Australian Government
Australian Transport Safety Bureau

Dewirement involving freight train YC77

Cooroy, Queensland, on 18 August 2018

ATSB Transport Safety Report
Rail Occurrence Investigation
RO-2018-011
Final – 1 September 2020

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 2463 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

Addendum

Page	Change	Date

Safety summary

What happened

On 18 August 2018, intermodal freight train YC77, operated by Aurizon, was en route from the Acacia Ridge Intermodal Terminal in Brisbane, Queensland. The train was powered by a diesel electric locomotive and one of its wagons contained a stack of three empty flat racks. During transit, the collapsible, rear end wall of the top flat rack extended upwards. This end wall contacted the Elm Street overpass on approach to Cooroy, and pulled down the high voltage overhead line equipment (OHLE). As a consequence, 1.3 km of OHLE was pulled down.

What the ATSB found

The ATSB found that personnel at the Acacia Ridge terminal did not check the collapsible end walls of the flat racks were secured on arrival at the terminal and after the flat racks were loaded onto YC77. In addition, Aurizon, did not have an effective system in place for ensuring personnel required to check the securing of unusual loads (such as empty flat racks) prior to departure had sufficient knowledge of their responsibilities, and had ready access to relevant procedures, guidance and checklists.

On multiple occasions following the dewirement, train crew accessed the exclusion zone associated with the close proximity of the extended end wall of the flat rack to the OHLE, prior to the wires being isolated and earthed on site. Network control centre personnel did not advise train crew of the status of the OHLE during the emergency response period, and Queensland Rail (QR) did not have an effective process in place to ensure that safety-critical actions were co-ordinated and completed when multiple network control officers were involved in responding to an OHLE emergency.

The ATSB also found that following the dewirement the driver and network control officer (NCO) did not follow required protocols for driver only operations (DOO) prior to the driver leaving the locomotive cabin, and Aurizon did not provide drivers with ready access to QR's procedures for DOO and OHLE emergencies when they were operating on the QR network.

What's been done as a result

Aurizon has updated processes and checklists in relation to flat racks, with further theoretical training undertaken for loading personnel at Acacia Ridge in relation to securing requirements. In addition, Aurizon is currently undertaking a program to increase mobility of access to its safety management system (including relevant procedures and checklists). For driver only operations, Aurizon has commenced drafting a procedure for use on its own network, with a checklist for emergencies affixed to 2800 class locomotives that operate on the North Coast Line, at sign-on locations and attached to train lists.

QR has mandated the use of the network control officer (NCO) checklist for OHLE emergencies, and is currently reviewing related aspects of its emergency response procedures. In addition, QR have provided further training to both NCOs and train crew in relation to identifying objects in close proximity to OHLE and applicable exclusion zones. NCOs have also undertaken DOO emergency procedure refresher training.

Safety message

This occurrence has highlighted the importance of having checklists for rarely conducted tasks and emergency response tasks in the rail environment, and ensuring these checklists are readily available and used by operational personnel. This includes checklists for loading and securing personnel, rail traffic crew and network controllers.

Contents

The occurrence **1**
Overview 1
Arrival of flat racks at freight terminal 1
Loading of flat racks onto train YC77 1
Departure of train YC77 2
Overhead line equipment circuit breaker trips 2
Dewirement near Cooroy 4
Post-dewirement activities 5
Consequences of the dewirement 7
Context **8**
Track and network information 8
General 8
Overhead line equipment (OHLE) 8
OHLE contact wire heights 9
Sequence of circuit breaker trips 10
Train and train crew information 11
Train information 11
Flat rack containers 11
Train crew information 13
Train performance and environmental conditions 13
Site inspection 13
Train loading and securing information 15
Loading and securing process 15
Loading and securing procedures 16
Loading and securing training 17
Loading and securing personnel 17
Previous occurrences 18
Rail management centre information 19
General 19
Network control 19
Overhead line equipment control 21
RMC personnel 22
Emergency procedures 23
Electric control room procedures during OHLE emergencies 23
Network control centre procedures during OHLE emergencies 24
Procedures for onsite personnel 25
Previous occurrence involving an emergency response 26
Overhead line equipment safety information 27
Description 27
Electrical safety 27
Instruction and training of OHLE dangers for QR personnel 28
Instruction and training of OHLE dangers for train crew 29
Recognition of OHLE danger presented by extended flat rack end wall 29
Driver only operations information 29
General 29
QR emergency procedures for driver only operations 30
Aurizon emergency procedures for driver only operations 30
Access to relevant procedures and forms 31

Application and knowledge of DOO emergency procedures 31
Driver only operations on the Aurizon network 31

Safety analysis 33
Introduction 33
Loading and securing of freight 33
Delivery of flat racks to Aurizon 33
Inspection of flat racks during delivery and loading 33
Unusual load responsibilities and access to guidance material 34
Electric control information anomalies 35
Post-dewirement response 35
Entries into an exclusion zone 35
Recognition of the risk associated with dewired OHLE 36
Co-ordination of network control activities post dewirement 37
Driver only operations procedures in an emergency 38

Findings 40
Contributing factors 40
Other factors that increased risk 40

Safety issues and actions 41

General details 45
Occurrence details 45
Train details 45

Sources and submissions 46
Sources of information 46
References 46
Submissions 46

Appendices 47
Appendix A – Dangers associated with high voltage overhead line equipment (OHLE) in dewirements 47

Australian Transport Safety Bureau 49
Purpose of safety investigations 49
Developing safety action 49
Terminology used in this report 50

The occurrence

Overview

On 18 August 2018, intermodal freight train YC77, operated by Aurizon, was scheduled to depart from the Acacia Ridge Intermodal Terminal in Brisbane, Queensland to the Portsmith freight terminal near Cairns, Queensland. The train was powered by a diesel electric locomotive and one of its wagons contained a stack of three empty flat racks.[1]

During transit, the collapsible, rear end wall of the top flat rack extended upwards. At about 2102,[2] this end wall contacted the Elm Street overpass on approach to Cooroy, and pulled down the high voltage overhead line equipment (OHLE).

Arrival of flat racks at freight terminal

On 14 August 2018, a freight forwarding company booked four 40 ft empty flat racks to travel by Aurizon train from Acacia Ridge to Portsmith. When booking, the freight forwarding company advised Aurizon by email that the flat racks would travel as a nest of three (stacked on top of each other) and a single. It also advised that the end walls of the nest of three had been chained down.

Sub-contractor truck drivers collected the flat racks from the freight forwarding company and delivered them to Aurizon's Acacia Ridge terminal in two consignments on 17 August.

When the two trucks arrived at the freight terminal, the Acacia Ridge terminal coordinator instructed the drivers to proceed to the container pad. The terminal coordinator did not visually inspect the loading of the consignments. The truck drivers parked at the container pad, where a heavy forklift driver unloaded the consignments.

A subsequent review of closed-circuit television (CCTV) footage of the delivery of the empty flat racks showed that the nest of three flat racks were not secured by straps or chains.

Loading of flat racks onto train YC77

On 18 August 2018, YC77 was assembled at the Acacia Ridge terminal. In relation to the empty flat racks, loading and inspection activities included:

- At about 1100, the Aurizon heavy forklift driver loaded the nest of three flat racks onto a flat wagon and the single flat rack onto a separate flat wagon. Securing was limited to spigots securing each nested flat rack to each other, and securing the bottom flat racks to their respective wagons. The flat rack end walls were not secured.
- At about 1530, once train loading was complete, two Aurizon train pinners[3] inspected the loading and securing of freight on all the wagons. A Form 04 (*Loading and securing advice*) was issued at completion, verifying the loading on the train was safe for travel.
- At about 1715, two Aurizon freight operators[4] conducted a train safety test, checking wagon integrity and correct train brake operation. A Form SW57 (*Train inspection / repair certificate*) was issued at completion, certifying the train as fit for travel.
- At 1749, YC77 departed Acacia Ridge yard, during which an Aurizon freight operator conducted a slow speed roll-by examination for train defects.

These activities did not identify any problems with the empty flat racks.

---

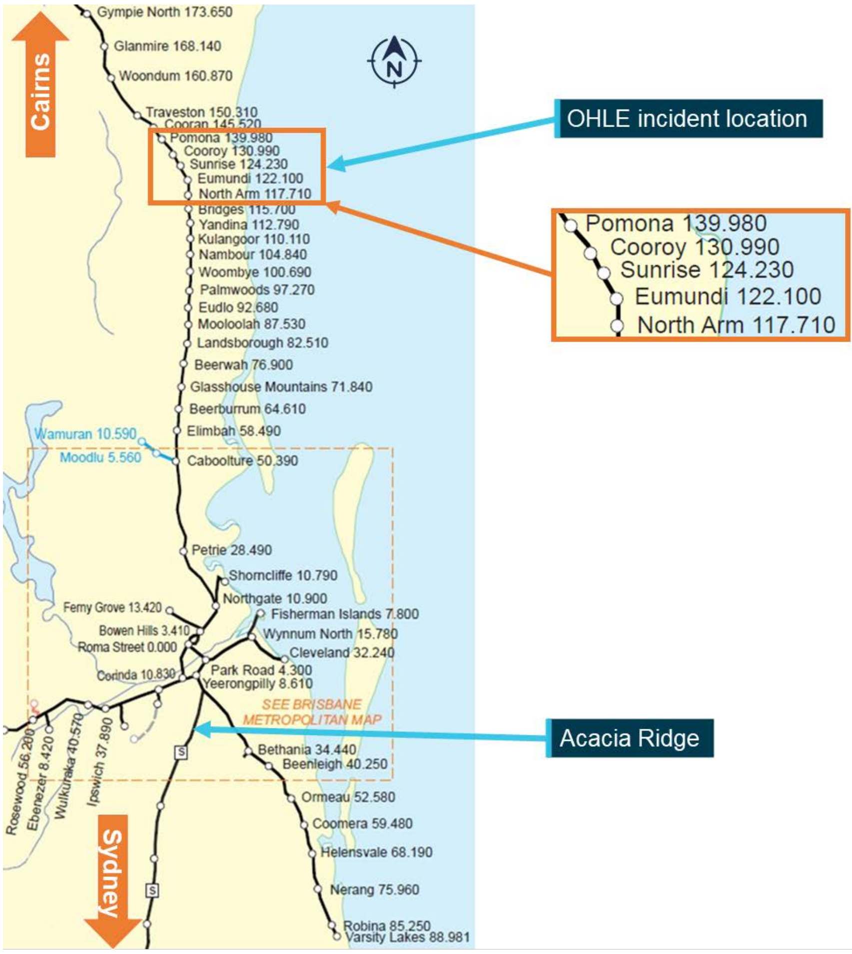
1 Flat rack: a type of shipping container used for over dimension loads. The end walls could be collapsed to allow stacking (nesting) when empty.
2 All time references in this report are in local time (Eastern Standard Time).
3 Train pinner: a heavy forklift driver who inspected the loading and securing of freight on a train.
4 Freight operator: conducted shunting, train pre-departure tests and roll-by examinations.

Departure of train YC77

YC77 was planned to travel from Acacia Ridge (12.181 km)[5] to Portsmith (1,677.088 km) on Queensland Rail's (QR's) North Coast Line.[6] This involved operating on track that had OHLE from Acacia Ridge to Rockhampton (638.790 km).

There was no indication of any problems or concerns with the operation of the train on its journey between Acacia Ridge and when it passed through Yandina (112.790 km) at 2043. CCTV footage from a sample of stations showed that the rear end wall of the top nested flat rack remained in the down position up until the train passed Yandina, and it moved to being extended upwards at some point prior to reaching Eumundi (122.100 km) at 2049. Figure 1 shows a map of the Brisbane rail network with the departure point and the area of the occurrence highlighted.

Figure 1: Brisbane rail network showing departure point and occurrence location



The image shows stations and their distance from Roma Street Station in Brisbane.
Source: Queensland Rail, annotated by the ATSB

Overhead line equipment circuit breaker trips

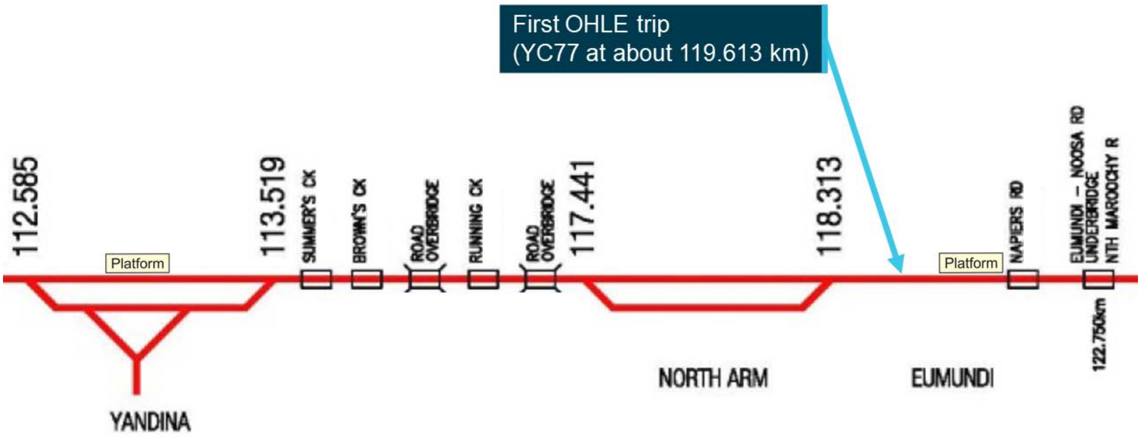
At 2048, after passing North Arm (117.710 km), a trip of the OHLE circuit breaker occurred, automatically de-energising[7] the electrical section from Woombye (100.690 km) to Traveston (150.310 km). The fault locator indicated to the electric control operator (ECO)[8] at QR's Brisbane rail management centre (RMC) that the trip had occurred at 119.500 km.[9]

---

5 Distances were measured from Roma Street station, Brisbane (0.000 km).
6 The North Coast Line ran from Roma Street station to Cairns station (1,680.940 km).
7 De-energised: the opening of high voltage circuit breakers disconnecting electrical energy.
8 Electrical control operator (ECO): person who monitored and controlled the OHLE systems on the QR network.
9 The fault locator was not always accurate (see *Electric control room procedures during OHLE emergencies*).

Given that train YC77 was in the estimated area of the circuit breaker trip at that time, the ECO requested the universal traffic control (UTC 7)[10] network control officer (NCO) to confirm the status of the OHLE with the driver. At that time, the northside relief NCO was monitoring and controlling UTC 7 (see *Network control*). At 2052, the northside relief NCO contacted the driver of YC77, and the driver advised observing nothing unusual. After receiving this information, the ECO reset the OHLE circuit breaker, which held closed. The reset of the circuit breaker re-energised the high voltage OHLE. The ATSB subsequently identified that this first OHLE circuit breaker trip occurred at about 119.613 km, the location of YC77 at the time Figure 2 (see *Sequence of circuit breaker trips*).

Figure 2: Approximate location of first OHLE circuit breaker trip



Source: Queensland Rail, annotated by the ATSB

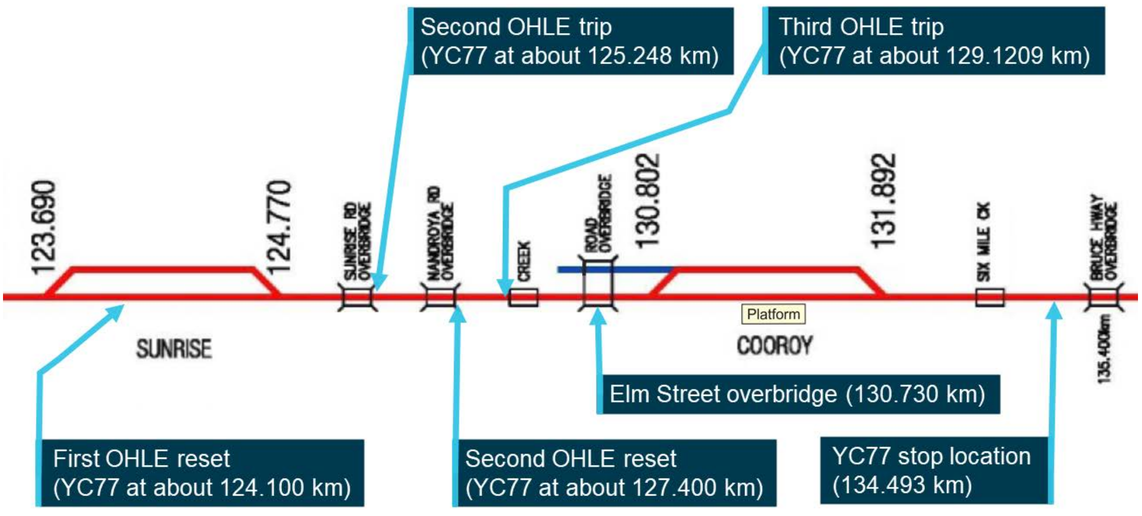
At 2052, a track circuit showed 'occupied'[11] three track sections[12] behind YC77, followed at 2053 by a second trip of the OHLE circuit breaker (Figure 3). The ECO identified that the fault locator did not work on this occasion, which meant the fault could have occurred anywhere on the Woombye to Traveston electrical section. At that time, in addition to YC77, there were two other trains within this electrical section.

10 UTC 7: Brisbane's QR Citytrain network was divided into 10 sectors for train control purposes. UTC 7 managed sections of the North Coast Line that included North Arm to Cooroy.

11 A track circuit unexpectedly showing occupied may occur in instances of OHLE faults, where high voltage contacts the rail.

