RAIL SAFETY INVESTIGATION REPORT

BALLAST TRAIN COLLISION

BENGALLA TO MANGOOLA SECTION

18 MAY 2012

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ACRONYMS AND ABBREVIATIONS

ARTC ............ Australian Rail Track Corporation
CAMS ............ Complete Asset Management Services
CAN ............... Condition Affecting the Network
CFCLA .......... Chicago Freight Car Leasing Australia
ITSR ............... Independent Transport Safety Regulator
JHG ............... John Holland Group
LPA ................ Local Possession Authority
LS Rail .......... Leighton Swietelsky Joint Venture
NCCN .......... (ARTC's) Network Control Centre North, Broadmeadow
OTSI ............... Office of Transport Safety Investigations
PPO ............... Possessions Protection Officer
PO ................ Protection Officer
RIMAC ......... Rail Infrastructure Maintenance and Certification
RISSB .......... Rail Industry Safety and Standards Board
SWMS ............ Safe Work Method Statement
TOC ............... Train Operating Conditions (Manual)
TTM ............. Train Transit Manager
### GLOSSARY OF TERMS

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<th>Term</th>
<th>Definition</th>
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<tr>
<td>Consist</td>
<td>Listed order of the vehicles arranged to make up a complete train.</td>
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<tr>
<td>Detonator</td>
<td>A device that explodes on impact, used to attract the attention of drivers and track vehicle operators.</td>
</tr>
<tr>
<td>Disabled</td>
<td>Unable to travel due to a defect.</td>
</tr>
<tr>
<td>Discrete Channel</td>
<td>A system in which only the intended participants in a radio conversation can take part in the conversation.</td>
</tr>
<tr>
<td>Driver</td>
<td>A qualified worker controlling the movement of a train.</td>
</tr>
<tr>
<td>Effective Communication</td>
<td>The ability to successfully send, receive and understand information. The communication does not need to be continuous.</td>
</tr>
<tr>
<td>Local Possession Authority (LPA)</td>
<td>An advertised formal authority to occupy a closed defined portion of track for a specified period.</td>
</tr>
<tr>
<td>Location</td>
<td>A place in the ARTC Network with a designated name, identification number, or kilometrage.</td>
</tr>
<tr>
<td>Marshal</td>
<td>To arrange the order of vehicles in a train’s consist.</td>
</tr>
<tr>
<td>Must</td>
<td>The word ‘must’ indicates that a statement is mandatory.</td>
</tr>
<tr>
<td>Network Control</td>
<td>The function responsible for managing train paths and issuing occupancy authorities.</td>
</tr>
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<td>Network Control Officer (NCO)</td>
<td>A train controller for an unattended location, a signaller for an attended location, or a delegate carrying out some functions of a train controller or signaller.</td>
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<tr>
<td>Network Procedures</td>
<td>Procedures issued by ARTC for the safe conduct of work on the ARTC Network. To be read in conjunction with the Network Rules.</td>
</tr>
<tr>
<td>Network Rules</td>
<td>Rules issued by ARTC to mandate the requirements for safe operation in the ARTC Network.</td>
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<td>Pilot</td>
<td>To direct or guide drivers and track vehicle operators and advise them about local conditions and operating restrictions on running lines and at worksites. A qualified worker who accompanies, directs and advises drivers and track vehicle operators.</td>
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<tr>
<td>Possession Protection Officer (PPO)</td>
<td>The qualified worker responsible for coordinating protection of worksites under a Local Possession Authority (LPA). See also Protection Officer.</td>
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<tr>
<td>Propel</td>
<td>To manage airbrake operation of moving rail traffic from a cab that is not in the lead vehicle of a train.</td>
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<tr>
<td>Protection</td>
<td>The means used to prevent rail traffic from entering a worksite or other portion of track, or to prevent road or pedestrian traffic entering a level crossing.</td>
</tr>
<tr>
<td>Protection Officer</td>
<td>The qualified worker responsible for protection. See also Possession Protection Officer.</td>
</tr>
<tr>
<td>Qualified Worker</td>
<td>A worker certified as competent to carry out the relevant task.</td>
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<tr>
<td>SAFE Notice</td>
<td>An authorised notice distributed to give advice in addition to that provided in the published ARTC Network Rules, ARTC Network Procedures or Local Appendices.</td>
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<tr>
<td>Section</td>
<td>The line between the departure-end yard limit of one location and the arrival-end yard limit of another location. A section consists of one or more blocks.</td>
</tr>
<tr>
<td>Stable</td>
<td>To leave a train, track vehicle or vehicle unattended and secured, usually in a siding.</td>
</tr>
<tr>
<td>Track Vehicle Operator</td>
<td>A qualified worker controlling the movement of a track vehicle.</td>
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<tr>
<td>Track Work</td>
<td>Construction, maintenance or repair work on or around infrastructure in the Rail Corridor.</td>
</tr>
<tr>
<td>Train</td>
<td>A locomotive or self-propelled vehicle, alone or coupled to one or more vehicles.</td>
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<tr>
<td>Train Operating Conditions (TOC) manual</td>
<td>A manual issued by ARTC that prescribes the minimum operating requirements for trains and track vehicles in the ARTC Network.</td>
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EXECUTIVE SUMMARY

At approximately 0515 on Friday 18 May 2012, the leading wagon of Australian Rail Track Corporation (ARTC) ballast train 6M21 was derailed after colliding with an unmanned ballast regulating machine within a worksite in the Bengalla to Mangoola section on the Ulan line. The regulator was stationary, having run out of fuel. Four workers who were riding on the train underwent precautionary examination at Muswellbrook Hospital and were treated for minor bruising. Although the regulator was pushed approximately 50 metres by the train, the rolling stock suffered comparatively minor damage.

At the time of the collision the train was being propelled under the direction of a Pilot standing on the rear platform of the leading wagon. The Pilot had been made aware of the disabled regulator by the qualified worker acting in the capacity of Protection Officer of a resurfacing team responsible for it. However, he had not been given, nor had he sought, details of the machine’s exact location and believed it was standing approximately three kilometres beyond the intended drop point for the ballast. The Pilot did not see the regulator until just before the train collided with it.

The collision of ballast train 6M21 with the disabled ballast regulating machine, and the subsequent derailment of the leading wagon, was found to be attributable to ineffective communication between safety critical staff about the location of the disabled ballast regulator.

Overreliance was placed on the direction lights on the regulator to indicate its stationary presence and provide sufficient warning of an obstruction on the track, but these lights were reported to not be illuminated when the ballast train was approaching. Also contributing to the incident was the fact that no warning devices were placed on the track in accordance with ARTC’s Network Rule ANTR 416 Disabled Trains when the regulator ran out of fuel.

The investigation also found shortfalls in a number of supervisory, management and protection practices employed by the work groups.

1 Times shown throughout are Australian Eastern Standard Time (AEST), 10 hours ahead of Coordinated Universal Time (UTC+10).
The majority of recommendations are directed to the Australian Rail Track Corporation with the intention of improving the protection arrangements for disabled rail vehicles within worksites, the practices and procedures employed at work sites, the documentation held at worksites and standardisation of safety equipment on ballast wagons. Details of the Findings and Recommendations are contained in Parts 2 and 3 respectively.
PART 1 CIRCUMSTANCES OF THE INCIDENT

Incident Synopsis

1.1 At approximately 0515 on Friday 18 May 2012, the leading wagon of Australian Rail Track Corporation (ARTC) ballast train 6M21 was derailed after colliding with an unmanned ballast regulating machine (the “regulator”) at 300.500kms. The train was being propelled within a ballast cleaning worksite in the Bengalla to Mangoola section on the Ulan line. The regulator, which was disabled because it had run out of fuel, was pushed for approximately 50 metres by 6M21 after the collision. However, the rolling stock suffered comparatively minor damage. The ballast train was being directed by a Pilot (the “Pilot”) from the platform at the rear of the leading wagon (in the direction of travel) at the time.

1.2 The worksite spanned approximately 13 kilometres of the line from Muswellbrook and was one of a number of worksites associated with a major, five day close-down of the ARTC leased network in the Hunter Valley Region. Multiple workgroups were operating within the bounds of the worksite.

1.3 Five workers were riding on the train; four suffered minor bumps and bruising and were transported to Muswellbrook Hospital for precautionary examination. This included two who jumped from the train when alerted to the impending collision.

