Australian Government
Australian Transport Safety Bureau

Near miss with maintenance worker on Skitube Alpine Railway

Bullocks Flat, New South Wales, on 3 July 2019

ATSB Transport Safety Report
Rail Occurrence Investigation (Defined)
RO-2019-014
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Cover photo: Source OTSI

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Addendum

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Safety summary

What happened

On 3 July 2019, a rolling stock maintenance electrician obtained clearance from the duty controller to enter the west track at the station terminus at Bullocks Flat. The electrician sought to install a missing traction motor cover retaining clip under stationary train Alpha 24. While the electrician was under the platform, he heard the train brakes release and the electrician moved out from under the train before the train moved a short distance. The electrician was not injured.

What the ATSB found

The duty controller granted an electrician access to the west track while the daily 1700 shunt on west track was taking place. It is likely the duty controller did not connect the two activities, the 1700 shunt and the electrician accessing west track, due to other activities occurring at the time, including a visit from an off-duty controller. The Skitube system for managing access to track did not detect the conflict of the rail maintenance worker under the train at the same time the train was being shunted.

The electrician had not applied the required protection flags to the train set to indicate work was being conducted on the train. The system of placing protection flags on both ends of a train set does not isolate energy to ensure a train cannot be moved when it is being worked on.

Elements of the Skitube safety and environment management system are reliant on procedures being followed to manage safety risks. There is little scope for the system to recover when there has been a human error or other procedural error.

The ATSB also found:

- The rolling stock return to service authority was ineffective as a control in providing assurance that all required tasks were completed and verified.
- The electrician felt an urgency to re-install the missing R-clip with concerns a dislodged inspection cover may lead to an equipment failure from the ingress of foreign material into the traction motor.

What has been done as a result

The temporary track access procedure and form were reviewed, updated and documented. The Skitube train red flag procedure was formalised and documented as a discrete procedure. Including the requirement to lower the pantograph, apply brakes, remove the keys, lock the driver's cab and place a "Do Not Operate" tag onto all driver's cabs when a person is required to be in close proximity to a stationary train. The feasibility of a positive lockout within the driver's cabin that locks the pantograph in the lowered position is being reviewed. This is not a standard mechanism available from the manufacturer and requires re-engineering and completion of a change management process.

The completed changes and other major safety rules and processes were communicated to all staff who were required to demonstrate an understanding of the requirements prior to the 2020 operating season. Further consultation and communication will be undertaken with staff on other changes that are still in progress.

Safety message

Workers must ensure they are protected and follow safety procedures before entering the danger zone or when interacting with trains. Systems should identify when conflicting activities take place that increase the risk to workers. Organisations should assess their risk controls for adequacy in protecting workers, and where required consider additional lines of defence.

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The occurrence

On 2 July 2019 a Skitube 2-carriage train set (set 3) was scheduled for service at the Bullock's Flat maintenance centre. An electrician (electrician 1) conducted the scheduled maintenance requirements on set 3, which would form part of the 4-carriage train, Alpha 24.

Electrician 1 started work on set 3 understanding the train set would re-enter service that afternoon. Nearing completion he was told set 3 would not be returning to service that day.

Electrician 1 completed the remaining tasks and then completed the return to service authority, ticking off all check tasks as complete. Thinking he had completed all tasks successfully, he did not go back under the train set to confirm.

Set 3 was signed off as complete and ready for service at 1515 AEST[1] on 2 July 2019.

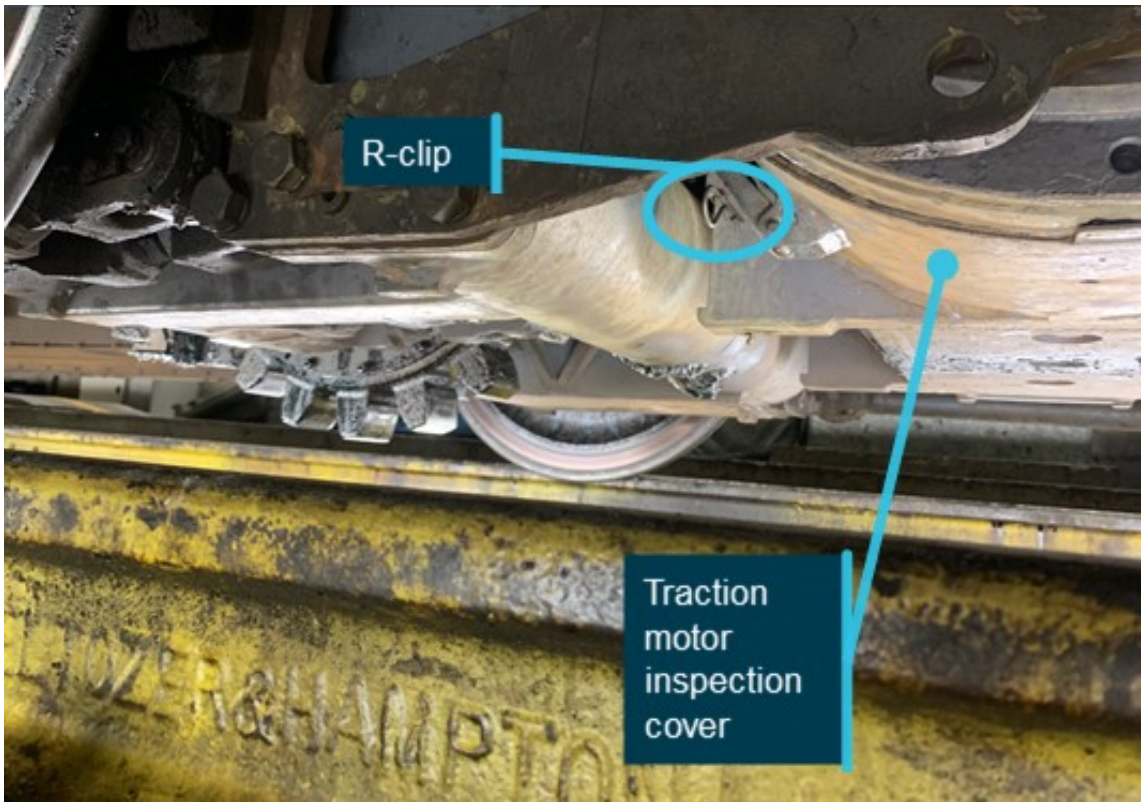
On the morning of 3 July 2019 set 3 entered service as part of the 4-carriage train which would subsequently be designated Alpha 24. The train service ran throughout the day without any reported issues.

