Australian Government
Australian Transport Safety Bureau

# Safe working irregularity

near Jumperkine, Western Australia | 29 September 2015


Investigation

**ATSB Transport Safety Report**
Rail Occurrence Investigation
RO-2015-018
Final – 15 June 2017

**Cover photo:** www.flickr.com - Phil Melling

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

**Publishing information**

**Published by:** Australian Transport Safety Bureau
**Postal address:** PO Box 967, Civic Square ACT 2608
**Office:** 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
**Telephone:** 1800 020 616, from overseas +61 2 6257 4150 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
**Facsimile:** 02 6247 3117, from overseas +61 2 6247 3117
**Email:** atsbinfo@atsb.gov.au
**Internet:** www.atsb.gov.au



**Addendum**

| Page | Change | Date |
|---|---|---|
| | | |
| | | |

# Safety summary

## What happened

On 29 September 2015, train 3K26 loaded with bulk grain was travelling from Avon Yard to the port at Kwinana in Western Australia, when it exceeded its limit of authority. On that day, track re-railing works were in progress along the route requiring the closure of the Up Main line between Moondyne and Jumperkine. The closure resulted in the diversion of train movements to the adjacent track and the implementation of s*ingle line block working* under the rules applicable to *train order working*.

The crew of train 3K26 received a *train order* to proceed from Moondyne to the s*tation limits board* at the 48 km location where they were to stop. Attached to the train order was an additional instruction relating to tasks required when approaching the worksite beyond the 48 km location. After accepting the train order and departing Moondyne, the train crew continued to discuss the additional instructions relating to the tasks required when passing the worksite.

As the train approached the 48 km location, the train crew observed a *station limits board* and a *track closed warning device* that marked the limit of the authority. With little time to respond, the driver applied an emergency brake application. The train collided with the track closed warning device before coming to a stop approximately 400 metres past the limit of authority. There was no imminent risk of collision with people or other rail traffic as the distance separating the train and the worksite was approximately 4 km.

## What the ATSB found

The ATSB found that the additional instructions attached to the train order distracted the crew from their principal task, which was to stop at the 48 km location. The ATSB also found that there were no visual cues to alert train crew that they were approaching the limit of their authority.

## What's been done as a result

Brookfield Rail erected non-crossing indicator boards on each approach to the station limits board. Additionally, safeguards to protect the worksite were increased to include extra infield protection at either end of the closed section of track.

In March 2016, Brookfield Rail introduced a new suite of safe working rules and procedures consistent with the Australian Network Rules & Procedures.

## Safety message

Communication of information through non-standard practices and/or the addition of information irrelevant to the intended task may reduce clarity and introduce a source of distraction.

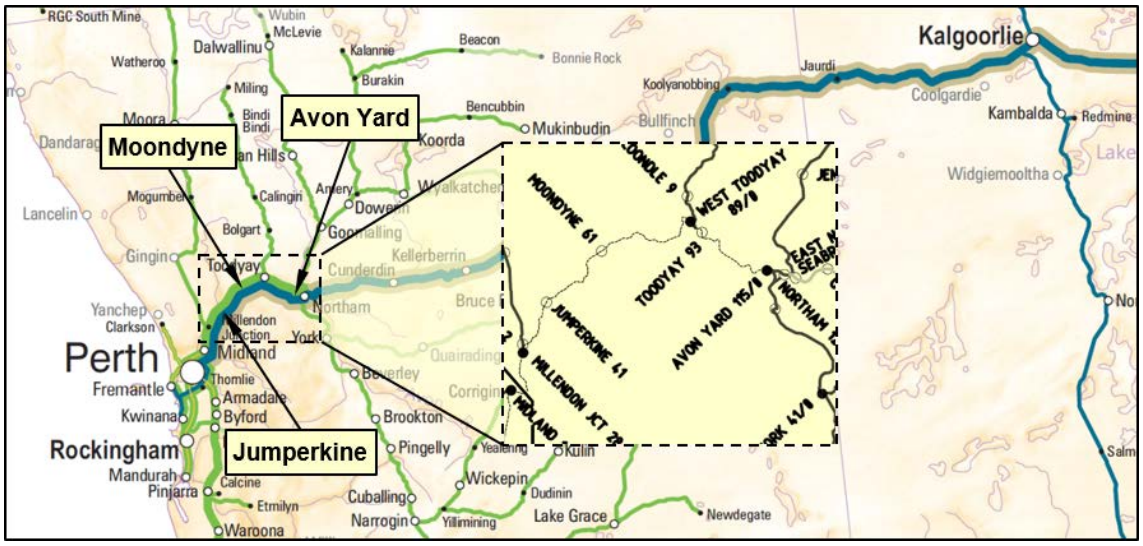
In an operational environment, effective communication, crosschecking and shared understanding by train crew, together with appropriate environmental cues contribute to ensuring the effective performance of tasks.