Location and Track Information

1.4 The incident occurred at 300.500kms in the vicinity of Roxburgh, in the Bengalla to Mangoola section on the Ulan line (see Figures 1 & 2). The Ulan line is a single branch line located in rail territory leased by ARTC from the NSW Government and runs generally west from Muswellbrook to Ulan in the Hunter Valley Region. Under the terms of the lease, ARTC is responsible for track maintenance and train control functions.

1.5 The line supports the movement of bulk commodities such as coal and grain, and provides access to a number of coal mines along its length. The track is classified as Class 1C track in accordance with the Rail Industry Safety and Standards Board (RISSB) National Codes of Practice.\(^2\)

\(^2\) Class 1C track is constructed using 60kg/m rail fixed to concrete sleepers.
Figure 1: Incident location

Figure 2: Overview of location

OTSI Rail Safety Investigation

Ballast Train Collision, Bengalla to Mangoola Section, 18 May 2012
The Worksite

1.6 The worksite between Muswellbrook and Mangoola was one of a number that formed part of a continuous, major, five day close-down and possession of the ARTC network. The possession encompassed the main and nominated branch lines between Islington Junction (Newcastle) and Narrabri as well as Muswellbrook to Ulan (see Figure 3).

Figure 3: Possession area

1.7 For the closedown period, ARTC had listed 117 individual projects to be carried out at various locations. Included in these projects were the following major works:

- re-railing
- ballast renewal
- resurfacing
- re-timbering turnouts and bridge works
- installing new turnouts
- widening of track cuttings.
The closedown utilised a Local Possession Authority (LPA) as the formal protection authority for the work on track and was effective for the period from 6:00am on 15 May 2012 to 6:00am on 19 May 2012. The LPA was issued in accordance with ARTC Network Rule ANWT 302 Local Possession Authority and ARTC Network Procedure ANPR 700 Using a Local Possession Authority. It was advertised vide ARTC Train Alteration Advice 0508-2012.

In accordance with Network Rule ANWT 302, the Possessions Protection Officer (PPO) for the LPA was required to ensure that each worksite inside the LPA boundaries had a Protection Officer (PO). Each PO was responsible for the planning and implementation of the worksite protection arrangements at the site under their control in accordance with ARTC Network Rule ANWT 300 Planning Work in the Rail Corridor.

The worksite between Muswellbrook and Mangoola was designated No.85. The project at worksite No.85 consisted primarily of multiple work groups carrying out ballast renewal/cleaning and resurfacing works within its bounds. The project was being managed by John Holland Group (JHG) under contract to ARTC with RailCorp managing the ballast cleaning machine works and Leighton Swietelsky Joint Venture (LS Rail) providing mechanised equipment and crews for the resurfacing operations. JHG maintained overall responsibility for ballast unloading operations and protection arrangements at the site.

Both the JHG and LS Rail engaged qualified workers\(^3\) to direct work train and track machine movements within the worksite. However, the qualified worker for the resurfacing works by LS Rail acted also in the capacity of PO for the team as it was operating as a separate workgroup within the worksite on night shifts. Although this arrangement was not documented in the control structure for worksite No.85, it was in place for the entire possession.

All POs engaged for the close-down were required to attend a briefing for the works. Briefings were held on 9, 10 and 11 May at Muswellbrook and Maitland. While two LS Rail supervisors attended the briefing at Maitland on 11 May, neither the PO nor the qualified worker (hereafter referred to as the Traffic Officer/PO) involved in the incident attended any of these briefings because they were short notice replacement personnel.

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\(^3\) The qualified workers were termed Traffic Officers in the organisational chart for the ARTC Scope of Works for the worksite.
Night Shift 17 May 2012

Site Conditions

1.13 Weather conditions at the time of the collision were described as dry and cold. Minimum night time temperatures of 2°C, 1.4°C and 0.9°C were recorded at the nearby Bureau of Meteorology weather recording stations at Jerry’s Plains, Singleton and Scone respectively. Workers on the ballast train reported that they had encountered patches of misty fog after departing the loading point near the site office. Because of the cold, they had positioned themselves between the leading two wagons to provide more protection as the train was being propelled. Despite the conditions, the Pilot was not wearing appropriate clothing to adequately protect him from the cold. Comments from the track machine operators supported the observations of the conditions by those on the ballast train.

The Ballast Train

1.14 6M21 was comprised of two locomotives (HL203 and GL102) hired by Freightliner Australia Pty Ltd from Chicago Freight Car Leasing Australia (CFCLA) and 22 ADFF coded ballast hopper wagons owned by ARTC4 (see Photographs 1 & 2). The train measured 298.9 metres in length.

1.15 All the wagons were fully loaded except for the leading and second wagons which were only partially loaded.

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4 The wagons were previously coded NDFF but were not listed in the ARTC or RailCorp Train Operating Conditions (TOC) Manuals after being modified and recoded.
Photograph 1: Locomotives of 6M21

Photograph 2: Locomotives and wagons of 6M21
The Regulator

1.16 The regulator (BX-045) was a Plasser PBR 203 model owned by ARTC weighing 22.5 tonnes and measuring 11 metres in length (see Photograph 3). It was hired and crewed by LS Rail for the duration of the possession. Its function was to profile the shoulders of the ballast and broom excess ballast from around the track fastenings.

![Photograph 3: Ballast Regulator BX-045](image)

The Work Teams

The Worksite Protection Officer

1.17 The Worksite PO was an employee of Rail Infrastructure Maintenance and Certification (RIMAC) and contracted by JHG for the night shifts during the possession.

1.18 The PO was qualified for the Safeworking role, holding current medical and competency qualifications as a Protection Officer Class 4 completed on 25 January 2012.
The Resurfacing Team

1.19 The resurfacing team operating the ballast regulator and a ballast tamping machine comprised of a Works Supervisor and five employees from LS Rail, and a contracted qualified worker (Traffic Officer/PO).

1.20 Two fitter/operators from the team worked the ballast regulator during the shift. They, and others in the team, were qualified overseas workers working in Australia under the 457 work visa scheme since October 2011 due to a shortage of competent machine operators. They had undergone initial training and qualification as “Track Vehicle Operator” and “Operate Self-Propelled Equipment on Track” with a registered training organisation upon arrival in Australia. The training included qualification in the ARTC Network Rules and Procedures and enabled them to operate the regulator and various other types of track machines on the ARTC Network.

1.21 Both operators had also undergone the requisite medical assessments for operation of the equipment on the network. Further, both operators completed a competency assessment on 30 April 2012 after a four day familiarisation with the regulator while it was stowed at Maitland. The assessment included both theoretical testing, including knowledge of the Network Rules and Procedures, and on-the-job observation by supervisory staff.

1.22 The Traffic Officer/PO was provided by Complete Asset Management Services (CAMS), a labour hire company. He held current medical and competency qualifications as a Protection Officer Class 4 and Hand Signaller Level 2 which qualified him for the Safeworking role.

The Ballast Unloading Team

1.23 The ballast unloading team on 6M21 comprised of a Works Supervisor, the Pilot and three labourers to operate the dumping controls for the wagons. The role of the Pilot was to direct the crew on the locomotives in accordance with ARTC Network Procedure ANPR 710 Piloting Trains and Track Vehicles. The Works Supervisor was an employee of JHG while the Pilot was subcontracted to JHG from Derryville Rail, a labour hire company. The three labourers were subcontracted to JHG from another labour hire company.

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5 The 457 work visa is a temporary work visa issued by the Australian Government which allows employers in Australia to sponsor overseas workers who can fill vacant skilled positions.
1.24 The Pilot held current medical and competency qualifications as a Protection Officer Class 3 and Hand Signaller Level 2; the requisite competency levels for piloting trains (see Glossary of Terms). However, he was not appropriately qualified or trained in the ARTC procedures for propelling trains which required the higher Safeworking Level 1 competency.

The Locomotive Crew

1.25 The locomotives of 6M21 were crewed by two Freightliner employees based at the Freightliner Depot at Sandgate (Newcastle).

1.26 Both crew members were within their respective medical and competency assessment periods. They were familiar with, and qualified for, the routes on the main line through Muswellbrook and the Ulan line.