12 Track section: a section of railway track between two locations (such as between two stations).

Figure 3: Approximate locations of second and third OHLE circuit breaker trips



Source: Queensland Rail, annotated by the ATSB

The ECO contacted the UTC 7 NCO workstation, and the northside relief NCO advised that, although there were intermittent track circuits showing as occupied, there were no trains in those areas. As there were no in-field reports of OHLE abnormalities, the ECO reset the OHLE circuit breaker at 2056, which held closed. The ATSB subsequently identified that this second OHLE trip occurred at about 125.248 km, the location of YC77 at the time.

Over the following 5-minute period, a further two occupied track circuit indications occurred in different track sections behind YC77.

At 2101, a third trip of the OHLE circuit breaker occurred, and a telemetry[13] failure occurred at Sunrise (124.230 km). The fault locator indicated to the ECO that the trip had occurred at 130.170 km, to the south of the Elm Street overbridge (130.750 km). The ATSB subsequently identified that this third OHLE trip occurred at about 129.1209 km,[14] the location of YC77 at the time.

Dewirement near Cooroy

At 2102, train YC77 was entering Cooroy. It passed under the Elm Street overbridge at a speed of about 42 km/h, which was under the maximum permitted speed of 50 km/h. Subsequent inspection found that the extended rear end wall of the top nested flat rack hit the underside of the bridge, and pulled down the high voltage OHLE wires (see *Site inspection*), resulting in a dewirement.[15]

Examination of CCTV footage showed that, as the train passed through Cooroy, the rear end wall of the top nested flat rack was still in the extended position. In addition, the OHLE, including copper wires, was entangled on the wagon and dragging along the station platform (Figure 4).

---

13 Telemetry: equipment used for encoding / decoding electronic commands between the RMC and in-field signalling equipment.

14 This location was 1,209 m past the 129 km peg (see *Sequence of circuit breaker trips*).

15 Dewirement: a situation in which the contact wire and / or catenary wire of the OHLE has detached from supporting structures, resulting in high voltage power lines sagging or contacting the ground, potentially touching trackside equipment.

Figure 4: CCTV footage at Cooroy station showing the flat racks with the extended end wall and OHLE wires that had been brought down

Source: Queensland Rail

At 2103, the ECO contacted the UTC 7 NCO workstation and advised the UTC 7 NCO, who had returned from a meal break, of the third circuit breaker trip. The ECO noted that YC77 may have had ‘a rope or something’ that was touching the OHLE. The NCO advised the ECO that a track fault had occurred, this time coinciding with the location of YC77. The ECO did not attempt a further reset of the OHLE circuit breaker.

At 2104, the UTC 7 NCO contacted the driver of YC77. The driver advised that, as the train passed through Cooroy station, the OHLE appeared to be ‘really loose’. The UTC 7 NCO acknowledged this report. The NCO also provided the driver clearance to proceed to outside Pomona (139.980 km), and advised the driver that the train may need to be examined, because the issue seemed to be following it.

At 2106, the UTC 7 NCO instructed the driver of YC77 to stop the train ‘straightaway’. The driver stopped the train at 134.493 km, between Cooroy and Pomona. At 2107, the driver contacted the UTC 7 NCO workstation and advised the northside relief NCO, who was now assisting the UTC 7 NCO, of the train’s location.

At 2107, the UTC 7 NCO instructed the driver of a southbound electric passenger train X906 to stop the train immediately. That train was near Woondum and scheduled to pass through the Traveston neutral section into the de-energised section 4 minutes later.

Post-dewirement activities

Where the train stopped, the OHLE was still in place. However, the extended end wall of the top nested flat rack on YC77 was still extended upwards and in close proximity to the OHLE contact wire. Although the OHLE was de-energised, a potential hazard still existed.

After the train stopped, there were a number of communications and activities involving the driver, network control personnel and emergency services personnel to assess and manage the situation. These activities included:

- At 2107: The northside relief NCO instructed the driver to walk and check the train, as there were concerns ‘…something might be sticking up from the train [towards the OHLE]…’. The driver confirmed this instruction. The northside relief NCO did not advise the driver of the electrical status of the OHLE.

- At 2111: The Queensland Police Service (QPS) contacted the RMC on the emergency phone line, and advised the southside train control leader (TCL) that the OHLE was down at Cooroy station. The QPS also advised that a witness observed '… wires on top of the train [YC77] that went through'.
- At 2115: The northside relief NCO attempted to contact the driver of YC77 by radio. There was no response as the driver was outside, inspecting the train.
- At 2119: The QPS again contacted the RMC by emergency phone, requesting that the OHLE be turned off in the area around Cooroy to help the police manage the scene. The caller noted that police on the scene reported that wires were down across fences and the pedestrian footbridge (north of the Elm Street overbridge). The southside TCL warned that, although the OHLE was de-energised, it was still not yet electrically safe until it was earthed and isolated at the site.
- At 2120: The UTC 3 NCO[16] called the driver of YC77's mobile phone and advised that the police had confirmed the OHLE was down. The driver advised the UTC 3 NCO of the general nature of the problem, after having walked the length of the train. The driver indicated there was a problem with one of the wagons on the train that was extending upwards towards the OHLE (Figure 5).[17] During the conversation, the UTC 3 NCO handed the phone to another network control person to clarify the situation with the driver, who advised it would be easiest to explain the situation by sending some photos. The driver returned to the locomotive cabin soon after.
- At 2133: The UTC 3 NCO called the driver's mobile phone to confirm whether the driver was in a safe place. The driver confirmed being in the locomotive cabin, but advised needing to leave the cabin to email photos of the flat rack to the RMC (due to problems with mobile phone data reception). The driver sent the photos soon after this conversation.
- At 2145: The day of operations coordinator (DOOC) instructed staff at the RMC to commence the 'DOOC & TCL Incident and Emergency Tool' checklist.
- At about 2200: A protection officer associated with a prior planned track closure to the north of the accident site arrived at the locomotive. The driver of YC77 left the locomotive cabin to talk to the protection officer, who then left the driver and inspected the train.
- At 2252: The rail operations response unit (RORU) QR commander arrived at Cooroy to take over coordination of the accident. After meeting with the onsite police, the QR commander allowed the police to proceed to the locomotive to perform drug and alcohol testing of the driver. The driver of YC77 left the locomotive cabin in order to be tested.
- At about 2307: The QR commander and a RORU officer attended the locomotive. The driver of YC77 left the locomotive cabin to accompany them as they inspected the train.
- At 2308: A QR OHLE linesman advised the ECO that the OHLE was intact above YC77.
- Early the following morning: A new driver relieved the driver of YC77, who left the locomotive cabin for changeover purposes. The new driver then entered the locomotive cabin of YC77.
- At 0300 (6 hours after the dewirement): The nominated person[18] issued a Form C (*Permit to Work*), confirming the OHLE at Cooroy station and above YC77 had been isolated, tested and earthed.

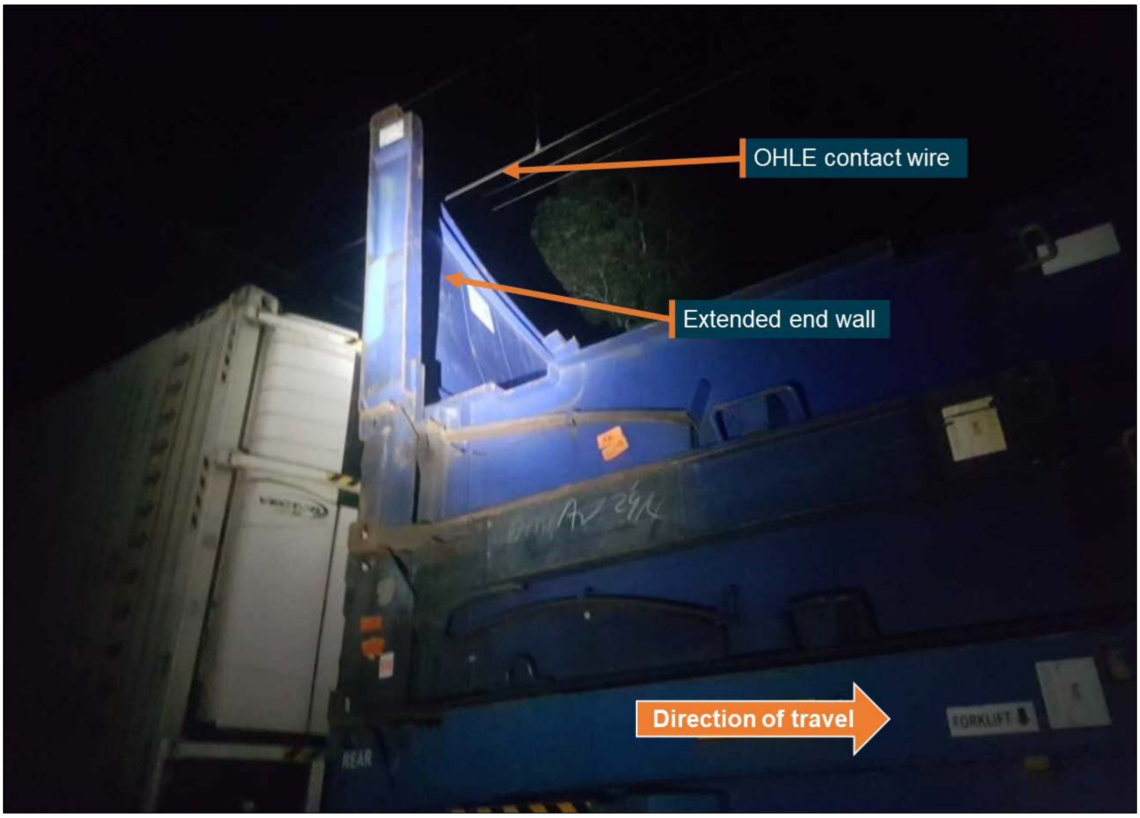
---

[16] UTC 3 NCO: the NCO allocated to the neighbouring UTC workstation to UTC 7. UTC 3 managed the North Coast Line from Sunshine (13.240 km) to Beerburrum (64.610 km) and, the Redcliffe Peninsula Line.

[17] The driver had not seen flat racks before and had difficulty describing the nature of the problem.

[18] Nominated person: a competent worker who switched, tested and applied local earths to OHLE, before issuing Form C.

Figure 5: Flat rack end wall in the extended position in close proximity to the OHLE



Source: Queensland Rail

Consequences of the dewirement

As a result of the dewirement, OHLE was brought down from 130.181 km to 131.447 km (about 1.3 km). High voltage wires, insulators and cantilever arms contacted the ground. Given the level of damage, the occurrence met the definition of an accident, as defined by the *Transport Safety Investigation Act 2003*.

There were no injuries. Although there were no people on the Cooroy station platform at the time of the dewirement, a southbound passenger train was scheduled to arrive about 30 minutes later.

Repair works were completed at 2215 on 20 August 2018, with the track reopened through Cooroy at 2301, 50 hours after the accident. During this period, all trains through the area were suspended.

Context

Track and network information

General

The North Coast Line consisted of 1,680 km of railway between Brisbane and Cairns, Queensland. Queensland Rail (QR) owned and managed 1,567 km of the North Coast Line, including the section from Brisbane through North Arm to Pomona (Figure 1).

Constructed in 1891, the section from North Arm to Cooroy (crossing the Blackall Range), was extensively realigned and regraded in 1988, in preparation for electrification. The new alignment increased the distance between North Arm and Cooroy. In addition, the track was lowered underneath several existing overbridges to provide clearance for the high voltage overhead line equipment (OHLE), including under the Elm Street overbridge at Cooroy.

Overhead line equipment (OHLE)

In OHLE-based electrified railways, traction power is supplied to electric locomotives and train units through a train-borne pantograph contacting the OHLE contact wire. The traction power circuit is completed by the current passing from the locomotive through the wheels of the train, into the rail and back to the feeder station and earth. Figure 6 indicates the major OHLE components.

Figure 6: QR mainline electrification OHLE components

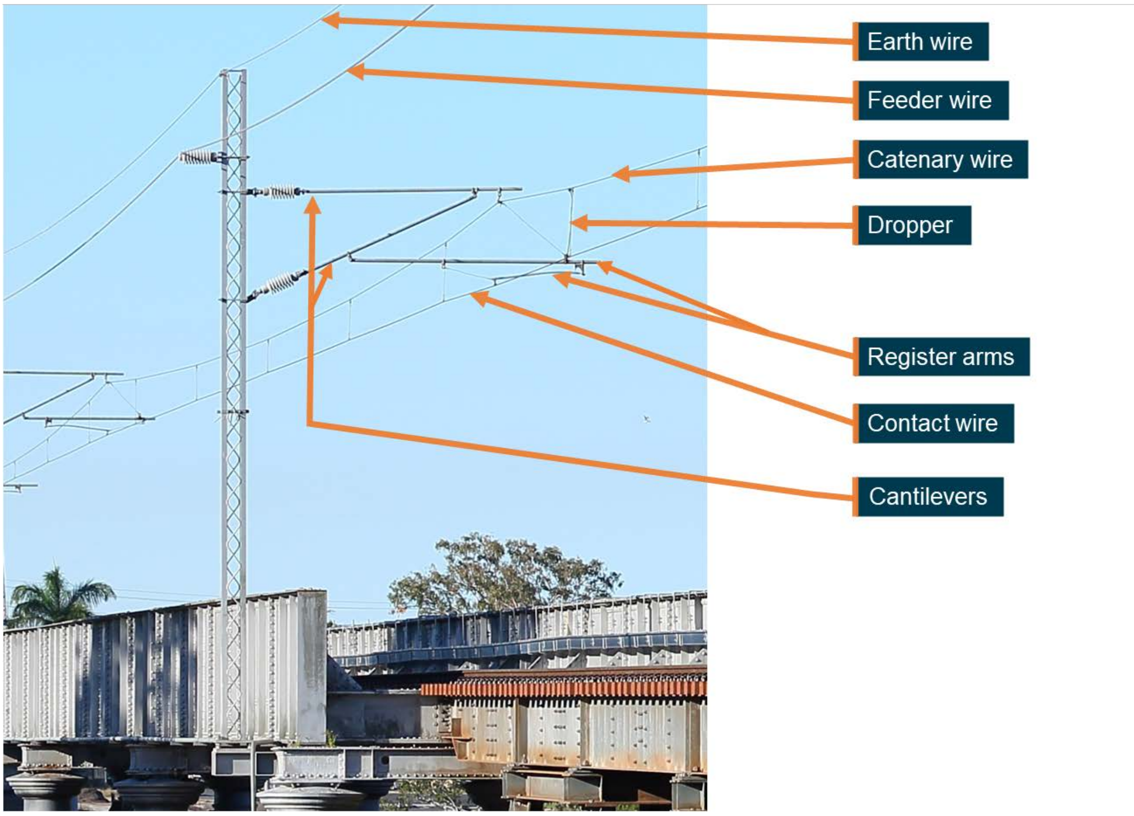


Image is of mainline electrification (autotransformer) OHLE components. Of particular note are the high voltage components, considered live at 25 kV, specifically, the catenary wire, contact wire, feeder wire, droppers, cantilevers and register arms.
Source: ATSB

QR's mainline electrification adopted an autotransformer type system for OHLE supply at 25 kV alternating current (AC).

The OHLE's lowest point above a train was the contact wire, which was at a nominal height of 4,900 mm above rail level. To allow for temperature-related expansion and contraction, and the effects of wind, the wires were kept tensioned by pulleys and weights placed at about 1.6 km intervals.

For general operations, the loads on trains were required to be a maximum of 3,820 mm above rail level. An authority to travel could be granted for heights up to 3,950 mm in electrified territory. However, QR advised that on the North Coast Line a special exemption for container traffic (including flat racks) allowed loads to reach up to 4,080 mm above rail level.

OHLE contact wire heights

Although the OHLE contact wire was set at a nominal height of 4,900 mm above rail level, this height was increased or decreased for clearance purposes; for example, over level crossings and under overhead bridges. As discussed in *Flat rack containers*, the height of an undamaged extended end wall on the top flat rack of a nest of three flat racks was about 4,845 mm above rail level, although that height would vary to some extent with the movement of a train.

OHLE contact wire heights were routinely measured by QR using a track recording vehicle, with the last survey conducted in the region of the dewirement on 14 June 2018, 2 months before the dewirement. Between Yandina (112.790 km), where the rear end wall of the top nested flat rack was last observed on closed-circuit television (CCTV) to be collapsed down, and Eumundi (122.100 km), where the rear end wall was first observed to be extended up, the OHLE contact wire height dropped to or below 4,845 mm at a number of locations. These are shown in Table 1 (in white rows).

Table 1: OHLE contact wire low points (in white rows) and location of key events (in blue rows) between Yandina and Cooroy

Kilometer-age	OHLE height (mm)	Location	Comment regarding YC77
112.790		Yandina Station	Station CCTV shows flat rack end wall down
112.952	4,837	Yandina Yard	
113.601	4,495	Yandina footbridge	
115.355	4,490	Bruce Highway tunnel	
115.720	4,839		
116.965	4,844		
117.104	4,733	North Arm–Yandina Creek Road overbridge	
117.682	4,816	North Arm Yard	
117.710		North Arm Station	
118.060	4,844	North Arm Yard	
118.545	4,832		
118.782	4,845		
119.613	4,844		First circuit breaker trip (2048 hours)
119.637	4,811		
121.075	4,841		
122.100		Eumundi Station	Station CCTV shows flat rack end wall up
122.581	4,838		
124.100			YC77 at about this location when first circuit breaker reset (2052 hours)
124.230		Sunrise Station	
125.248	4,853		Second circuit breaker trip (2053 hours)
126.354	4,838		
127.400			YC77 at about this location when second circuit breaker reset (2056 hours)
129.1209	4,842		Third circuit breaker trip (2101 hours)
129.1267	4,838		
130.136	4,830		
130.749	4,349	Elm Street overbridge	Flat rack end wall hits overbridge (2102 hours); dewirement
130.990		Cooroy Station	Station CCTV shows flat rack end wall up: OHLE wires down

Due to realignment of the line in 1988, the distance between the 129 km and 130 km pegs was 1,656 m. Therefore 129.1209 refers to 1,209 m beyond the 129 km peg and 447 m prior to the 130 km peg. Similarly, 129.1267 refers to 1,267 m beyond the 129 km peg and 389 m prior to the 130 km peg.