# The occurrence

In the second half of 2015, Brookfield Rail, scheduled maintenance work on the dual gauge rail line between Kwinana (near Perth) and Avon Yard (near Northam), Western Australia. Brookfield Rail contracted John Holland to remove and replace existing rail as part of this work.

The rail replacement work included sections of track located in the Avon Valley, between Millendon Junction at the 28 km[1] and Moondyne at the 61 km (Figure 1). This line consisted of duplicated tracks for the Up and the Down direction[2], with bypass loops adjoining the tracks at various locations to facilitate the crossing or passing of rail traffic.

**Figure 1: Location of Moondyne, Jumperkine and Millendon Junction in the Avon Valley**




Source: Australasian Railways Association with annotation by the ATSB

At the commencement of the re-railing works, John Holland implemented a rail safety sub-plan. The plan included the implementation of an alternative safe working system to facilitate the continuation of rail operations around the proposed worksites. The intention was to provide information, guidance and an outline of the general responsibilities assigned to the safe working personnel involved in the project. Brookfield Rail network operations issued *special train notices*[3] (STN) to advertise the commencement of these altered working arrangements.

In September 2015, Brookfield Rail issued a series of STNs for works between Moondyne and Jumperkine. The STN advised operators of the proposed track closure times required to facilitate the re-railing works programed for the Up Main line. Rail traffic would continue to operate on the Down Main line.

The signalling system did not allow for bi-directional running on the Down Main line. Consequently, the STNs specified that *Train Order Working*[4] was the alternative method of safe working during the closure. A *Network Control Officer*[5] located at the Eastern Midland control

---

1 Distance in kilometres from a track reference point located at Kwinana, Western Australia

2 Up track is the rail line designated for trains heading towards Perth and down direction towards Kalgoorlie.

3 A published notice providing details of train operations or events that might affect train operations.

4 Train Order Working: A system of safe working on single lines where train movements are governed by train orders issued by a network control officer, who ensures that no conflicting train orders are on issue.

5 Network Control Officer: A Competent Worker who authorises and issues Occupancy Authorities, and works points, signals and other signalling equipment to manage routes for safe and efficient transit of rail traffic in the network

centre in Perth would be responsible for the issuing *train orders*[6] for the passage of trains in the affected areas during the closure.

At about 0927[7], on 29 September 2015, the network control officer issued a *Safe Working Instruction Form SW6*,[8] instituting single line block working under the rules applicable to train order working. The rail replacement works advertised in the STN for that day were programmed on the Up Main line between the 43 km and 44 km track location, about 2 km west of Jumperkine.

Trains travelling towards Perth diverted from the Up to the Down Main line via the bypass loop at Moondyne. The trains would then travel towards Jumperkine before crossing back onto the Up Main and continuing to Perth under signal indications.