During end of shift clean-up in the maintenance centre, a maintenance technician found an R-clip on the ground and handed it to the maintenance electrician (electrician 2).

Based on the location it was found on the ground, electrician 2 understood where the R-clip may have come from and knew it to be a securing R-clip of a traction motor inspection cover.

The electrician took immediate action to ensure it was replaced.

Figure 1: R-clip securing traction motor inspection cover



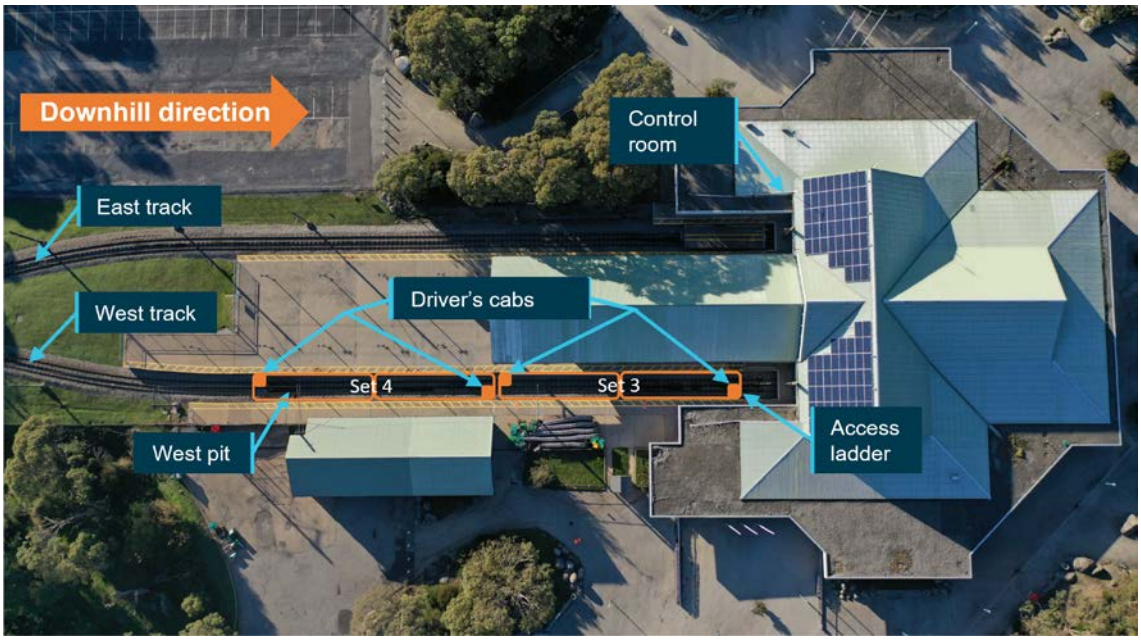
The image shows the traction motor inspection cover secured with the R-clip installed.
Source: Skitube, annotated by OTSI

[1] Times shown in 24 hour time as Australian eastern standard/daylight savings time (AEST/AEDT).

At 1645 the electrician approached the Skitube duty controller in the Skitube control room and asked that downhill train, Alpha 24, enter the station slowly for an inspection.

At 1652, the electrician requested formal clearance by radio from the duty controller to enter the west track at Bullocks Flat Terminal (BFT) to conduct a roll-by inspection[2] of the approaching passenger train. Alpha 24 was a 4-carriage train made up of two 2-carriage sets coupled together, set 3 (downhill) and set 4 (uphill).

Figure 2: Overhead view of Bullocks Flat Terminal



Approximate location of Alpha 24 (set 3 and 4) when it arrived at Bullocks Flat Terminal.
Source: OTSI

The inspection was carried out from a purpose built inspection pit under the track adjacent to the west platform. The electrician was looking for the location of a missing traction motor inspection cover R-clip, found on the ground in the maintenance area.

The duty controller provided the electrician clearance to enter the west track inspection pit (west pit). The duty controller's view of the west platform was partially obstructed by train Charlie 25, stationary at the BFT east platform.

At 1653, the electrician asked the duty controller to advise the train driver (driver 1) of Alpha 24 that the electrician would be in the inspection pit and to reduce the train's speed to under 10 km/h as the train passed over the inspection pit. Shortly after, the duty controller radioed Alpha 24 and requested that the driver "come in slow as people in the pit need to look underneath, no faster than 10km/h". Driver 1 repeated the details back to the duty controller, confirming the request.

As Alpha 24 crossed number one points on the way into the west platform, driver 1 reduced the train speed to under 10 km/h. The electrician and driver 1 made visual contact and the electrician acknowledged driver 1 with a hand wave as the train approached the pit.

At 1657, another driver (driver 2) entered the duty control room to advise the duty controller he would be assisting driver 1 with uncoupling of Alpha 24 train into set 3 and set 4. This uncoupling procedure regularly occurred around 1700 each day. Driver 2 then walked to, and waited along the middle of the east side of the west platform.