As indicated in Table 1, the contact wire at the Elm Street overbridge was 4,349 mm above rail level. This was the lowest contact wire height between Yandina and Cooroy. The Elm Street overbridge itself was 4,816 mm above rail level.

Sequence of circuit breaker trips

The ATSB examined the available evidence to determine the most likely locations of the train when the three circuit breaker trips occurred. Relevant details, summarised in Table 1, included the following:

- The first OHLE circuit breaker trip occurred at 2048, and it registered on the ECO's fault locator at 119.500 km. The closest contact wire low point was at 119.637 km. After considering the data logger data, the most likely location of the wagon of nested flat racks on YC77 when the circuit breaker tripped was determined to be 119.613 km, just prior to the 119.637 km low point. As the OHLE height dropped to 4,844 mm above rail level at that location, it would have allowed direct contact with the extended end wall of the top nested flat rack, resulting in the tripped OHLE circuit breaker de-energising the electrical section.

- The last contact wire low point prior to 119.637 km low point was at about 118.782 km (4,845 mm). Therefore, it is very likely that the unsecured end wall of the top nested flat rack raised somewhere between 118.782 km and 119.613 km.
- Although further OHLE contact with the extended rear end wall of the top nested flat rack would have occurred at about the 121.075 km low point and 122.581 km low point, these contacts did not result in circuit breaker trips as the electrical section was still de-energised. ATSB analysis determined that when the ECO reset the tripped circuit breaker at 2052, re-energising the OHLE, YC77 was at about 124.100 km.
- The second OHLE circuit breaker trip occurred at 2053; however, the ECO's fault locator could not determine the location of the trip on this occasion. ATSB analysis determined that the wagon of nested flat racks was near 125.200 km at this time. There were no areas of OHLE contact wire at or below 4,845 mm at this location. However, the OHLE contact wire did lower to 4,853 mm at 125.248 km, reducing the air gap between the extended end wall of the top nested flat rack and the OHLE contact wire to 8 mm. It is almost certain that either the OHLE arced across this air gap,[19] or the end wall contacted the OHLE, resulting in the tripped OHLE circuit breaker de-energising the electrical section.
- Although a further OHLE contact with the extended end wall of the top nested flat rack would have occurred at about 126.354 km (4,838 mm low point), this contact did not result in a circuit breaker trip as the electrical section was still de-energised. Analysis determined that when the ECO reset the tripped circuit breaker at 2056, re-energising the OHLE, YC77 was at about 127.400 km.
- The third and final circuit breaker trip occurred at 2101, and it registered on the ECO's fault locator at 130.170 km. The closest contact wire low points were at 130.136 km and 129.1267 km (389 m prior to the 130 km peg). After considering the data logger data, the most likely location of the wagon of nested flat racks on YC77 when the circuit breaker tripped was determined to be 129.1209 km, [20] just prior to the 129.1267 km low point. As the OHLE height dropped to 4,842 mm above rail level at that location, it would have allowed direct contact with the extended end wall of the top nested flat rack, resulting in the tripped OHLE circuit breaker de-energising the electrical section.

Train and train crew information

Train information

Aurizon train YC77 consisted of one 2800 class diesel electric locomotive hauling 32 container wagons. It was 659 m long, and had a total mass of 1,465 t. Although travelling on an electrified network, the locomotive did not use the OHLE to gain tractive power.[21]

The train was fitted with a data logger, and information from the data logger has been included in the report where relevant.

Flat rack containers

Flat racks were a type of shipping container, designed for oversized loads that could not fit within the normal profile of an enclosed side / top container. The end walls (if fitted) could be extended up or collapsed down. The advantage of collapsible end walls was their ability to be stacked flat

---

19 For further information regarding the ability for high voltage to arc across air gaps, see Appendix A.

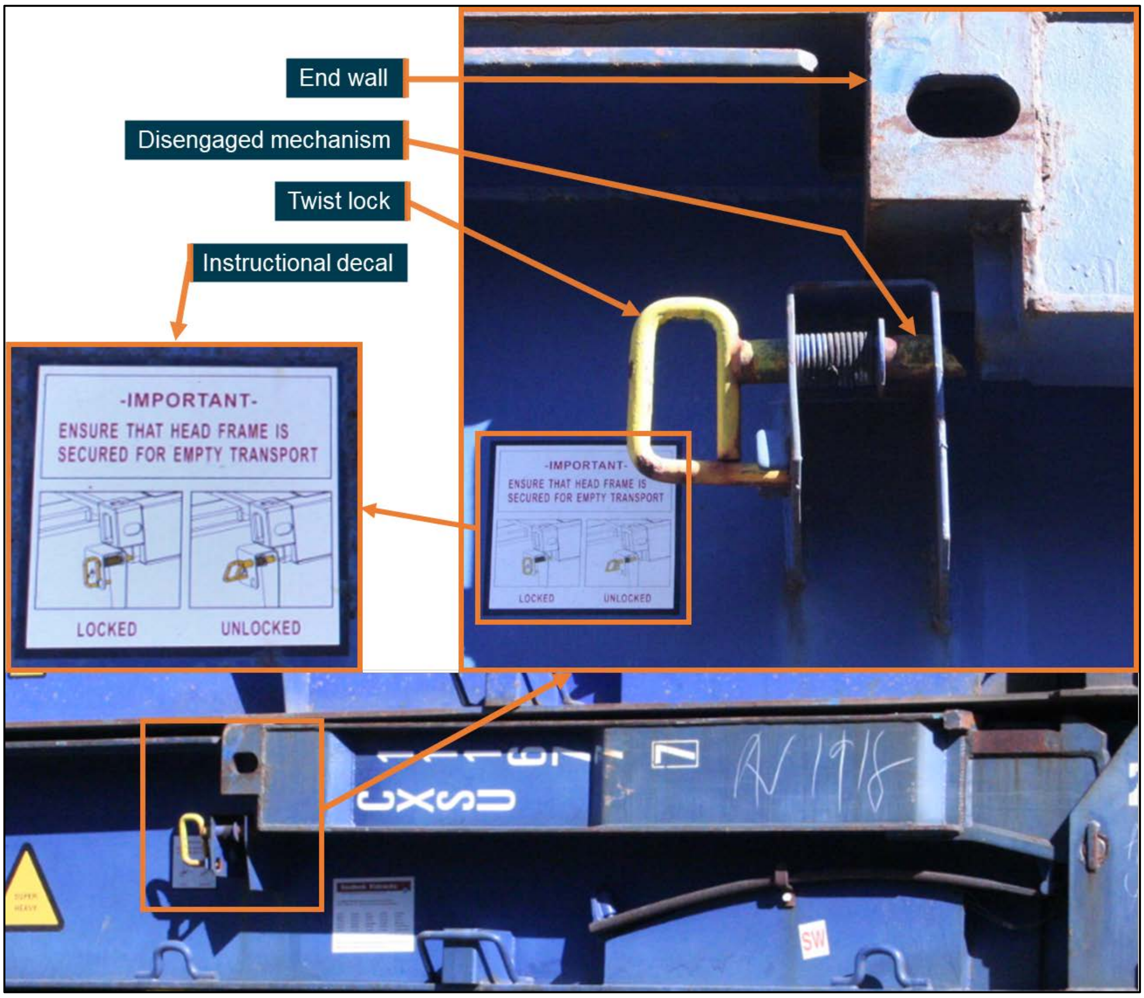
20 The distance between the 129 km and 130 km measured 1,656 m. Therefore 129.1209 refers to 1,209 m beyond the 129 km peg and 447 m prior to the 130 km peg.

21 A diesel electric locomotive uses a diesel motor driving generators or alternators to generate electric current to the traction motors.

on top of each other (or nested) when empty, allowing for efficient transportation. Flat racks were available in 20 ft or 40 ft lengths.

Flat racks with collapsible end walls were fitted with leaf spring or coil assistance for ease of raising. Once extended, two locking pins could be manually engaged to secure each end wall in the raised position. When collapsed, two twist locks (one on each side) could be manually engaged to secure each end wall in the down position (Figure 7). In addition, four spigots secured each flat rack to a flat rack below when nested, or to a flatbed rail wagon for transportation.

Figure 7: Twist lock mechanism for flat rack end wall



Source: ATSB

When travelling empty, Aurizon’s document SAF/STD/022/SWK/BUS (*Loading and securing of freight manual*) required flat racks to have all four twist locks engaged. It also required an additional chain or two web straps over each end wall of the top nested flat rack. This ensured that the leaf spring / coil raise assist end walls could not extend upwards during transit.

The flat racks on YC77 were Domino Seadeck 40 ft long type, similar to those shown in Figure 8. The collapsible end walls had leaf spring assist. A warning decal on the flat racks instructed the use of twist locks when a flat rack was travelling empty.

Figure 8: Flat rack containers

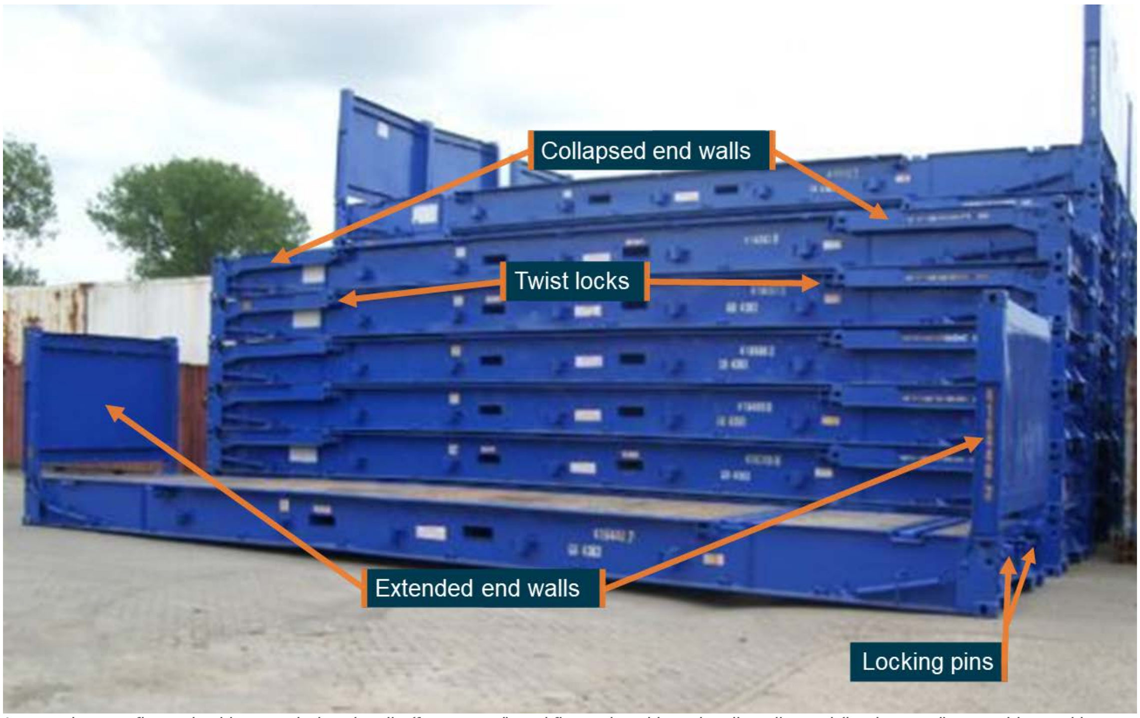


Image shows a flat rack with extended end walls (foreground) and flat racks with end walls collapsed (background) to enable stacking (nesting). Location of supplied securing methods when end walls were extended (locking pins) and collapsed (twist locks) are also shown.
Source: Mission & Relief Logistics, annotated by the ATSB

The height of a nest of three flat racks with the end walls collapsed, loaded on a flat wagon, was about 2,895 mm above rail level. The height of an undamaged extended end wall on the top flat rack of a nest of three flat racks was about 4,845 mm above rail level.

Train crew information

Train YC77 was crewed by a single train driver (see *Driver only operations information*). The driver had 7 years driving experience. This included commencing as a trainee driver with Australian Railroad Group[22] at Cloncurry (Queensland), then conducting train driving duties at Geraldton (Western Australia) and Rockhampton (Queensland), prior to being based at Acacia Ridge from January 2017.

Train performance and environmental conditions

A review of the train's data logger determined that the driver of YC77 followed sound train handling principles, including complying with maximum speed limits, between Yandina and the location of the dewirement. Between Yandina and shortly before 119.613 km, the location where the first circuit breaker trip occurred (see *Sequence of circuit breaker trips*), the speed of YC77 was held consistently between 75 and 80 km/h.

A review of Bureau of Meteorology data determined that maximum wind speeds at the time of the occurrence were under 10 km/h.

Site inspection

Onsite inspection by the ATSB on 19 August 2018 found scrape marks on the underside of the Elm Street overbridge. A broken OHLE contact wire found near the bridge had blue paint marks, identical to the colour of the top nested flat rack. Colourbond fencing on the southern side of the Elm Street overbridge was also damaged.

An inspection of the train where it had stopped (134.493 km) found damage limited to that of the extended rear end wall of the top nested flat rack. The end wall had minor damage and had been

[22] Australian Railroad Group was rebranded as Aurizon on 1 December 2012.

bent backwards, consistent with contact damage with the Elm Street overbridge. The height of the damaged extended end wall was 4,740 mm above rail level, slightly less than its expected undamaged height of 4,845 mm.

Analysis determined that the distance between the damaged extended end wall of the top flat rack and the OHLE contact wire at the location where the train stopped was about 210 mm (Figure 9).

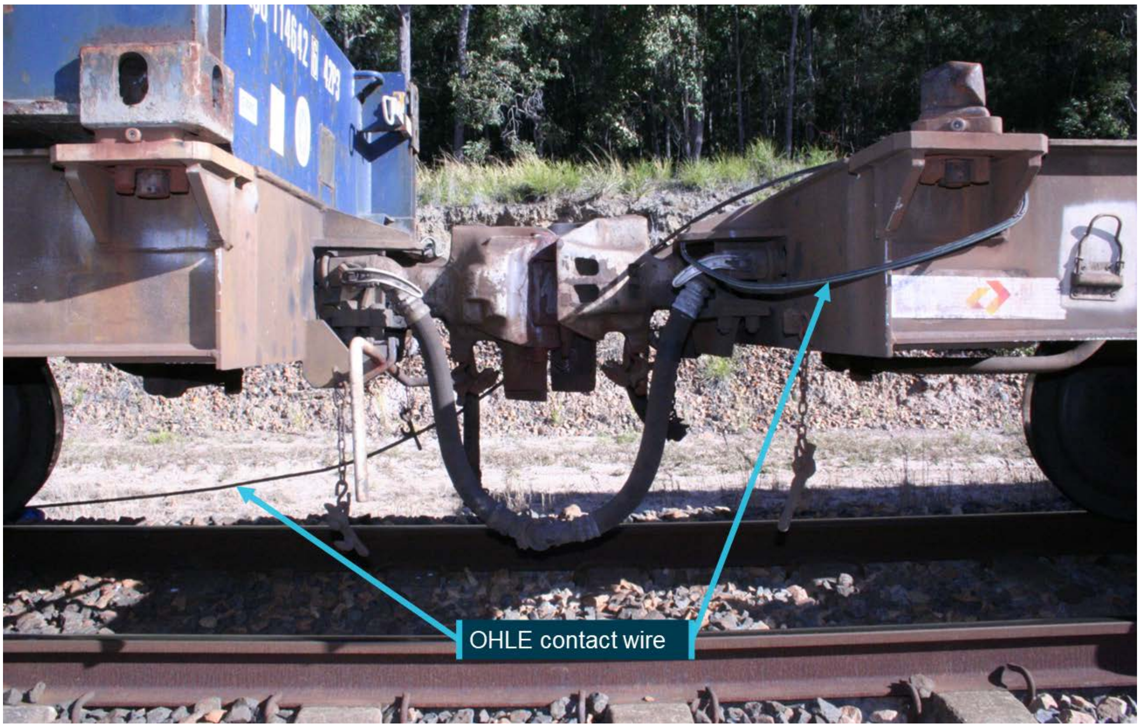
No web straps or chains secured the end walls of the top flat rack on the nest of three flat racks or the end walls of the single flat rack. In addition, neither of the top two flat racks on the nest of three had their twist locks engaged. A significant amount of rust was present on the twist lock mechanisms, indicating they had not been engaged for a significant period of time. The spigots securing the bottom flat rack to the wagon, and each flat rack to the one below, were in place.

Figure 9: Nest of three flat racks on train YC77, showing the damaged extended rear end wall

Image shows the extended end wall of the top nested flat rack, loaded on wagon BAZY 47520. The distance between the end wall and the OHLE contact wire is about 210 mm.
Source: ATSB

Although the OHLE above the train was intact, some wires from the OHLE that had been pulled down were entangled in parts of the train, as shown in Figure 10.

Figure 10: Part of train YC77 showing OHLE wires in contact with the train



Source: ATSB

Train loading and securing information

Loading and securing process

The Acacia Ridge Intermodal Terminal was located in the southern suburbs of Brisbane, and was owned and operated by Aurizon (Figure 11). The terminal handled the transhipment of road freight to rail transport and vice versa.