The Commencement of the Shift

1.27 At approximately 1700 on 17 May 2012, the PO and the staff members for the two teams on night shift commenced arriving at the worksite. The PO arrived at the site office located at 294.000kms and received a handover briefing from the day work PO before conducting a pre-work briefing for the ballast unloading team which he completed at 1815. The briefing and supporting documentation were the same as for the previous briefings conducted at the worksite. The pre-work briefing form included the identification of the hazard “struck by machinery” for which a 10m exclusion zone around machines was implemented as a control measure. The ballast unloading team, including the Pilot, signed the form and commenced their allotted tasks.

1.28 The resurfacing team, having established its own separate work group, went directly to a road crossing located at 299.000kms near where a regulator and tamper were being used to resurface the track. Here, a handover between day shift and night shift teams occurred as well as a pre-work briefing which was conducted by the Traffic Officer/PO and completed at 1745. Again, the pre-work briefing and supporting documentation were the same as for the previous briefings conducted for the resurfacing team. Significantly, the only time that any members from the resurfacing team attended the site office for a briefing with the Worksite PO was at the commencement of the works on 15 May 2012.
1.29 The operators assigned to the regulator and tamper conducted a routine inspection of their machines before commencing operations. At interview, the operator of the regulator stated that, while no significant defects were identified during the inspection, he had noted that the fuel gauge on the machine was indicating a low amount and reported this to the Works Supervisor. The Supervisor indicated that the regulator would be refuelled during the next day.

1.30 The ballast unloading and tamping operations proceeded during the early part of the shift without incident. The PO monitored updates on the movements and position of vehicles within the worksite area as they were reported, using a board inside the site office.

1.31 Shortly after 0400, a replacement locomotive crew arrived at the worksite to relieve the locomotive crew on work (ballast) train 6M21. They stated that they were given a pre-work briefing at the site office which they considered was more relevant to the track workers on site rather than their role. They then signed the pre-work briefing form and proceeded to the ballast train which was being loaded at the time from a stock pile near the site office at 293.907kms.

1.32 At about the same time, the LS Rail operators on the regulator and the tamper, who were working between 300.500kms and 301.000kms, changed roles. The role change had been planned at the beginning of the shift to allow the operator on the regulator to maintain his competencies with the operation of the tamper.

1.33 Some five minutes after taking charge of the regulator (reportedly 0413), the new operator noted its engine begin to run roughly as if it was beginning to run out of fuel. Noting the fuel gauge on the dashboard was indicating empty, he immediately stopped the regulator and reported the situation by radio to the LS Rail Supervisor who was at the tamper.

1.34 The new operator decided to leave the regulator and go to collect fuel from the nearest source being the tamper which was carrying approximately 2000 litres. He stated that while a number of lighting configurations were available on the regulator, including an amber rotating beacon light, he left it set with a pair of the flashing red direction lights positioned diagonally opposed on the roof. Although the regulator was now effectively disabled, he did not deal with the situation in accordance with ARTC Network Rule ANTR 416 Disabled Trains or place any protection on the track in accordance with ARTC Network Rule ANTR 400.
Protecting Trains. Instead, he advised the LS Rail Works Supervisor that there were lights operating on the regulator. A LS Rail survey assistant stated later that he recalled seeing the lights of the regulator operating as the operator passed his work location near the tamper on the way to collect fuel.

1.35 At the completion of loading, the Pilot on work train 6M21 notified the PO of an intended train movement to the nearby Old Bengalla Road level crossing in order to refuel a generator set being used to provide lighting as the train was being propelled. At 0421, the PO notified the Pilot that workers were on their way to assist with the refuelling of the generator at the fuelling point.

1.36 At 0426, the PO telephoned the Traffic Officer/PO to inform him that the ballast train was ready to set back and propel into the section. The Traffic Officer/PO advised the PO that the regulator was out of fuel. He did not provide any advice or confirmation about any protection arrangements in place at the regulator. Instead, the Traffic Officer/PO advised that the machines were “towards the end of the job but approaching it” although, significantly, no actual kilometrage was ever specified by the Traffic Officer/PO, nor sought by the PO. The Traffic Officer/PO further advised the PO that the ballast train did not need to be propelled back as far as his location to commence the ballast drop. The commencement of the drop point was later established to be at 300.800kms.

1.37 Meanwhile, at 0434 as the generator was being refuelled, the Pilot received a telephone call from the Traffic Officer/PO informing him that the regulator was out of fuel and “sitting 300 metres back towards Bengalla from the end of the worksite at Mangoola”. With the end of the worksite at 303.550kms, the Pilot assumed this positioned the regulator at around 303.250kms.

1.38 The Pilot called the PO via discrete radio to inform him that the ballast train was ready to move as the generator had been refuelled. The PO advised that he had spoken with the Traffic Officer/PO about the regulator and that it was standing 300 metres back from the end of the worksite. Significantly, again, no actual kilometrage was mentioned. The PO also advised the Pilot that he was to stop 6M21 at the Old Bengalla Road level crossing at 299.000kms and pick up workers involved with controlling the dropping of the ballast.
As this was occurring, the regulator operator was sourcing containers in order to drain fuel from the tamper and refuel the regulator. The tamper continued operations.

The Pilot then directed 6M21 to be propelled to the Old Bengalla Road level crossing. However, he did not establish any agreed intervals for communications with the locomotive crew in accordance with ARTC Network Rule ANTR 424 Propelling Trains or provide any details of the kilometrages for the drop points.

When it stopped at the Old Bengalla Road level crossing, a supervisor and three other workers boarded the ballast train, standing with the Pilot on the adjoining platforms between the leading and second wagons (in the direction of travel) (see Photograph 4). This location is not in accordance with Network Rule ANTR 424 which requires propelling movements to be directed from the leading end. However, the Pilot considered that, from his chosen position, and with the lighting operating, he could still direct the train movement with adequate vision over the top of the wagon. The position also offered some protection from the cold conditions as he was not wearing sufficiently warm clothing.

The driver of 6M21 accelerated to 15km/h. He conferred with the Pilot regarding the speed and was told he could go a little faster. He increased the speed to roughly 20km/h but had difficulty maintaining a constant speed due to the weight of the train, the dark conditions and the small rolling grades.

Looking across a valley, the Pilot noticed floodlights at a worksite in the distance. He also noticed the lights of a track machine a little closer. On the advice of the Traffic Officer/PO for the resurfacing team, he considered this to be the location of all the track machines.

Between 0510 and 0515, nearing the location at 300.000kms, the ballast train passed through patches of misty fog. At this point, the Pilot considered the ballast train was some three kilometres from the track machines.
The Collision and Derailment

1.45 The Pilot stated that, as 6M21 was nearing the drop point (300.800kms), he was about to contact the driver to commence slowing down when he suddenly noticed the “faint figure” of the regulator come into sight without lights operating. He immediately called “red light, red light, red light”\(^6\) to the locomotive crew. He estimated that the ballast train was approximately 35 metres from the regulator when he first sighted it. Without any means of making an emergency brake application on the wagon, he waited for the driver to do so, warning the other workers on the wagons to brace themselves for impact. Two of the workers immediately jumped from the wagon. The absence of lights operating on the regulator was corroborated by the Supervisor and the other workers travelling on the wagon.

\(^6\) Railway terminology equivalent of ‘stop, stop, stop’. He is not reporting seeing a red light.
1.46 On impact, the wagon rode up onto the broom box of the regulator causing the leading bogie to become disengaged from the wagon body and derail (see Photograph 5). The regulator was pushed approximately 50 metres along the track before 6M21 came to a stand.

After the Collision

1.47 Immediately after 6M21 came to a stand, the Pilot confirmed the welfare of everyone on the wagon, including the workers who had jumped, and directed them to move to a safe place. He telephoned the PO to inform him of the collision.

1.48 Following the call to the PO, the Pilot telephoned the Traffic Officer/PO to inform him also and ask him why there were no lights on the regulator. The Traffic Officer/PO replied that he had been assured the regulator lights were on although he had not personally verified this.
1.49 The locomotive crew secured 6M21 and attempted to call the Pilot using the
discrete radio. Unable to contact him after three attempts, they made their way
to the leading end to inspect the damage. They stated that they had not noticed
any lights in the vicinity of the regulator as they proceeded towards the point of
collision. They also stated that the regulator was in total darkness when they
arrived at the site.

