

Rail Industry Safety Notice

31 January 2012

RISN No 1 / 2012

SAFE WORKING PROCEDURES

Background

The Rail Safety Unit requests that rail transport operators in Tasmania read the attached investigation report released by the Office of Transport Safety Investigations (NSW) into a collision between a rail motor (two car passenger train) and a hi-rail truck on the Zig Zag Railway.

The report can be found at the following internet link:

[OTSI Investigation Report - Zig Zag Collision 1 April 2011](http://www.otsi.nsw.gov.au/rail/Interim-Factual-Statement-Zig-Zag-Collision-2011-04-01.pdf)

(<http://www.otsi.nsw.gov.au/rail/Interim-Factual-Statement-Zig-Zag-Collision-2011-04-01.pdf>)

Action

The report highlights:

- Organisational structures must clearly defining the roles, responsibilities and authorities of management positions and various classes of rail safety workers, and that these are fully understood by individuals holding these positions.
- The importance of appropriate and robust operating and safe working procedures.
- All Rail Safety Workers following and adhering to approved operating and safe working procedures is critical to the safety of rail operations. This is equally important during abnormal situations, correcting previous errors and in response to incidents
- Rail Organisations must not tacitly permit relaxation or breaches of operating or safety working procedures. Adherence to operating and safe working procedures must be regularly monitored and corrective action taken where breaches of safety requirements become known or detected (see paragraph 2.29).
- Emergency Management Plans/Procedures are to be implemented following incidents (see paragraph 2.37).

Continued →

- Clear and unambiguous means of communication are vital, viz:
 - Communication devices provided for the purpose of safe working are available for monitoring at all times by relevant personnel
 - Communication and the interaction between rail safety workers must not be hampered by a culture of seniority.

The Rail Safety Unit suggests that accredited rail organisations review this alert and the OTSI report. The information and risks described should be assessed against your individual operations to ensure that any similar risks are being managed.

Craig Hoey
Manager – Rail Safety



Office of Transport Safety Investigations

RAIL SAFETY INVESTIGATION REPORT

COLLISION BETWEEN HI-RAIL AND RAIL MOTOR

ZIG ZAG RAILWAY

CLARENCE

1 APRIL 2011



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CLARENCE

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Released under the provisions of
Section 45C (2) of the *Transport Administration Act 1988* and
Section 67 (2) of the *Rail Safety Act 2008*

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THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of accidents and incidents in the rail, bus and ferry industries. OTSI investigations are independent of regulatory, operator or other external entities.

Established on 1 January 2004 by the Transport Administration Act 1988, and confirmed by amending legislation as an independent statutory office on 1 July 2005, OTSI is responsible for determining the causes and contributing factors of accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence. Importantly, however, OTSI does not confine itself to the consideration of just those matters that caused or contributed to a particular accident; it also seeks to identify any transport safety matters which, if left unaddressed, might contribute to other accidents.

OTSI's investigations are conducted under powers conferred by the Rail Safety Act 2008 and the Passenger Transport Act 1990. OTSI investigators normally seek to obtain information cooperatively when conducting an accident investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to interview persons, enter premises and examine and retain physical and documentary evidence.

It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI's investigation reports strive to reflect a 'Just Culture' approach to the investigative process by balancing the presentation of potentially judgemental material in a manner that properly explains what happened, and why, in a fair and unbiased manner.

Once OTSI has completed an investigation, its report is provided to the NSW Minister for Transport for tabling in Parliament. The Minister is required to table the report in both Houses of the NSW Parliament within seven days of receiving it. Following tabling, the report is published on OTSI's website at www.otsi.nsw.gov.au.

OTSI cannot compel any party to implement its recommendations and its investigative responsibilities do not extend to overseeing the implementation of recommendations it makes in its investigation reports. However, OTSI takes a close interest in the extent to which its recommendations have been accepted and acted upon. In addition, a mechanism exists through which OTSI is provided with formal advice by the Independent Transport Safety Regulator (ITSR) in relation to the status of actions taken by those parties to whom its recommendations are directed.

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GLOSSARY OF TERMS

Bottom Road	The track between Bottom Points and the workshops.
Brake Block	The part of the braking system which is applied to the tread of the wheel tyre to effect braking.
EP Valve	The Electro-Pneumatic Valve provides the driver control over air braking.
Hi-Rail	A vehicle capable of running on both road and rail. Often these are standard road vehicles that have retractable assemblies fitted front and rear which incorporate a pair of flanged rail wheels.
Middle Road	Zig Zag Railway section between Top Points and Bottom Points Yard limits.
National Standard for Health Assessment of Rail Safety Workers	This standard underpins a system for monitoring the health of rail safety workers and enables consistent application of health standards across the Australian rail industry. All health assessments for rail safety workers are conducted in line with this Standard which was approved by the Australian Transport Council (ATC) in April 2004.
Permanent Way	The path that carries the rolling stock, or trains. It is made up of rails, sleepers, and fastenings joined together and held in position by the ballast.
Safety Critical Worker (Category 1)	According to the National Standard for Health Assessment of Rail Safety Workers, rail safety tasks are High Level Safety Critical if sudden worker incapacity such as a heart attack or blackout could result in a serious incident affecting the safety of the public or rail network. Single operator train driving on the commercial network is an example of a High Level Safety Critical task (Category 1).
Safety Critical Worker (Category 2)	Safety Critical tasks which are not High Level include those where fail-safe mechanisms ensure that sudden incapacity does not affect safety of the rail network. For example, in many cases a signalling task is Safety Critical (Category 2) but not High Level Safety Critical because fail-safe systems ensure the safety of the network in case of worker incapacity.
Safeworking Advice Form (SAF)	Safeworking Advice Forms are used to convey authority and information to workers. One use is where it is issued as authority to enter a section when altered train arrangements result in the Staff not being available and serious delay would be incurred by transferring it, provided that a number of conditions are met. Another use is where it provides information such as for temporary speed restrictions or the locations of worksites. The use of SAF is not limited to the above examples.
Staff	The token used in a Train Staff system, the possession of which gives the train driver authority to enter a block section.
Staff and Ticket System	A system regulating the traffic on single track lines, under which the right to enter a section is given to the train through delivery of a Staff or an associated Ticket to the train driver.
Ticket	A written authority issued after a driver has identified the Staff for a section.
Top Road	Zig Zag Railway section between Top Points and Clarence Yard limits.
Train	An engine or engines coupled with or without vehicles, a rail motor with or without trailers attached, section cars and track maintenance machines.
Train Register	A book used in signal boxes and staff huts to record information about the condition of the line or the movement of rail traffic.

EXECUTIVE SUMMARY

At 1:30pm¹ on 1 April 2011, a Zig Zag Railway maintenance vehicle (the Hi-Rail), collided with a two-car Rail Motor on the No 1 Viaduct, Top Road, between Clarence and Top Points stations. The Hi-Rail, with a Driver and Passenger on board, was freewheeling down the hill in reverse in the section from Clarence towards Top Points. The Rail Motor, operated by a Driver, was travelling empty in the opposite direction from Top Points.

The Rail Motor Driver saw the approaching vehicle and applied the brakes. However, the two persons onboard the Hi-Rail, facing the opposite direction, did not see the Rail Motor before the collision. The force of the collision compacted the body of the Hi-Rail such that neither cab door would open. The two occupants of the Hi-Rail were injured in the collision and were assisted out of the Hi-Rail and onto the Rail Motor by the Rail Motor Driver who was uninjured. The force of the collision caused a minor misalignment of the track.

The investigation established that the collision resulted from the Driver of the Rail Motor and the Driver of the Hi-Rail not being aware that they were travelling towards each other on the same track in the Top Points-Clarence section. This lack of situational awareness resulted from procedural errors. The Rail Motor Driver departed Top Points without communicating his intention to his Guard or the Hi-Rail crew, and the Rail Motor Guard exceeded his authority by authorising the Hi-Rail to leave a worksite and proceed to Top Points. A number of other factors were found to have contributed to the collision, particularly a lack of radio communications and operational safeworking errors. Other safety issues identified during the investigation included delayed notification of the accident; poor maintenance of Train Register Books; passengers travelling in the Rail Motor driver's cab; Rail Motor Driver's fatigue; and excess speed of the Hi-Rail.

As a result of its investigation, OTSI recommends that Zig Zag Railway reviews current operational procedures for the implementation of safeworking systems; improves monitoring and auditing of safeworking procedures; ensures that the Train Register Books are maintained; reviews the structure and staffing of safety operational positions; and reinforces reporting requirements following an incident.

¹ All times referred to in this report are in Australian Eastern Daylight Time.

Full details of the Findings and Recommendations of this investigation are contained in Parts 3 and 4 respectively.

PART 1 FACTUAL INFORMATION

Incident Synopsis

- 1.1 At 1:30pm on 1 April 2011, a Zig Zag Railway (ZZR) maintenance vehicle (the Hi-Rail), carrying two employees, collided with a two-car Rail Motor on No. 1 Viaduct, Top Road, between Clarence and Top Points stations (see *Figure 1*). The Hi-Rail, with two people on board, was travelling in reverse in the section from Clarence towards Top Points. The Rail Motor, operated by a Driver (no other persons being on board), was travelling in the opposite direction from Top Points. The collision caused minimal damage to the larger Rail Motor and its Driver was not injured. The smaller Hi-Rail was significantly damaged and its two occupants both sustained injuries.