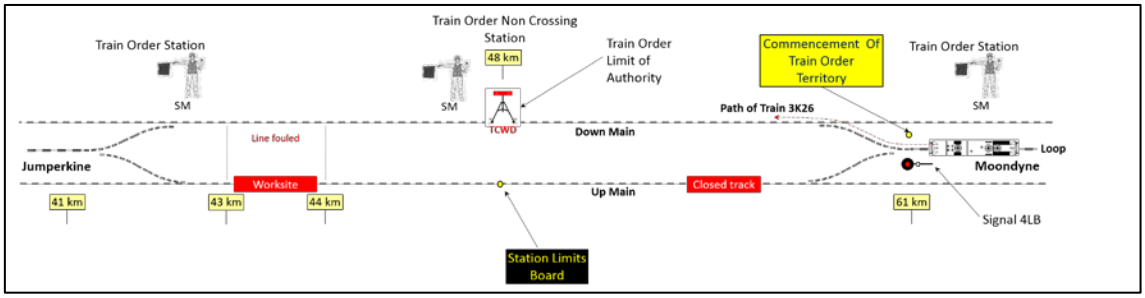
Suitably qualified employees designated as *stationmasters*[9] were positioned at Moondyne (61 km) and Jumperkine (41 km) to facilitate the train order working. An additional stationmaster was also positioned at an intermediate *train order non-crossing location*[10] at the 48 km location, approximately 4 km prior to the worksite. The responsibilities of the stationmaster included receiving the train orders from the network control officer and delivering them to the train crew at the appropriate time.

At about 1000 hrs, the train crew involved in the occurrence signed on for duty at Avon Yard. They were rostered to relieve the crew of train 3K26, a service operated by Watco. The train comprised two lead locomotives hauling 52 loaded grain wagons. After the crews changed, the train departed Avon Yard and proceeded to West Toodyay and then on towards Moondyne.

At 1125, the network control officer contacted the stationmaster at Moondyne and issued a train order for the passage of train 3K26 from Moondyne to the 48 km location. The network control officer advised the stationmaster that the expected arrival of the train at Moondyne would be around 1145. The stationmaster subsequently conferred with the *track protection officer* in charge of the work site confirming it was clear to issue the train order to train 3K26 on its arrival at Moondyne.

The network control officer advised the crew of train 3K26 that train order working was in place from Moondyne to Jumperkine. At 1149, train 3K26 arrived at Moondyne and after a brief stop the train entered the bypass loop and stopped at signal 4LB (Figure 2).

**Figure 2: Map showing positions of the Stationmasters and authority limits**




Source: Australian Transport Safety Bureau

The stationmaster entered the cab of the locomotive and provided the crew with Form SW6, advising of train order working and delivered the completed train order to proceed onto the

---

6 Train Order: An instruction, on the prescribed form, issued by the train controller, in train order territory to direct the movement of rail traffic.

7 The 24-hour clock is used in this report to describe the local time of day, Australian Western Standard Time (AWST), as particular events occurred.

8 Form SW6: Form Instituting Train Order Working for Double Line Automatic Signalling (Form SW6).

9 Stationmaster: A Qualified Employee appointed to work each at each end of the single line section and whose role may include the division of section for permissive working

10 Train order non-crossing stations are to facilitate the movement of following trains.

section. The crew received both documents to read and acknowledge their understanding of the contents. The crew signed the train order and it remained with them in the cab of the locomotive.

The train order stated in part:

> Proceed to 48 km Station Limits
>
> Do not enter until authorised
>
> There are no unfulfilled train orders for opposing trains

In addition, the stationmaster had attached a yellow *post-it note*[11] to the train order, which included instructions relating to the track section beyond that of the train order. The note stated the following:

> Speed restriction 40 km/h
>
> 43-44 km
>
> Blow horn continuously please

The stationmaster also initiated a short discussion with the train crew concerning the required actions on approach to the worksite, also relating to the track section beyond that of the train order. There was no further discussion surrounding the contents of the train order.

The stationmaster then exited the cab and removed the red flag centred in the middle of the track next to signal 4LB.

At about 1203, the train crew advised the network control officer that they were in possession of the train order and completed a *read-back*[12] of the information. During the read-back, the crew also mentioned information contained on the post-it note, stating:

> There is a speed restriction of 40 km/h between the 43 and 44 km

The network control officer acknowledged that the read-back of the authority was correct, but made no mention about the additional instructions not contained in the train order. The network control officer then advised the crew that the points were set and locked, and authorised the crew to pass signal 4LB at stop and depart Moondyne (Figure 2).