Emergency Notification and Response

1.50 Upon notification of the collision by the Pilot, the PO immediately drove to the
incident site.

1.51 First notification to the Possession Protection Officer (PPO) was made at 0526
by the Supervisor on the wagons via a Closedown Manager who was assisting
the PPO. This was approximately 11 minutes after the incident, with the
Supervisor stating to the Closedown Manager that he had run back to his car in
order to retrieve his telephone. Significantly, during the call, he stated that he
believed there were no lights operating on the regulator at the time of the
collision.

1.52 When the locomotive crew reached the leading wagon, they reported the incident
to Freightliner’s Compliance and Human Resource Director at 0524. They also
reported the incident to Freightliner’s Operations Manager before reporting the
collision to the Upper Hunter 1 Controller at the ARTC Network Control Centre
North at Broadmeadow (NCCN) at 0529. This was the first notification of the
incident to Network Control and about 15 minutes after the event.

1.53 The Traffic Officer/PO and the tamper crew drove the tamper to the site of the
incident. They noted that the lights on the regulator were not operating when
they arrived.

1.54 Although arriving at the incident site at 0535, the PO did not notify Network
Control of the incident in accordance with Network Rule ANGE 206 Reporting
and responding to a Condition Affecting the Network (CAN) until 0553. Although
on site for nearly 20 minutes, he only provided limited information about the
occurrence and it was not until 0623, when Network Control contacted the driver
of 6M21, that more accurate details were given regarding the exact location and
identification of vehicles involved.
1.55 OTSI was advised of the incident by the ARTC Train Transit Manager (TTM) at NCCN at 0628 with an initial report that there was some damage but no injuries. OTSI requested that an update of the situation be provided by the TTM when more information became available.

1.56 At 0655, the TTM notified OTSI that a report had been received about a number of workers being injured in the incident but accurate details could not be provided. OTSI then directed that the site be immediately quarantined and deployed two investigators from Sydney.

1.57 The OTSI investigators arrived at 1130 and commenced initial examination of the site. They were informed that four workers had undergone precautionary examination at Muswellbrook Hospital and had been treated for minor bruising.

1.58 The site was handed back to ARTC for recovery at 1630.

1.59 A review of the incident-related telephone calls recorded at NCCN noted that, initially, no one at the site could provide accurate details of the damage or location. Further, during these calls, no information was given or sought regarding injuries even though four workers eventually attended the Hospital. This was still the case more than one and a half hours after the incident when the Team Leader from the ARTC Provisioning Centre at Muswellbrook called the TTM at around 0645 to enquire about the incident.

**On-Site Observations and Testing**

1.60 When OTSI commenced its initial inspection of the incident site and vehicles, it was noted that the battery isolating switch on the regulator was in the open (‘off’) position. However, despite extensive inquiries, it could not be established when the switch had been opened or by whom. The position of the switch is relevant to the actions of the operator when he left the regulator.

1.61 The site inspection also revealed the following:

- The regulator had been pushed approximately 50 metres from the point of impact (see Photograph 6).

- The leading bogie had derailed and disengaged when the wagon rode up the broom assembly of the regulator.
Photograph 6: Scouring to ballast formation as the regulator was pushed by 6M21

- The regulator’s wing blades were in the lowered position (see Photograph 7).

Photograph 7: Lowered wing or side blades of the regulator

- The regulator ignition key switch was in the open (‘off’) position with the transmission in the neutral position (see Photograph 8).
Photograph 8: Regulator dashboard panel

- There was no emergency equipment located on the regulator, nor was there any evidence that any protection equipment, in the form of flags, lights or detonators, had been placed on the track.

- The leading wagon of the ballast train was partially loaded (see Photograph 9). However, it could not be established whether the loading was evenly distributed within the wagon hopper before the collision. Additionally, the risks and controls for uneven loading for ballast wagons were not identified on the pre-work briefing forms and other documents at the site.
The leading wagon was not fitted with an emergency valve for the Pilot to vent the brake pipe in the event of an emergency. This was contrary to a requirement stated in ARTC training documents for ballast train workers that an emergency cock be available.7

The wagon was jury-rigged with a lighting tower powered by a portable generator set to provide the Pilot with visibility of the track as the train was being propelled (see Photograph 10). However, its lighting power only provided illumination for the immediate area ahead of the wagon and was not comparable to the distance of illumination provided by locomotive headlights.

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7 ARTC's "Ballast Train Unloading Awareness Training" presentation dated 12 September 2011.
1.62 When the battery isolating switch was closed (i.e., turned ‘on’):

- only the flashing red direction lights positioned diagonally on the roof illuminated;
- there was sufficient power held in the batteries to start the regulator. Although it was reportedly stopped because of rough running and a lack of fuel, the regulator started on the first attempt and without priming of the fuel system; and
- the flashing beacon light, headlights, direction lights, brake lights and work lights all operated normally when tested.

**Toxicology Testing**

1.63 The Pilot, the PO, the Traffic Officer/PO, the operator of the regulator, both supervisors and both members of the locomotive crew underwent post incident drug and alcohol testing by authorised testing agents. All returned negative results.
Fatigue

1.64 Fatigue was considered as a possible factor affecting the actions of the rail workers involved in this incident. In a 24-hour period, humans experience variations in degrees of alertness and fatigue. Known as circadian rhythms, they affect how a person responds to job demands during the course of the day and night. Alertness falls to its daily low-point in the early hours of the morning (about 3-5am, or slightly later on a night shift), when the physiological drive for sleep is greatest.8 This is still the case with shift workers who sleep during the daytime and work at night. They will still experience a reduction in alertness during these hours.

1.65 Shiftwork also disrupts the normal sleep cycle and it is usually more difficult to sleep during daytime hours. Research into fatigue in train drivers shows that shiftwork limits the amount of sleep that workers are able to obtain to ensure that they are able to maintain alertness.9 Another contributor to a reduction in alertness is the time spent on task without a break. Research shows that the risk of making an error increases with the time on task.10

1.66 In examining the performance of those involved directly in the incident, the following conditions were identified as having the potential to contribute to fatigue or reduced cognitive performance:

- All workers were using motel style accommodation for rest.
- The incident occurred at a time when alertness is at a low point.
- All workers, except the locomotive crew, had been working 12 hour shifts since the possession commenced, with this shift being the third in succession.
- The Pilot and ballasting crew were travelling in a cold and exposed position on the wagon as 6M21 was being propelled.
- The Pilot was not wearing clothing that adequately protected him from the prevailing cold conditions.

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1.67 However, the following conditions and observations would support the contention that the personnel involved were not affected by fatigue:

- The regulator operator had only been at its controls for approximately five minutes before returning to the tamper, some 600 metres away, to obtain a resupply of fuel.
- The Pilot actively assisted in the refuelling operation of the generator.
- The Pilot had counted the distance of the train from the stopping point over the radio when picking up the ballasting team at 299.000kms, some five minutes before the collision.
- The Pilot was active on the platform of the wagon as 6M21 was being propelled, standing and conversing with the other workers with him.
- The generator was operating and providing additional noise to that from the moving wagons.
- The Traffic Officer/PO responded to all telephone and radio calls although he was delayed in providing advice to the PO about the regulator running out of fuel.
- The Pilot responded to all telephone and radio calls and provided timely advice to the PO when advised that the regulator had run out of fuel.
- The train crew and the Pilot responded immediately to radio communications between each other after 6M21 was loaded.
- The Pilot warned the other workers onboard 6M21 of the impending collision.
- This was the first shift for the locomotive driver after being booked off for the previous two days.
- The assistant driver had only worked 15 hours in the preceding 5 days with all hours worked during daylight time.

1.68 Although some conditions existed which could have contributed to fatigue, no behavioural indicators or performance errors consistent with reduced cognitive performance or being fatigued were identified. On balance, it is concluded that there is insufficient evidence to suggest that fatigue was likely to have been a significant contributing factor in this incident.
Subsequent Remedial Actions

1.69 On 22 May 2012, ITSR issued ARTC with an Improvement Notice that directed the organisation “to carry out railway operations so that safety is not threatened or likely to be threatened”. On 7 June 2012, in response to the notice, ARTC issued SAFE Notice No 2-1708 (2012) Multiple Workgroups and Work Train/Track Vehicle Movements within a Worksite. It required additional protection to be provided to maintain separation between work groups where multiple work groups were located within a single worksite.