Figure 11: Acacia Ridge Intermodal Terminal

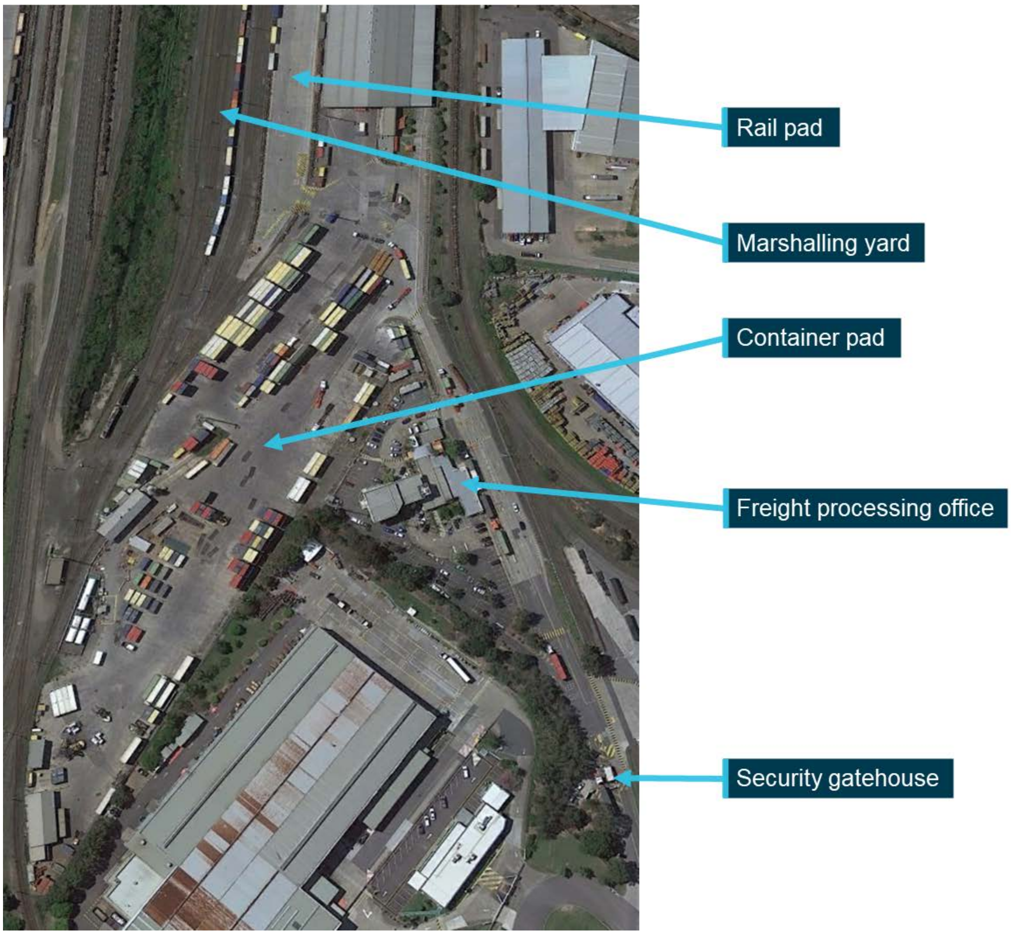


Image shows the location of the checkpoint (freight processing office), container pad, rail pad and marshalling yard at Acacia Ridge Intermodal Terminal.
Source: Google Earth, annotated by the ATSB

After arriving at the security gatehouse, incoming road freight proceeded to the freight processing office and the delivering truck driver presented relevant paperwork to the terminal coordinator. If it was deemed an unusual load,[23] the terminal coordinator was required to check the load to ensure it was correctly secured for rail travel. If secured correctly, the terminal coordinator directed the trucks to the rail pad for train loading, or to the container pad for short-term storage. If loading was found to be incorrectly secured, the terminal coordinator would not be accept the load until the issue had been fixed by the delivering truck driver.

A heavy forklift driver unloaded loads from trucks and either stored them as required on the container pad, or placed them directly onto wagons at the rail pad. After loads had been placed on the wagons, pinners ensured the loads were correctly secured. Freight operators shunted the wagons from the rail pad to the marshalling yard, where the train was finalised for departure.

Loading and securing procedures

Aurizon had several documents that contained procedures associated with the loading and securing of loads. A comprehensive and detailed 242-page document 07-STD-022-SWK (*Loading and securing of freight manual*), and supporting checklists, were provided to assist staff. The manual provided guidance on how to secure a wide range of loads.

The procedure for securing empty flat racks was included in the loading and securing manual, within a number of other instructional dot points. As noted in the manual, the procedure required that each collapsed end wall on the top flat rack of a nest of flat racks was to be secured by either

---

[23] Unusual load: in relation to intermodal freight, referred to freight that was not a 20' or 40' closed side container.

one chain or two web straps, and the two fitted twist locks. The maximum height above rail level for nested flat racks loaded on a flat wagon was not to exceed 3,165 mm.

In addition to the loading and securing manual, checklist 14-FRM-017-INT (*Loading & securing checklist – Flat-racks*) provided guidance on the securing of nested empty flat racks. This guidance was consistent with the content of the manual.

Other documents outlined the roles and responsibilities for personnel involved in ensuring loads were appropriately secured. More specifically:

- Work instruction 14-WI-011-INT (*Loading & securing – Inspection of incoming loads at terminals*) provided instructions on inspecting unusual incoming loads. It stated that the terminal coordinator was to inspect any load that was not a 20 ft or 40 ft container to ensure the loading met the requirements of the loading and securing manual, using the relevant checklist.
- Work instruction 07-WI-013-ACR (*Train pinning: Work method statement*) provided instructions for the pinners. The stated purpose was 'when rail wagons have been loaded, the containers have to be secured and pinned up'. The stated process included walking around both sides of the train and pinning all manual spigots and checking for any non-conformances. The list of potential non-conformances included 'unsecured loads'. However, the instruction did not provide guidance on how this was to be identified. There was no reference to the loading and securing manual or related checklists for unusual loads.

The loading and securing manual and associated checklists were stored on Aurizon's intranet system 'iN-Gauge'. Hard copies were not readily available.

If an incoming load was deemed unusual, the terminal coordinator would inspect the loading and securing arrangements as per the loading and securing manual and the relevant checklist, after accessing iN-Gauge. Computer access to iN-Gauge was available in the freight processing office.

On encountering an unusual load while pinning a train, pinners were required to return to the office, access iN-Gauge, find and print the relevant checklist, and recommence the loading and securing inspection.

All interviewed personnel advised that flat racks were rarely encountered at the Acacia Ridge terminal.

Loading and securing training

Aurizon provided training and assessment for loading and securing of flat racks to personnel with these responsibilities. This training included an on-line course, which contained extensive and complex loading and securing instructions for a variety of different types of loads.

Personnel were also required to sign an acknowledgement sheet that they had received a particular instruction (such as 14-WI-011-INT for inspection of incoming loads or 07-WI-013-ACR for train pinning) and received a training session on the instruction, which included a small number of competency assessment questions.

Neither the on-line, nor the work instruction training, contained practical instruction or assessment.

Loading and securing personnel

The personnel involved in the loading and preparation of train YC77 included the following:

- The terminal coordinator on duty when the flat racks were delivered had 7 months' experience in the role and was previously employed as a heavy forklift driver. Although reporting that it was a busy evening when the flat racks were delivered, the terminal coordinator felt alert at the time of the flat rack delivery.
- The heavy forklift driver who unloaded the truck on the night of delivery, and loaded YC77 the following morning, had two 2 years' experience in the role, as well as previously working as a heavy forklift driver with another rolling stock operator. The forklift driver also performed pinner duties on a rotational basis.

- Two pinners inspected YC77 prior to handover to the freight operators. Pinner no. 1 was a temporary contractor with the heavy lift section. The 6-month contract period ended shortly after the accident. Pinner no. 2 had 5 years' experience as a heavy forklift driver and had also acted in the terminal coordinator position.

Table 2 summaries Aurizon's records of the training received by each of these personnel for the loading and securing of freight. Although most of the personnel had conducted the detailed, online course, there was no record to indicate that pinner no. 1 had completed this training.

Table 2: Loading and securing of freight training records (date completed)

	On-line course	14-WI-011-INT	07-WI-013-ACR
Terminal coordinator	12 July 2017	No evidence	9 November 2017
Heavy forklift driver	1 June 2017	16 April 2018	16 June 2017
Pinner no. 1	No evidence	No evidence	No evidence
Pinner no. 2	15 March 2018	No evidence	9 November 2017

Aurizon was unable to provide evidence that the terminal coordinator, pinner no. 1, or pinner no. 2 (who had previously acted as a terminal coordinator) had received work instruction training for 14-WI-011-INT. In addition, Aurizon was unable to provide evidence that pinner no. 1 had received work instruction training for 07-WI-013-ACR.

During interview, the terminal coordinator, pinner no. 2 and heavy forklift driver agreed that the terminal coordinator was responsible for checking flat rack securing on arrival at the Acacia Ridge terminal. However, the terminal coordinator and pinner no. 2 said they understood this was limited to Aurizon loading only, not that received from external customers.

In terms of checking loads after they were lifted onto the wagons, pinner no. 2 and the heavy forklift driver said they understood that checks during pinning were limited to ensuring the provided securing was tight. Pinner no. 2 added that they assumed securing was not required if it was absent. Both pinner no. 2 and the heavy forklift driver advised that they were not aware of guidance material for checking unusual loads.

Form 04 (*Loading and securing advice*), which was issued on completion of train pinning, advised that further loading and securing checks were to be performed. Aurizon's manual SAF-SPC-SWK-0048 (*Testing of trains)* advised these checks were to be conducted during a train safety test. In addition, form FDB819A (*Loading and securing non-compliance report*) was to be completed in instances of unsecured loads identified during a train safety test, shunting or roll-by examination. Freight operators performed all of these duties. However, Aurizon advised that freight operators were not qualified to perform loading and securing checks, nor were they required to do so.

Previous occurrences

Aurizon and its predecessor companies had previously reported two notifiable occurrences that involved load irregularities involving flat racks.

In January 2012, the collapsible end wall of a flat rack on Interail (QRNational) train 5MB7 collided at speed with a timber overpass north of Wauchope, New South Wales. The collapsible end walls were not secured with twist locks and chains or web straps. QRNational recommended that further training tools and information guides be developed for the transport of flat rack containers.

In April 2018, a 10,000 L polyethylene water tank fell from Aurizon train YU55 at Kinkuna (south of Bundaberg, Queensland). The loss was not identified until the train had travelled a further 211 km to Mount Miller (north of Gladstone, Queensland). Three remaining water tanks on the flat rack were also insufficiently secured. This incident related to flat rack loading and not the securing of end walls. However, the investigation report by Aurizon included the following findings:

> - non defined process to ensure every flat rack checked by [the terminal coordinator] prior to unloading off [incoming road] vehicle

- lack of awareness / ownership of chain of responsibility by driver / loader / [terminal coordinator]
- insufficient practical load restraint training and awareness for Aurizon staff.

Aurizon recommended delivery of further training, both theory and practical, in relation to 'sufficient load restraint for out of scope loads'. Delivery was to occur by 31 May 2018. There was no evidence that this training occurred prior to the dewirement at Cooroy on 18 August 2018.

Rail management centre information

General

Queensland Rail's (QR's) rail management centre (RMC) was located on the northside of Brisbane. The RMC housed the QR Citytrain network control centre for controlling and monitoring trains, and the electric control room for controlling and monitoring OHLE supply. Both were required to interface with each other to ensure safe operation of the QR Citytrain network.

Network control

QR's Citytrain network control operated from Tamaree[24] to the north, Varsity Lakes and Acacia Ridge to the south, and Rosewood to the west. It was divided into nine universal traffic control (UTC)[25] areas for train control and monitoring purposes, with a tenth used during busy periods. The UTC 7 workstation managed the North Coast Line[26] between Glasshouse Mountains and Tamaree, which included Cooroy. The neighbouring UTC workstation, UTC 3, managed the North Coast Line from Sunshine to Beerburrum, and the Redcliffe Peninsula Line (Figure 12).

24 Tamaree was the boundary between the Citytrain and regional network control centres. It was located one track section north of Gympie North.

25 Universal traffic control (UTC): QR designed train control system for remote controlled signalling territory.

26 The North Coast Line was referred to by supplementary names, i.e. Caboolture line and Sunshine Coast line, for passenger purposes.

Figure 12: North Coast Line QR Citytrain universal traffic control boundaries

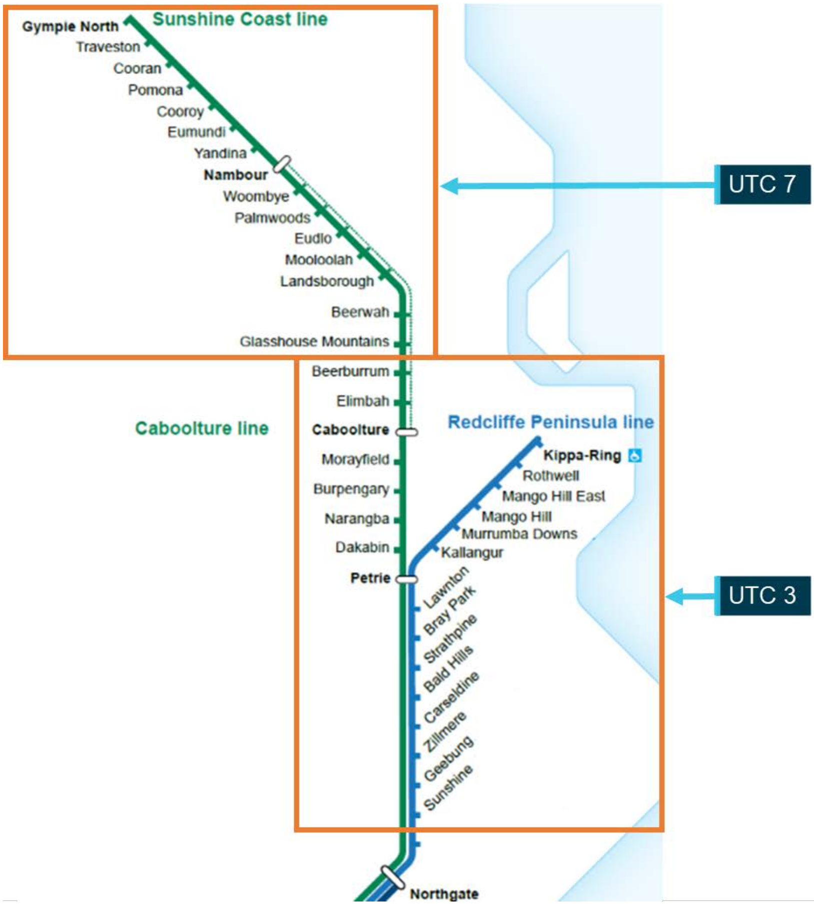
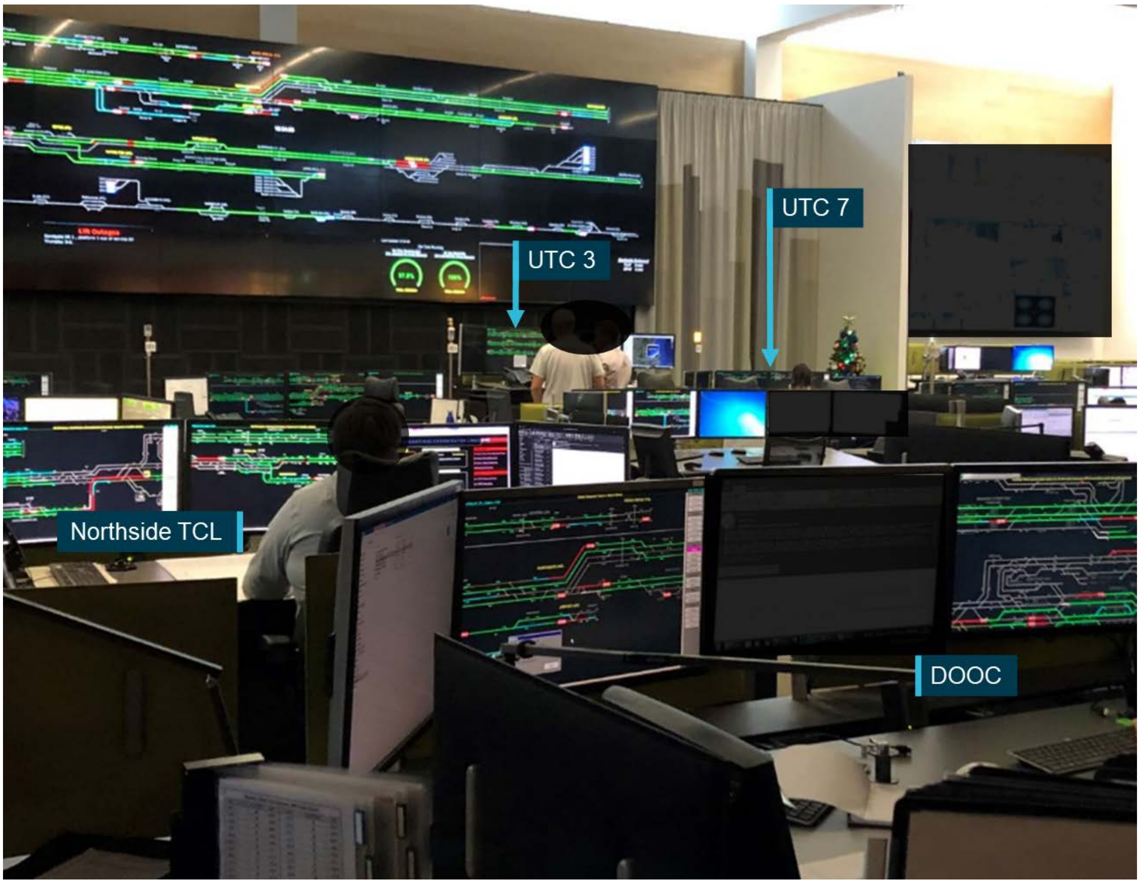


Image shows the location of the UTC 3 and UTC 7 boundary, between Beerburrum and Glasshouse Mountains.
Source: TRANSLink, annotated by the ATSB

Network control officers (NCOs) operated the UTC workstations. The NCOs were supervised and assisted by two train control leaders (TCLs). The TCLs were senior, experienced NCOs, each of which was allocated supervision of either the northside or southside NCOs. Two experienced, relief NCOs provided additional support to the NCOs, for example, during breaks. Relief NCOs were, like the TCLs, allocated to either the northside or southside. The day of operations coordinator (DOOC) was a senior, experienced NCO, who provided overall supervision of the network control centre, including of the NCOs and TCLs (Figure 13).

