a SPAD incident at the enterprise level as Medium.

On 11 January 2024, Queensland Rail conducted a comprehensive review of its SPAD Risk Management framework against relevant Australian Standard *AS 7457:2019 Management of SPADS and Proceed Authority Exceeded* to inform a review and update of MD-10-89 SPAD Risk Management Standard. MD-10-89 was updated on 23 August 2024.

ATSB comment

Queensland Rail identified that there were several locations on the SEQ network where an alarm may not be generated following a SPAD. While the locations were generally associated with an automatic signal, there were situations where an alarm would also not generate at the next signal (automatic or controlled) if the replacement track of the following signal was already occupied. The ATSB notes that in this instance a driver would have passed 2 signals at stop. In these situations, the emergency response was reliant on the driver self-reporting the SPAD to the network control officer (NCO).

The self-reporting of a SPAD by the driver is not effective in scenarios where the driver does not recognise that they have passed a signal at stop (that is, the driver completely missing the limit of authority), and consequently does not self-report the SPAD. Previous investigations conducted by the ATSB (RO-2018-002, RO-2017-010) found in both instances the driver exceeded their limit of their authority without realising and, following the display of an alarm, the NCO actively intervened to stop the train, mitigating risk to train operations.

The ATSB considers the scenario where a SPAD alarm is not generated, and the driver does not report the SPAD, had not been considered in the Queensland Rail risk assessments.

Safety recommendation to Queensland Rail

The ATSB makes a formal safety recommendation, either during or at the end of an investigation, based on the level of risk associated with a safety issue and the extent of corrective action already undertaken. Rather than being prescriptive about the form of corrective action to be taken, the recommendation focuses on the safety issue of concern. It is a matter for the responsible organisation to assess the costs and benefits of any particular method of addressing a safety issue.

Recommendation number:	RO-2023-004-SR-01
Responsible organisation:	Queensland Rail
Recommendation status:	Released

The Australian Transport Safety Bureau recommends that Queensland Rail reviews the risk associated with a signal passed at danger (SPAD) in circumstances where the inherent constraints of the universal traffic control system do not alert the network control officer and the driver does not self-report, and any additional risk controls that may be appropriate for the current signalling system.

General details

Occurrence details

Date and time:	24 May 2023 – 0944 Eastern Standard Time	
Occurrence class:	Serious incident	
Occurrence categories:	Signals Passed at Danger	
Location:	Between Fortitude Valley Station and Bowen Hills Station, Queensland	
	Latitude: 27° 27.159'S	Longitude: 153° 2.199'E

Train details

Track operator:	Queensland Rail	
Train operator:	Queensland Rail	
Train number:	TE43	
Type of operation:	Suburban Passenger	
Consist:	6-car set of interurban multiple unit (IMU) lead car 181 and trailing suburban multiple unit (SMU) 295	
Departure:	Cooper Plains, Queensland	
Destination:	Bowen Hills, Queensland	
Persons on board:	Crew – 2	Passengers – unknown
Injuries:	Crew – 0	Passengers – 0
Damage:	None	

Glossary

AWS	Automatic warning system
ETCS	European train control system
IMU	Interurban multiple unit
LOA	Limit of authority
NCO	Network control officer
QR	Queensland Rail
RTCD	Risk triggered commentary driving
RTO	Rail transport operator. Encompassed both rail infrastructure managers (track, signalling etc.) and rolling stock operators (locomotives, wagons etc.).
SEQ	Southeast Queensland operations
SMU	Suburban multiple unit
SPAD	Signal passed at danger (also known as a proceed authority exceedance)
TSD	Train service and delivery operations
UTC	Universal traffic control system

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the train driver of TE43
- Queensland Rail

References

RISSB AS 7711:2018 Signalling Principles: Train control systems standard

RISSB Glossary of Terms

Australian Centre for Disease Control 2024, *Coronavirus Disease 2019 (COVID-19): CDNA National Guidelines for Public Health Units*. https://www.health.gov.au/sites/default/files/2024-06/coronavirus-covid-19-cdna-national-guidelines-for-public-health-units_0.pdf

Office of the National Rail Safety Regulator's Reporting Requirements for Notifiable Occurrences Guideline. Version 2. https://www.onrsr.com.au/operator-essentials/reporting-requirements/notifiable-occurrences

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 train driver of TE43
- Queensland Rail
- Office of the National Rail Safety Regulator
- Queensland Government Department of Transport and Main Roads.

Submissions were received from:

- Queensland Rail
- Office of the National Rail Safety Regulator
- Queensland Government Department of Transport and Main Roads.

The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

About the ATSB

The **Australian Transport Safety Bureau** is the national transport safety investigator. Established by the *Transport Safety Investigation Act 2003* (TSI Act), the ATSB is an independent statutory agency of the Australian Government and is governed by a Commission. The ATSB is entirely separate from transport regulators, policy makers and service providers.

The ATSB's function is to improve transport safety in aviation, rail and shipping through:

- the independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis, and research
- influencing safety action.

The ATSB 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.

About ATSB reports

ATSB investigation final reports are organised with regard to international standards or instruments, as applicable, and with ATSB procedures and guidelines.

Reports 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

An explanation of ATSB terminology used in this report is available on the ATSB website.