1.70 The Traffic Officer/PO was removed from Safeworking duties by CAMS post-interview on 20 June 2012. He subsequently underwent a Safeworking counselling session in the ARTC Network Rules and Procedures with a Director from CAMS on 21 June 2012 and was recertified on 27 June 2012.

Site Recovery and Restoration

1.71 Heavy lifting equipment was required to lift the damaged wagon clear of the track before the regulator could be moved. The wagon was subsequently transported by road to wagon repair facilities in Newcastle. The regulator was transferred to track machine maintenance facilities at Dubbo for subsequent repair. The track was not damaged in the collision and resurfacing of the section was completed in accordance with the original scope of works. The line was reopened to rail traffic at the fulfilment of the LPA at 0600 on 19 May 2012.

Wagon Condition

1.72 From a detailed inspection of the damaged wagon (ADFF 2981P), it was concluded that all damage to it was a consequence of the collision and derailment. No defects were identified with any of its safety critical components - wheels, axles, brakes, bogies, couplings or vehicle body.

Train Management

1.73 Locomotive event recorder data indicated that, while 6M21 was being propelled, its speed fluctuated from 15km/h to 20km/h between the loading point and the stop point (299.000kms) where the workers joined the train. After the stop, the speed of 6M21 reached 26km/h immediately prior to an emergency brake application being made. Only throttle notch 1 (of 8) had been used to power the
locomotives immediately prior to the emergency brake application. The data correlated with the comments made by the Pilot and the train crew about the manner in which they controlled 6M21 during the movement.

1.74 Normally a plough van is marshalled at each end of a ballast train consist to spread the ballast as it is being dropped. With plough vans attached, the train is usually configured with a locomotive at each end to negate the requirement for propelling movements. However, this method was not adopted due to insufficient clearance between the locomotive bogie components and the freshly dropped ballast, a situation which had given rise to a previous incident which resulted in the derailment of a plough van. Instead, it was decided to dispense with the plough vans and propel the ballast train into position to commence the drop, then operate the consist with the locomotives leading as the ballast was being dropped. Mechanised road plant was then used to spread the ballast before tamping and regulating operations were carried out.

System Failures

Protection for Disabled Trains

1.75 With the regulator running out of fuel, the vehicle had effectively become disabled in accordance with the terminology contained in the glossary for the ARTC Network Rules and Procedures. As a result, the situation with the regulator should have been actioned in accordance with ARTC Network Rule ANTR 400 Protecting Trains and ARTC Network Rule ANTR 416 Disabled Trains.

1.76 Network Rule ANTR 400 states the following:

Trains require protection in all circumstances if:
- they need assistance, or
- they obstruct, or might obstruct, adjacent lines, or
- the line is obstructed.

If rail traffic needing assistance is in a location that prevents the Train Crew or track vehicle crew from placing detonator protection, the Network Control Officer must give assisting rail traffic a Condition Affecting the Network (CAN) warning.

1.77 Network Rule ANTR 416 states the following:

The Train Crew of a disabled train must:
• tell the Network Control Officer about the failure, and
• follow the requirements of Rule ANTR 400 Protecting trains, and
• determine the nature of the failure.

1.78 When the regulator became disabled, the operator claims he left it illuminated with the single flashing red direction lights on its roof. He did not search for, nor place, any protection equipment, i.e., detonators (audible warning devices) or red lamps, on the track before he left the vehicle unattended. Although stating that he had provisioned the regulator in the days prior, there was no emergency equipment, as listed in Section 9 of the ARTC Train Operating Conditions (TOC) Manual, available on the regulator, nor were there any secure storage facilities available (see Photograph 11). Further, although a supply of emergency equipment was readily available on the tamper, the operator did not return with any of this equipment to protect the regulator.

1.79 When questioned about the placement of protection equipment on track, both the operator and the Traffic Officer/PO stated that they understood the requirement for protection in accordance with the ARTC Network Rules and Procedures. The operator admitted that, in hindsight, he should have placed protection on the track. However, the Traffic Officer/PO considered that some protection aspects of the Network Rules and Procedures did not necessarily apply inside worksites as additional protection could not be placed on the track inside a possessions area. It was found that he was not alone in this belief although no one sharing the view could positively identify appropriate supporting documentation.

1.80 Personnel records for the operator indicated that he had undergone training as a track machine operator in October 2011 and a competency assessment for the operation of the regulator on 30 April 2012. The competency assessment encompassed 20 hours of supervision by the Worksite Supervisor and included knowledge of the emergency equipment and procedures, site specific hazards and the requirements for leaving a machine unattended. However, it did not require the operator to undertake a practical demonstration of his competency for dealing with a disabled rail vehicle or placing protection on track though this would have been difficult given there was no emergency equipment onboard the regulator during the assessment. As such, it demonstrated that the assessment was based on routine tasks and the workers were being assessed as competent without being required to demonstrate their ability to recognise emergency
situations, the requirements of Network Rules and Procedures and their implementation.

Photograph 11: Unsecured emergency equipment locker in cab of the regulator

Communications

General

1.81 All spoken communications between the parties on site were carried out using discrete radio channels or mobile telephones. Generally, such communications are not recorded unless the calls are to or from the Network Control Centre.
1.82 The content of those spoken communications that were recorded at the NCCN did not conform to the standards contained in the ARTC Network Rule ANGE 204 *Network Communication* and Network Procedure ANPR 721 *Spoken and Written Communications*. This nonconformance included the following:

- The standard terms and protocols in the Rule and Procedure were not used.
- The calls lacked full particulars of the incident.
- Despite a requirement in the ARTC *Incident Management Manual* (TA44), no directions were given by the Network Controller to ensure all necessary steps had been taken to lessen the impact of the incident and to protect the site.
- Despite the driver of 6M21 referring to the incident as being serious, the Network Controller did not determine the circumstances or severity of the incident, the injuries or potential effects to other rail traffic in the area in accordance with TA44.
- Neither the Closedown Manager nor the Network Controller queried what protection arrangements had been implemented at the incident site.

*Prior to the Collision*

1.83 When they arrived at the main site office, the locomotive crew were given a pre-work briefing by the PO. However, they stated that little of its content related to their roles and responsibilities at the worksite. They also stated that no instructions were discussed with the PO or the Pilot regarding the frequency of radio contact or the immediate stopping of the train when radio or visual contact was lost. This was despite the requirements in Network Rule ANTR 424 which states:

> Drivers and track vehicle operators, and Qualified Workers directing propelling, must maintain effective communication at agreed intervals.

> If communication between a Driver or track vehicle operator and the Qualified Worker directing propelling is interrupted, the Driver or track vehicle operator must stop the train or track vehicle immediately.

It was also a requirement highlighted in the ARTC *Ballast Train Unloading Awareness Training* that “all of these issues must be highlighted to the train crew”.
1.84 When the regulator ran out of fuel, the operator first informed the LS Rail Worksite Supervisor of the situation. He did not immediately inform the Traffic Officer/PO or the PO despite these persons being responsible for the worksite protection arrangements and safety at the site. Rather, he focussed on the immediate situation of seeking containers to transport fuel for the disabled regulator.

1.85 Being informed of the situation, the LS Rail Worksite Supervisor only sought, and was given, an assurance from the operator that there were lights operating on the regulator. Although aware of the impending ballast train movement, he did not ascertain whether any protection had been placed on the track, instead focussing on the immediate tasks at hand.

1.86 At 0425 the PO called the Traffic Officer/PO to ascertain his location and inform him that “the ballast train was nearly ready to push back towards the country end of the worksite again”. The Traffic Officer/PO informed the PO that he was “currently at the country end of the worksite”. Despite some 12 minutes elapsing after the operator reportedly informed the LS Rail Worksite Supervisor that the regulator was out of fuel, no mention of this situation was made to the PO by the Traffic Officer/PO. Additionally, no precise kilometrage was given for the location of the regulator. The absence of any information regarding the stoppage of the regulator in the call to the PO indicated that the Traffic Officer/PO had not been informed by either the operator or the LS Rail Worksite Supervisor; nor had the LS Rail Worksite Supervisor reacted in a timely manner to reassess the risks associated with the now disabled regulator.

1.87 At 0429 the PO advised the Pilot that he had spoken with the Traffic Officer/PO and that the Traffic Officer/PO was aware that the ballast train would be pushed back towards the country end of the worksite and towards the track machines. He also advised the Pilot to keep in contact with the Traffic Officer/PO throughout the train movement.