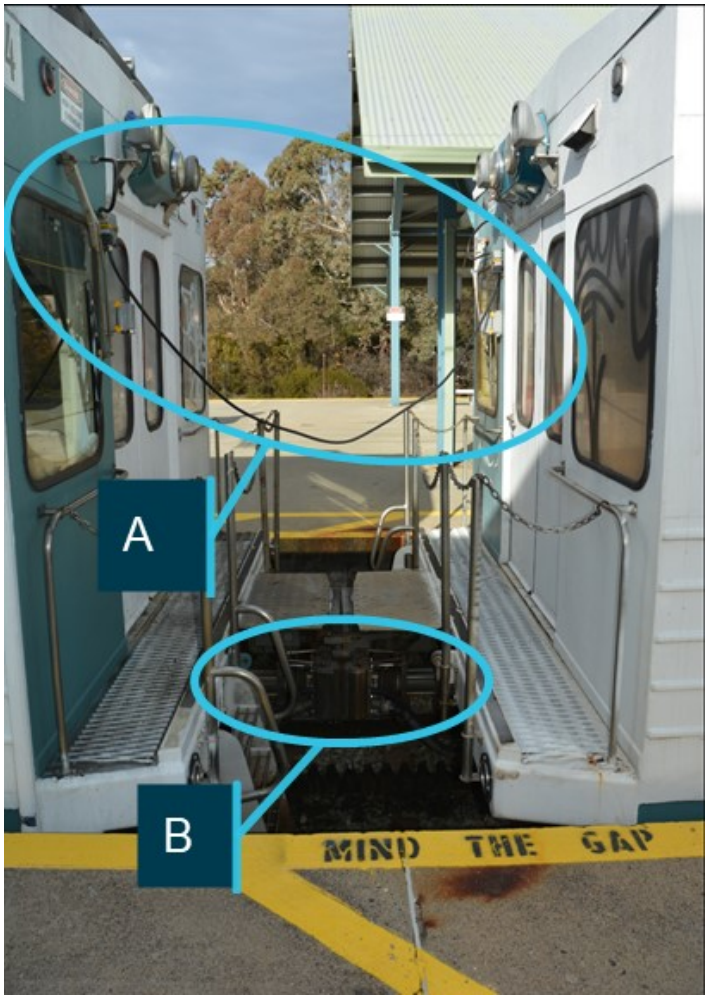
At 1658, driver 1 brought Alpha 24 into the west platform and stopped approximately four metres from the platform dead-end. Driver 1 opened the carriage side doors and the passengers alighted

[2] A roll-by inspection is a visual inspection of a moving train as it passes by.

from the train. Shortly after, the electrician advised the duty controller by radio that he was clear of the inspection pit. The duty controller acknowledged the electrician was clear of the pit. The electrician locked the access to the inspection pit and walked to the downhill end of Alpha 24 on the west platform.

At 1659, driver 1 and driver 2 commenced uncoupling Alpha 24, by firstly removing the hi-fog fire suppression system inter-car connector between set 3 and set 4. Driver 2 then entered the driving cab on the uphill end of set 3 and propelled set 3 (first movement) downhill towards the platform dead-end by approximately 50 cm to ensure disengagement of the Scharfenberg type couplers.

Figure 3: Coupling between set 3 and set 4



Hi-fog fire suppression system inter-car connector (A) and Scharfenberg type coupling mechanism (B)
Source: OTSI

Not long after set 3 came to a stand, at 1701:32 the electrician used the radio to request clearance from the duty controller to enter the west track at west platform and the duty controller provided clearance to enter the track.

At 1701:45, the electrician descended the ladder attached to the lead end (downhill) of set 3 and entered the crawl space between the underside of the west platform and set 3.

Moments after, driver 2 walked through the interior of set 3, and at 1701:53, entered the driving cab at the downhill end of the set. Driver 2 then drove set 3 approximately three metres towards the platform dead-end. The electrical pantographs on both sets 3 and 4 were up and in contact with the electrical overhead power supply while on the west track.

Just prior to this second movement of set 3, the electrician had located traction motor three in readiness to replace the missing R-clip. Before replacing the R-clip, the electrician heard the

brakes on set 3 release, moved back against the wall under the platform and clear of the train set before it moved. When the train set stopped again, the electrician installed the missing R-clip.

Shortly after, the electrician climbed out from west track and at 1703 advised the duty controller by radio that he had cleared west track from under set 3 and the duty controller acknowledged the clearance.

Following the incident, the electrician approached driver 2 to report that he was under the train set during the second shunting movement. The incident was then reported through the company's incident reporting system. Driver 2 advised he was not aware anyone was working on the train set.

No one was injured during the incident.

Context

Skitube Alpine Railway

The Skitube Alpine Railway (Skitube) operates trains between Bullocks Flat Terminal (BFT), off the Alpine Highway near Jindabyne, New South Wales (NSW), and the Perisher and Blue Cow snow-ski fields. The Skitube comprises passenger stations at the BFT and at the Perisher and Blue Cow ski-fields. Additionally, the Skitube has a maintenance facility in a siding near BFT. The rollingstock operates on a rack mechanism to enable the train to negotiate the 1 in 8 ruling grade and the track is a standard gauge configuration.

Operating at capacity, Skitube is capable of carrying up to 4,500 passengers per hour between the three passenger stations. Services run to a schedule during the ski season and typically operates from the June long weekend to the October long weekend, with a peak season from July to September. BFT experiences a morning and afternoon peak period during the ski season in line with skiers heading to and returning from the ski fields.

Passenger carriages

Skitube passenger carriages are wide-body design vehicles and operate in 2 and 4-carriage configurations. The train set will operate with a driving cab at each end to enable the train set to be operated in the opposite direction from a dead-end station.

Alpha 24 consisted of 4-carriages when it arrived at BFT. It was uncoupled into two 2-carriage configurations set 3 and set 4 just prior to the incident.

Figure 4: View from Control room window

Set 3 on west track, east track clear at Bullocks Flat Terminal.
Source: OTSI

Control room

The Control Room is located at BFT on the eastern side of the platform. The duty controller is seated in this room where there is visibility of east and west track. There is limited access to the

control room to minimise disruption to the duty controller and to ensure integrity of the control room and the rail system is maintained. No more than three persons may occupy the control room during winter operations. The only staff permitted in the control room, and only whilst conducting Skitube business are; incoming and outgoing duty controllers, Skitube Manager, Assistant Skitube Manager and the Skitube Operations Supervisor. Other staff may enter the control room for work-related purposes at the request of the duty controller. Where possible other staff members should enter the visitors area only, via the terminal entry, not the concourse entry.