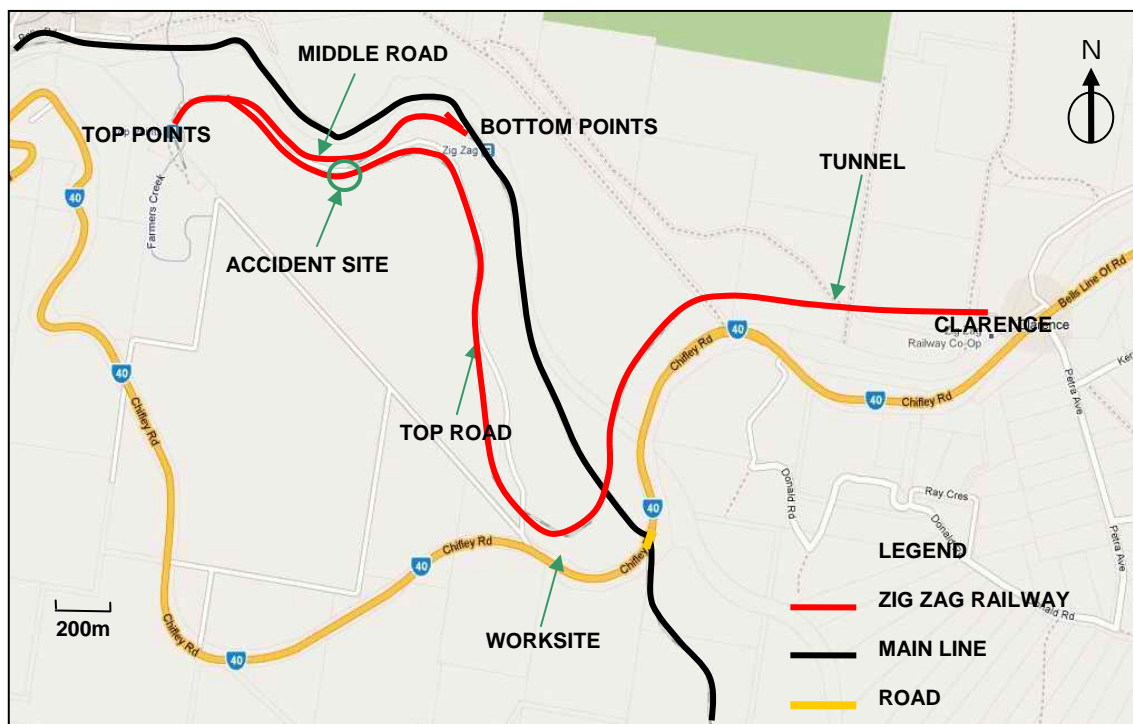


Figure 1: Zig Zag Railway Map

Location

- 1.2 The Zig Zag Railway is located 140km by road (160km by rail) West of Sydney and 10km East of Lithgow on the western escarpment of the Blue Mountains (see *Figure 2*). It is not connected to the main rail line. The elevation at the start of the Zig Zag at Clarence is 1115m and at Bottom Points 994m.

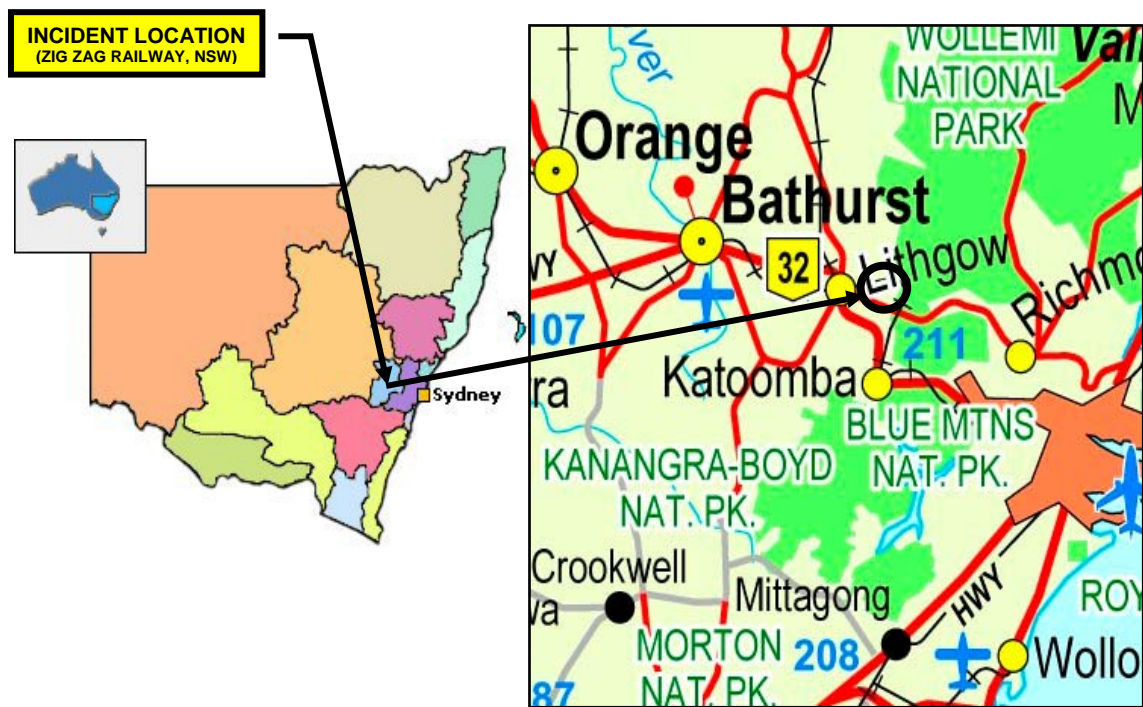


Figure 2: Incident Locality

Before the Collision

- 1.3 The Rail Motor Driver started the day at 8:30am and prepared the two-car Rail Motor for service. During this preparation, the Driver found that a brake block had been placed on the EP valve in each cab to prevent them from leaking and so allow brake pipe air pressure to be built up and maintained. The placement of a brake block, or any heavy object, on the EP valve also has the effect of rendering the deadman system inoperative.
- 1.4 The Driver removed the brake blocks from the Rail Motor and contacted maintenance staff. The EP valve was replaced in Rail Motor 2006 (see *Figure 3*) while the other was found to be serviceable to the extent that air pressure could be built up and maintained, so allowing the Rail Motor to enter service.