1.88 At 0434 the Pilot was informed by the Traffic Officer/PO that the regulator had run out of fuel. He was also informed that it was “sitting 300 metres back towards Bengalla from the end of the worksite at Mangoola”. Believing this was in reference to the end of the worksite at Mangoola at 303.550kms, the Pilot assumed the regulator would be standing at 303.250kms and roughly three
kilometres further on from the intended ballast drop point at 300.800kms. Also, being aware that the regulator and tamper had been working in the general vicinity of 300.500kms during the previous ballast drop, based on the Traffic Officer/PO's information, he believed that the machines had now moved clear from the area. Again, no exact kilometrage was given by the Traffic Officer/PO nor sought by the Pilot regarding the precise location of the disabled regulator.

1.89 At 0447 the Pilot notified the PO that he had been informed that the regulator had “run out of fuel” about 300 metres from the country end of the worksite. Again, no kilometrage was given or sought as to the exact location of the regulator and the PO advised the Pilot to keep in contact with the Traffic Officer/PO throughout the train movement.

1.90 At 0450 the Pilot advised the locomotive crew by radio to commence propelling. He did not brief the crew in person and did not give them any details about the regulator, its stoppage or its location; nor did he give any instructions regarding the speed for the propelling movement. Further, he and the locomotive crew did not come to any arrangement in accordance with ARTC Network Rule ANTR 424 regarding agreed intervals for effective communication during the propelling movement.

1.91 As the ballast train was being propelled, the locomotive crew attempted to maintain the speed at between 15 to 20km/h and the Pilot only directed them as required. In response to a query about the speed of the movement from the locomotive crew, the Pilot directed they could increase speed. They increased the speed to 25km/h.

1.92 The Pilot directed the locomotive crew to stop at the Old Bengalla Road level crossing to pick up the crew conducting the ballasting operation. The Pilot called the stopping distance from the crossing to the locomotive crew. With the ballast crew onboard, the Pilot informed the locomotive crew by radio to again commence propelling.

1.93 As the locomotive crew passed the 300km post, they were discussing their proximity to the drop point when they heard the Pilot yell “Red Light, Red Light, Red Light” on the radio. The driver immediately made an emergency brake application and attempted to call the Pilot. After three attempts to contact him, the Pilot responded saying “it doesn’t look good”. The crew secured the train
and headed towards the leading wagon. On the way, they encountered “a track worker” who told them “he has run us into the regulator”. The track worker, later identified as the Ballast Train Supervisor, explained he had to go and retrieve his telephone from his car in order to report the incident.

Lighting System on the Regulator

1.94 The Pilot and other workers on the ballast train reported that, immediately prior to the collision, they did not see any lights operating on the regulator. The locomotive crew also reported that there were no lights operating on the regulator when they reached it. Conversely, the regulator operator reported that he had left the vehicle with a set of diagonally opposed flashing red direction lights operating on its roof. This was verified by the LS Rail survey assistant who stated that he had seen the lights operating when the regulator operator walked past him at the tamping machine to source fuel to restart the unit. He further stated that the lights were not operating when he arrived at the regulator after the collision.

1.95 The regulator was fitted with the following external lighting fixtures (see Photograph 12):

- dual headlights on each end of its roof
- a single amber rotating beacon
- forward (white) and rear (red) direction lights on each end of its roof (one set shown in Photograph 12)
- dual brake lights on each end of its roof (one set shown in Photograph 12)
- pivoting work (spot) lights at the broom (engine) end.
It was also fitted with reflective signage at various positions around the vehicle. However, most signage was small and in a poor reflective condition.

1.96 Contained within the electrical circuitry of its lighting system were the following features:

- an air pressure switch which opened when the air pressure on the regulator fell below 3 bar (300kPa) interrupting the power supply to a number of circuits including the lighting;

- an amber rotating light which only operated when the regulator was operating in a “work” mode in either forward or reverse direction. Its control switch on the operator’s dashboard had been bypassed to ensure the light could not be turned off by the operator as the regulator was moving. This was done in accordance with recommendations made as a result of investigations into a number of collisions between track machines travelling in convoy;
the four red and white direction light units had been converted from incandescent to light emitting diode (LED) type lighting to improve light output, conserve battery power and reduce maintenance. These lights were also linked to the operating direction of the vehicle with white indicating forward and red indicating the rear;

- four red brake lights (also LED type) which operated when the regulator brakes were applied;

- a flasher unit which operated only single flashing red direction lights diagonally on each end of the regulator roof when it was stopped and out of “work” mode; and

- a contact incorporated in the ignition switch which opened to interrupt the power supply to the lighting circuits when the key was partially withdrawn.

All lights and circuits operated as designed when tested onsite after the incident and at the ARTC maintenance facilities at Dubbo (see Photograph 13).

Photograph 13: Lights operating on regulator at Dubbo (broom removed)

Onsite examination revealed that the operator had left the regulator parked in neutral when he left it. In the neutral position, the amber flashing light did not operate and only the red direction lights worked. The cab light and the spot lights were also found to be switched off.
1.98 In trying to establish the reason(s) why no lights were seen on the regulator immediately before the collision, the following scenarios were examined as detailed below.

1.99 **That the regulator batteries were low or poorly maintained.** Post incident testing at the incident site noted that the regulator engine restarted normally on a number of occasions and there appeared to be no conditions that affected the performance of the batteries. An inspection of the batteries at Dubbo indicated that, although dusty, the terminal connections were tight and without corrosion, the battery casings were securely housed and there was no loss of electrolyte (see *Photograph 14*). Further, with the engine running, the battery charging system was functioning normally.

![Photograph 14: Regulator battery condition when inspected at Dubbo](image)

1.100 **That the air pressure switch had opened after the regulator had become disabled and lost sufficient air pressure.** On-site, no obvious leaks were located within its air system that would have caused the switch to open in the one hour (approximately) that elapsed between the time the regulator ran out of fuel and the collision. Similarly, later testing at Dubbo did not locate any discernable pressure loss within the regulator’s air system during a similar time span to that in the incident. However, it could not be conclusively excluded that, without the engine running, sufficient pressure was drained from the air system
by the operator applying the brakes and park brake to cause the air pressure switch to open and the regulator’s lights to stop operating.

1.101 That the ignition key switch had been operated inadvertently by the operator. Onsite inspection revealed that the operator had left the ignition key in the vertical position (see Photograph 15). In this position, without the key fully inserted into the switch, a potential exists for the electrical contacts within the switch assembly to open inadvertently under spring tension. Although loose in the switch and badly worn, the key still closed the contacts and remained captured within the switch when it was turned to the ‘On’ position. However, its position immediately post-incident was not properly verified before the unit was restarted as its relevance in the lighting system was not understood at the time.

Photograph 15: Dashboard layout of regulator

1.102 That the operator had attempted to stop an alarm indicating failure of the pump in the differential (final drive) oil lubrication system. The regulator is fitted with a warning system which activates a loud audible alarm when insufficient oil is being pumped throughout the differential housing. The alarm system was added as a modification after the failure of a number of regulator differentials because of poor lubrication. The system, when activated, can only be isolated by removal of the ignition key or opening of the battery switch. Again, the ignition key was in the vertical position when the regulator was
inspected on site however, the battery switch was open at the time of the initial inspection.

1.103 **The battery isolation switch was opened by the operator, or others, after the regulator stopped running.** Although denied by the operator, a possibility existed that the battery isolation switch may have been opened to conserve battery power which may have been required to reprime the fuel system when restarting the engine (see Photograph 16). No other person onsite has made comment about the switch being opened.

![Battery Isolator Switch](image)

**Photograph 16: Battery isolator switch in the closed ('on') position.**

1.104 **That the lights stopped working in the impact of the collision.** Although the impact of the collision was sufficient to push the regulator approximately 50 metres with the wing blades lowered, no blown light globes were found on it after the incident. However, this did not exclude the possibility that the collision generated sufficient force to open either or both the air pressure switch or the ignition key switch and cause the regulator lights to stop working.
1.105 *That fog obscured the Pilot's vision of the regulator's lights.* Although only patches of misty fog were encountered as 6M21 was being propelled, it cannot be excluded that a fog patch may have enveloped the regulator and obscured the Pilot's view at a critical moment. However, no comment about such conditions was made by any of those involved in or near the collision when it occurred.