Communication between train control and train crews was normally by radio. TCLs monitored and answered the QR staff, emergency services and members of the public emergency telephone.

Figure 13: Network control centre showing the train control leader and relevant network controller positions



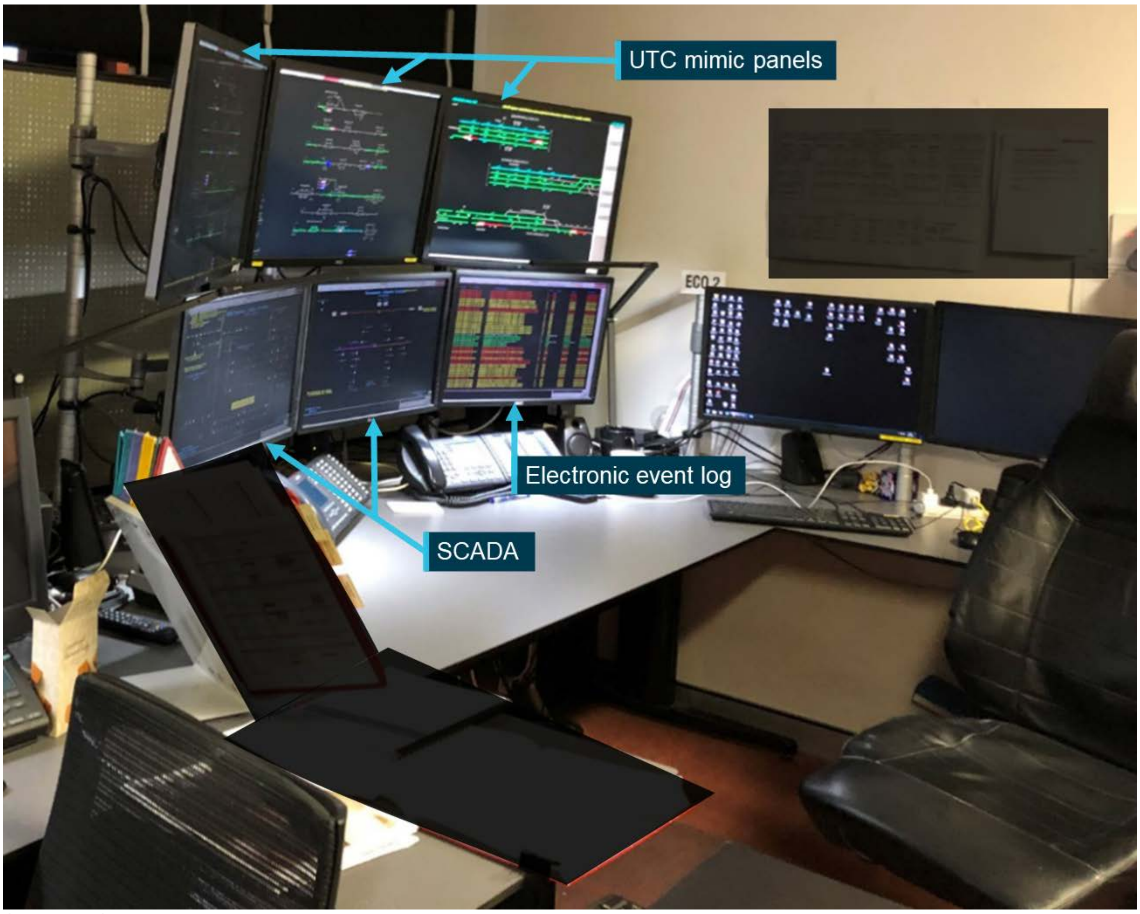
The image is taken from the approximate boundary between northside and southside halves of the network control centre. The southside NCOs and TCL are located to the left of the image (out of frame).
Source: ATSB

Overhead line equipment control

An electric control room situated at the RMC was used for monitoring and controlling the QR high voltage OHLE systems. An electric control operator (ECO) monitored and controlled the OHLE via a supervisory control and data acquisition system (SCADA).[27] An electronic event log provided information to the ECO of electric traction system alarms, issues and associated actions. The ECO workstation was also fitted with a UTC mimic panel. This panel enabled the ECO to monitor the real-time location of train movements within the electrified areas of the QR network (Figure 14).

[27] SCADA: refers to a computer system that monitors and controls a process. In the case of the QR OHLE, the process was transmission and distribution, with elements including substations, transformers and other OHLE related electrical assets.

Figure 14: Electric control operator workstation



Source: ATSB

The electric control room was segregated from the network control centre and NCOs, with communications between these areas undertaken by telephone. The ECO was able to monitor NCO radio conversations with train crew, but was not able to communicate directly to train crews. Therefore, if an ECO needed to communicate with a train crew, they were required to telephone the NCO, who would then pass on the message.

RMC personnel

In terms of the personnel on duty at the time of the accident:

- The NCO allocated to UTC 7 workstation qualified as an NCO on the northside UTC workstations just over 18 months prior to the dewirement.
- The northside relief NCO qualified as an NCO assistant 13 years previously, and qualified as an NCO in 2009
- The southside TCL had 36 years' experience in the RMC, and was qualified as a TCL for both northside and southside UTC workstations.
- The northside TCL commenced as an assistant NCO in the Brisbane freight network control centre 21 years previously, later transferring to the RMC and becoming a TCL about 3 years prior to the dewirement.
- The DOOC, who commenced his shift at the time of the dewirement, had previously been an NCO and a TCL, and had been acting in the DOOC role for about 2 years.
- The ECO initially qualified as a high voltage OHLE substation electrician, and then qualified as an ECO about 3 years prior to the dewirement.
- The UTC 7 NCO, northside relief NCO, ECO and DOOC all stated that they felt alert at the time of the dewirement and emergency response. Although they stated that their workload was high during the emergency response, they felt it was manageable.

Emergency procedures

As a prescribed electricity entity, QR was required to have a discrete safety management system (SMS) for managing electrical safety risks.[28] QR standard MD-13-73 (*Electrical safety management plan (ESMP) for declared electrical entity works*) complied with this legislative requirement. A further ten supporting documents comprising of standards, instructions, procedures, plans and checklists were provided to guide personnel during OHLE emergencies.[29] These guidance materials included responsibilities and actions for the ECO, NCO, DOOC, train driver (including when appointed as onsite coordinator), nominated person and QR commander.

Electric control room procedures during OHLE emergencies

The QR procedure MD-11-4403 (*Electric control room*) provided guidance to ECOs about how to respond to OHLE circuit breaker trips. Outside a 'high risk area',[30] (including between Eumundi and Cooroy), the ECO could reset a tripped OHLE circuit breaker after 1 minute, after reviewing all available information. Provided the reset OHLE circuit breaker remained closed, no further action was required. However, train crews were to be requested to remain vigilant for OHLE abnormalities.

A 'persistent' fault was defined as one which resulted in an immediate circuit breaker trip after the circuit breaker was reclosed. The procedure stated that persistent faults:

> … may involve dewirement or objects hanging from the OHLE. Re-energisation of traction OHLE under these conditions may expose people in the vicinity of the fault to the risk of contact with live OHLE and serious injury or electrocution…

Accordingly, the procedure stated that in this circumstance the circuit breaker was not to be reclosed. The procedure also stated:

> Should the ECO receive indications of persistent traction faults with non-electric trains on section, the ECO shall immediately arrange for blockage to all traffic to be applied to the affected area.

In addition to a dewirement or objects hanging from the OHLE, the procedure stated that another potential source of persistent faults was over-dimensional loads.

Although the circumstances which occurred on 18 August 2018 did not strictly meet the definition of a persistent fault, they did involve recurring faults close together. The ECO effectively followed the same procedure.

In instances of non-life threatening emergencies, the ECO was to:

- de-energise the OHLE between the two adjacent neutral sections[31]
- arrange a block to all trains [by the NCO] to the affected section
- warn onsite personnel [through the NCO] to maintain a 3 m exclusion zone of the OHLE and anything in contact with it
- arrange OHLE staff to attend.

During the events on 18 August 2018, the neutral sections were located at Woombye and Traveston, requiring de-energisation of 50 km of OHLE. The ECO de-energised the section and arranged for a block to all trains. However, based on the available evidence, the ECO did not ensure the NCO had communicated the dangers of the OHLE to the driver of YC77.

In terms of identifying the location and reasons for circuit breaker trips, MD-11-4403 noted that the fault locator function was not always accurate. In addition, the ECO advised that unidentified causes for OHLE circuit breaker trips on the North Coast Line were common. The area north of

---

[28] *Electrical Safety Act 2002* (Qld), s. 67; *Electrical Safety Regulation 2013* (Qld), rr. 233–234.

[29] OHLE emergency: an occurrence involving OHLE, which has the potential to cause injury, loss of life or property damage.

[30] High risk area: these areas included major construction sites, Brisbane CBD stations and major rail yards and depots.

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

Caboolture (50.390 km) was predominantly bushland, with OHLE circuit breaker trips commonly attributed to wildlife and tree branches.

Network control centre procedures during OHLE emergencies

During a confirmed high voltage OHLE emergency, QR procedure MD-11-33 (*High voltage (HV) electric traction infrastructure emergency module EP1-04*) was to be followed. The procedure outlined some general safety rules, including:

> Electric traction exposed lines and equipment (and any objects in contact with exposed equipment) shall be treated as live and dangerous…
>
> Maintain minimum 3 metre exclusion zone from all electric traction exposed lines and equipment (and any objects in contact with exposed equipment) and keep others away. Situational hazards may require a much greater exclusion zone...
>
> Do not approach unless advised safe to do so by the relevant Network Control Centre.

The procedure outlined required actions for a wide range of personnel, including NCOs and ECOs. It stated:

> Even when the Electric Control Operator (ECO) has informed the Network Control Officer (NCO) that the overhead line equipment (OHLE) has been de-energised, it is still NOT electrically safe until the Queensland Rail Nominated Person (NP) has isolated, tested de-energised and earthed the HV [high voltage] Electric Traction Infrastructure and issued a Form C or a Form D Permit to Work.

In addition to communicating dangers and safety requirements of the OHLE to onsite personnel, the NCO was to place track blocks[32] on the affected sections of track.

Hard copies of the emergency procedures were readily available at NCO workstations. In addition, QR provided NCOs with a supporting checklist, MD-17-482 (*NCO incident and emergency response tool*), for quick reference during an emergency. This checklist was introduced in 2017 and included three sections: immediate actions, communication and emergency response. Items specific to OHLE electrical safety were highlighted in red in each section. These highlighted sections included:

- immediate actions: confirm OHLE status
- communication: reinforce current OHLE status to train crew and emergency services, with status updates as required
- emergency response: advise on OHLE status (de-energised, isolated, earthed, tested) (see *Electrical safety*).

Under the last item, the checklist stated:

> Ensure Emergency Services are aware that the OHLE can only be considered safe when this [de-energised, isolated, earthed and tested] has been completed.

QR advised the ATSB that this checklist was a guide only, and was 'not required to be completed by the network controllers during the course of an incident'. One TCL indicated it was better to use experience than a checklist, and the other thought that checklists assisted in ensuring tasks were completed. Several NCOs stated that no checklist for the NCOs existed, with one stating they would be helpful for those new to the role. The UTC 7 NCO did not complete a checklist during the 18 August 2018 emergency response.

In terms of the procedures and guidance for other personnel:

- There was no specific procedures or guidance for NCOs allocated to neighbouring UTC workstations to that dealing with an OHLE emergency, and no specific procedures or guidance for the relief NCOs.

---

[32] Track block: an electronic command placed on the track section by the NCO, preventing entry to the track section. In remote controlled signalling territory, this would place signals allowing entry to the track section at red (stop).

- TCLs were not provided with specific procedures or guidance to assist in process coordination during times of an emergency. A mandatory checklist, MD-17-486 (*OHLE incident – DOOC and TCL incident and emergency tool*), for both the TCL and DOOC existed; however, the main focus of this checklist was effective stakeholder engagement and the organisation of alternate passenger transport. One entry related to ensuring emergency services were aware of OHLE dangers, and another related to arranging assistance for the NCO dealing with the emergency. Neither of these two action items were marked as completed during the 18 August 2018 emergency response, although the southside TCL did warn the QPS communications centre of the OHLE dangers onsite at Cooroy (see *Post-dewirement activities*).
- Procedural guidance for the DOOC during an OHLE emergency was limited to stakeholder communications, declaring an emergency, activating a QR commander to manage the accident site, and providing general assistance.

In terms of responsibilities during an emergency response, the DOOC advised that the TCLs provided supervision and handled operational incidents, with the DOOC's role limited to communication with stakeholders. One of the TCLs noted '… everyone knows what goes on [during an incident]', with the DOOC providing oversight. The other TCL believed the DOOC was responsible for coordination and decisions. Several personnel noted that NCOs commonly divided tasks among themselves when handling an incident.

During interview, most of the network control personnel felt that the emergency response on 18 August 2018 was well managed, with good teamwork and utilisation of previous experiences.

The UTC 7 NCO recalled being in charge of handling activities associated with train YC77, with the only assistance being from the southside TCL (although UTC 7 was under the northside TCL's supervision). Audio recordings of communications indicated that the UTC 7 NCO had limited communications with the driver of YC77 after the dewirement, and was occupied with other train control duties during the emergency response period, including managing other trains and answering phones. The UTC 7 NCO was unaware the driver was instructed to inspect the train by another NCO.

The southside TCL recalled having minimal involvement during the emergency response, limited to answering the emergency phone, and thought the northside TCL likely assisted the UTC 7 NCO.

The northside TCL, in charge of supervising the UTC 7 NCO, felt that the NCO 'probably' managed the accident train. After a review of all available evidence, the ATSB could not determine what involvement the northside TCL had during the emergency response.

Procedures for onsite personnel

MD-11-33 also outlined procedures for other personnel, such as the train crew. The procedures relating to rail traffic crew (RTC) included:

> Stay on the radio to NCO and await instructions…
>
> Advise passenger/RTCs to remain on the train until further notice if it is safe to do so
>
> Do not leave the train until the NCO confirms it is safe to do so…

MD-11-30 (*Rail emergency response module EP1-01*) outlined additional procedures. It stated that, in the initial stages, the NCO would appoint an onsite coordinator to take control of the scene. After declaration of an emergency by either the DOOC or business operations shift supervisor, a QR commander could be activated to attend onsite and take over coordination of the scene from the onsite coordinator.

The QR commander's duties included:

- onsite point of contact
- conducting site assessment for hazards
- (as an authorised person) receiving Form C from the nominated person

- communicating the limits of electrical safety to onsite teams.

During the emergency response on 18 August 2018, the driver of YC77 was initially appointed the onsite coordinator, with the QR commander taking over after arriving at the site at 2252. The QR commander then contacted the ECO, who confirmed that the OHLE was de-energised from Traveston to Woombye but was not yet isolated. The ECO further advised that OHLE personnel were yet to determine what earthing requirements were required in the vicinity of the train itself.

Shortly afterwards, the QR commander met with the QPS who were required to conduct alcohol and drug testing of the driver of YC77.[33] Although the QPS were empowered to enter exclusion zones in the event of an emergency (to direct evacuations and exclude persons from premises),[34] this did not apply to conducting post-accident drug and alcohol testing. The QR commander allowed the QPS to attend the locomotive of YC77, requiring the driver to leave the locomotive cabin.

Previous occurrence involving an emergency response

On 31 January 2013, a Queensland Rail (QR) passenger train (T842) failed to stop at the Cleveland station platform (due to problems with braking system effectiveness) and collided with the end-of-line buffer stop, the platform and the station building at a speed of about 31 km/h. There were 19 people on board the train (including the driver and a guard); three people were on the platform and five were in the station building. During the collision sequence, the train contacted an OHLE mast resulting in a dewirement, with wires brought down onto the train and platform.

It was identified that during the emergency response the guard (after communicating with network control) had assisted two passengers to evacuate the train before the OHLE was made electrically safe. In its investigation report,[35] the ATSB made the following finding:

> During the period immediately following the collision there were a series of communication issues which resulted in incomplete information being provided to key personnel. This resulted in the train control operator and train guard miscommunicating the status of the downed overhead power lines, leading to the guard permitting some passengers to exit the train before emergency services had ensured it was safe to do so.

At the time of the 2013 accident, QR had not provided NCOs with a checklist for responding to an emergency such as an OHLE dewirement. The ATSB report provided discussion about the relevance of checklists and the handling of the emergency response by the network control centre, including:

> With no quick reference decision aids or checklists to refer to, train control personnel were required to interpret ambiguous and incomplete information about a complex situation, based solely on voice communications from a remote location...
>
> The use of standardised procedures for emergencies enables personnel to use rule-based decisions to react quickly and effectively to contain a situation. It permits the considered design of procedures by experts to be efficiently implemented by operators, and has the potential to mitigate the effects of inexperience and misunderstanding of an event. However, the effectiveness of these procedures is influenced by familiarity with, and accessibility of the procedures. In this case, the train control personnel had no quick reference guides or checklists to assist in diagnosing the situation (to then determine which module would apply), nor was the document organised in a way that facilitated ease of identification of required actions and their sequencing…
>
> The investigation established that some train control personnel referred to the Derailment procedure, whilst another followed the Overhead Line Equipment Emergency procedure. Other staff did not make use of the specification [relating to OHLE emergencies], but instead relied on memory and experience to guide their actions. In some instances, this resulted in a lack of clarity as to allocation and priority of responsibilities and tasks, as well as some ineffective communications…

---

33 *Rail Safety National Law 2012*, s. 126; *Transport Operations (Road Use Management) Act 1995* (Qld), s. 80.