Duty controller

The duty controller manages activities on the Skitube by communicating with staff through a discrete two-way radio and by telephone. The duty controller monitors the railway through a network of closed-circuit television (CCTV) cameras. The duty controller also controls the movement of trains by operating signals and points through a supervisory control and data acquisition (SCADA) control system. The duty controller issues and monitors permits to work for those who are required to work in the rail corridor.[3]

The duty controller completed Skitube Duty Controller training and assessed as competent on 31 August 2018. Additionally, he completed a number of units of competency, relevant to his role as duty controller, through the Transport Industry Skills Centre. He was deemed competent in these units on 21 September 2018. The duty controller completed Skitube refresher training for train driver and duty controller and assessed competent on 31 May 2019.

Train driver 1

Train Driver 1 (driver 1) was the driver in control of the downhill train designated Alpha 24. Driver 1 commenced as a seasonal driver in 2006, completed training and assessed competent as a train driver. He worked the 2007 season then took a break and returned to work the 2015 through 2019 seasons. He completed and assessed competent in driver refresher training each year.

Train driver 2

Train Driver 2 (driver 2) was the driver assisting driver 1 to uncouple the Alpha 24 4-carriage set into two, 2-carriage sets. Driver 2 was employed by Skitube in 2003 as a seasonal train driver. Driver 2 was a permanent employee and has held roles as the Head Controller and was Skitube Operations Supervisor at the time of the incident.

Driver 2 completed and was assessed as competent for both train driver and duty controller refresher training on 4 June 2019. Driver 2 was also a qualified trainer and assessor for Skitube train drivers and duty controllers.

Maintenance electricians

The maintenance electrician conducts electrical maintenance on Skitube assets, including rolling stock, in accordance with Perisher Blue standards and procedures. The maintenance electrician will typically conduct rollingstock maintenance at the Bullocks Flat maintenance facility, however, the maintenance staff may carry out tasks at other work locations in accordance with the relevant procedures for that location.

There were two maintenance electricians involved in this incident.

The electrician that conducted the maintenance inspection on set 3 (electrician 1) commenced as an electrician in March 2016. He had certified in Electrotechnology – Systems Electrician from TAFE in 2011. He had also been deemed competent in a number of Skitube competencies, including Locomotive Operation in 2016 and Service and Repair Electric Train in 2017.

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[3] The land on which a railway is built; comprising all property between property fences, or if no fences, everywhere within 15m from the outermost rails.

The electrician directly involved in this incident (electrician 2) commenced in February 2017. He was a qualified level 4 electrician. He had been trained and deemed competent in the Skitube's track safety awareness program, track access and track and maintenance lock-out procedures.

Safety and environment management system

Return to service authority

At the completion of a maintenance service on a train set, the maintenance team were required to complete a rolling stock return to service authority. Depending on the type of work completed on the train set, the mechanic or electrician conducting the work was required to initial next to the work item to indicate the work had been completed.

On 2 July 2019, according to the information on the completed return to service authority, set 3 was fit to return to service at 1515. Set 3 had undergone routine mechanical and electrical work. A mechanic and electrician that worked on the set had initialled all tasks on the form, including the check task, 'All motor covers replaced and secured'. This check task was a single check box to denote all motor covers were replaced and secured. The motor car on set 3 has four traction motors hence four motor covers to replace and secure.

Skitube duty controller's manual – track access

The Skitube duty controller's manual requires any person entering within 3 metres of the track (track area) have permission from the Skitube duty controller to access the track area. Additionally, the person must report to the duty controller when clear of the track area. The manual states permission to access the track may be obtained by Skitube radio.

Electrician 2 accessed the track area on two occasions, the first was to get into the west pit and the second was to get access under set 3 to replace the R-clip.

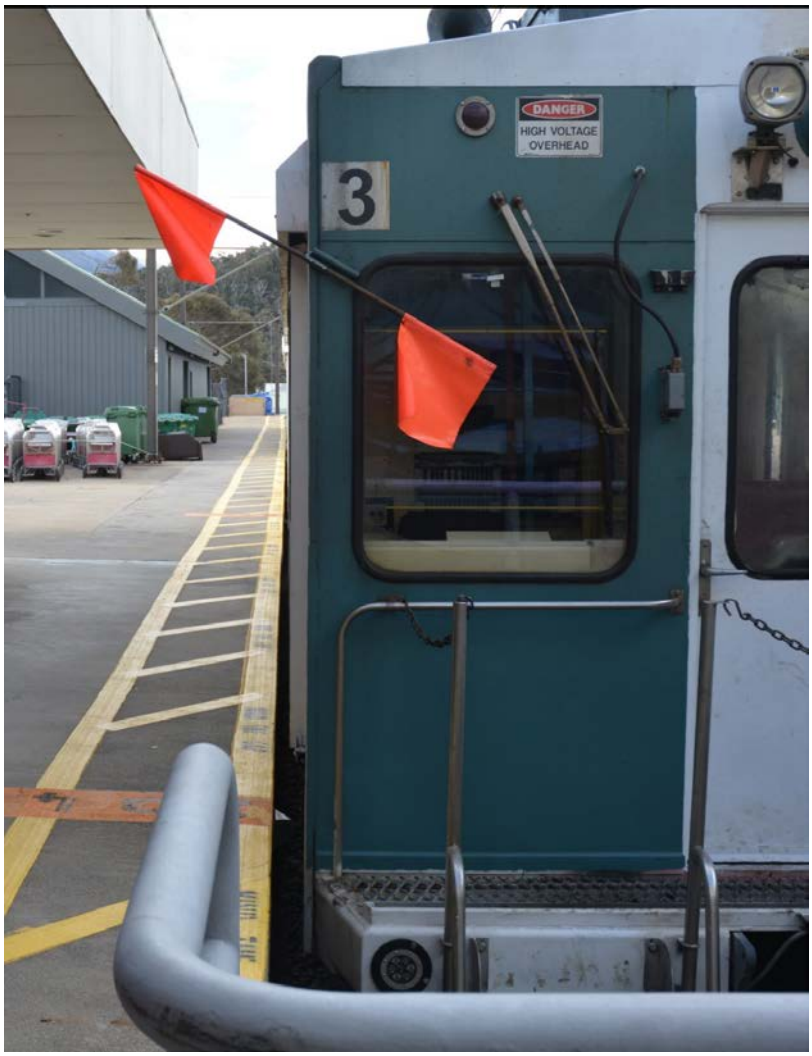
On both occasions, he made contact with the duty controller over Skitube radio and was granted permission by the duty controller prior to accessing the track area.