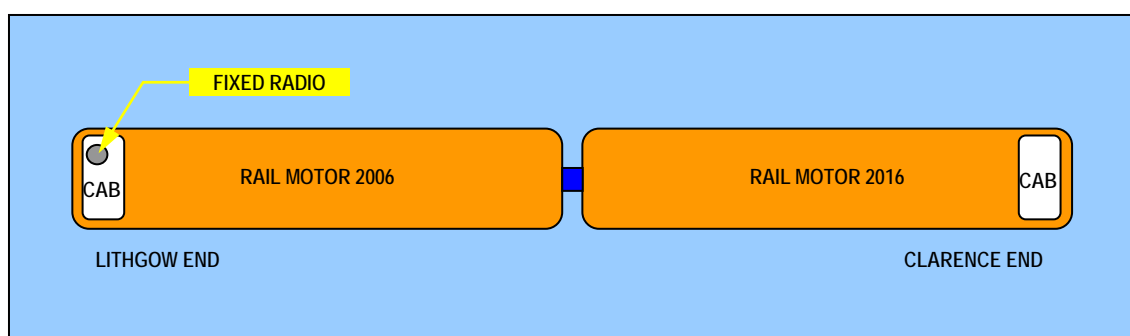


Figure 3: Two-car Rail Motor configuration

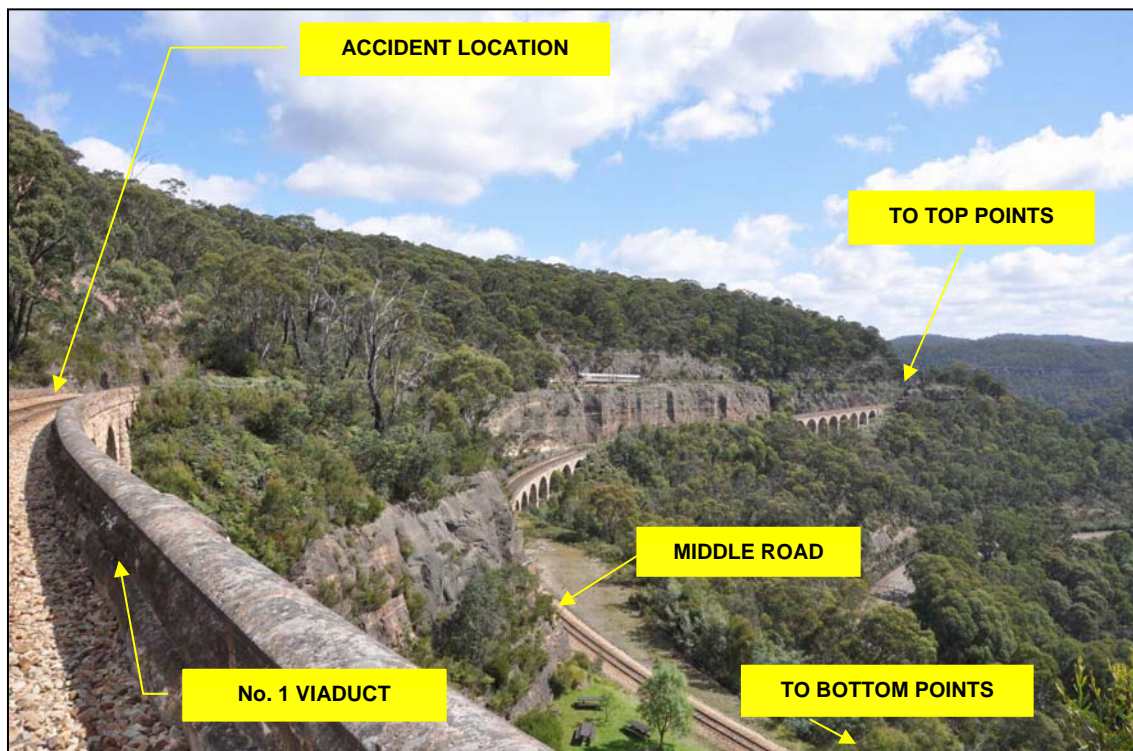
- 1.5 The Rail Motor departed Bottom Points at approximately 10:33am with the Driver and Guard on board, travelling empty to Clarence ready to commence the first passenger service which was timetabled to depart from Clarence at 11:00am. Two subsequent services were scheduled to depart from Clarence at 1:00pm and 3:00pm.
- 1.6 The Rail Motor departed Clarence at the scheduled time of 11:00am with eight passengers on board. It returned to Bottom Points without incident, arriving at 11:20am. Also at Bottom Points was the Hi-Rail, with two maintenance staff on board, waiting to depart. The Hi-Rail needed to travel to Clarence to be ready to provide worksite protection for a Roads and Traffic Authority (RTA) worksite some 2.2km West of Clarence near an old coal stage. The RTA was completing drainage work adjacent to the track.
- 1.7 While the Rail Motor Guard took the passengers on a tour of the Bottom Points workshops, the Driver conferred with maintenance staff to have the EP valve replaced in Rail Motor 2016 as a suitable replacement EP valve had been located.
- 1.8 In order to depart from Bottom Points, the Hi-Rail Driver took both Staffs from the Lithgow end of the Rail Motor, leaving the first Staff in the Bottom Points Signal Box and, as per procedure, wrote a Staff Ticket as the authority for him to travel through the section.
- 1.9 The Hi-Rail departed from Bottom Points, without first seeking the Train Controller's permission, taking the Top Points-Clarence Staff so that a further Staff Ticket could be issued from Top Points to Clarence. This Staff was correctly left in Top Points Signal Box.
- 1.10 On arrival at Clarence, the Hi-Rail Driver completed Safeworking Advice Form (SAF) No. 2069 for the RTA worksite, and in anticipation of the Rail Motor arriving with the Staff. The Hi-Rail Driver reported to the Train Controller by radio that he had arrived at Clarence.
- 1.11 The Rail Motor travelled from Bottom Points to Top Points with the Staff which was retrieved from Bottom Points Signal Box by the Guard and placed in one of the Staff receptacles in the Rail Motor's Lithgow end. On arrival at Top Points, the Driver changed ends and the Guard operated the Signal Box to allow the Rail Motor to travel to Clarence.

- 1.12 The Guard did not pick up the Staff from Top Points Signal Box, as he should have, when he rejoined the Rail Motor at the Clarence (driver's) end. He then pressed the signal bell twice as an indication to the Driver to proceed. The Driver said that he did not view the Staff before he departed *"as it normally travels in the Lithgow end"*. This was contrary to the requirements of ZZR's Operations Manual which states that: *"After receiving the Train Staff or Ticket the driver shall not proceed until both the driver and the fireman are satisfied as to the correctness of same"*.² The Rail Motor departed from Top Points and travelled through the section to Clarence without the Staff for the section.
- 1.13 On arrival at Clarence, the Hi-Rail Driver asked the Rail Motor Driver to give him the Staff. This was because the Rail Motor would be travelling back to Top Points first and could therefore depart on the authority of a Staff Ticket with the Hi-Rail following, using the Staff. It was here that it was discovered that the Staff had been left at Top Points. This error could have been rectified if the Staff had been retrieved from Top Points Signal Box and brought to Clarence. Because the Signal Box at Top Points was unattended, retrieval of the Staff would have necessitated a difficult round trip of about 40 minutes duration involving both highway driving and a 4 wheel drive-only accessible dirt track, followed by a steep foot descent. The Operations Manager did not undertake such a remedial course of action but proceeded with a system of railway working which was contrary to operational safeworking procedure and eventually broke down, leading to the collision.
- 1.14 At 1:02pm the Rail Motor departed Clarence towards Top Points with four passengers on board as the scheduled 1:00pm service. The Rail Motor Driver, who was also acting as Train Controller on the day as well as holding the position of Operations Manager, authorised this movement even though the Staff was at the wrong end of the section and not secured. No written authority was issued. The Rail Motor Driver stated that: *"There was no paperwork done for this as there was nobody at Top Points to secure the Staff and issue a Safeworking Advice Form."*
- 1.15 After passing through the tunnel on the way to Top Points, the Rail Motor Driver radioed the Hi-Rail Driver to inform him that the line was clear to that point and the Hi-Rail departed Clarence on that assurance. The Hi-Rail was

² Zig Zag Railway – Operations Manual – June 2009 - section 11.13

travelling in reverse since, as a matter of convenience and usual practice, it was on the track facing the direction it began with, although it is possible that it could have been dismounted from the track at Clarence and turned around to allow the Driver to face the direction of travel.

- 1.16 Once the Rail Motor passed the location where the RTA worksite was to be established, the Rail Motor Driver again radioed the Hi-Rail Driver to inform him that the line was clear to the worksite and that it was safe for the Hi-Rail to proceed there. The Hi-Rail travelled to the worksite location and set up the worksite protection as required for the RTA.



Photograph 1: View across top of No. 1 Viaduct

- 1.17 The Rail Motor then proceeded to Top Points, as scheduled, halting before No.1 Viaduct to allow the passengers to alight to view the Viaduct and obtain a panoramic view of the Zig Zag Railway (see *Photograph 1*). The passengers then rejoined the Rail Motor which continued to Top Points Station.
- 1.18 On arrival at Top Points Station at 1:24pm, the Rail Motor Guard took the passengers on a short tour around the station area while the Driver changed ends and drove the Rail Motor a short distance away and brought it to a stand adjacent to Top Points Signal Box (see *Photograph 2*).



Photograph 2: Top Points Signal Box and Signals

- 1.19 On arrival, the Rail Motor Driver entered the Signal Box, saw the Staff on the table inside the door and made the decision to take the Staff to the Hi-Rail which he believed to be stationary at the worksite. The Rail Motor departed Top Points with the Staff. The Rail Motor Driver did not have a hand-held radio nor was there a fixed radio in Rail Motor 2016, and he did not discuss with the Guard his intention to leave Top Points Signal Box. The Guard, who was taking passengers on a tour of Top Points Station and the 1901 runaway site, had no visibility of the Rail Motor which he believed to be waiting for him at Top Points Signal Box.
- 1.20 While the Guard was conducting the tour, he received a call on his hand-held radio from the Hi-Rail Driver. The Hi-Rail Driver had made several calls in an attempt to reach the Driver, not knowing that the Driver did not have any form of radio communication as he was travelling from Top Points to the worksite and was separated from his Guard (who had a radio). The Guard eventually responded to the Hi Rail Driver's call, who advised him that the RTA worksite was clear and requested permission to travel from the worksite location to Top Points. The Guard informed the Hi-Rail Driver that the line was clear to the

Outer Home signal; the first signal encountered on approach to Top Points on the Top Road from Clarence. The Guard did not have authority to approve this movement by the Hi-Rail; the Rail Motor Driver in his capacity as the Train Controller was the only person who could have given authority for it.

- 1.21 Having confirmed with the Guard that the line was clear, the Hi-Rail duly proceeded towards Top Points travelling downhill in reverse with the vehicle's gearbox in neutral and the engine idling. This freewheeling condition prevented any retardation effect by the gearbox and effectively disabled the audible reversing alarm.
- 1.22 The Hi-Rail was freewheeling backwards down a gradient of 1 in 42 (see *Figure 4*) with the Driver controlling the speed of the vehicle using the foot brake. According to the Driver and Passenger, the Hi-Rail was travelling at about 20km/h over No. 1 Viaduct in a designated 10km/h speed restricted area just before the collision. The crew of the Hi-Rail stated that they were not keeping a constant lookout during the descent.