34 *Public Safety Preservation Act 1986* (Qld), s. 8 & Schedule.

35 ATSB RO-2013-005, Collision of passenger train T842 with station platform, Cleveland, Queensland, 31 January 2013.

> The train control operator continued to provide control services to the other lines under his control … there was no initiation of processes to reallocate [his] extraneous tasks in order to enable him to focus on the emergency response to this event, nor was there any consideration for this to occur documented within the emergency procedures.
>
> The effective management of an emergency situation from a location remote to the event presents a number of challenges for the train control staff, primarily related to ensuring that timely and accurate information is available, communicated, and understood, and that the response is handled in an efficient and coordinated manner. To that end, it is critical that standard procedures are in place, but it is equally critical that those procedures are designed to accommodate human performance limitations in conditions of high stress and/or workload, and that they are well understood through staff training and well-practised through field based and desk-top exercises.

On 31 January 2003, a passenger train derailed at Waterfall, New South Wales. The special commission of inquiry[36] provided a detailed discussion about emergency response activities. The commission report stated:

> The rail industry needs to develop checklists for its staff to follow in the event of a particular kind of incident, such as a derailment. For example, the train driver should have a simple checklist identifying the information which he should immediately communicate to the RMC [rail management centre]…
>
> Other railway personnel need to have checklists identifying clearly and precisely what they are required to do in the case of an emergency and the order in which things are to be done…
>
> Such checklists should be provided as part of the ICS [incident command system]… They should be on a sheet in the driver's cabin, guard's compartment or signaller's or train controller's work station.

Accordingly, the commission recommended that the RailCorp [the rolling stock operator and rail infrastructure manager] emergency response plan should include action checklists for each relevant employee.

Overhead line equipment safety information

Description

The autotransformer system used by QR consisted of a feeder wire that was energised at 25 kV AC (-25 kV), but at opposite phase;[37] that is, 180º to the contact wire (+25 kV). Although supply to trains remained at 25 kV AC, this system introduced an additional nominal phase-to-phase[38] voltage of approximately 50 kV AC. This was in addition to the 25 kV AC phase to neutral[39] in comparison to ground; that is, the return rails (0 kV). An additional earth wire electrically connected adjacent OHLE structures, to ensure safe return to ground in the event of a failed earth bond on a single structure.

The advantage of the autotransformer system was the ability to energise further distances due to the higher 50 kV AC feed, halving the number of high cost feeder stations.

Electrical safety

The Queensland *Electrical Safety Regulation 2013* stipulated exclusion zones that applied to untrained persons in relation to high voltage overhead uninsulated electric lines. In instances where the phase-to-phase voltage was approximately 50 kV, as for the OHLE in the Cooroy precinct:

- the exclusion zone between an untrained person and the overhead line was 3,000 mm
- the exclusion zone between a vehicle operated by an untrained person and the overhead line was 2,100 mm.

---

36 McInerny PA 2005, Special Commission of Inquiry into the Waterfall Rail Accident, Final Report, Volume 1.

37 Phase: an expression of relative time difference between or among AC voltages having the same frequency.

38 Phase to phase: the voltage measured between two single phase feeds, i.e. between the contact and feeder wires.

39 Phase to neutral: the voltage measured between a single phase feed and the unpowered neutral, i.e. between either the contact wire or feeder wire, and the return rail.

The regulation stated that a person 'comes within an unsafe distance of an overhead electric line if the person is within the exclusion zone'. An untrained person was a person who was not technically proficient or experienced with the OHLE. Train drivers and emergency services personnel would generally be classified as untrained persons.

In instances where exclusion zones were not reasonably practical to achieve, the regulation allowed an organisation to reduce the distance after a risk assessment and control measures had been implemented. For the purposes of a vehicle operated by untrained persons, QR advised the ATSB that its nominated exclusion zone was 300 mm, accounting for arc distance and a safety margin.

In other words, if the rolling stock or anything being carried by the rolling stock was within 300 mm of the OHLE, then it was within an unsafe distance. Accordingly, an exclusion zone then applied to the rolling stock, such that an untrained person could not approach within 3,000 mm of the rolling stock. A person who was still on the rolling stock from before it entered the exclusion zone was still in effect in a safe place. However, if they attempted to leave the rolling stock, they would be entering an exclusion zone. Appendix A – Dangers associated with high voltage overhead line equipment (OHLE) in dewirements provides further details of the hazard associated with OHLE following dewirements, including touch potentials (a person touching the ground and the rolling stock) and a step potential (a person being in close proximity to the rolling stock with both feet on the ground).

In the case of the 18 August 2018 dewirement, as the rear end wall of the top nested flat rack extended into the 300 mm exclusion zone associated with the rolling stock, the end wall and train YC77 were subject to an exclusion zone for untrained persons of 3,000 mm.

As noted in *Network control centre procedures during OHLE emergencies*, QR procedure MD-11-33 prohibited entry to exclusion zones until the high voltage OHLE was electrically safe, by being de-energised, isolated, tested and earthed. More specifically:

- De-energised: the opening of high voltage circuit breakers, either automatically by excess current or manually by the ECO, to disconnect electrical energy. This did not guarantee the electrical energy had been discharged from the OHLE.
- Isolated: the opening and, lock and tag out of isolation switches, to disconnect all possible sources of electrical energy to the section of OHLE, including by unintentional energisation. This was performed by the nominated person in the field.
- Tested: confirmed the isolated section of OHLE had been de-energised. This was performed by the nominated person in the field.
- Earthed: the isolated section of OHLE was connected to the general mass of the earth, to ensure discharge of any residual energy. This ensured the OHLE could not be made live from external sources, for example, other live wiring. This was performed by the nominated person in the field.

Once earthing was confirmed, the nominated person could issue a Form C (*Permit to work*) to an authorised person. It was at this point that the section of high voltage OHLE nominated on the Form C was considered electrically safe, allowing entry to the exclusion zone.

In the case of the 18 August 2018 dewirement, the OHLE was de-energised at 2101, just prior to the dewirement. The nominated person issued the first Form C at 0300 the morning after the dewirement. The QR commander delegated the receipt of Form C from the nominated person to the accompanying rail operations response unit (RORU) officer, who was also qualified as an authorised person.

Instruction and training of OHLE dangers for QR personnel

QR provided general guidance regarding the hazards associated with OHLE in various procedures and other documents. In addition to MD-11-33, this included the MD-14-36 (*General appendix*) and MD-10-191 (*Electric traction systems*) manuals. The general instructions section of the general appendix stated:

> All employees and contractors shall constantly bear in mind the ever present danger of electrocution from the high voltage overhead line equipment in electrified areas. It is dangerous for anyone to touch, or to come into close proximity of, live overhead line equipment.
>
> Similarly it is dangerous to allow any object to touch or to come close to live equipment.
>
> Note: Always treat overhead line equipment as live until it has been ascertained that the equipment has been made safe for persons to approach or to come into contact with it.

Although the documents used by network control personnel and other operational personnel provided guidance regarding the 3,000 mm (or 3 m) exclusion zone between a person and OHLE, none of the documents provided clear guidance on the additional aspect of the 300 mm exclusion zone between a vehicle and OHLE.

NCOs completed OHLE safety training, including TLIF2080 (*Safely access the rail corridor*), when initially appointed to their position. This unit of competency was reassessed as part of periodic NCO competency reassessments. TLIF2080 training included dangers associated with objects in close proximity to OHLE, but did not provide an indication of a safe gap distance between rolling stock or objects on rolling stock and the OHLE. NCO duties did not include in-field operations.

QR commanders completed authorised person training, which allowed them to receive a Form C when OHLE was made electrically safe. Authorised person training included dangers associated with objects in close proximity to OHLE, but did not provide an indication of a safe gap distance between rolling stock or objects on rolling stock and the OHLE.

Instruction and training of OHLE dangers for train crew

Aurizon advised that the driver of YC77 completed OHLE safety training in January 2014, as part of the nationally-recognised unit of competency TLIF2080C (*Safely access the rail corridor*), while based in Geraldton, Western Australia. There was no OHLE fitted in Geraldton. Although the training included dangers associated with objects in close proximity to OHLE, it did not provide an indication of a safe gap distance between rolling stock or objects on rolling stock and the OHLE.

A review of the driver’s last reassessment of competence found a single question in relation to OHLE safety during a dewirement emergency. In addition, the driver operated diesel locomotives only, which did not rely on OHLE for traction purposes. The driver reported never having been in a dewirement occurrence before.

Although Aurizon drivers did not work for QR, they were required to follow QR procedures while operating a train on the QR network. The driver of YC77 was aware QR documents were available on Aurizon’s iN-Gauge intranet service, but was not sure which document contained the OHLE emergency procedures. There was no computer access available on board YC77. Therefore, the driver did not have access to enable referral to the procedure at the time of the emergency response.

Recognition of OHLE danger presented by extended flat rack end wall

During interviews after the dewirement, it was apparent that almost all network control centre personnel handling the emergency response, the QR commander and the driver of YC77 did not recognise the hazard associated with the extended end wall of the flat rack being close to the OHLE. The general belief was that OHLE dangers were limited to the site of the actual dewirement at Cooroy, about 3 km behind where YC77 stopped. As the OHLE was still erect above YC77, most personnel on the evening of the accident felt it was in a safe state.

Driver only operations information

General

Driver only operations (DOO) was a train crewing configuration where a single driver operated the train without the presence or assistance of any other on-board personnel.

On the QR network, Aurizon operated DOO services between Acacia Ridge and Townsville on the North Coast Line (1,353 km), Fisherman Islands and Ebenezer on the West Moreton system (79 km), and Stuart and Mount Isa / Phosphate Hill on the Great Northern Railway (1,032 km). Further, on its own network, Aurizon advised it operated DOO services between the nearest depot and ports on the Moura, Blackwater, Goonyella and Newlands coal systems.

The Queensland *Work Health and Safety Regulation 2011,* and an accompanying Code of Practice,[40] required that the movements of remote or isolated workers[41] be monitored, including ensuring adequate communication methods were maintained.[42] Train drivers in a DOO configuration would generally be classified as remote or isolated workers. The purpose of these requirements was to ensure timely assistance in the event of an emergency or incapacitation.

QR emergency procedures for driver only operations

The North Coast Line was subject to open access by third party operators. A formal access agreement and interface risk management plan (IRMP) arranged access by Aurizon on QR's network. The IRMP detailed interface risks and resultant controls between QR as the rail infrastructure manager[43] and Aurizon as the rolling stock operator.[44] QR provided Aurizon access via a customer portal to all relevant sections of QR's SMS, in connection with the risk controls nominated in the IRMP. Aurizon arranged access to QR documents for its personnel via its own intranet system 'iN-Gauge'.

According to the QR IRMP, risks to drivers trackside when in a DOO configuration were to be managed in accordance with the DOO emergency procedure within QR's MD-14-36 (*General appendix*). The procedure stated that when a train had been stopped due to an accident, obstruction or exceptional circumstances, drivers would secure their train from uncontrolled movement, and complete form MD-15-457 (*Authority for driver only rail traffic driver to leave locomotive*) with the NCO prior to leaving the locomotive cabin to investigate the nature of the problem. The procedure also stated:

> Instructions must not be given to the rail traffic driver to take any action that could affect his/her personal safety or the safety of the train.

QR introduced form MD-15-457 in November 2015 (replacing an earlier form, no. 22513). The form required the driver and NCO to describe the details of the train, the location and the situation and agreed reporting times (to ensure effective communication was maintained with the driver at all times they were outside the locomotive cabin). A maximum reporting interval of 15 minutes was nominated by the DOO procedure. In the event of a loss of communication, the NCO was to assume an emergency existed and immediately arrange assistance (for example, from emergency services).

Aurizon emergency procedures for driver only operations

Aurizon's procedures stated that, in the event of an emergency, drivers were to refer to emergency checklist 16-FRM-012-COM (*Duty card train crew*) for immediate actions, including when vacating a locomotive cabin. There was no reference to the DOO procedure or requirements on the duty card.

Aurizon drivers carried an on-the-spot risk assessment tool called *Stop! Take time and switch on*. This tool was used to identify hazards and control risks, prior to performing an unusual or non-routine task, for example, vacating a locomotive cabin at an unusual location. Aurizon advised

---

40 *Managing the work environment and facilities,* Code of Practice, 2018.

41 Remote or isolated workers were those that performed work isolated from the assistance of other persons due to the location, time or the nature of the work.

42 The Code of Practice specifically excluded mobile phones as a method of communication due to unreliability of signal.

43 Rail infrastructure manager (RIM): a person who has effective control and management of the rail infrastructure (e.g. track, signalling, OHLE and supporting components). Source: *Rail Safety National Law 2012*, s. 4.

44 Rolling stock operator (RSO): a person who has effective control and management of the operation or movement of rolling stock on rail infrastructure (e.g. locomotives and wagons). Source: *Rail Safety National Law 2012*, s. 4.

that, although this tool had a supporting instruction, this instruction was withdrawn following the 18 August 2018 dewirement.

Although form MD-15-457 contained a 'situation report' section, neither it, nor QR's DOO emergency procedure, required an on-the-spot assessment of hazards and control of risks prior to the locomotive cabin being vacated.

Access to relevant procedures and forms

In order to be able to complete form MD-15-457, hard copies needed to be provided in the locomotive cabin. No forms were stored on train YC77.

Access to Aurizon's duty card, QR's DOO procedure and form MD-15-457 were limited to Aurizon's iN-Gauge intranet service. There was no computer access available on board YC77. Therefore, the driver did not have access to these documents at the time of the emergency response, or any time while undertaking driving duties.

The driver reported not having seen form MD-15-457 before, instead referencing the older form (*no. 22513*), which was withdrawn almost 3 years previously. The driver was aware QR documents were available on Aurizon's iN-Gauge intranet service, but was not sure which document contained the DOO procedure.

Application and knowledge of DOO emergency procedures

Based on a review of recorded voice communications, neither the driver of YC77 nor multiple NCOs followed QR's DOO procedure during the emergency response. The driver of YC77 left the locomotive cabin on five occasions during the emergency response (two in the absence of any other personnel), without completing form MD-15-457. The NCO was not advised on all occasions, no agreed report back times were agreed and, a mobile phone was used as the method of communication.

During interview, it was found that knowledge of the DOO procedure was well known among network control centre personnel. Some personnel noted that it was difficult to identify if a train was operating in a DOO configuration. However, based on a review of recorded voice communications, there was no evidence that the driver of YC77 or the NCOs discussed the type of crewing arrangement during the emergency response.

Although the DOO procedure was included in initial NCO training, it was not contained within the NCO periodic reassessment of competency. Of the network control centre staff interviewed, one had seen a DOO form, and another two advised not having issued such a form for more than 10 years.

The driver reported being aware of the QR DOO procedure, but could not recall being trained in its use. Periodic driver reassessments of competence did not contain the DOO procedure. The driver further advised of not having been in a situation requiring its use in almost 5 years.

Driver only operations on the Aurizon network

During investigation, the ATSB found that both Aurizon and third party operators operated DOO services extensively on the Aurizon owned network in Queensland. As a rail infrastructure manager, Aurizon was required to provide third party operators with access to relevant sections of its SMS documents, which controlled risks while operating on its network. Although referenced within the Aurizon risk assessments, the ATSB found that no DOO procedure existed for the Aurizon owned portion of the North Coast Line.

In November 2015, when QR made changes to the DOO form in use on its network, Aurizon issued an advice notice to staff advising of QR form *no. 22513* being replaced by QR form MD-15-457. In addition, Aurizon (with the withdrawal of form *no. 22513*), elected to adopt an existing form (SW12, which was used for a variety of purposes), to be used when operating DOO on its own network. This advisory notice was withdrawn from circulation on 19 February 2016.

Despite changing to a different DOO form on the Aurizon network, Aurizon advised that no documents within its SMS were altered to reflect this change.

To ensure correct implementation of the altered DOO procedural form requirements on both the QR and Aurizon networks, Aurizon recommended follow-up inspections and auditing of the process. Aurizon could not provide evidence this had occurred.

Safety analysis

Introduction

Aurizon freight train YC77 departed Acacia Ridge Intermodal Terminal with one of its wagons containing a stacked nest of three empty flat racks. During its journey, the rear collapsible end wall of the top flat rack extended upwards (reaching a height of about 4,845 mm). The top of this end wall impacted the underside of the Elm Street overbridge (a height of 4,816 mm), just prior to Cooroy Station, and pulled down overhead line equipment (OHLE). The dewirement resulted in a significant amount of damage to 1.3 km of OHLE, and the consequences could have been much worse had passengers been on the Cooroy Station platform at the time of the accident.

Analysis of closed-circuit television (CCTV) footage, OHLE circuit breaker trips and related information determined that the rear end wall very likely raised upwards at some point between 118.782 km and 119.613 km, and then remained in the extended position until hitting the Elm Street overbridge (130.750 km).

YC77's data logger indicated that the train's speed was consistently between 75 and 80 km/h for an extended period immediately prior to the rear end wall of the flat rack extending upwards. It is therefore likely that running at this speed for an extended period eventually resulted in the unsecured rear end wall raising from passing wind resistance, assisted by the flat rack's leaf spring raise-assist design. There was no evidence that the driver's actions on approach to Cooroy Station, problems with the serviceability of the train or excessive wind conditions contributed to the accident.

This analysis focuses on the loading and securing of the flat racks on YC77 and reasons why the load was not effectively secured. In addition, it considers the control of hazards at the accident site following the dewirement and aspects associated with driver only operations (DOO) procedures.