At 1205, the train departed Moondyne (61 km). The crew continued to discuss the instructions contained on the note attached to the train order. They discussed the implications of continuously sounding the horn while approaching a worksite, its possible misinterpretation as an emergency and the effect it might have on track workers. They agreed to sound the horn intermittently to avoid any confusion as they approached the worksite.

Meanwhile, the network control officer contacted the stationmaster at the 48 km location and issued a further train order for train 3K26 to proceed to Jumperkine.

This provided the authority for train 3K26 to travel from the 48 km, past the worksite at the 43-44 km location and on to Jumperkine. The stationmaster was to hand the authority to the train crew[13] on the train's arrival at the 48 km location.

The stationmaster seated within a motor vehicle at the 48 km location had the vehicle headlights illuminated and was facing the train's approach. The vehicle was located adjacent to the Down Main line and within the immediate vicinity of a level crossing. A *Track Closed Warning Device*[14] (TCWD), placed to protect against unauthorised movements, was located within the gauge of the

---

11 A Post-It note: (or sticky note) is a small piece of paper, made for temporarily attaching notes to documents and other surfaces.

12 Read-back: The repetition of a message received, in order to acknowledge its receipt and ensure its accuracy.

13 The operating rules require the train crew to be in possession of a valid Train Order before entering the section to which it applies.

14 TCWD: A Brookfield Rail approved Stop sign designed to lock into the gauge as part of in field protection.

Down Main line next to the vehicle's location. Adjacent to the TCWD, positioned within the gauge of the Up Main line, was a temporary station limits board.

At about 1220, train 3K26 was approaching the limit of its authority (48 km), negotiating a sweeping left bend followed by a straight section of track. The train crew initially observed the station limits board from a distance and briefly discussed its relevance. The crew discounted the significance of the board because of its position on the adjacent line.

At that point, the train was travelling at about 67 km/h on a slight descending grade. The locomotive was already in *dynamic brake*[15] and the driver had made an initial air brake application to further control train speed.

A short time later, at about 1221, the driver noticed the TCWD located immediately in front of the train. The driver made an emergency brake application and sounded the train horn, followed shortly thereafter by the collision with the TCWD. It was also at this time that the stationmaster leaned out of the car window and waved to the train crew to get their attention.

The train came to a stop at about 1222, approximately 400 metres beyond its limit of authority. The driver exited the locomotive cab and walked back to check on the circumstances with the stationmaster. The second driver contacted the network control officer and reported the incident.

In consultation with the operator, the crew exchanged driving positions, with the second driver taking up the driving duties. The train then continued to Jumperkine under the authority of a new train order. The train arrived at Jumperkine where the drivers undertook routine drug and alcohol testing which provided a negative result. They were relieved from driving duties and returned to their depot by motor vehicle.

---

[15] Braking effect obtained when the electric traction motors of the locomotive are used as generators and the power is dissipated as heat through fan blown grids on the locomotive.

# Safety analysis

## Train authorities

The train order working system is predominately an administrative control to maintain safe separation between trains. The effectiveness of this control relies on the accurate communication of relevant safety critical instructions and the understanding and retention of their meaning by the train crew.

The safe working rules and procedures applicable to train order working required the network control officer to issue train orders in a prescribed format to the train crew. The network control officer could transmit the train order either directly to the train crew or, if required, to a qualified worker who was then responsible for delivering the train order to the relevant train crew.

On the day of the occurrence, the network control officer issued the train order to the stationmaster at Moondyne, who then delivered it to the train crew. However, a post-it note was attached that contained additional instructions for action by the train crew.

The crew understood the meaning of the instructions within the train order and read it back to the network control officer, including the additional instructions written on the post-it note. The network control officer authorised the train crew to depart Moondyne, without questioning the inclusion of the additional instructions relayed by the crew during the read-back process.