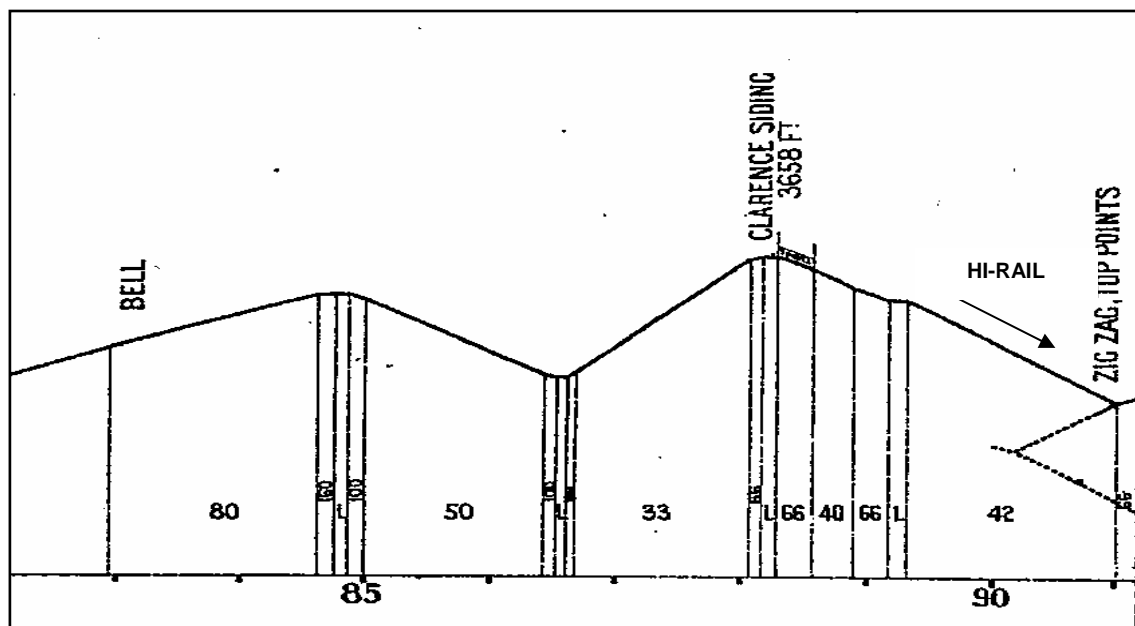


Figure 4: Gradient diagram (from 1894)

- 1.23 The Rail Motor was travelling in the opposite direction, up the gradient, with the Rail Motor Driver as its sole occupant. He was positioned in the front cab of Rail Motor No. 2016 looking ahead at the curved track towards the Viaduct (see *Photograph 3*). According to the Driver, he had driven the Rail Motor at speeds up to about 40km/h before reducing to about 15km/h on approach to

the 10km/h speed restricted area over No. 1 Viaduct. This speed restricted section is signposted at both ends of the Viaduct.

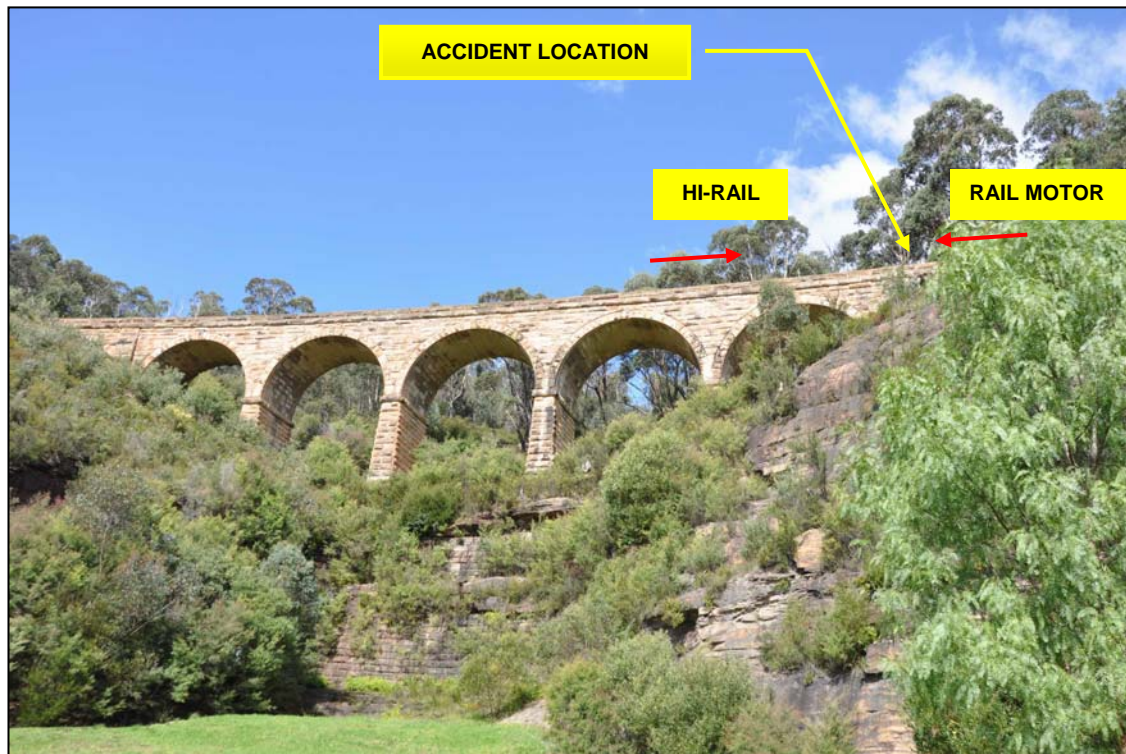
The Collision

- 1.24 As the Rail Motor approached the Viaduct, the Driver said that he looked down to check his instruments and, when he looked up again, saw the Hi-Rail about 50m away. He immediately applied his brakes and then cut back the throttle. He said that he did not sound the Rail Motor horn as he had his hand on the brake and did not want to remove it.



Photograph 3: View from Rail Motor towards No.1 Viaduct

- 1.25 The two occupants of the Hi-Rail traversed the Viaduct still unaware of the oncoming Rail Motor. Both occupants of the Hi-Rail stated that at no time did they either see or hear the approaching Rail Motor before the collision.
- 1.26 The rear of the Hi-Rail and front of Rail Motor collided on the No.1 Viaduct (see *Photograph 4*) at an estimated combined speed of 35km/h. The force of the collision was such that the front of the Hi-Rail was lifted in the air. The Passenger of the Hi-Rail said: “all I could see was sky”. He was concerned that they might have been thrown over the edge of the Viaduct.



Photograph 4: No.1 Viaduct from below, looking South

After the Collision

- 1.27 Immediately after the collision the uninjured Rail Motor Driver exited from his train and went to the cab of the Hi-Rail to ascertain the occupants' wellbeing. The occupants were dazed, particularly the Hi-Rail Driver. The Passenger said that it is possible the Driver was unconscious for about 10 seconds following the collision.
- 1.28 The force of the collision compacted the body of the Hi-Rail cab such that neither cab door would open. The Driver and Passenger were assisted from the cab through the open side windows by the Rail Motor Driver. All three persons then boarded the Rail Motor. The Hi-Rail's towbar had punctured the Rail Motor's stainless steel body causing the two vehicles to be locked together.
- 1.29 The Rail Motor Driver determined that, as the two Hi-Rail occupants required medical attention, he would move the Rail Motor with the Hi-Rail attached back to Top Points and thence to Bottom Points. The Rail Motor Driver said that he propelled the Rail Motor with the Hi-Rail attached at a slow speed, however, after about 500m, the Hi-Rail detached from the Rail Motor and derailed. The Driver checked the position of the Hi-Rail and determined that it

was not going to move or run away. It was left foul of the line and the Rail Motor continued on to Top Points. There was no protection placed on the track following the collision.

- 1.30 Meanwhile, at Top Points the Guard had completed the tour around the Station with the passengers, ending at the Signal Box. The Guard observed that the Rail Motor was not there and so walked back to Top Points Station. He then saw the Rail Motor as it approached the Signal Box, saw that it had been damaged and realised that there had been a collision. The Guard and passengers rejoined the Rail Motor and at 1:40pm proceeded on to Bottom Points.
- 1.31 The Rail Motor Driver did not report the collision by radio and it was not until the Rail Motor reached Bottom Points that other ZZR staff learnt of the collision. The Maintenance Manager at Bottom Points saw one of his injured workers and was told there had been an accident.
- 1.32 The two Hi-Rail occupants were then transported to Lithgow Hospital, arriving at 2:30pm, while the passengers from the Rail Motor were transferred back to Clarence by road vehicle. The Rail Motor Driver proceeded to make up a works train and loaded a crane on board with the intention of returning to the collision site to clear the track. This train had reached Top Points when the Acting General Manager was notified of the collision by a ZZR volunteer worker. He directed that all operations cease and the collision site be preserved for investigators.
- 1.33 The Acting General Manager notified the Independent Transport Safety Regulator (ITSR) of the collision at 3.30pm and drove to Top Points to collect the Rail Motor Driver and drive him to Lithgow Hospital for Drug and Alcohol testing. The Rail Motor Guard was taken to hospital in a separate vehicle.

Injuries and Damage

- 1.34 The Rail Motor Driver was uninjured. However, the Hi-Rail Driver was rendered unconscious briefly and reported a sore lower back, shoulder and legs while the Passenger suffered a bruised spine and temple.
- 1.35 As a result of the collision the Rail Motor and Hi-Rail became locked together with damage to both vehicles (see *Photographs 5 & 6*).



Photograph 5: Hi-Rail after collision



Photograph 6: Rail Motor 2016 collision damage

- 1.36 While neither vehicle was derailed, the Hi-Rail did so when it became detached as it was being towed towards Top Points. The track at the collision location suffered a slight misalignment.