Skitube duty controller's manual – protection flag

The Skitube duty controller's manual outlines the function of the protection flag. The protection flag (red rectangular flag) is to be fitted on the end of trains to indicate the train is defective or someone is working on the train. When the flag is in place it states the action is "do not move the train".

Electrician 2 did not place protection flags on the train prior to entering the track area below the train. The duty controller had not checked that the electrician had taken the protection flags from the control room.

Figure 5: Example of protection flag on set 3



Source: OTSI

Control room logbook

The duty controller is required to fill in the Control room logbook to provide an account of the activities that occurred throughout the shift. The logbook entries on the 3 July 2019 included the following entries amongst many others;

> '1658 - split 3 & 4 set 3 oos'
>
> '1702 – EM x 1 BFW under set 3 clear 1703'

The first entry referred to set 3 and set 4 being separated, with set 3 being left out of service (oos).

The second entry referred to one electrical maintenance person (EM x 1) at Bullocks Flat West (BFW) under set 3 and was clear at 1703.

Temporary track access form

The duty controller is required to follow check list, PBPL SEMS 3.6.2 – Temporary track access form before providing clearance for a worker to enter the track.

There is no reference to this form in the Skitube duty controller's manual. Use of the form is included in duty controller training. It is not included in duty controller refresher training or assessment.

The form had been set up to provide the duty controller a set of logic gates which would aid the decision of whether track access should be granted or not.

On the day, the duty controller granted access and recorded the electrician accessing the track under set 3 at 1702 and clearing the train at 1703.

Skitube train driver's manual – multiple unit operations

This Skitube train driver's manual outlines the procedure to uncouple a train. The instructions in the document refer to the specifics of coupling and uncoupling the train sets only. It does not cover the requirements for the driver to notify the duty controller that uncoupling is going to take place.

Uncoupling the carriage sets was a routine task that occurred at approximately 1700 hours each day. It enabled the uphill two-carriage set to complete a return run to Perisher and Blue Cow Terminals to pick up and return staff finishing work on the mountain and to pick up rubbish from the resorts accumulated throughout the day.

Safety analysis

Returning vehicles to service

When train set 3 was deemed fit to return to service at 1515 hours on 2 July 2019, the return to service authority had been completed by a Skitube maintenance mechanic and maintenance electrician (electrician 1). They were also the maintenance staff that completed the maintenance tasks on the train set.

The rolling stock return to service authority indicated all return checks had been completed and it was ready to return to service.

It is likely set 3 operated throughout the day on the 3 July 2019 without the R-clip securing the motor cover, the R-clip was found in the maintenance pit by one of the maintenance technicians during clean-up near the end of the day.

Electrician 1 had worked on the train set on the 2 July 2019 and was responsible for completing the maintenance work and completing the return to service authority, including securing the traction motor inspection covers.

In electrician 1's statement, the electrician said,

> I needed to complete this work quickly as the train was required to be put back in service.

On completion of the electrical work under the train, electrician 1 moved onto working on the pantographs (on top of the train) and on completion filled in the return to service authority. Electrician 1 stated,

> I did not re-enter under the train to complete a check as I believed I had completed all the work as I moved through.

The risks of using checklists for maintenance tasks has been reviewed in past research. Pearl and Drury[4] identified,

> Checklists… aid the mechanic in recalling all the numerous tasks to be performed in the check. As the worker performs these tasks repeatedly, there is a tendency to perform them partially from memory, with a block of sign offs made at a convenient time. This is not how workcards [checklists] are intended to be used, and as such use can result in errors.

The return to service authority was used in the manner described by Pearl and Drury. The task of ensuring a securing R-clip had been replaced was not checked at the same time the checklist was completed. This allowed the maintenance worker to make an error (omission) thinking they had completed the task but had not.

A process or system provides little assurance when it requires the same person doing the work to complete a check sheet to attest the work has been completed. Without a second person checking that work has been completed as required, the system is not resilient to a human error.

The rolling stock return to service authority was ineffective as a control in providing assurance that all required tasks were completed and verified.

Replacing the R-clip

At interview, electrician 2 recalled being given an R-clip found on the ground by one of the technicians during clean up. Based on the location it was found on the ground, electrician 2 understood where the R-clip may have come from and knew it to be the securing R-clip of a traction motor inspection cover. When he was given the R-clip, the electrician took immediate action to ensure it was replaced.

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[4] Pearl and Drury, 1995, chapter 8

E*lectrician 2 expressed concern that the missing R-clip may lead to an equipment failure if the inspection cover dislodged and allowed the ingress of foreign material into the traction motor.*

It is likely his appreciation of the potential damage risk to the traction motor caused the electrician to seek the location and replace the R-clip immediately, rather than wait for it to be replaced when set 3 was back in for scheduled service.

Managing track access

Any person entering the track area requires permission from the duty controller before accessing the track area and is also required to inform the duty controller when they are clear of the track area.

This mechanism of control ensures a single point of contact is informed of all activities occurring on the track network area. This enables the duty controller to make informed decisions about all activities on the network and ensure there are no conflicting tasks.

When electrician 2 requested access to the west track, the duty controller granted access over the radio.

There were two secondary layers of control that did not help the duty controller identify there was about to be conflicting tasks on the network.

A secondary layer of control in the Skitube system was for the duty controller to record all activities into the Control room logbook. While this task serves multiple purposes, a known benefit for the duty controller is deeper processing and understanding of the task when a written record is made in the logbook. A number of studies have found deeper processing and understanding of information when the information is summarised and written down.[5] This additional task of recording information into the logbook is likely to provide the duty controller with a greater level of processing about each task occurring on the network.