## Factors affecting the actions of the train crew

The train order provided authorisation for train 3K26 to travel from Moondyne to the 48 km location. The instructions on the post-it note were related to the worksite beyond the 48 km and had no relevance to the block section the train was about to traverse. Similarly, the in-cab discussion between the train crew and the stationmaster at Moondyne also related to the track section beyond that of the train order.

The process for authorising and issuing train orders is deliberately constrained. Train orders should convey information or instructions essential and relevant to the section the train is to traverse. This premise reduces the potential for errors or misunderstanding of safety critical information.

The train crew were executing a non-routine task involving train order working to operate on a line against the normal direction of rail traffic flow. The train crew were presented with additional instructions that were not standard practice (sounding the horn continuously at the worksite) and not relevant to the current authority or section of track. The crew were concerned that track workers might misinterpret the actions described in the instructions, so were discussing the issue while travelling towards the 48 km location.

The introduction of the unrelated instructions, reinforced by the stationmaster at Moondyne, resulted in the crew formulating plans that applied to the block section beyond the one which they were traversing. This may have distracted the crew from the immediate task of planning to stop at the 48 km location.

Without having formed a clear plan to stop at the 48 km location, and with their attention focussed on discussing the actions required at the worksite, the train crew most likely forgot about the direction to stop at the limit of authority.

Forgetting to perform a known future task (stopping at the 48 km location) while occupied by a current task (planning actions at the worksite) is common and referred to as a failure of prospective memory. Failure in prospective memory is sometimes described as forgetting to remember.

Prospective memory depends on several cognitive processes, including planning, attention, and task management. It requires forming an intention to perform the task, retaining that intention while performing other unrelated tasks and then remembering to perform the task at a later time, often without being explicitly prompted to do so (Dismukes and others, 2005 and Kramer and others, 2006).

In this case, the train crew understood the task was to stop at the limit of authority (as documented on the train order), but forgot about the task when it became time to remember it. In addition, there were limited prompts to remind the crew about the task.

### *Operational cues*

In operating a train, drivers take cues from their knowledge of track infrastructure and signage to assist in performing tasks to safely manage the train. Effective train handling requires drivers to consider the previous, present and potential future performance of the train, and prepare for conditions sometimes several kilometres in advance of the train's current location. Heavy freight trains can take many hundreds of metres to stop (dependent on speed) and the driver must commence braking at an appropriate distance before the required stopping point.

The rules and procedures, current at the time, did not require the provision of station limits or station indicator (advanced warning) boards where rail traffic on double line automatic signalling sections was being worked over one line under train order working. However, the rail safety sub-plan stipulated the placement of a station limits board and a track closed warning device to mark the location of the temporary train order non-crossing station at the 48 km mark. The plan made no mention of utilising any form of advance warning board. The station master positioned the track closed warning device in the middle of the Down Main line while the station limit board was positioned adjacent the warning device in the middle of the Up Main line.

The crew initially sighted the station limits board but concluded it was not applicable to the passage of their train since the board was position within the profile of the adjacent closed track.

The track closed warning device was positioned within a tree-shaded area of the rail corridor. The sign was painted with a non-reflective material and was in a faded condition. The sign placement and condition made it inconspicuous to the approaching train crew. When the crew observed the track closed warning device, it was too late to stop. Although an emergency brake application was made, the train collided with the warning device and exceeded the limit of authority.

The absence of a visual cue before the 48 km location meant that there were limited prompts to alert or remind the crew about the task of stopping the train at the limit of authority.

# Findings

From the evidence available, the following findings are made with respect to the authority exceedance of train 3K26 at the 48 km track location near Jumperkine, WA on 29 September 2015. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

**Safety issues, or system problems, are highlighted in bold to emphasise their importance.** A safety issue is an event or condition that increases safety risk and (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.

## Contributing factors

- The additional instructions attached to the train order distracted the crew from their principal task, which was to stop at the 48 km location.
- There were no visual cues provided to alert the train crew that they were approaching the limit of their authority.

## Other factors that increased risk

- The rules applicable for train order working on one line, in a double line signalled section, did not require the installation of cues to draw train crew attention to the limit of authority.
- The additional information attached to the train order, did not form part of the instructions issued by the network control officer.