Zig Zag Railway Information

- 1.37 **History and Ownership.** In order for trains to descend the western side of the Blue Mountains, John Whitton, Chief Engineer of the NSW Government Railways, designed the 'Great Zig-Zag' (what is now known as the Zig Zag Railway), which opened on 18 October 1886. This single track eventually became inadequate for the increased rail traffic and a new line, including ten tunnels, was constructed through the escarpment. The new line, which bypassed the Zig Zag, opened in 1910. The Zig Zag was then abandoned.
- 1.38 In 1972 a group of volunteers formed a co-operative, the Zig Zag Railway Co-operative Ltd, and began restoration work on the disused line. Operations began on the Middle Road (from Bottom Points to Top Points) in 1975. In 1988 the track along Top Road to Clarence was opened. A Clarence to Newnes Junction section is currently under construction. The ZZR owns the infrastructure and is the only operator to use it.
- 1.39 **Size and Scope of Operations.** ZZR is the fourth largest rail passenger operator in NSW and in the 2009/2010 financial year carried over 81,000 passengers. There are about 70 regular volunteers (out of a total membership of 396) and 18 employees (seven full-time, three part-time and eight casual) engaged in operating ZZR. There are daily services using diesel operated rail motors or steam-hauled trains, or a combination of both. The operations are conducted on about 8km of track that is not connected to the main NSW rail network. The Bottom Road of the ZZR runs within metres of the Main Western Line on which there is a small Zig Zag Station platform.
- 1.40 The Zig Zag Railway consists of a series of steeply graded tracks (with gradients of up to 1 in 42) which form the shape of the letter 'Z' with a 'top', 'middle' and 'bottom' roads making up the 'Z'. The Bottom Road is only a short dead end section which leads into the workshops with trains operating over the Middle and Top Roads. There are three sandstone viaducts and two tunnels.

- 1.41 **Narrow Gauge.** The ZZR operates on narrow gauge 1067mm (3'6") track rather than the standard gauge 1435mm (4'8½") for which the railway was originally designed and the rest of the NSW main line network uses. It was decided to relay the line using narrow gauge in the 1970s when the ZZR reopened, mainly due to the availability of narrow gauge rolling stock from Queensland.

Employee Information

- 1.42 The Rail Motor Driver was a volunteer member of ZZR and had been a member for 39 years. He was qualified to carry out a number of other safeworking duties such as that of guard and signaller, and held the position of ZZR Operations Manager. The Driver's Certificate of Competency (ZZ0281) was valid, expiring in October 2015. The Driver had a current Category 2 medical assessment, issued in February 2011. The medical assessment category is determined according to the National Standard for Health Assessment of Rail Safety Workers.
- 1.43 The Rail Motor Guard was also a volunteer. He had experience as a volunteer driver and conductor on the Loftus Tramway in Sydney, holding a Certificate of Competency issued by Loftus Tramway Museum as a tram driver and conductor. He had recently completed training at ZZR and had been passed as competent to work as a trainee Rail Motor guard on 11 December 2010. A few days prior to the collision the Guard commenced his duties unsupervised. However, on the day of the collision, he had yet to be issued with a ZZR Certificate of Competency. It was eventually issued on 15 May 2011 but there is no documentation relating to the guard's transition from 'trainee guard' to 'guard'. The guard had a current Category 1 medical certificate issued in March 2009.
- 1.44 The Hi-Rail Driver was a full-time employee of ZZR. He had begun employment as a carriage building apprentice in 2007 and, on completion, had transferred to permanent way (track) work. The Driver was certified to operate the Hi-Rail truck (Certificate No. ZZ169B) but did not hold a NSW driving licence. He had a current Category 2 medical certificate, issued in February 2011.

- 1.45 The Passenger in the Hi-Rail was a casual employee and had been so for about 12 months. He had a Certificate of Competency (ZZ0201) with 'Trainee Fettler' (track maintenance worker) identified as the only capacity in which he could work. The employee had a current Category 2 medical certificate, issued in February 2011.

Train and Vehicle Information

- 1.46 The Rail Motor involved in the collision is a two-carriage double-ended train consisting of Rail Motors No. 2006 and No. 2016. It was built in 1960-61 by Comeng in Queensland. Each carriage has seating for 54 passengers. The body is stainless steel with an 11.3 litre AEC diesel engine generating 150HP. Each carriage is 17.2m long and 2.6m wide and has a driver's cab at one end.
- 1.47 The Rail Motor "QR 2000 Class Railmotor Preparation Checklist" dated 29 March 2011 had the following note handwritten in the comments section by the driver: *"EP's valves in drivers cabs of both units blowing through – require replacement"*. On the day of the collision, it is evident that both EP valves were leaking and had not been attended to in the three days since the defect was reported.
- 1.48 The Hi-Rail is a Toyota Dyna truck (see *Photograph 7*), road registered until July 2011. It has a standard configuration of rubber tyres as well as being equipped with flanged steel rail wheels. The rail wheels can be raised or lowered using a hydraulic mechanism to allow it to be driven on track. It is used as a general purpose transport for tools and maintenance equipment around the rail infrastructure. On the day of the collision, the flat-bed tray was loaded with timber, star pickets, tools, oxy-acetylene gas bottles and detonators. Most of these materials and equipment were loosely loaded on the tray with some items stored in metal boxes and garbage bins.



Photograph 7: Hi-Rail vehicle

Environmental Conditions

- 1.49 The weather around the time of the collision was cool and dry with cloudy skies. The temperature recorded approximately 10km away at Lithgow was 18°C at 3.00pm, while the wind was reported as calm.
- 1.50 At the time of the collision the sun's altitude was approximately 47°, high enough for glare not to be an issue. When questioned, both drivers said the sun's glare was not a problem for them, and it was deemed not to be a factor contributing to the collision.

PART 2 ANALYSIS

System of Safeworking

- 2.1 **Staff and Ticket Overview.** During normal operations on the ZZR, a Staff and Ticket system is used. This system is used on single lines to facilitate the safe movement of individual trains in either direction. It is a simple and effective system where a single Train Staff is provided for each section (see *Photograph 8*). Each Train Staff is engraved with the section name and the colour of the Staff Box. As well, in the eye of the Staff, there is a distinctive shape to assist in differentiating between Staffs.



Photograph 8: Train Staffs

- 2.2 When trains are to travel across the section alternating in opposite directions, each train takes the Staff in turn, so ensuring that only one train is in that section. The system is safe providing the train crew is diligent in checking they have the correct Staff for the section they are about to enter. However, this single Staff presents problems when the next train to traverse the section is to travel in the same direction. To overcome this, a Staff Ticket is used.

The Staff is seen and verified by the driver of the first train and a Ticket is then written giving it authority to use the line. The next train is required to wait before entering the section until a message is received from the far end stating that the line is clear, then it is sent forward with the Staff (unless there is a third train headed in the same direction, in which case another Ticket is used). The tickets are pre-printed, consecutively numbered and clearly marked with the section name. Inside the signal box, Staff Tickets are kept in the Staff Box (see *Photograph 9*) which can only be opened with the correct Staff.



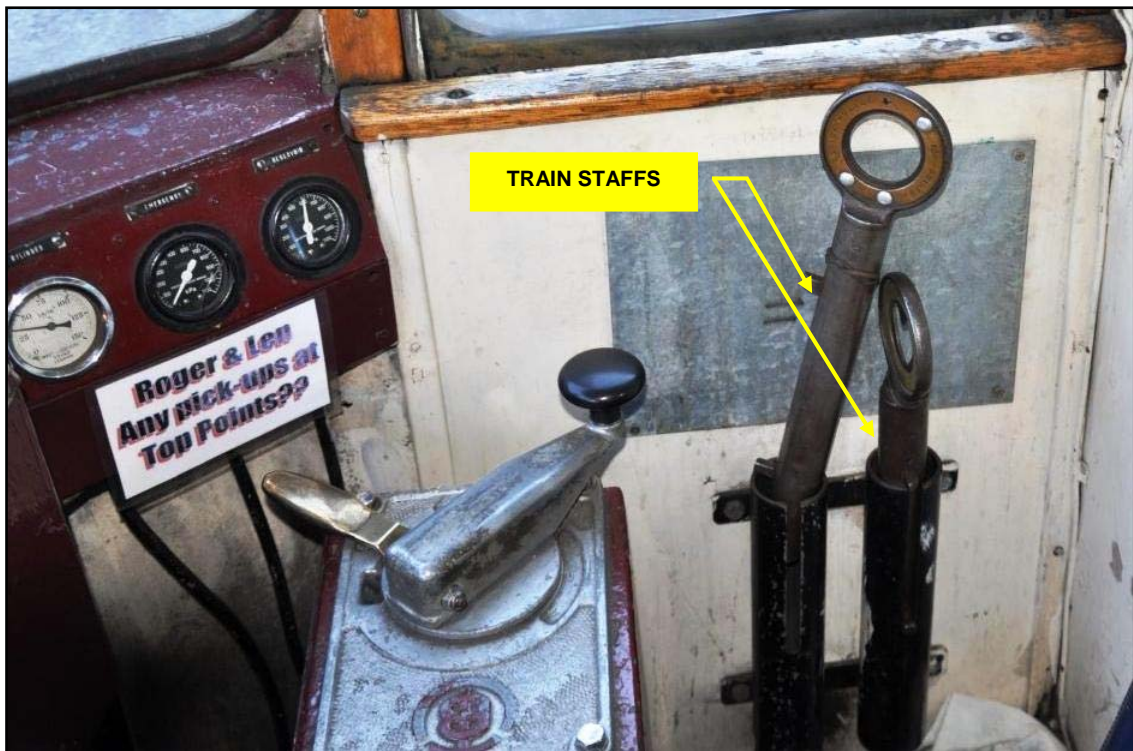
Photograph 9: Staff Boxes in Top Points Signal Box

- 2.3 The ZZR Operations Manual details how the Staff and Ticket system operates. There are currently two Staffs in use at ZZR; Bottom Points - Top Points and Top Points – Clarence.