The records in the Control room logbook indicated the duty controller made entries about the train uncoupling and the electrician requesting access under set 3, however this mechanism of control did not trigger a conflict in the duty controllers mind.

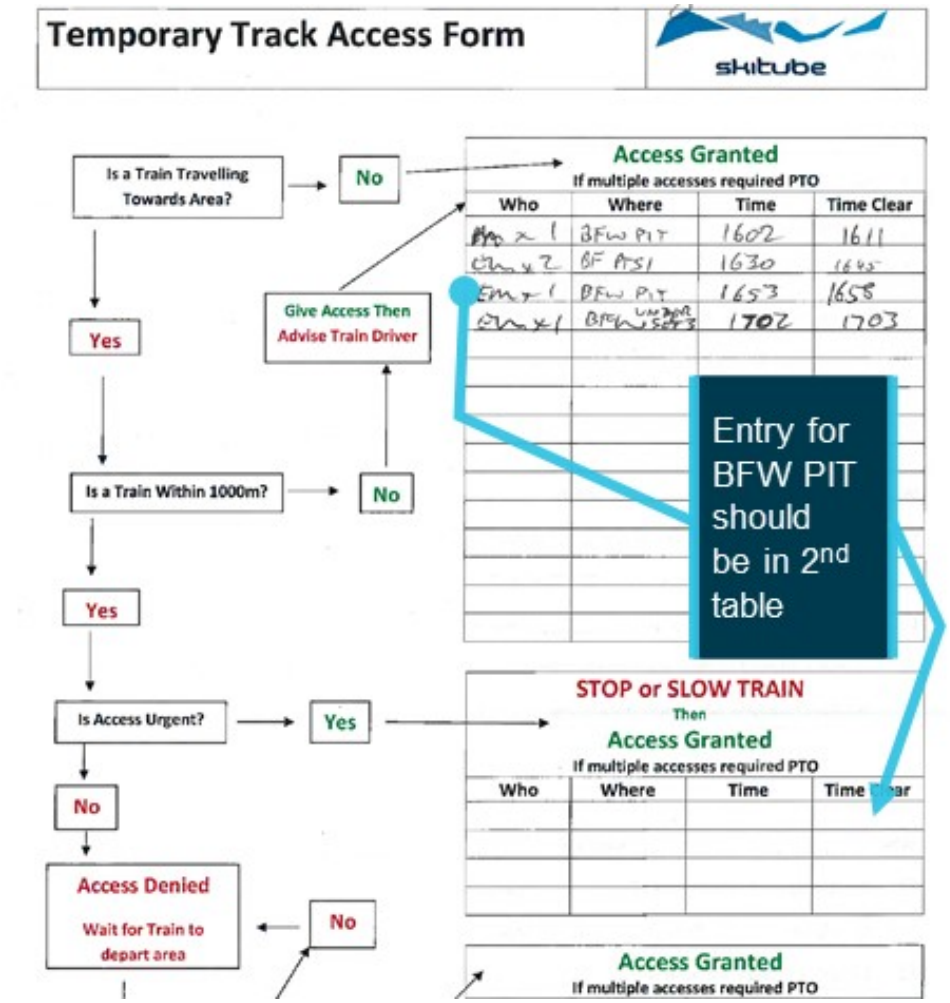
Another secondary layer of control in the Skitube system was for the duty controller to record when workers were accessing the track area on the temporary track access form. The intent of the control was to aid decision making and provide greater awareness of the activities occurring on the track.

It is likely this form was not being used as intended and therefore did not assist in raising the awareness of the duty controller to the pending conflict.

The duty controller granted access and recorded the details of workers accessing the track in the first table on the form. This indicated there was no train travelling towards the area when access was granted on each of the four occasions listed. When electrician 2 requested access to the Bullocks Flat West Pit (BFW PIT), it was to observe a train pass over the west pit to determine where the missing R-clip had come from. The nature of the request suggests the temporary track access form should have had this as an entry in the second table. The train was travelling towards the area, the train was within 1,000 m and access was considered urgent.

[5] Bohay et al 2011, Mueller and Oppenheimer 2014, Christmas et al 2019.

Figure 6: Temporary Track Access Form completed 3 July 2019



Source: Skitube, annotated by OTSI

The temporary track access form recognises and seeks to address the immediate risk of a train travelling towards the area, the distance the train is from the area and how urgent access to the track is. If followed correctly, a discussion about the work being done would happen in order to determine the level of protection needed.

The temporary track access form required an input from the duty controller which is the same input required for the Control room logbook (to write details about a person entering the track area).

The input required from the duty controller is the same however the two controls serve different purposes. The control room logbook maintains a record of all activity on the rail network, the temporary track access form aids the duty controller to make the right decision when granting a person access to the rail network. The repetition of required input from the duty controller likely resulted in the temporary track access form not being followed as intended.

While other controls, such as restricted access to the control room, are in place to help minimise distraction to the duty controller, it is likely the duty controller was also distracted by a number of other activities occurring at around the same time.

- The train on the east platform (Charlie 25) had just departed,
- The platforms were crowded by the passengers alighting from the arriving train (Alpha 24) on west platform,

- The duty controller was acknowledging radio calls from train services operating between the three terminals,
- Two people that alighted from Alpha 24 (one an off-duty controller) had made their way and presented at the control room to retrieve a personal item.

These distractions likely led the duty controller to the unintended action of granting the electrician access under set 3. Reason[6] summarises similar situations in the following;

> Common among the acts of humans are moments of absent-mindedness when we become aware that our actions have strayed from their intended path. Two conditions appear to be necessary for the occurrence of these slips of action: the performance of some largely automatic task in familiar surroundings and a marked degree of attentional 'capture' by something other than the job in hand.

The primary control for managing access to the track is the duty controller. The duty controller is subjected to various distractions which can reduce the effectiveness of duty controller to safely manage access. Skitube's secondary layers of control, the temporary track access form and the control room logbook can assist the duty controller but require concerted effort from the duty controller to be effective.

