RAIL SAFETY INVESTIGATION REPORT

SIGNAL PASSED AT DANGER BY TRACK MACHINE CONSIST 8M71

GOOBANG JUNCTION

10 MAY 2009
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Section 67 (2) of the Rail Safety Act 2008

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## GLOSSARY

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<th>Term</th>
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</thead>
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<tr>
<td>Ballast Regulator</td>
<td>A track machine used to shift ballast in preparation for tamping and to move surplus ballast after tamping.</td>
</tr>
<tr>
<td>Drawbar</td>
<td>A drawbar is a solid bar connection between two vehicles. Modern purpose-designed track maintenance vehicles now incorporate draw gear similar to locomotives and wagons on trains.</td>
</tr>
<tr>
<td>Electric Staff</td>
<td>A system of safeworking, usually used on single lines in non track-circuited areas, to give sole occupancy of the block. Under normal conditions the authority for a train to occupy the section is a metal token known as an electric staff obtained from an electric staff instrument.</td>
</tr>
<tr>
<td>Glued Joints</td>
<td>Glued joints are insulated joints that electrically isolate one adjoining rail from another for signalling purposes.</td>
</tr>
<tr>
<td>Home Signal</td>
<td>A home signal affords protection against risks associated with a rail area/location. Often these signals are placed just prior to railway track points, sidings, railway yards and locations where other trains might be shunting.</td>
</tr>
<tr>
<td>Landmark and Location Signs</td>
<td>Landmark and location signs are used generally in the more remote areas of NSW. These signals serve to warn train drivers and operators of track machines to prepare to bring their train or machine under control as a control/home signal is pending.</td>
</tr>
<tr>
<td>Network Control</td>
<td>A control centre which manages train movements on a designated area of the network. The Australian Rail Track Corporation (ARTC) has two control centres in NSW, Network Control Centre North (NCCN) at Broadmeadow and Network Control Centre South (NCCS) at Junee.</td>
</tr>
<tr>
<td>Phoenix System</td>
<td>A train control system which includes a replay capability.</td>
</tr>
<tr>
<td>Pilot</td>
<td>A Qualified Worker who accompanies, directs and advises train drivers and track vehicle operators who are not qualified for or familiar with a route over which they are to travel.</td>
</tr>
<tr>
<td>Rail Location</td>
<td>A rail location is a designated area whereby a rail section ends or starts. Generally these locations are in the vicinity of a township but may simply be a location identified for strategic railway operational purposes.</td>
</tr>
<tr>
<td>Safeworking</td>
<td>Systems and procedures for the working of trains safely and for the protection of employees, passengers, freight and vehicles on or about the line.</td>
</tr>
<tr>
<td>SPAD</td>
<td>Signal Passed At Danger – unauthorized passing of a signal displaying a stop indication.</td>
</tr>
<tr>
<td>Staff Hut</td>
<td>A location where tokens (staffs) are kept.</td>
</tr>
<tr>
<td>Tamping Machine</td>
<td>A track machine that packs and tamps ballast around the sleepers of a track to restrain the sleepers from movement.</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

On the morning of Sunday 10 May 2009, Track Australia was transferring two track machines from Dubbo to Cootamundra via Parkes on behalf of the Australian Rail Track Corporation (ARTC). The machines were operating in convoy with a ballast regulator leading and a tamping machine following. Both track machines were crewed by personnel from Track Australia and the convoy was running as train number 8M71.

At approximately 10:00am the ballast regulator closed on signal GJ144 on the approach to Goobang Junction near Parkes. Signal GJ144 was displaying a stop indication. While trying to stop his machine at the signal, the ballast regulator operator checked through the rear window of the machine and assessed that the trailing tamping machine was not going to stop in time to avoid a collision. He then made the decision to speed up and pass the signal at stop (SPAD). However, the tamping machine collided with the ballast regulator approximately 20m prior to the signal. The tamping machine stopped short of the signal but the ballast regulator came to a stand approximately 60m beyond the signal. No crew members were injured and both machines suffered only superficial damage.

The investigation revealed that the collective knowledge and experience of the crew members on the route being travelled was confined to that gained travelling in the opposite direction as passengers on the machines a week earlier. This lack of route knowledge was determined to be a major contributing factor to the incident.

The ballast regulator operator was relying on location signs as his primary navigational aid. Despite being qualified in signal recognition, he did not respond to a landmark sign 869m prior to the signal, and did not react to the signal until he was approximately 40m from it although its presence was clearly visible for well in excess of that distance.

Although the crews maintained contact with Network Control, when the Network Controller questioned them following his noticing an operational anomaly on his
Phoenix train control system, they were reticent in admitting to the SPAD and advising that a collision had occurred. Contrary to ARTC’s network rules and procedures, the Protection Officer for the convoy, who was driving the tamping machine at the time, also instructed the ballast regulator operator to set back behind signal GJ144 without first obtaining the express permission of the Network Controller, as he was concerned the machine could be in the path of forecast shunting manoeuvres within Goobang Junction Yard.

In the Pre-Work Brief for the re-positioning of these two track machines, the hazards and safety controls recorded were more relevant to a track machine work site than a convoy movement. Running in convoy and travelling in virtually unknown territory constituted comparatively major risks that were not identified in the preparation for this activity.