- 2.4 **Safeworking Advice Forms.** Another system of safeworking is also available at ZZR. This alternative safeworking system, also documented in the Operations Manual, is called Safeworking Advice Forms (SAF). According to the Manual: *“A Safeworking Advice Form may be issued as an authority to enter a section, when altered arrangements result in the Staff not being available and a serious delay would be incurred by transferring it”*.³ The other main use of the SAF system is for the authorising of worksites. A number of conditions apply before using SAF; these include that a qualified worker is available with the Staff and that there is an effective means of communication available among all parties.
- 2.5 When only one train, such as a Rail Motor, is operating, normal practice has been to retain the Staffs for both operational sections in the ‘Lithgow end’ of the Rail Motor during operation. To this end, two receptacles are fitted to accommodate the Staffs (see *Photograph 10*). This is because the Rail Motor driver is usually also the Train Controller and, if he has possession of both Staffs on those days, he can authorise the issuing of a SAF for either section. This practice is contrary to ZZR Operations Manual which states: *“The Train Staff shall be placed on the relative Ticket Box (at the end of the section)”*.⁴
- 2.6 In addition, maintenance vehicles often need to operate between scheduled train services. All rail traffic and persons who wish to establish a worksite on ZZR are required to carry a book of SAF forms. These forms have two purposes:
- to allow the holder of a Staff to authorise, after communicating with the train controller, a movement by rail traffic into or through the section to which the Staff relates; and
 - to record advice of the establishment of a worksite in that section.

³ Zig Zag Railway – Operations Manual – June 2009, section 12.1

⁴ Ibid., section 11.12



Photograph 10: Both Staffs in receptacles in Rail Motor Cab

- 2.7 Train Register Books.** In order to record rail traffic movements, a Train Register Book is kept in the Top Points Signal Box. The ZZR Operations Manual states that: *“a Train Register Book shall be maintained in each signal box”*.⁵ The Train Register Book at Top Points Signal Box comprised loose leaf sheets photocopied from the Bottom Points Train Register Book. The Top Points Train Register Book was not used to record the departure of the Rail Motor towards the work site, nor was the collision recorded as might have been expected, and the Bottom Points Signal Box Train Register Book was not being maintained.
- 2.8 Train Control.** The operation of the railway is under the control of the train controller. The train controller’s duties include *“Arranging the running times for any special train or rail mounted vehicle so as they do not interfere with scheduled trains”*.⁶ On days when the Rail Motor is the only train operating, the Rail Motor driver also acts as the train controller. When there are more trains operating, a train controller is stationed at Top Points Signal Box who also fulfils the signaller’s duties.

⁵ Ibid., section 2.16.13

⁶ Ibid., section 13.2.2

- 2.9 **Operations Manager.** ZZR has an Operations Manager, a position filled by a volunteer. In the event that *“a situation arises where for any reason these rules (as contained in the ZZR Operations Manual) cannot be carried out without serious delays to traffic, the Operations Manager may suspend all or part of these rules and will be personally responsible for ensuring that every precaution for safety has been taken”*.⁷ On the day of the collision, the Rail Motor Driver was also Train Controller as well as holding the position of Operations Manager.
- 2.10 **Working of Trains.** The operation of the Rail Motor is meant to be a two person operation. The Operations Manual stipulates that: *“Rail Motors must be worked by a crew of two; driver and guard”*.⁸ In addition, the ZZR Notice of Accreditation imposes restrictions on ‘Driver Only’ operation. These requirements were not complied with when the Rail Motor Driver made the decision to depart Top Points alone, leaving the Guard behind.
- 2.11 The practice of keeping both Staffs in the Lithgow end cab of the Rail Motor had led to a custom of the driver, when driving from the other end, leaving Top Points without seeing the Staff for the section. This is contrary to the requirement that: *“the driver shall not proceed until both the driver and fireman are satisfied as to the correctness of same (the Staff)”*.⁹ There is no reference to the responsibilities of a Rail Motor Guard in this respect. On the day of the collision, the Staff was left behind at Top Points by the Rail Motor crew and was therefore not available when the Rail Motor arrived at Clarence. Both the Driver and Guard should have ensured the Staff was with them.
- 2.12 At the time of the collision, the normal safeworking systems, both the Staff and Ticket and SAF systems had been set aside on the authority of the Operations Manager. What remained was a verbal communication system using two-way radios. This relied on the respective drivers of the Hi-Rail and Rail Motor maintaining effective communication.

Actions of the Rail Motor Driver

- 2.13 The Rail Motor Driver, as mentioned previously, was also the Train Controller on the day and Operations Manager. The decisions made by him were made

⁷ Ibid., section 17

⁸ Ibid., section 6.1.3

⁹ Ibid., section 11.13

in isolation from any other person in authority in ZZR. An examination of the various responsibilities of his three different roles indicates that the overlapping responsibilities of these roles removed the opportunity for checks and balances.

- 2.14 During preparation of the Rail Motor for service it was discovered, by the Rail Motor Driver, that there was a problem with the EP Valves which needed to be rectified. A number of witnesses commented that he was agitated by the situation and vented his frustration. This start to the day may have had an unsettling effect, both on the Driver himself and the Guard who witnessed this.
- 2.15 Although there was no policy or specific procedures relating to persons travelling in the Rail Motor cab, it was a routine practice. On the journey from Top Points to Clarence, the Driver allowed two passengers to ride with him in the Rail Motor cab. Their presence may have caused a distraction and contributed to his departing Top Points without checking that he had the Staff for the section.
- 2.16 The Driver did not sight the Staff as required before departing Top Points and entering the section to Clarence; this oversight by ZZR Rail Motor drivers occurred routinely. The Driver, acting in his capacity as Operations Manager, was able to authorise the Rail Motor's return movement from Clarence to Top Points with the Staff for the section unsecured at Top Points. He authorised the Hi-Rail to follow him to Top Points and, once he had passed the worksite, he authorised the Hi Rail Driver via the radio to enter the section.
- 2.17 The Rail Motor Driver decided to take the Staff up to the Hi-Rail Driver. In doing so he did not comply with the Operations Manual as the Guard was not on board. The Guard at the time was conducting a guided tour for passengers around Top Points Station and had been told by the Driver that he would "*see him back at the Signal Box*". The Guard interpreted this routine communication as meaning the Rail Motor would travel to Top Points Signal Box and remain there until he arrived.
- 2.18 The Rail Motor Driver's decision to take the Staff and deliver it to the Hi-Rail without communicating his intent was unsafe; the Driver said he was trying to restore normal systems of safeworking. He said that he thought the RTA worksite would be there considerably longer and therefore the Hi-Rail would require formal worksite protection. But, once the Staff was secured (in the

Rail Motor Driver's possession), a SAF could have been issued to formalise the existence of the worksite and to allow the Hi-Rail to travel to Top Points or back to Clarence.

- 2.19 The Rail Motor Driver had no communication device readily available when he set off on the journey from Top Points to take the Staff to the Hi-Rail; he did not have a hand-held radio and the fixed radio was at the other end of the Rail Motor.
- 2.20 The Rail Motor Driver, as Operations Manager, was aware of occasions when rail traffic departed Top Points towards Clarence without correct authority, especially in the case of Rail Motors, but he had not initiated any corrective actions. Part of the Operations Manager's role was to *"Initiate corrective actions where breaches of safety requirements are detected"*.¹⁰ Similarly, the Operations Manager had taken no action in regard to the practice of retaining both Staffs in the Rail Motor despite it also being contrary to Operations Manual requirements.¹¹

Actions of the Rail Motor Guard

- 2.21 The Guard did not collect the Staff from Top Points Signal Box. The Operations Manual discusses unattended signal boxes and states that:

*"The train guard shall operate the lever frame and make the necessary entries in the Train Register when no signalman is on duty."*¹²

However, no mention is made in this section of any responsibility for handling the Staff. Another section discusses when the Train Staff is to be handed to the driver, stating:

"the signalman shall hand the staff to the driver".¹³

However, there is no reference in the Operations Manual as to who takes on this responsibility when the signal box is unattended.

- 2.22 The Guard authorised the Hi-Rail Driver to travel from the worksite to the Outer Home Signal at Top Points when the Hi-Rail Driver radioed requesting

¹⁰ Zig Zag Railway – Rail Safety Management Plan – Feb 2009, Rev1.1, section 2.3

¹¹ Zig Zag Railway – Operations Manual – June 2009, section 11.12

¹² Ibid., section 2.16.15

¹³ Ibid., section 11.4

permission to travel in the section. The Guard stated that he was hesitant to authorise the move but, as he thought the Rail Motor was still at Top Points Station, he believed he could do so without reference to the Train Controller. It should be noted that the Guard had only recently been qualified as a guard on ZZR and indeed had yet to be issued with a ZZR Certificate of Competency. The issue of the train controller authorising non-timetabled movements is not included in the ZZR Guard's Instruction Check Sheet or Safeworking Exam.