At a time when the duty controller's attention was captured by other activities, the procedures for managing access to the rail network did not assist in alerting the duty controller to the pending conflict.

The Skitube system for managing access to track did not detect the conflict of the rail maintenance worker under the train at the same time the train was being shunted.

Protection flags

The Skitube system requires a worker to place red protection flags on each end of the train to stop a train from being moved when the train is defective or when work is being conducted on the train. When these flags are in place it is easy for the driver of the train to see them when they step into the driver cabs at either end of a train set.

In this incident, the driver was reliant on electrician 2 installing flags across the driver's cab windscreen on both ends of the train set to indicate work was being conducted on the train. In his statement, electrician 2 understood he had a responsibility to place protection flags on the train set but also felt there was a breakdown in communication as he was given clearance without the train set being flagged out. Skitube's system does not specifically allocate who is responsible to ensure protection flags are in place before work commences.

The operator's internal investigation highlighted their system contains references and documentation on the use of protection flags, although further additional information is required to clarify the protection flag process.

As protection flags had not been placed on the train set, there was nothing to alert the driver of the electrician being under the train. However, protection flags on the far ends of the train may not have been visible from the inwards cabs between set 3 and set 4. Therefore, there was a possibility of the driver missing the visual cue of the red protection flag and moving a train set when uncoupling.

The incident may have been averted if the duty controller was compelled to obtain assurance the red protection flags were in place on the train before finalising the clearance for the electrician to enter west track.

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[6] Reason, J 1990.

Positive isolation

The placement of protection flags on the ends of the train is not a positive isolation of energy. The protection flags do not ensure the train is isolated and cannot be moved while being worked on.

In this incident, the train was moved twice by the drivers uncoupling the train sets. The first movement of the train set occurred in order to separate the scharfenberg type couplers. If the electrician had placed protection flags on the ends of the train set, it is likely the drivers would have spotted these due to the external flag that protrudes out from the side of the train.

However, there is a possibility the drivers, when working in between train sets, could miss the visual cue of the flags and move a train set whilst a person is working on it. The protection flag is only a visual cue. There is nothing to stop a driver from moving a train set when a worker has placed protection flags on the train.

In the rail industry and in other heavy industries, the practice of de-energising equipment (e.g. turning off starter switch and lowering pantographs) and then isolating (locking the starter switch in off position) to ensure energy cannot be placed back into the equipment until repairs are complete, is a common practice.

The provision of lock-out tags to maintenance staff to prevent drivers (or other persons) operating controls could reduce the risk of recurrence significantly.

Safety and environmental management system not error tolerant

The safety factors identified in the course of the investigation highlighted a dependency these areas of the Skitube system has on workers correctly following procedures to effectively manage safety risk.

The effectiveness of the return to service authority was dependent on the diligence of the maintainer ensuring critical steps had been completed before signing off. As highlighted in this incident, it is easy for an error to occur in this process as there is no timely check on the work of the maintainer, to pick up any error that may have been made. Once the omission to replace the R-clip was made, there was no other mechanism of control to allow the system to recover.

The duty controller has responsibility for managing access to the track. The Skitube system has considered the likelihood of the duty controller making an error and has in place, two secondary layers of control to aid the duty controller. These secondary layers of control, the control room logbook and the temporary track access form, did not provide the duty controller with any greater awareness of a pending conflict. This was likely due to an unintended action where key information was not considered due to distractions and incorrect use of the temporary track access form. Once this conflict was missed, the system was reliant on electrician 2 using the protection flag procedure to indicate he was working on the train set.

The protection flag procedure relies on workers following and installing the protection flags on the train set before commencing work. As this was not done by electrician 2, there was no mechanism for the driver to realise there was a person under the train set. As the protection flag system does not isolate energy from the train set, the risk of the train set being moved whilst a worker is working on it can be realised.

These mechanisms of control in the Skitube system are dependent on people following documented procedures to be effective. When a person has made an error in judgment or by omission, the system is left open for safety risks to be realised.

These elements of the Skitube safety and environment management system are reliant on procedures being followed to manage safety risks. There is little scope for the system to recover when there has been a human error or other procedural error.

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 near miss of a maintenance worker on Skitube Alpine Railway, Bullock's Flat, on 3 July 2019.

Contributing factors

- The duty controller granted an electrician access to the west track at the same time the daily 1700 shunt on west track was taking place.
- The electrician had not applied the required protection flags to the train set to indicate work was being conducted on the train.
- **The Skitube system for managing access to track did not detect the conflict of the rail maintenance worker under the train at the same time the train was being shunted. [Safety issue]**

Other factors that increased risk

- The rolling stock return to service authority was ineffective as a control in providing assurance that all required tasks were completed and verified.
- **The system of placing protection flags on both ends of a train set does not provide a positive isolation of energy to ensure a train cannot be moved while it is being worked on. [Safety issue]**
- **Elements of the safety and environment management system are reliant on procedures being followed to manage safety risks. There is little scope for the system to recover when there has been a human error or other procedural error. [Safety issue]**

Other findings

- The electrician felt an urgency to re-install the missing R-clip with concerns a dislodged inspection cover may lead to an equipment failure from the ingress of foreign material into the traction motor.
- It is likely the duty controller did not connect the two activities, the 1700 shunt and the electrician accessing west track, due to other activities occurring at the time, including a visit from an off-duty controller.

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.

Managing track access

Safety issue description

The Skitube system for managing access to track did not detect the conflict of the rail maintenance worker under the train at the same time the train was being shunted.

Issue number:	RO-2019-014-SI-01
Issue owner:	PerisherBlue Pty Ltd
Transport function:	Rail: Operations control
Current issue status:	Closed – adequately addressed
Issue status justification:	Re-iteration of the procedure and form requirements has merit in keeping current employees aware of the procedures' purpose. Re-iteration of these requirements would be required at regular intervals to maintain awareness of the risks controlled by the procedures. A refresher of the safe working rules and procedures prior to each operating season would achieve this.