Loading and securing of freight

Delivery of flat racks to Aurizon

The freight forwarding company advised the rolling stock operator 4 days prior to the accident that a set of four flat racks were to be delivered for rail transport and that the end walls of the nest of three flat racks were secured by use of chains.

Based on CCTV evidence, the ATSB identified that neither of the end walls on the top flat rack on the nest of three were strapped or chained when delivered, as required for rail travel. The ATSB's inspection after the dewirement found no evidence that chain or straps had been in place at either end of the flat rack to provide an additional means of restraint. In addition, the ATSB identified that the twist locks to lock the end walls of the top two flat racks in the down position were not engaged, and given the condition of the twist locks it is unlikely they had been locked for some time. It also seems very unlikely that the twist locks could have moved during transit, or that anyone would have unlocked them prior to transit.

In summary, the nested set of three flat racks were delivered to the Acacia Ridge terminal without the collapsible end walls of the top nested flat rack being secured for rail travel. The ATSB did not examine the reasons why the flat racks were delivered in an unsecured state, instead focussing on the controls the rolling stock operator had in place to ensure the security of loads on its train.

Inspection of flat racks during delivery and loading

According to Aurizon's procedures, securing of the end walls of any flat racks travelling as freight were to be checked twice prior to the departure of a train. The terminal coordinator was required to check the flat racks when they were first delivered, and the pinners were required to check the security of any loads (including flat racks) after they had been loaded onto a wagon.

In this case however, the terminal coordinator did not check the securing of the flat racks on arrival at the terminal and, consequently, the flat racks were loaded onto YC77 in an unsecured state. The terminal coordinator (and another person who sometimes acted in the role) advised they were not aware of the requirement to inspect loading from external freight forwarding companies.

Similarly, the pinners did not check for the absence of chains or web strapping during the securing inspection, and consequently the flat racks departed Acacia Ridge in an unsecured state. Personnel who performed this task stated they believed checks during pinning were limited to ensuring any provided securing was tight, rather than checking what securing was absent (such as straps or chains). However, the investigation could not determine the exact reasons why the twist locks on the top two nested flat racks were not identified as disengaged during the securing inspection. The twist locks on the top flat rack would have been almost 3 m above the ground, but the position of the handles (which indicated whether the twist locks were engaged) should still have been visible from the ground.

Unusual load responsibilities and access to guidance material

The terminal coordinator and pinners' limited understanding with regard to their responsibilities for checking unusual loads highlighted issues relating to training and continued competency assessments in the roles.

Aurizon was unable to provide evidence that the terminal coordinator or another person who had performed that role had received training in the instructions for the terminal coordinator role. Although one of the pinners and the heavy forklift driver had received training in the work instruction for pinning, that work instruction provided limited detail regarding what type of checks of unsecured loads were required and it did not refer to the relevant checklists.

These personnel had received the on-line loading and securing of freight training course, which provided extensive complex instruction on securing of unusual loads. However, it was conducted up to 14 months previously for some personnel. All interviewed personnel advised that flat racks were rarely encountered at the Acacia Ridge terminal. As any such instructions were rarely used, it was likely their accurate recall was diminished by the time they were required to be used.

Issues with knowledge of flat rack securing requirements had been identified after two previous accidents involving inadequate securing of unusual loads. Although Aurizon had recommended that staff undertake further theory and practical training, this training had not occurred prior to the 14 August 2018 dewirement.

In addition to the effectiveness of the training, the ATSB also identified problems related to access to relevant guidance material. Given the low frequency that each type of unusual load was encountered, ready access to checklists or other guidance material would help ensure familiarisation with the relevant procedures at the relevant time. Although Aurizon provided access to manuals, instructions and checklists through its intranet site 'iN-Gauge', this was problematic for several reasons:

- The *Loading and securing of freight manual* (07-STD-022-SWK) contained 242 pages, with instructions to secure empty flat racks appearing on one page within a number of other instructional dot points. This limited the ability to source relevant information quickly and easily.
- Although checklists for unusual loads were available on-line, and referenced in the work instruction for inspecting incoming loads, Aurizon stated they were not readily available in hard copy. As such, each time a pinner encountered an unusual load, and wanted to refer to guidance material, they would have been required to return to the office, find and print a checklist and recommence a train inspection. This was unlikely to occur.
- As already noted, the work instruction for train pinning did not refer to the available checklists for checking unusual loads. In addition, personnel who performed that role reported they were not aware any guidance documentation existed.

Therefore, based on the available evidence, the ATSB found that Aurizon did not have an effective system in place for ensuring personnel required to check the securing of unusual loads (such as empty flat racks) prior to departure had sufficient knowledge of their responsibilities, and had ready access to relevant procedures, guidance and checklists. Had these problems been addressed, it is likely that the checking of unusual loads would have been more effective.

Electric control information anomalies

YC77 departed Acacia Ridge at 1749, and the first indication of a problem to the rail management centre occurred at 2048 when the first OHLE circuit breaker trip occurred. The dewirement did not occur for another 14 minutes. Accordingly, the ATSB considered the potential opportunity for the problem with YC77's load to have been detected during this period prior to the dewirement.

In non-high risk areas such as Yandina to Cooroy, the electric control operator (ECO) could reset OHLE circuit breaker trips after 1 minute, after reviewing all available information. Provided the reset OHLE circuit breaker remained closed, no further action was required. During the event sequence, the ECO reset two separate occurrences of OHLE circuit breaker trips. The third occurrence, 13 minutes after the first, was not reset. Although these three OHLE circuit breaker trips occurred on the same electrical section, the information presented to the ECO to assist decision making was conflicting and ambiguous. More specifically:

- The driver of YC77 reported observing nothing unusual after the first OHLE circuit breaker trip.
- The fault locator (which may be inaccurate) did not operate for the second OHLE circuit breaker trip. Therefore, the location of this trip was unknown, encompassing a 50 km section of track on which three trains were operating.
- During each of the first two OHLE circuit breaker trips the circuit breaker reset held closed, suggesting there was not a persistent fault (which would have provided a more obvious indication of an over-dimensional load).
- Until the dewirement, multiple track circuit occupied indications (which are occasionally associated with OHLE traction faults) were either not near the location of YC77, or they did not coincide with OHLE circuit breaker trips.
- OHLE circuit breaker trips on the North Coast Line were not uncommon and were often attributed to wildlife and tree branches touching the OHLE.

With consideration of the available information during the sequence of events leading up to the dewirement, the ECO followed the correct procedure, with no firm indication until after the third OHLE circuit breaker trip that YC77 was the probable reason for the observed indications.

Post-dewirement response

Entries into an exclusion zone

High voltage electricity is a significant hazard, and a primary risk control to ensure safety prior to the equipment being made electrically safe is the implementation of exclusion zones. In relation to QR's OHLE, the following exclusion zones applied for untrained persons (such as train crew):

- 3 m between an untrained person and the overhead line
- 3 m between an untrained person and the train and objects on the train if an object was within 300 mm of the overhead line.

Exclusion zones applied at two locations following the dewirement at Cooroy. The first was in the Cooroy Yard precinct, in the area of the actual dewirement. The second was near where YC77 stopped. As the end wall of the top nested flat rack extended within 300 mm of the OHLE, the train was subject to an exclusion zone of 3 m.

In this case, the actual risk around the train was relatively low as the OHLE had been de-energised. However, the OHLE had not been made electrically safe, and there was the potential for the OHLE to be inadvertently re-energised by the ECO, dewired OHLE contacting external supply authority lines, or an electric train entering into the de-energised electrical section from an adjacent live section. In the case of the latter, an electric passenger train was scheduled to enter the de-energised electrical section 9 minutes after the dewirement.

If the OHLE had been re-energised, the likelihood of arcing over a 210 mm air gap was also relatively low. However, initially no-one knew the exact nature of the problem. It is acknowledged that in circumstances of an OHLE circuit breaker trip of an unknown cause, with no immediate indication of a problem, it is impractical to not allow an external inspection of the OHLE by train crew prior to the OHLE being made electrically safe (assuming the train crew first conduct an inspection from their cab prior to leaving the train). However, in this instance there had been sufficient evidence to indicate either a dewirement or, at the very least, some part of YC77 had been intermittently contacting the OHLE. The distance from that object to the contact wire after the train stopped, or the extent to which the train had pulled down wire close to where it had stopped, was unknown.

Therefore, even though the actual level of risk (determined after the emergency response) was relatively low, during the emergency response the risk level was unclear and the situation should have been treated as if there was a genuine level of risk. Accordingly, no-one should have approached the train (or exited the train) until the applicable exclusion zone could be determined or until the OHLE at that location had been made electrically safe (that is, de-energised, isolated, tested and earthed). The extent of the damage was not determined until an OHLE linesman inspected the area about 2 hours after the dewirement. The process to make the OHLE electrically safe around the train was not completed until 6 hours after the dewirement occurred.

Initially the driver entered the exclusion zone by exiting the locomotive to conduct an inspection of the train, under instruction from a network controller officer (NCO) and before the police had advised that wires had been pulled down. After the driver sighted the extended end wall, the exact distance of the gap between the end wall and the contact wire was still unknown. When inspected from the ground at night, it would have been difficult to estimate the gap accurately. The prudent course of action at that stage would have been to assume the end wall was within 300 mm of the OHLE, and therefore an exclusion zone of 3 m applied around the train.

The ATSB determined that the driver of YC77 and other train crew then entered this exclusion zone on multiple other occasions before the OHLE was made electrically safe. More specifically:

- the driver proceeded to a location to improve mobile phone data reception and send photos to the rail management centre
- the driver met with a protection officer, associated with an unrelated track closure
- the driver undertook post-accident drug and alcohol testing with the Queensland Police Service
- the driver accompanied the QR commander and other personnel while they inspected the train
- the driver changed with a relief driver.

The ATSB could not determine if the police, QR commander or other personnel also entered the exclusion zone associated with YC77 while interacting with the driver.

Recognition of the risk associated with dewired OHLE

During an OHLE emergency, the NCO was required to advise the OHLE status to train crew and onsite personnel. A report to the network control centre confirming there had been a dewirement at Cooroy and possible OHLE contact with YC77 was received 9 minutes after the dewirement occurred. That information was not passed to the train driver for a further 9 minutes, after an NCO had already instructed the driver to leave the locomotive and inspect the train and OHLE for damage. At no stage during the emergency response was the driver advised that, although the OHLE was de-energised, it was still not electrically safe.

These omissions of key actions appeared to be associated with limited recognition that a potential problem existed at the train, and problems with the coordination of actions between multiple network control personnel.

In terms of the limited recognition of the potential risk, the general belief of interviewed personnel was that OHLE dangers were limited to the site of the actual dewirement at Cooroy, about 3 km behind YC77. The fact that there was known to be significant damage to the OHLE at Cooroy may have focussed their attention on that area. There was limited expectation that a problem could also exist where the train was located, even though it was recognised that the train may have had an object that had been contacting the OHLE.

Although training for the driver of YC77, NCOs and QR commander included dangers associated with objects in close proximity to OHLE, due to the danger of arcing, it did not provide an indication of the appropriate safe gap distance in this situation (that is, 300 mm). This limitation in the training materials may have reduced their ability to recognise the danger posed. Nevertheless, a conservative approach should have determined the gap was problematic, even if the safe gap distance was unknown.

Co-ordination of network control activities post dewirement

In terms of the coordination of actions during the post-dewirement response, there was no single assigned person who was in charge of coordinating activities and managing the ongoing issues as they related to the dewired high voltage OHLE. Although it is not unusual for tasks to be conducted by multiple personnel in an emergency, in this instance the allocation of tasks appeared to rely on an informal division of tasks, teamwork and previous experience.

This resulted in a situation where the UTC 7 NCO, who was responsible for managing YC77, was conducting a number of tasks involving other trains. Meanwhile, at least two other NCOs communicated with and provided instructions to the driver of YC77, including an instruction to inspect the train, without the knowledge of the UTC 7 NCO.

One means of ensuring an effective response is having very clearly defined roles, responsibilities and required actions for different personnel. A review of procedural documentation found that allocation of safety critical tasks during OHLE emergencies was not clear, particularly in relation to the roles of NCOs on neighbouring workstations, relief NCOs and the train control leaders (TCLs). It is recognised that emergencies can take many forms and procedures need to have some flexibility regarding the specific roles of each position in any specific emergency. Nevertheless, ensuring that one person is coordinating all the required actions and ensuring they are completed is essential.

Another means of ensuring an effective response is the use of checklists. Although a mandatory checklist for OHLE emergencies applied for the day of operations coordinator (DOOC) and TCL, this was of limited safety value, as it dealt more with stakeholder management aspects. QR had recently developed a second checklist that summarised NCO responsibilities during an OHLE emergency, which was underpinned by a number of standards, procedures and instructions. It included three entries related to advising electrical safety status to onsite personnel. This checklist was not used or referred to by the UTC 7 NCO or other personnel, and QR advised that its use was optional.

Emergency responses can involve high workload, distractions and interruptions, time pressure, ambiguous sets of information and stress. There can be many different tasks and objectives to achieve, and many people involved in gathering information and conducting the required actions. Such environments provide an ideal opportunity for omission errors to occur. As Hales and Pronovost (2006) explain, cognitive function can be compromised under stressful conditions, particularly in complex, high-intensity environments (such as a network control centre). These authors noted that checklists have the capacity to summarise masses of information that need to be recalled rapidly under challenging circumstances.

Reason (1990) also noted the potential for omission errors associated with the limitations with prospective memory, where an intended task can be forgotten during the interval between intention to perform the task and its execution (due to interruptions or competing priorities). He further noted checklists can assist in reducing these error types when under stressful conditions, such as an emergency response, by acting as a memory aid, thereby ensuring all required steps are completed.

Similarly, it is worth noting that the RISSB guideline document *Rail emergency management planning* stated:

> Maintaining ‘quick references’ is recommended to support response and recovery. In the initial onset/identification of the emergency, Procedures or Action Cards and Checklists should detail immediate and important actions to help workers at all levels perform effectively.

There are two types of checklists that are useful in this regard. The first is ‘read-do’, where the checklist item is read and the action performed, which is particularly useful when performing an infrequent task (Dismukes and Berman 2010). The second is ‘flow-then-check’, where a number of actions are performed from memory, then verified as completed through a checklist. As such, there are two opportunities for ensuring the required procedure has been followed (Dismukes, Berman and Loukopoulos 2007).

Due to the benefits of checklists during an emergency response, the Australian *Manual of Air Traffic Services*,[45] used by both civil and military air traffic control, includes a series of checklists for controllers to use when responding to in-flight emergencies. The manual stated that on notification of the emergency, the checklist actions were to be initiated and the checklist items were to be continually reviewed to ensure all actions had been completed.

QR are to be commended for developing a checklist for NCOs to use for responding to an emergency. However, not making its use mandatory, or ensuring that NCOs continually refer to the checklist during an emergency response, provided a missed opportunity to capture important errors of omission.

Driver only operations procedures in an emergency

Another set of emergency response procedures that should have been applied on this occasion related to driver only operations (DOO). These procedures required that, before a driver left the locomotive following an accident or similar event, they would discuss the situation with network control and establish a report interval.

The DOO procedures were generic in nature and did not require discussion of OHLE safety specifically. However, if the procedures were formally applied, they provided an opportunity for a driver and network control personnel to consider the situation and relevant hazards.

In the case of the 18 August 2018 dewirement, multiple NCOs and the driver did not follow QR’s DOO procedure for leaving the locomotive cabin. On the five occasions that the driver left the locomotive during the emergency response, not all were advised to the NCO. Of those that were, no report back time was agreed or appropriate method of communication formalised.

In terms of potential reasons why the procedure was not followed:

- Queensland Rail (QR) provided access to their DOO and OHLE emergency procedures to Aurizon, via a customer portal. Aurizon arranged personnel access to these via its intranet system ‘iN-Gauge’. However, no computer access to the iN-Gauge intranet was available on board YC77. Therefore, the driver was unable to access these procedures and associated forms in an emergency, when required for use.
- The driver of YC77’s recollection of the DOO procedure was incomplete, having not referred to it for almost 5 years. Where memory of procedures is degraded, ready access to procedural documentation is important to ensure they are followed.
- Aurizon provided a duty card in the form of an emergency checklist for drivers in the event of an emergency. However, a hard copy was not provided and there was no reference within the on-line checklist to the DOO procedure or requirements.

---

[45] Manual of Air Traffic Services (MATS): MATS is a joint document of the Department of Defence (Defence) and Airservices Australia (Airservices) and is based on the rules published in the Civil Aviation Safety Authority Civil Aviation Safety Regulations Part 172 – Manual of Standards (MOS) and the International Civil Aviation Organization (ICAO) standards and recommended practices, combined with rules specified by Defence and Airservices.

- Aurizon provided a hard copy on-the-spot risk assessment tool for drivers to use prior to performing a non-routine task, for example, an unplanned exit of the locomotive cabin. There was no reference to the DOO procedure or requirements within this tool.
- Although network control centre personnel knew of the DOO procedure, it was rarely used. The NCOs also were not aware of the crewing arrangements on board YC77, although this could have been clarified in the initial communications with the driver after the train had stopped.
- In summary, Aurizon did not provide drivers with ready access to QR's DOO procedures for when they were operating on the QR network. The same problem applied with access to QR's OHLE emergency procedures. Limited access, knowledge of existence and supporting document prompts to follow for the DOO and OHLE procedures increased the likelihood of these procedures not being followed during the emergency response. In the case of the DOO procedure, this increased the risk that, had the driver of YC77 required emergency assistance, there may have been a significant delay in recognition and response.

In addition, there was no procedural document for DOO on the Aurizon-controlled section of the North Coast Line. A number of rolling stock operators, including those that also operated DOO services, accessed this track. As such, although Aurizon had adopted a generic form for DOO on its network in November 2015, there was no underlying procedure to instruct its use, or emergency procedures to be followed, in the event of a DOO train emergency.