Actions of the Hi-Rail Driver and Passenger

- 2.23 When it was discovered at Clarence that the Staff had been left behind at Top Points, the drivers of the Hi-Rail and Rail Motor discussed the situation. The Hi-Rail Driver accepted the arrangements proposed that the Hi-Rail follow the Rail Motor on the Rail Motor Driver's (Operations Manager's) authority. He stated that while he *"thought it was not the safest (way to do it)"* he accepted the authority of the Operations Manager.
- 2.24 When the Hi-Rail was travelling from Clarence to Top Points, immediately before the collision, the Hi-Rail was not facing the direction of travel. It was incumbent on the Hi-Rail crew, therefore, to keep a lookout while reversing, either by checking their mirrors or turning and looking through the rear window. The Hi-Rail Driver stated that he did maintain a lookout using the vehicle's rear view mirrors but that he did not see the Rail Motor. Unlike looking ahead through the windscreen, observing images in rear view mirrors requires a deliberate act which involves some effort and concentration (see *Photograph 11*).
- 2.25 As the Hi-Rail Driver had been given authority (by the Rail Motor Guard) and had an expectation that the line was free from any other rail traffic, the incentive to maintain a vigilant lookout is likely to have been diminished. The elapsed time between the Rail Motor and Hi-Rail becoming visible to each other and the collision, at a distance that available evidence puts at approximately 100m, would have been about 10 seconds. If the Hi-Rail crew had been reasonably vigilant, it could be expected that they would have observed the Rail Motor and applied the brakes. Both the Driver and Passenger said they did not see the Rail Motor before impact.



Photograph 11: Rear view mirror

Operations Management

- 2.26 There are only two operational sections in the ZZR: Clarence to Top Points, and Top Points to Bottom Points. Contrary to specified operational procedures, trains regularly departed Top Points for Clarence without the Staff for the section. This was due primarily to the long-standing practice of carrying both Staffs (Clarence - Top Points, Top Points - Bottom Points) in the Lithgow end cab of the Rail Motor, thereby preventing the Staffs from being sighted by the driver upon departure from Top Points.
- 2.27 On the day of the collision, the Rail Motor travelled from Top Points to Clarence without the Staff. The Rail Motor Driver, who was also the ZZR Operations Manager and Train Controller on the day, made the decision to travel back to Top Points on his own authority. While it was in his delegated authority, as Operations Manager, to make this decision, other options were not considered. These options might have included recovering the Staff from Top Points by road or arranging for someone from Bottom Points to travel to Top Points, secure the Staff and issue a SAF.
- 2.28 It was reported that, on occasions, ZZR qualified workers acted independently or in concert with others to arrange rail traffic movements without the express

permission of the train controller. Although such movements contravened the requirements of the Operations Manual,¹⁴ the existence of the practice may have led to the Rail Motor Guard, a relative new-comer to ZZR, believing that he had the authority to authorise the Hi-Rail's movement from the worksite to the yard limits of Top Points.

- 2.29 Both of these latent conditions were known to ZZR management, and crucially to the Operations Manager, but they were tacitly permitted to be practiced. The Operations Manager had a documented responsibility to: *"Initiate corrective action where breaches of safety requirements are detected"*¹⁵ but did not do so in relation to the Staffs. That such a senior member of the organisation was involved in actions contrary to good safety practice is indicative of a lax approach to safety management within the organisation.
- 2.30 The ZZR is established as a co-operative under the requirements defined by the NSW Department of Fair Trading. There is a Board of Directors which is elected from the ranks of the volunteers. According to the Department of Fair Trading, it is the Board of Directors that manage the business of the co-operative and *"are responsible for issuing instructions to those persons charged with the day to day management of the co-operative"*.¹⁶
- 2.31 The Board appoints other positions within the organisation such as the Chairman, the Operations Manager and the General Manager. The General Manager has authority to make decisions on operational and maintenance issues but any major capital expenditure must be referred to the Board. There had been a change of General Manager in the previous year and the Acting General Manager's last day was coincidentally the day of the collision. These organisational changes detracted from ZZR's ability to implement a stable environment for effective operational management.

Fatigue

- 2.32 In examining the performance of the Rail Motor Driver on the day, the issue of fatigue was considered and the following factors were weighed:

¹⁴ Ibid., section 13.3

¹⁵ Zig Zag Railway – Rail Safety Management Plan – Feb 2009, Rev1.1, section 2.3

¹⁶ NSW Department of Fair Trading website accessed on 14 June 2011

http://www.fairtrading.nsw.gov.au/Cooperatives_and_associations/Cooperatives/Directors_officers_and_auditors.html

- The collision happened on a Friday afternoon at 1.30pm which is around the time when an afternoon circadian low begins and research shows that human performance can be degraded, resulting in reduced vigilance, slowed reaction times and attention deficits.¹⁷
- This research also found that: *“in the older driver (age greater than 65) fall-asleep crashes occurred predominately during mid-afternoon”*. The Rail Motor Driver fell into this age category.
- The Driver had started work at 8.30am and had worked continuously without a break until the collision. Research shows that the risk of making an error increases with the time on task.¹⁸
- The Driver stated that he had not been sleeping well and did not sleep well the night before, as he was disturbed during the night. He said: *“I probably was fatigued, although I didn’t believe I was”*.

Given these fatigue indicators and his own post-accident assessment, it is likely that fatigue adversely affected the Driver’s task performance on the day of the accident.

2.33 The shift length and roster patterns for the Hi-Rail Driver and Passenger were also examined for two weeks leading up to the collision and were found to be compatible with industry guidelines for a low risk of fatigue. They both stated that they had an early night, slept for eight hours and were feeling rested when they started that day. They had both just completed a lunch break and had had a morning tea break as well. These factors would indicate that the Hi-Rail crew members were unlikely to have been affected by fatigue.

2.34 The Rail Motor Guard had worked nine consecutive days before the collision. When interviewed, he stated that he had six hours sleep the night before, about an hour shorter than his usual work and non-work day sleep length. He said that, although he had slept for a reduced amount of time, his sleep quality was good and he was feeling good on the day of the collision. During the day, he had had a 20 minute break. These factors increased the likelihood that there may have been some degree of fatigue present but there

¹⁷ Al Pack, AM Pack, E Rodgman, A Cucchiara, D Dinges & C William Schwab, ‘Characteristics of crashes attributed to the driver having fallen asleep’, *Journal of Accident Analysis and Prevention*, Vol. 27, No. 6, 1995, pp. 769-7

¹⁸ Rail Safety & Standards Board, ‘Human factors study of fatigue and shift work – Appendix 1: Working patterns of train drivers – Implications for fatigue and safety, T059, 2004

were no behavioural indicators or performance errors consistent with his being fatigued.

Incident Response

- 2.35 Despite the collision being classified as a Category 'A' notifiable incident,¹⁹ there was a three-hour delay in notifying ITSR of the collision and four hours had elapsed by the time OTSI learnt of the collision.
- 2.36 The collision was not reported immediately by the Rail Motor Driver. The Driver stated that upon arrival at Bottom Points the *"incident was known about"* and he felt that there was no need to report it further. The General Manager learnt of the collision about 30 minutes after it had occurred. The accident scene was not preserved and it seems that the accident site would have been cleared up if not for the intervention of the General Manager.
- 2.37 The procedures outlined in the document entitled "Emergency and Occurrence Management" were not followed by the Rail Motor Driver.²⁰ An ITSR inspection a few weeks before the collision found that this document was currently being developed and ZZR were directed to provide the finalised document by 30 March 2011. At the time of the accident the document was not finalised.

Communication

- 2.38 Geographically, the ZZR organisation is split between the main office at Clarence and the workshop and office at Bottom Points. The area of Top Points is isolated and the Operations Manager and Train Controller are often on track. There is no mobile phone reception in the vicinity of Clarence and Top Points. Communications between drivers and train controllers is by two-way radio. The usual practice is that two hand-held radios are taken onto the Rail Motor even though one car is fitted with a base radio. On the morning of the accident, when the Guard went to take the radios, only one was serviceable, leaving them one short.
- 2.39 There was a fixed radio in the Lithgow end of the Rail Motor but not in the Clarence end. The Guard had taken the hand-held radio, leaving the Rail

¹⁹ Rail Safety (General) Regulation 2008, Clause 27

²⁰ Rail Safety Management Plan Emergency and Occurrence Management - ZZR P052 - September 2010

Motor Driver operating from the Clarence end with no means of communication. The Operations Manual stipulates that every *“train, signalman, worksite supervisor, hi-rail vehicle, section car operator and track machine operator must have a working UHF radio.”*²¹ On departure from Top Points, the Rail Motor complied with the letter of this directive, but the reality was that, as the radio was located in the unoccupied cab, it was not available to the Driver to use.