1.106 Maintenance records for the regulator indicated that it had been inspected in accordance with the recommended maintenance schedule. Further, the records indicated that no defects had been reported about the operation of the lighting system since 5 July 2011 when the amber flashing light had been repaired. There were no other log book entries related to the condition of the batteries or the operation of the lighting system.

1.107 While the operator was adamant he left the regulator with lights operating, he did not consider any risk that the lights could subsequently stop operating or fail, despite the existence of a number of potential causes for the lights to stop operating. Although it cannot be stated with certainty that the lights were operating at the time, or not, there is a consensus amongst those on the train and those from the tamper that the lights were not operating immediately after the collision.

**Fuelling the Regulator**

1.108 Fuel usage rates for the regulator indicated that the unit used approximately 32.6 to 34.6 litres per hour at load. It had a fuel tank capacity of 270 litres, giving the regulator between 7¾ and 8 hours continuous operating time at load.

1.109 The first operator stated that, upon arrival at the regulator at the commencement of the shift, he noted that the fuel level was low during his pre-start inspection. He reported the situation to the LS Rail Worksite Supervisor. However, despite the regulator standing at a designated fuelling point where fuel trucks could readily access the machines, the LS Rail Worksite Supervisor decided to have the regulator refuelled the next day.

1.110 Records indicated that the regulator had been refuelled during the early afternoon of 16 May 2012 when 160 litres were added. 36 hours then elapsed before the regulator ran out of fuel, indicating that the LS Rail Worksite Supervisor did not properly calculate the previous fuel usage or the likely fuel
usage of the regulator for the shift. Further, it also indicated that he did not consider the risks or consequences of the regulator becoming disabled in the section away from fuel access points.

Hazards and Controls

1.111 ARTC Network Rule ANWT 300 required the PO to:

- make a safety assessment
- make sure that the work was done safely
- keep records about protection arrangements.

Additional instructions for ballasting works are contained in ARTC Safe Working Method Statement (SWMS) TRA-027 Unload NDFF Air Operated Ballast Train and a training presentation titled Ballast Train Unloading Awareness Training (air operated).

1.112 Records for the safety assessments, pre-work briefings and worksite protection arrangements for Worksite No.85 were retrieved after the incident. A review of the documentation compiled at the main site office for Worksite 85 noted the following:

- There was no correlation between the hazards listed on the pre-work briefing form and the work method statements for the operations.
- There was no information recorded on the worksite protection plan regarding the LS Rail team which was effectively operating as a separate worksite within the worksite.
- While all of the LS Rail team had signed their pre-work briefing form, none of the team members, including the Traffic Officer/PO, had signed onto the pre-work briefing form at the main site office. This applied to all shifts at the worksite.
- Although the hazards of “struck by moving plant” and “derailment” were listed, the controls implemented for these related solely to workers on the track and not others such as the locomotive crew.
- There were no hazards or controls listed for the train movements in the worksite. No speeds were nominated for either hauling or propelling
movements despite a requirement in SWMS No: TRA-027 that “the train is to travel at no more than walking pace” when workers are travelling on the train.

- Despite a potential requirement for the train to be loaded outside the worksite at Antiene and propelled some 23 kilometres back to the drop point, no instructions or procedures were developed to ensure the safety of such lengthy propelling movements of the train.

- There were no hazards or controls identified that dealt with disabled rail vehicles or the maintenance of separation between work trains and track machines in the worksite.

- There were no hazards or controls listed for partial and uneven loading of ballast wagons despite a requirement in SWMS No: TRA-027 that “trains to travel at speed (25kph), as per standard, when part loaded”.

- There were no hazards or controls listed for loss of communication or visual sighting between the Pilot and the locomotive crew.

- No additional hazards or controls for night time ballast operations had been assessed or considered despite SWMS No: TRA-027 requiring them to be considered and added to the work method statement.

- There was no information on the risk assessment or changes in control measures after the configuration and operation of the train was altered because of the removal of the plough van.

1.113 Review of the documentation compiled by the LS Rail team noted the following:

- There was no correlation between the hazards listed on the pre-work briefing form and the work method statements for the operations.

- The LS Rail pre-work briefing forms were photocopies of the same form with the same identification number and same hazards/controls listed.

- The forms also spanned both day and night shifts despite each shift being under the control of a different Protection Officer. This indicated that both the Supervisor on day shift and the Traffic Officer/PO on night shift were not conducting new safety assessments in accordance with Network Rule ANWT 300 prior to the commencement of the work each shift; nor were any hazard reviews being conducted as the works progressed.
• Although the hazards of “struck by moving plant”, “derailment” and “speed” were listed, the control measures implemented were generic. The control measure for speed required operators to “drive to conditions; 15kph through work groups”. It is noted that this speed does not correlate with any designated in the SWMSs or Network Rules and Procedures.

• There were no hazards or controls identified that dealt with disabled rail vehicles or maintenance of separation between work trains and track machines.

• There were no hazards or controls listed for loss of communication or sighting between the track vehicle crews.

• The only additional control implemented for working at night was to ensure that headlamps were supplied to workers.

• There were no controls implemented for the effects of adverse natural and workplace environmental conditions such as fog, cold or dust.

• Despite the creation of a new hazard when the regulator ran out of fuel, the situation and controls were not properly re-assessed by the Traffic Officer/PO or the PO who jointly had the responsibility to ensure that safety at the worksite was being maintained.

Propelling and Piloting Trains

1.114 The requirements when propelling and piloting trains are contained in Network Rule ANTR 424 Propelling trains and Network Procedure ANPR 710 Piloting Trains. Additional instructions are also contained in SWMS TRA-027Unload NDFF Air Operated Ballast Train and the Ballast Train Unloading Awareness Training (air operated) training presentation.

1.115 ARTC required qualified persons propelling trains to hold Safeworking Level 1 qualifications as a minimum. The Pilot only held Hand Signaller Level 2 qualifications which permitted him to pilot but not propel a train. In ARTC’s Competency/Communication Protocol for Entering Rail Corridor - Safety Procedure SP-05-02, the duties of a Safeworking Level 1 qualified person are defined as “Activities prescribed for a Hand Signaller Level 2” as well as the transfer of track vehicles as a train and the operation of points and signals in accordance with the ARTC Network Rules and Procedures. However, no
reference is made in the “permitted activities” of either competency level for propelling trains.

1.116 OTSI noted that the SWMS TRA-027 and the training presentation both required review on the basis that the documentation:

- referred to different coded wagons to those on 6M21
- did not incorporate a number of recent modifications made to the rolling stock by ARTC
- did not relate to a number of the ARTC wagons because they were not fitted with the emergency equipment (emergency air release valve) as described
- did not identify any requirements or controls for maintaining separation between train and other rail vehicles
- did not give instructions for operating trains without plough vans attached
- did not give guidance for long distance propelling movements between loading points and drop points. In this incident, speeds higher than the nominated “walking pace” were used for expediency and to shorten movements likely to take hours to complete.

It was also noted that various contractor pilots and POs were unaware of the information or instructions contained within SWMS TRA-027 or the training presentation. Neither document had been distributed to them, nor were copies available on site. Further, they were not aware of any associated training courses.

Audit and Compliance

1.117 Part of an accredited operator’s Safety Management System for operations in NSW is the requirement to undertake regular audit of the elements making up the system. Audit records supplied by JHG and LS Rail indicated that they undertook major audits of worksite protection arrangements annually. No records were provided for any other types of audits or monitoring functions.

1.118 Despite the size of the possession and its large number of worksites, no audit or compliance inspections were programmed or conducted by any of the organisations involved, nor were any programmed by regulatory authorities. Given the scale of works being undertaken, this possession represented a good
opportunity for all organisations to ensure that the works were being conducted in compliance with rules, procedures and legislation.

Remedial Actions by LS Rail

1.119 In response to this incident, LS Rail reports having implemented the following remedial actions:

**Action 1**: Safety direction issued to all managers, safe working personnel safe working trainers/assessors and safe working compliance inspectors on 21st September 2012

*Requirements for Safe Working Officers (NSW) protecting a work group and/or delivering a pre-work briefing:*

**Safe Working Officer records:**
- The use of the duplicate (triplicate, carbon copy) worksite protection books is mandated at all times when undertaking protection duties
- A hand drawn representation of the track layout and protection in place (where applicable) will be completed by the Safe Working Officer
- The diary will be completed as the work progresses in the duplicate book
- If more people need to sign onto the brief than there is space on the form, an additional sign on record must be completed that references the unique record within the duplicate book; OR; another duplicate record is to be completed.