# Safety actions

## *Additional safety action*

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

### *Proactive safety action taken by Brookfield Rail Pty Ltd*

Brookfield Rail in consultation with John Holland arranged for the placement of Train Order 'non-crossing indicator boards' at 600 metres either side of the Station Limits Board to further identify the Train Order non-crossing location for the remainder of the re-railing project. There was also an increase with infield protection to include three track-warning devices 20 metres apart on each rail in advance of the track closed warning sign. Brookfield subsequently carried out similar works under newly implemented Brookfield Rail Network Safe working Rules and Procedures.

### *Proactive safety action taken by Watco Pty Ltd*

Watco have undertaken improvements regarding emphasis on Crew Resource Management (CRM) following the incident. These included

- Providing additional checkpoints to their Operational Check Ride form related to cab situational awareness
- Cab situational awareness monitoring through periodical locomotive data downloads
- Increased time at the footplate by Managers of Operating Practices (MOP's) and Operational Zone Managers (OZM's) to reinforce, coach and mentor the concept and practices surrounding cab situational awareness.

# General details

## Occurrence details

| | | |
|---|---|---|
| Date and time: | 29 September 2015 – 1220 WST | |
| Occurrence category: | Serious Incident | |
| Primary occurrence type: | Exceedance of authority | |
| Location: | 7 km west of Jumperkine, WA | |
| | Latitude: 31° 42.475' S | Longitude: 116° 5.148' E |

## Train details

| | | |
|---|---|---|
| Train operator: | Watco | |
| Registration: | 3K26 | |
| Type of operation: | Bulk freight | |
| Persons on board: | Crew – 2 | Passengers – Nil |
| Injuries: | Crew – Nil | Passengers – Nil |
| Damage: | None | |

# Sources and submissions

## Sources of information

The sources of information during the investigation included:

- Brookfield Rail Pty Ltd
- John Holland Pty Ltd
- Watco
- Train crew and qualified workers involved in the occurrence

## References


Rail Safety Sub Plan – Avon Valley Re-railing Project, John Holland, 2015,

Rail Industry and Safety Standards Board, 2010, National Guideline Glossary of Railway Terminology

Westnet Rules and Procedures

Dismukes, K 2010, *Remembrance of Things Future: Prospective Memory in Laboratory Workplace and Everyday Settings*. NASA Ames Research Centre.

Dismukes, K & Nowinski, J 2005, *Prospective Memory, Concurrent Task Management, and Pilot Error.* New York: Oxford University Press.

Dodhia, R M & Dismukes, R K 2008, Interruptions Create Prospective Memory Tasks, San Jose: Wiley InterScience.

Kramer, A F & Weigmann, D A Kirlik, A 2006. Attention: From Theory to Practice. New York: Oxford University Press.

Loukopoulos, L D Dismukes, R K Barshi, I 2016, The Multitasking Myth: Handling Complexity in Real-World Operations. U.K.: Routledge.

Stanton, N A Stewart, R Harris, D Houghton, R J Baber, C McMaster, R Salmon P 2006, Distributed Situation Awareness in Dynamic Systems: Theoretical Development and Application of an Ergonomics Methodology, *Ergonomics,* vol. 49, pp. 1288-1311.


## Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act 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 Brookfield Rail, Watco, Office of the National Rail Safety Regulator (ONRSR) and individuals involved in the occurrence.

Submissions were received from Brookfield Rail, Watco, Office of the National Rail Safety Regulator (ONRSR) and individuals involved in the occurrence. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

# Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in 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 that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

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

## Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine 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.

## Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

**Australian Transport Safety Bureau**

**Enquiries** 1800 020 616
**Notifications** 1800 011 034
**REPCON** 1800 011 034
**Web** www.atsb.gov.au
**Twitter** @ATSBinfo
**Email** atsbinfo@atsb.gov.au
**Facebook** atsbgovau

Investigation

**ATSB Transport Safety Report**
Rail Occurrence Investigation
Safe working irregularity near Jumperkine, WA
29 September 2015

RO-2015-018
Final – 15 June 2017