Findings

From the evidence available, the following findings are made with respect to the dewirement involving freight train YC77 that occurred at Cooroy, Queensland on 18 August 2018. 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

- As freight train YC77 approached Eumundi, the rear collapsible end wall of the top nested flat rack raised up, resulting in multiple arcs and contacts with the overhead line equipment, which ultimately resulted in the dewirement at Cooroy.
- The nested set of three flat racks and a single flat rack were delivered to the Acacia Ridge Intermodal Terminal without the collapsible end walls of the flat racks being secured for rail travel.
- Personnel at the Acacia Ridge Intermodal Terminal did not check the collapsible end walls of the flat racks were secured on arrival at the terminal and after the flat racks were loaded onto freight train YC77, and the train departed without these end walls being secured.
- **Aurizon did not have an effective system in place for ensuring personnel required to check the securing of unusual loads (such as empty flat racks) prior to departure had sufficient knowledge of their responsibilities, and had ready access to relevant procedures, guidance and checklists. [Safety issue]**
- Although the electric control operator was provided with indications of overhead line equipment faults in the minutes prior to the dewirement, the pattern of information presented was ambiguous and did not enable the reason for the trips to be easily identified.

Other factors that increased risk

- On multiple occasions following the dewirement, train crew accessed the exclusion zone associated with the close proximity of the extended end wall of the flat rack to the overhead line equipment, prior to the wires being isolated and earthed on site.
- Multiple personnel did not recognise the potential risk associated with part of YC77 being very close to the OHLE after it stopped. In addition, network control centre personnel did not advise train crew of the status of the OHLE during the emergency response period.
- **Queensland Rail did not have an effective process in place to ensure that safety-critical actions were co-ordinated and completed when multiple network control officers were involved in responding to an overhead line equipment emergency. [Safety issue]**
- Following the dewirement, the driver and network control officer did not follow required protocols for driver only operations prior to the driver leaving the locomotive cabin.
- **Aurizon did not provide drivers with ready access to Queensland Rail’s procedures for driver only operations and overhead line equipment emergencies when they were operating on the Queensland Rail network. In addition, Aurizon did not have procedures for driver only operations that applied to its own network. [Safety issue]**

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.

Unusual loads responsibilities and guidance material

Safety issue description

Aurizon did not have an effective system in place for ensuring personnel required to check the securing of unusual loads (such as empty flat racks) prior to departure had sufficient knowledge of their responsibilities, and had ready access to relevant procedures, guidance and checklists.

Issue number:	RO-2018-011-SI-01
Issue owner:	Aurizon
Transport function:	Rail: Freight
Current issue status:	Open - Safety action pending
Issue status justification:	To be advised

Proactive safety action taken by Aurizon

Action number:	RO-2018-011-NSA-035
Action organisation:	Aurizon
Action status:	Monitor

In December 2018, with updates provided in January 2020 and August 2020, Aurizon advised it had taken the following safety action:

- updated the checklist for nested flat racks
- implemented further work instructions related to restraint requirements and acceptance for travel of flat racks
- retrained all staff involved in the occurrence.

In addition, Aurizon advised it was undertaking an upgrade of its safety management system (SMS) to enable the mobility of access to relevant documents for operational personnel, including personnel responsible for loading and securing loads on trains. The estimated completion date for this project is January 2021.

ATSB comment

The ATSB acknowledges the proactive safety action of Aurizon in developing further guidance materials and training for staff in relation to loading and securing requirements of flat racks. In relation to mobility of access to Aurizon's SMS for operational personnel, the ATSB will seek updates on the progress of this project to address this issue on a regular basis.

Access to QR procedures and existence of Aurizon documents

Safety issue description

Aurizon did not provide drivers with ready access to Queensland Rail's procedures for driver only operations and overhead line equipment emergencies when they were operating on the Queensland Rail network. In addition, Aurizon did not have procedures for driver only operations that applied to its own network.

Issue number:	RO-2018-011-SI-02
Issue owner:	Aurizon
Transport function:	Rail: Freight
Current issue status:	Open - Safety action pending
Issue status justification:	To be advised

Proactive safety action taken by Aurizon

Action number:	RO-2018-011-NSA-036
Action organisation:	Aurizon
Action status:	Monitor

In December 2018, with updates provided in January 2020 and August 2020, Aurizon advised it was undertaking an upgrade of its safety management system (SMS) to enable the mobility of access to relevant documents for operational personnel, including to third party rail infrastructure manager documents. The estimated completion date for this project is January 2021.

Within the rail emergency plan, there is a specific *Train crew duty card* (16-FRM-012-COM). Following the 18 August 2018 dewirement, all intermodal train crew were sent a memo with a refresh regarding the availability and use of the duty card. This memo included the instruction:

> These Duty Cards are being rolled out as a physical hard copy on all 2800 locomotives, also made available at sign on locations and will be affixed to train lists. In the event you are involved in an emergency situation, please refer to the Train Crew Duty Card as a checklist that can referred to…

In addition, in January 2020 with an update provided in August 2020, Aurizon advised it was in the process of drafting procedures for driver only operations (DOO) on its network, particularly focussing on procedures for exiting the locomotive cabin. The draft procedure is expected to be implemented in November 2020. Reference to the DOO procedure within 16-FRM-012-COM and Aurizon's on-the-spot risk assessment tool (*Stop! Take time and switch on*) is also being considered within this process.

ATSB comment

The ATSB acknowledges Aurizon's intent to implement a DOO procedure on its network, in addition to a review of supporting documents. In addition, the ATSB acknowledges Aurizon's current project to enable mobility of access to Aurizon's SMS for operational personnel. The ATSB will seek updates on the progress of both these projects on a regular basis.

Process for co-ordinating network control activities during an emergency response

Safety issue description

Queensland Rail did not have an effective process in place to ensure that safety-critical actions were co-ordinated and completed when multiple network control officers were involved in responding to an overhead line equipment emergency.

Issue number:	RO-2018-011-SI-03
Issue owner:	Queensland Rail
Transport function:	Rail: Operations control
Current issue status:	Open - Safety action pending
Issue status justification:	To be advised

Proactive safety action taken by Queensland Rail

Action number:	RO-2018-011-NSA-037
Action organisation:	Queensland Rail
Action status:	Monitor

In July 2020, in response to the draft ATSB report, Queensland Rail (QR) advised:

> Post this incident occurring, Queensland Rail has re-enforced the understanding of the contents of the mandatory checklist MD-17-486 [*OHLE Incident – DOOC and TCL incident and emergency tool*] with key Network Control employees and has scheduled an assurance activity for Quarter 2 of the 20/21 financial year to verify improvements and effectiveness in relation to use of this checklist…

Following further discussion with the ATSB, QR advised in August 2020:

> Queensland Rail took the decision to make the NCO [network control officer] emergency checklist [MD-17-482 (*NCO incident and emergency response tool*)] mandatory for Category A and Prescribed Incidents after reviewing ATSB feedback provided in July 2020. The NCO checklist is currently undergoing consultation and review for resultant incident categories, currency and workload. Once this review is completed, the Rail Emergency Response Module will be updated and issued. The updated information will be cascaded to relevant parties via email and prestart briefs. The DOOC/TCL [day of operations coordinator / train control leader] will be responsible for ensuring MD-17-482 is completed, which is linked to the Rail Emergency Response Module.

In addition, in relation to controller training, QR advised:

> In light of this particular incident Queensland Rail has subsequently developed “RMC Training: TT-04 Identifying Emergency Situations, OHLE”.
>
> This training material is designed to increase the ability of Network Control to respond to emergency situations where initial information is unclear and to heighten individual understanding of risks relating to OHLE, in particular re-enforcing the need to establish a 3m exclusion zone where an incident results in OHLE equipment being within 300mm of rollingstock until the OHLE has been de-energised, isolated and earthed.

This training was conducted in July 2020.

ATSB comment

The ATSB acknowledges the activities by Queensland Rail (QR) to address this safety issue. Although the activities to date have not specifically provided clearer descriptions of the roles of the various network control personnel in an emergency, the ATSB notes that QR is undertaking further work to revise its NCO checklist and Rail Emergency Response Module, and the ATSB will seek updates on the progress of QR's additional work to address this issue.

Safety action not associated with an identified safety issue

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

Additional safety action by Queensland Rail

In July 2020, Queensland Rail (QR) advised that it had taken the following proactive safety action in relation to driver only operations (DOO) on its network:

> Post this incident occurring, Queensland Rail has re-enforced the understanding of requirements relating to driver only operations and delivered training in this area to key Network Control employees. An assurance activity for Quarter 2 of the 20/21 financial year has been scheduled to verify improvements in this area.

This training was in the form of a tool box talk, delivered in March 2019, and included the DOO emergency procedures and issuance of form MD-15-457 (*Authority for driver only rail traffic driver to leave locomotive*).

In August 2020, QR also advised that it had:

> …issued an Important Safety Notice [ISN] to Rail Traffic Crew [train drivers and guards] addressing identifying emergency situations involving OHLE.

This ISN, issued in August 2020, advised train crew that in the event of an overhead line equipment (OHLE) issue, they were to:

- confirm the status of the OHLE with the network control officer (NCO)
- remain within the train and advise the NCO in the case of a suspected dewirement or high voltage earth alarm on the train
- if while inspecting a train an object or rolling stock was found to be within 300 mm of the OHLE, apply an exclusion zone of 3 m around the rolling stock, until the OHLE has been de-energised, isolated and earthed.

QR document MD-11-30 (*Rail Emergency Response Module EP1-01*), required that a comprehensive review / debrief be undertaken after an emergency on QR's network. This was to include all affected QR operational staff, with an invitation to attend extended to emergency services and a representative from the third party operator, in this case Aurizon. The purpose was to review the effectiveness and identify improvements in the emergency response and recovery process.

QR advised that it did not undertake a debrief after the Cooroy dewirement response. However, it noted that there were some informal discussions between network control personnel after the occurrence. In addition, QR advised that it typically did conduct debriefs for multi-agency emergencies, and provided examples of three other incidents in 2018-2019 where these occurred. It also advised that:

> Post this incident occurring, Queensland Rail has re-enforced the importance of a conducting a formal debrief for incidents involving multi-agency emergencies.

General details

Occurrence details

Date and time:	18 August 2018 – 2102 EST	
Occurrence category:	Accident	
Primary occurrence type:	Overhead line equipment dewirement	
Location:	Elm Street overbridge on southern approach to Cooroy yard, North Coast Line, Queensland	
	Latitude: 26º 25.191' S	Longitude: 152º 54.668' E

Train details

Track manager:	Queensland Rail	
Train operator:	Aurizon	
Train number:	YC77	
Type of operation:	Intermodal freight	
Consist:	1 x 2800 class locomotive, 32 x flat wagons	
Departure:	Acacia Ridge (Brisbane), Queensland	
Destination:	Portsmith (Cairns), Queensland	
Persons on board:	Crew – 1	Passengers – n/a
Injuries:	Crew – nil	Passengers – n/a
Damage:	Substantial damage to overhead line equipment, minor damage to rear end wall of top nested flat rack	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Aurizon (train operator)
- Acacia Ridge Intermodal Terminal personnel
- the driver of train YC77
- Queensland Rail (QR) (infrastructure manager)
- rail management centre personnel
- the QR commander.

References

Dismukes RK & Berman BA 2010, *Checklists and monitoring in the cockpit: why crucial defences sometimes fail*, National Aeronautics and Space Administration Technical Memorandum NASA/TM-2010-216396.

Dismukes RK, Berman BA & Loukopoulos LD 2007, The limits of expertise: Rethinking pilot error and the causes of airline accidents, Ashgate Aldershot UK.

Hales BM & Pronovost PJ 2006, 'The checklist – a tool for error management and performance improvement', *Journal of Critical Care*, vol. 21, pp. 231–235.

Reason JT 1990, *Human error*, Cambridge University Press Cambridge, UK.

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 Queensland Rail, Aurizon, the driver of train YC77, Acacia Ridge Intermodal Terminal personnel, network control personnel, the QR commander and the Office of the National Rail Safety Regulator (ONRSR).

Submissions were received from Queensland Rail (primarily safety action), Aurizon (safety action only) and the terminal coordinator. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Appendices

Appendix A – Dangers associated with high voltage overhead line equipment (OHLE) in dewirements

Although voltage is required to force an electric current to flow in a circuit, electrical dangers to the human body are the result of an electric current passing through it, not the voltage. Voltages as little as 50 V AC are capable of overcoming the human body's limited resistance to electric current, with severity of injuries increasing as voltage and thereby corresponding electric current increases.[46] Electrical safety guidance material states that a current of 2 Amperes is capable of stopping the heart and causing severe burns to internal organs.[47]

Under fault conditions (that is, a short circuit), current flow directly to rail or earth could reach thousands of Amperes due to a shortened pathway with less resistance than the normal electric circuit. A dewirement situation could result in such a short circuit where OHLE touched or came in close proximity to a train. This could allow current to flow directly through the metallic wagons or locomotive, into the rails. The greatly increased amperage would result in the circuit breaker for the electrical section tripping to protect OHLE from overheating or causing an electric shock. In this situation, the potential danger posed to personnel during fault conditions includes both touch and step potentials.

A touch potential occurs when a person is touching an object electrified under fault conditions and the earth. An example is holding the handrails on the egress ladder of a locomotive, with one or both feet on the ballast. As electric current will flow from a point of high voltage to low voltage, the voltage difference between the person's hand (high voltage) and feet (low voltage) causes a large electric current to flow through their body to earth as part of the short circuit (Figure A1).

Figure A1: Touch and step potentials

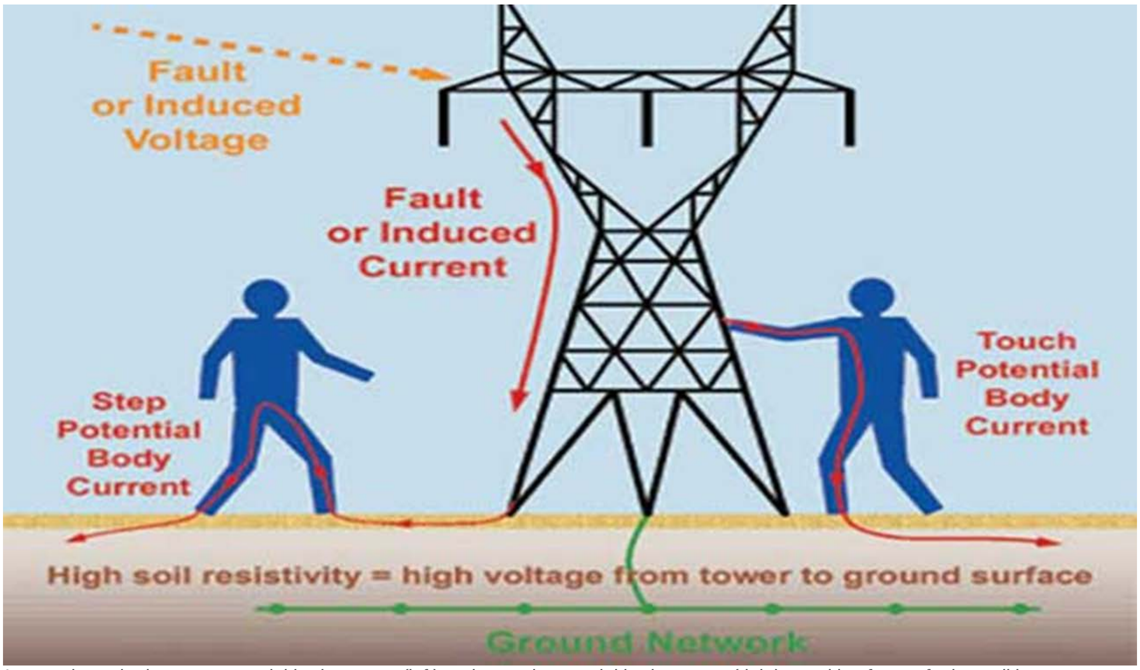


Image shows both a step potential body current (left) and a touch potential body current (right), resulting from a fault condition.
Source: Voltage Lab

A step potential occurs when high voltage OHLE, or an item touching OHLE, is touching the ground, causing a current to flow through the ground to the rail or another return / earth path back to the substation. The ground voltage reduces as the distance increases from the point of contact

[46] *Managing electrical risks in the workplace, Code of Practice* (Qld), 2013.
[47] Ruschena, R 2012, 'Chapter 23.1: Electricity', in *OHS Body of Knowledge*, Tullamarine, Vic.

the short circuit makes with the ground. This can cause a difference in voltage between a person's feet standing nearby, where one foot is closer to the short circuit and thereby at higher ground voltage than the other foot. This may cause an electric current to flow from one foot through the body to the other foot (Figure A1).

Due to the high voltages of OHLE and resultant high electric currents, rubber-soled shoes may not provide protection for either touch or step potentials. All materials have a 'breakdown voltage', at which point a highly resistant material will lose its insulating abilities and become conductive. Similarly, high voltage OHLE can create an arc, where high voltage causes a breakdown of the air gap between an electric conductor and a conductive earthed component, allowing electricity to 'jump' across the air gap. The distance that electricity can arc across an air gap is dependent on a number of factors including voltage level, humidity and air pressure.

These dangers are well recognised, with rail infrastructure managers often investing in marketing campaigns to warn members of the public of the danger presented by high voltage OHLE. Figure A2 is one such example.

Figure A2: Queensland Rail's 'High Voltage Can Jump' public awareness campaign

Image of Queensland Rail's stand at the 2019 Brisbane Exhibition, highlighting the dangers of electrical arc from high voltage OHLE. The campaign was widespread throughout Brisbane, including significant display materials at Brisbane's Central station.
Source: ATSB

Australian Transport Safety Bureau

The 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 the ATSB's 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.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

(a) the occurrence would probably not have occurred; or

(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or

(c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interest of improved transport safety.