**Construction work adjacent to operational lines:**
- No work is to be completed which has the potential to foul a stationary train at any time, irrespective of any form of protection in place at the time. This specifically relates to the potential reach of excavators, EWPs and cranes. All work of this nature must be suspended until the train has cleared the work area and a suitable means of protection of the operational railway put in place.

**Action 2**: Implementation of safe working compliance inspection regime which are under the control of the National Manager – Safety & Assurance.

**Action 3**: Cessation of trading with the Safeworking/personnel supply company involved in the incident until competency assurances are provided.
PART 2 FINDINGS

Causation

2.1 The collision of ballast train 6M21 with the disabled ballast regulating machine, and the subsequent derailment of the leading wagon, is attributable to ineffective communication between safety critical staff about the location of the disabled ballast regulator.

Contributory Factors

2.2 Overreliance was placed on the direction lights on the regulator to indicate its stationary presence and provide sufficient warning of an obstruction on the track, and these lights were reported not to be illuminated when the ballast train was approaching.

2.3 No protection was placed on the track in accordance with ARTC Network Rule ANTR 416 Disabled Trains when the regulator ran out of fuel.

Effectiveness of Risk Management Strategies

2.4 There were inadequacies in the supervisory, management and protection practices employed at the worksite. These included the following:

- Despite being informed that the regulator had run out of fuel, the Traffic Officer/PO and the PO did not consider the vehicle to be disabled in accordance with the definition contained within the Glossary of the ARTC Network Rules and Procedures. In the absence of any controlling rules or procedures for disabled vehicles in worksites, adequate vehicle separation and protection was not provided. Further, there was an understanding by the Traffic Officer/PO that, because the regulator had run out of fuel within a worksite, it did not require protection in accordance with ARTC Network Rules ANTR 400 and ANTR 416. [Recommendation 3.1]

- The LS Rail Worksite Supervisor did not consider the risks and consequences of the regulator becoming disabled in the section away from fuel access points despite being informed that it was low on fuel at the commencement of the shift.
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- The Traffic Officer/PO and the PO did not review or undertake another risk assessment despite the changes in risk when the regulator became disabled.
- The PO did not review or undertake another risk assessment when the plough van was removed from the ballast train.
- The track tamper and regulator were effectively operating as a worksite within a worksite. However, this was not recorded on any worksite documentation; nor were the LS Rail team signing onto the pre-work briefing forms at the main site office. [Recommendation 3.6]
- The Pilot did not direct the movement of the train in accordance with ARTC Network Rule ANTR 424 and SWMS TRA-027. Further, he was unaware of the speed requirements in SWMS TRA-027 because he had not been trained in ARTC’s Ballast Train Unloading Awareness Training package and a copy of the SWMS was not available on site. [Recommendation 3.5]
- No instructions or procedures had been developed for lengthy propelling movements.
- Environmental conditions and inadequate personal protective equipment influenced the position taken by the Pilot when directing the train.

2.5 Communications used at the worksite were not clear and concise and, particularly post-incident, did not comply with ARTC Network Rule ANGE 204, Network Procedure ANPR 721 and the ARTC Incident Management Manual TA44. This incident is one of a number of incidents investigated by OTSI where noncompliant communications have been identified as a causal or contributing factor. It again highlights the dangers in not complying with network rules and procedures designed to protect work and workers on track.

2.6 The LS Rail pre-work briefing forms were photocopies which were not uniquely numbered and did not follow document control procedures. There was no reference to any SWMSs on the forms and there were no hazards or controls identified for disabled rail vehicles inside the worksite. Further, the hazards and controls that were listed were the same for both day and night shifts.

2.7 The pre-work briefing form compiled by the Protection Officer at the main site office was deficient as it made no reference to any SWMSs; nor were any of these documents available at the worksite. Further, the hazards of disabled rail
vehicles, partially or unevenly loaded wagons, propelling movement speeds between worksites and communications failure between the Pilot and locomotive crew were not identified and recorded on the form; nor was the fact that another worksite was effectively operating within the worksite. [Recommendation 3.2]

2.8 The regulator was not carrying any emergency equipment as listed in Section 9 of the TOC Manual and there was no designated secure storage space on the vehicle. [Recommendation 3.3]

2.9 The wagon upon which the ballasting team was riding was not fitted with an emergency valve to apply the brakes on the train. Because of this, the Pilot had to alert the locomotive crew by radio to stop the train when the regulator came into view. [Recommendation 3.4]

2.10 There were no apparent defects on the lighting system of the regulator. However, at least two possibilities existed within the system for the lights to cease working without intervention of the operator, neither of which was recognised by the operator.

Adequacy of the Incident Response

2.11 The notification of the incident was delayed and laboured by all those at the incident site. Instead of immediately reporting the incident to Network Control, in accordance with ARTC Network Rule ANGE 206 Reporting and responding to a Condition Affecting the Network (CAN), the locomotive crew first notified senior managers within their company before reporting the incident to the Network Controller some 15 minutes after the event. The Ballast Train Supervisor first notified the Closedown Manager but was unable to provide basic details of damage or injuries. Despite arriving at the incident site at 0535, the PO did not notify Network Control until 0553, again with incomplete details of the incident. Further, the Traffic Officer/PO did not immediately notify anyone despite incident notification being one of his primary responsibilities.

2.12 This was still the case over one hour after the incident when Network Control and the locomotive crew did not properly establish or confirm injury details in a subsequent update at 0623.
Other Safety Matters

2.13 Pilots and POs were unaware of the safety information and instructions contained within SWMSs and *Ballast Train Unloading Awareness* package which had not been distributed to the worksites.

2.14 There were no audit or compliance activities considered or implemented during the Local Possession Authority by any party despite the scale of, and the opportunity presented by, the works.

2.15 SAFE Notice No 2-1708 (2012), issued subsequent to an ITS Improvement Notice, does not include defined procedures for the protection of disabled track vehicles in worksites.

2.16 Reflective strips and signage on the regulator were in a poor reflective condition.
PART 3  RECOMMENDATIONS

To prevent a recurrence of this type of rail incident, it is recommended that the following remedial safety actions be undertaken by the specified responsible entities.

**Australian Rail Track Corporation**

3.1 Define and promulgate to all relevant qualified persons clear and concise procedures and training materials for the protection of disabled vehicles within worksites.

3.2 Include all associated risk assessments and SWMSs in worksite documentation packages.

3.3 Ensure all track machines operating on its network in NSW carry, at all times, the emergency equipment as listed in Section 9 of the TOC Manual in a designated secure but readily accessible storage space on each vehicle.

3.4 Fit all wagons in its ballast wagon fleet with emergency valves (in easily accessible locations) as part of the onboard safety equipment, and amend training documentation to accurately describe the installed equipment.

3.5 For controlling ballast train movements on its network, engage only workers who are trained and assessed as competent in the relevant ARTC Network Rules, ARTC Network Procedures and related work method statements for propelling trains.

**Leighton Swietelsky Joint Venture**

3.6 Revise its practices for operations within worksites so that its teams are included on the primary documentation of the worksite.
Appendix 1: Sources, Submissions and Acknowledgements

Sources of Information

- ARTC Network Controller and Train Transit Manager (NCCN Broadmeadow)
- ARTC Technical Services Senior Investigator, Maitland
- ARTC Plant Coordinator (South)
- Bureau of Meteorology
- CAMS Qualified Worker
- Crew members of train 6M21
- Derryville Rail Qualified Worker
- Independent Transport Safety Regulator
- John Holland Group
- LS Rail operators
- RIMAC Protection Officer

References

- ARTC Network Rules, Procedures and Safe Notices
- Glossary for the National Codes of Practice and Dictionary of Railway Terminology
- Passenger Transport Act 1990 (NSW)
- Rail Industry Safety Standards Board Standards
- Rail Safety Act 2008 (NSW)
- Rail Safety (General) Regulation 2008 (NSW)

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:
Submissions were received from:

- Australian Rail Track Corporation
- Freightliner Australia
- Independent Transport Safety Regulator
- John Holland Group
- Leighton Swietelsky Joint Venture
- Rail Infrastructure Maintenance and Certification

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.

**Acknowledgements**

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