- 2.40 The pairing of a newly qualified Guard with a long-serving experienced Driver meant that communication between them may have been constrained. At one point, the Guard needed to interrupt the Driver who was engaged with passengers but he did not do so. The Guard said that he had difficulty in communicating with the Driver and felt especially unable to question his decisions due to his seniority. This authority gradient, where there is a large difference in the authority level of crew, has been cited as a factor in other accidents. A Canadian rail accident investigation stated:

*“New conductors can be expected to rely on the experience of the locomotive engineer to assist them in performing their duties. It can be intimidating for newly trained conductors to assert themselves when they are paired with locomotive engineers who have many more years of experience.”*²²

The Guard should not have left the Staff behind at Top Points Signal Box. However, this error should have been detected, if the procedures had been followed, before the Rail Motor set off from Top Points. Better communication between the Driver and the Guard was needed.

- 2.41 The Driver also did not communicate with the Guard when he made the decision to leave Top Points and travel to the worksite to give the Hi-Rail Driver the Staff. It is possible that the Driver did not think it necessary to confirm his actions with the newly-qualified Guard.
- 2.42 An authority gradient also existed between the younger Hi-Rail Driver and the experienced Rail Motor Driver. The Hi-Rail Driver accepted the Operations Manager's decision without expressing his reservations even though he later

²¹ Zig Zag Railway – Operations Manual – June 2009, section 1.11

²² Transportation Safety Board of Canada – Rail Report - Rear-end Train Collision, R98V0148, 11 August 1998

said he was not entirely satisfied with the proposed arrangements for departing Clarence.

Other Safety Matters

2.43 ITSR Audits and Compliance Activity. Since 2005, ITSR has conducted 10 audit and inspection activities on ZZR. The most recent inspection before the collision was on 7 March 2011, the purpose of which was to follow up an Improvement Notice relating to the Health and Fitness of Rail Safety Workers issued on the 12 May 2010. ITSR was satisfied with the actions taken by ZZR and closed the notice.

2.44 At the time of the inspection, three other findings remained open from previous ITSR inspections. At the time of the collision, the following matters were still outstanding:

- 1. ZZR at this time has not developed specific Safety performance indicators relating to the operation of the railway.*
- 2. It was found that ZZR are currently developing an updated Emergency Management Plan with local emergency services. This Plan is required to comply with s17 of the Rail Safety Act 2008.*
- 3. ZZR are required to provide Safety Performance Indicators or alternative systems that monitor the implementation of rollingstock and infrastructure programs.²³*

2.45 Since the collision on 1 April 2011, ITSR has issued a number of Improvement and Prohibition Notices to ZZR. On the 20 June 2011, ITSR issued a Prohibition Notice stating that:

- (a) All movements of rolling stock on the ZZR rail network must be authorised by the Train Controller, or in the absence of a Train Controller, the competent person appointed by the ZZR Operations Manager*
- (b) All movement of rolling stock must be confirmed before departure, adopting the radio protocols in clause 1.1 of the ZZR manual.*
- (c) The Train Controller must have effective radio communication with all railway operations on the ZZR network at all times.*

²³ ITSR letter to ZZR, ref. A260993/qA10063, dated 30 March 2011

(d) ZZR to develop and implement a contingency in the event of a failure of the Train Controller radio communication.

2.46 On the 6 September 2011, ITSR issued a Improvement Notice to ZZR stating that:

ZZR have not been able to demonstrate effective governance and management of its railway operations by not identifying the risk profile of its railway operation including the failure to implement adequate controls to monitor and manage risks to safety of its railway operations and the effectiveness of its stated rail safety standards and procedures. ZZR have not been able to demonstrate compliance with their obligation to have systems and procedures in place to enable it to meet its regulatory obligations of its stated operating procedures and standards for the safety of its railway operation.

As a result, ITSR has requested that ZZR, amongst other things: review its *Rail Safety Management Plan*; review its operational rules in its *Operations Manual*; provide evidence that it has adequately reviewed its processes and implemented controls, and provide demonstrable evidence that it has identified risks associated with rail operations.

2.47 As a result of a another collision between two track maintenance vehicles on 28 July 2011, ITSR issued a Prohibition Notice to ZZR on 22 September 2011, stating that:

The movement of the tamper under its own power is to be prohibited until such time as ZZR develop procedures and train staff and improve the braking capacity.

In addition, ITSR completed a full compliance inspection on 17 October 2011.

Remedial Actions

2.48 Since the collision, ZZR has instituted a number of changes and issued reminders to staff, those which are relevant to the accident being:

- The Train Staff or Ticket is to be carried in the driving compartment of the vehicle that is being operated.
- All train movements need the approval of the train controller who will record the details of each movement.

- Every train driver and guard, signalman, ganger, worksite supervisor, hi-rail vehicle, section car operator and track machine operator must have a working ZZR UHF radio at the commencement of operations.
- If effective communications with the Train Controller cannot be established or maintained, then no train movements are permitted until communications have been restored.
- Rail Motors must be worked by a crew of two - driver and guard.
- The Hi-Rail is to be driven in a forward direction wherever possible.
- Train Register Books are now located at Top Points Signal Box, Bottom Points Signal Box and Clarence Safe Working Hut.

PART 3 FINDINGS

Causation

- 4.1 The collision occurred because the Driver of the Rail Motor and the Driver of the Hi-Rail were unaware that they were travelling towards each other on the same track in the same section and, in the case of the Rail Motor Driver, when he saw the approaching Hi-Rail, was unable to take any emergency action which would have been effective in preventing the Hi-Rail from colliding with the Rail Motor.
- 4.2 The lack of situational awareness resulted from the following procedural errors:
- the Rail Motor Driver departed Top Points without communicating his intention to his Guard or the Hi-Rail crew, and
 - the Rail Motor Guard exceeded his authority by authorising the Hi-Rail to leave the RTA worksite and proceed to Top Points.

Contributing Factors

- 4.3 The Driver of the Hi-Rail was unable to take any emergency action to prevent the collision because he was travelling backwards down the track and neither he nor his Passenger was maintaining an effective lookout. [Recommendation 5.2]
- 4.4 The Rail Motor Driver left Top Points without any radio communication at his end of the Rail Motor and no other means of communicating with other staff. Consequently, he did not hear the Hi-Rail Driver request and get approval from the Guard to travel to Top Points. [Recommendation 5.2]
- 4.5 Both the Driver and Guard of the Rail Motor had made an error on a previous trip when they failed to check they had the Staff when they departed Top Points. [Recommendation 5.2]
- 4.6 The Rail Motor Driver, acting in his capacity as Operations Manager, authorised both the Rail Motor and Hi-Rail to depart Clarence with the Staff unsecured at the other end of the section. [Recommendation 5.1]

Other Safety Issues

- 4.7 The collision was not notified immediately by the Rail Motor Driver to anyone else in ZZR. There was also a delay in the notification to the OTSI and ITSR Duty Officers. [Recommendation 5.5]
- 4.8 The Train Register Books at the Top and Bottom Points Signal Boxes were not being maintained as required. [Recommendation 5.3]
- 4.9 The management of operations was concentrated in the hands of one person on the day of the collision. The Rail Motor Driver was also acting as the Train Controller as well as holding the position of Operations Manager. [Recommendation 5.4]
- 4.10 There was an accepted practice of qualified workers authorising rail traffic movements without reference to the train controller. [Recommendation 5.2]
- 4.11 It was accepted practice for both Staffs being kept in the Lithgow end of the Rail Motor. This increased the probability that the required check, that the correct Staff was at hand, was not done if the Rail Motor was driven from the Clarence end. [Recommendation 5.2]
- 4.12 The procedure relating to the collection of Staffs from Signal Boxes was ambiguous. [Recommendation 5.1]
- 4.13 The Rail Motor Driver allowed two passengers to ride in the front cab on a journey from Top Points to Clarence. This may have distracted him and, to a lesser extent, the Guard from checking if they had the Staff before departing. There was no rule about passengers travelling in the cab of the Rail Motor. [Recommendation 5.1]
- 4.14 The Rail Motor Driver's performance may have been degraded by fatigue.
- 4.15 The Hi-Rail was travelling above the posted speed restriction of 10km/h on the No.1 Viaduct. [Recommendation 5.2]

PART 4 RECOMMENDATIONS

To improve the safety of its operations and prevent a recurrence of this type accident, it is recommended that the following additional remedial safety actions be undertaken by the Zig Zag Railway Co-Operative Ltd:

- 5.1 Review current operational procedures for the implementation of safeworking systems and ensure they are being adhered to by the Operations Manager.
- 5.2 Develop and implement an effective internal monitoring and auditing program for testing compliance with safeworking rules and procedures.
- 5.3 Ensure the Train Register Books are maintained and train movements are recorded correctly.
- 5.4 Review the structure and staffing of operational safety positions, in particular with regard to the functions of Train Control and Operations Manager.
- 5.5 Ensure that all incidents are reported promptly within the organisation and to OTSI if the incident is a notifiable occurrence in accordance with the *Rail Safety (General) Regulation 2008*.

PART 5 APPENDICES

Appendix 1: Sources and Submissions

Sources of Information

- Bureau of Meteorology
- Independent Transport Safety Regulator
- Zig Zag Railway

Submissions

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Independent Transport Safety Regulator
- Zig Zag Railway Co-operative Ltd

Submissions were received from both.

The Chief Investigator considered all representations made by DIPs and responded to the author of each of the submissions advising which of their recommended amendments would be incorporated in the Final Report, and those that would not. Where any recommended amendment was excluded, the reasons for doing so were explained.