Proactive safety action taken by PerisherBlue Pty Ltd

Action number:	RO-2019-014-NSA-011
Action organisation:	PerisherBlue Pty Ltd
Action status:	Closed

Internal consultation was carried out and the Temporary Track Access Procedure (Procedure) was reviewed, updated and documented.

Internal consultation was carried out and the Temporary Track Access Form (Form) that would be referred to by the Duty Controller in all cases where temporary track access was requested, was reviewed and updated to include the situation where access is required in close proximity to a stationary train.

Information regarding the Procedure and the Form was provided to staff (Duty Controllers, Train Drivers, Maintenance staff and Concourse staff) prior to the 2020 operating season in the form of an information packet.

A document titled Skitube Safe Working (Network) Rules and Processes was produced and supplied to Skitube staff. This document is a compilation of all major safety rules and processes and a reference tool for staff. As part of the communication and training process, staff were required to complete a short quiz on the material to demonstrate an understanding of the requirements.

Positive isolation

Safety issue description

The system of placing protection flags on both ends of a train set does not provide a positive isolation of energy to ensure a train cannot be moved while it is being worked on.

Issue number:	RO-2019-014-SI-03
Issue owner:	PerisherBlue Pty Ltd
Transport function:	Rail: Operations control
Current issue status:	Closed – adequately addressed
Issue status justification:	The requirement to lower the pantograph and the additional, brakes applied, keys removed and driver's cab locked with do not operate tag placed on the driver cab effectively isolates power from the train. Locking the driver's cab and placing the do not operate tag is an effective mechanism of stopping another person from re-powering and moving a train without understanding why the cab is locked and the do not operate tag is in place.

Proactive safety action taken by PerisherBlue Pty Ltd

Action number:	RO-2019-014-NSA-012
Action organisation:	PerisherBlue Pty Ltd
Action status:	Closed

Internal consultation was carried out and the Skitube Train Red Flag Procedure (Procedure) has been formalised and documented as a discrete procedure. This includes the requirement to lower the pantograph when a person is required to be in close proximity to a stationary train. Once the pantograph is lowered and brakes applied, the keys are removed, and the driver's cab locked. A "Do Not Operate" tag is placed onto all driver's cabs.

The feasibility of a positive lockout within the driver's cabin that will lock the pantograph in the lowered position is being reviewed. This is not provided by the manufacturer as standard equipment and will require re-engineering and completion of the change management process. The change management process may include a request for additional resources. The feasibility assessment was commenced following receipt and review of the draft ATSB report in early September but at the time of writing this has not been finalised.

Information regarding the Procedure was provided to staff (Duty Controllers, Train Drivers, and Maintenance staff) prior to the season in the form of an information packet.

A document titled Skitube Safe Working (Network) Rules and Processes was produced and supplied to Skitube staff. This document is a compilation of all major safety rules and processes and a reference tool for staff. As part of the communication and training process, staff were required to complete a short quiz on the material to demonstrate an understanding of the requirements.

Elements of the safety and environment management system not error tolerant

Safety issue description

Elements of the safety and environment management system are reliant on procedures being followed to manage safety risks. There is little scope for the system to recover when there has been a human error or other procedural error.

Issue number:	RO-2019-014-SI-02
Issue owner:	PerisherBlue Pty Ltd
Transport function:	Rail: Operations control
Current issue status:	Closed – partially addressed
Issue status justification:	A broadcast radio call to make all operations staff aware of a red flagged train and its whereabouts provides another layer of control to strengthen existing controls. The requirement to confirm all controls are in place decreases the opportunity for a procedural error to occur. The Safeworking Check is a suitable method of monitoring compliance with procedures. The process for implementing independent verification of work when returning vehicles to service will be monitored.

Proactive safety action taken by PerisherBlue Pty Ltd

Action number:	RO-2019-014-NSA-013
Action organisation:	PerisherBlue Pty Ltd
Action status:	Closed

Perisher has formalised a radio call in the red flag procedure to ensure that all operations staff are aware a train is being red flagged and its location. A further requirement for involved parties to confirm all controls are in place during the call decreases the opportunity for a procedural error to occur. The radio recordings provides an opportunity for review after the incident.

This “Safeworking check” of procedures can be undertaken after the event with the recorded radio transmissions and the Duty Controllers Logbook examined. This can identify if the person involved is confirming that the controls are in place and that the duty controller acknowledges this prior to granting permission to enter the track area.

Perisher is reviewing the feasibility of implementing independent confirmation of the completeness of all the routine electrical and/or mechanical work needing to be verified as complete, in the return to service authority.

The completed changes and other major safety rules and processes were communicated to all staff who were required to demonstrate an understanding of the requirements prior to the 2020 operating season. Further consultation and communication will be undertaken with staff on other changes that are still in progress.

General details

Occurrence details

Date and time:	3 July 2019 – 1700 AEST	
Occurrence category:	Incident	
Primary occurrence type:	Near miss with worker	
Location:	Bullocks Flat Terminal	
	Latitude: 36º 26.571' S	Longitude: 148º 26.534' E

Train details

Train operator:	Perisher Skitube	
Registration:	Alpha 24	
Type of operation:	Passenger	
Departure:	Bullocks Flat Terminal	
Destination:	Bullocks Flat Terminal	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – 0	Passengers – 0
Damage:	None	
Speed:	2km/hr	
Length:	16.8m	
Width:	3.8m	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Duty controller on shift at the time of the incident
- Train driver operating set 3 at the time of the incident
- Electrician that conducted the maintenance on 2 July 2019
- Electrician that accessed west track
- Maintenance manager and safety manager of Perisher Skitube
- Recorded closed circuit television at the Bullocks Flat Terminal
- Recorded audio files of Skitube network operations
- Maintenance data and checklists from Perisher Skitube
- Operational and maintenance procedures from Perisher Skitube

References

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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:

- PerisherBlue Pty Ltd
- Office of the National Rail Safety Regulator
- Transport for NSW

Submissions were received from:

- PerisherBlue Pty Ltd
- Office of the National Rail Safety Regulator

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.