Since there were no voice recorders on the track machines, there remains uncertainty as to why a radio warning about signal GJ144, claimed to have been sent by the ballast regulator operator, was not received by the tamping machine crew. Similarly, in the absence of data loggers on the machines, verification of detail about machine handling and responsiveness to signals was confined to what was evident or could be deduced from the Phoenix system replays.

The key recommendations are that:

- track machine operators driving the leading vehicle in track machine convoy movements be required to possess sound knowledge of the routes on which they are to operate, similar to that required of train drivers;
- training support be provided to gain and maintain route knowledge certification, and mechanisms be established to check that operators sourced from labour hire and subcontracted organisations also possess relevant route knowledge certifications;
- pilot drivers be used when available crews do not possess the necessary route knowledge;
• the requirement for all operational staff to use correct communications protocols be reinforced;

• Track Australia review and improve risk management training for operators required to complete Pre-Work Briefs or the equivalent; and

• ARTC implement a program of installing voice and data recording devices in all track machines that operate at speeds in excess of 25km/h.

It is also recommended that ARTC issue clear rules or guidelines in relation to track machine separation when travelling in convoy in terms that include minimum distances allowable at various speeds.

In a comparable incident involving a track machine collision at Lochinvar in 2003, an independent inquiry raised concerns about the separation of track vehicles travelling in convoy, rules and procedures, competency-based training and assessment in route knowledge for track vehicle operators, as well as the status of remedial safety action in response to recommendations made in previous investigations, in particular, one into a collision at Darnick three months earlier.

Accordingly, it is also recommended that the Independent Transport Safety and Reliability Regulator (ITSRR) publish a safety notice alerting the rail industry to the key findings and recommendations of this investigation, together with those of the 2003 Lochinvar and Darnick investigations.
PART 1  CIRCUMSTANCES OF THE INCIDENT

Incident Synopsis

1.1 On the morning of Sunday 10 May 2009, Track Australia was transferring two track machines from Dubbo to Cootamundra via Parkes on behalf of the Australian Rail Track Corporation (ARTC). The machines were operating in convoy with a ballast regulator leading and a tamping machine following. Both track machines were crewed by personnel from Track Australia and the convoy was running as train number 8M71.

1.2 At approximately 10:00am the leading ballast regulator approached signal GJ144 which was displaying a stop indication. Signal GJ144 is a ‘home’ signal which affords protection for Goobang Junction Yard near Parkes, NSW (see Figure 1).

1.3 The operator of the ballast regulator did not react to the red signal until he was approximately 40m from it when he then attempted to stop. However, on checking through the rear window of his machine, he realised that the trailing
tamping machine was not stopping and, in order to try to prevent a collision, the operator of the ballast regulator decided to continue past the signal at stop (SPAD).

1.4 Due to the close proximity of the machines, the tamping machine operator was not able to stop in time to avoid a collision with the ballast regulator approximately 20m prior to the signal. The tamping machine stopped short of the signal near the point of impact while the ballast regulator came to a stand approximately 60m past the signal. The operator of the ballast regulator then reversed his machine back behind the signal under instructions from the Protection Officer (PO) located in the tamping machine.

1.5 There were no injuries resulting from the incident and only superficial damage to both track machines.

8M71 Information

1.6 It is common practice for track machines to be given train run numbers for operational control and train timetabling purposes. In this case the two track machines were designated as train run number 8M71.

1.7 8M71 consisted of two track machines, a ballast regulator machine number BX-031 (see Photograph 1) and a tamping machine number TJ-062 (see Photograph 2). Both track machines are the property of ARTC. They were being operated by Track Australia personnel as Track Australia was under contract to ARTC for previous track work and transfer of the machines from Dubbo to Cootamundra via Parkes.

Operations Information

1.8 The safeworking system for the single line Dubbo to Goobang Junction section is electric staff controlled under ARTC’s Network Rule ANSY 504 Electric Staff System. 8M71 had authority from the Network Controller at the Network Control Centre South (NCCS) at Junee to traverse the section and the crew were in possession of an electric staff in conjunction with a Track Occupancy Authority (TOA).
There are specific instructions for the operation of track machines in convoy under the provisions of ARTC’s Network Rule ANWT 304 *Track Occupancy Authority*, Network Rule ANWT 316 *Track Vehicles* and Network Procedure ANPR 748 *Transferring Track Vehicles*. ANWT 316 specifies that “track vehicles travelling in convoy must travel as closely as is safely practicable”. Further, the documents specify that the operators of these machines must communicate when stopping short of any obstruction and this message must be relayed to each following machine.
Crew Information

Ballast Regulator Crew
1.10 The ballast regulator operator had over 20 year’s railway employment experience, the last thirteen months of which had been with Track Australia. He was qualified in signal recognition which satisfied ARTC’s Network Rule ANWT 316 Track vehicles which requires a “Qualified Worker who is competent in signal recognition to travel in the leading vehicle”. However, he advised investigators that, although he had travelled over the section as an observer a week earlier, he had never actually driven a track machine between Dubbo and Parkes. He added that he was more familiar with the Northern regions of NSW than the Western region.

1.11 A trainee who had been with Track Australia for two years was also on board the ballast regulator. He was learning the various operations of the company and observing the general operation of the ballast regulator.

Tamping Machine Crew
1.12 The tamping machine operator had been with Track Australia for 30 months. At the time of the incident he was sitting next to the Protection Officer (PO) and was training the PO in the operation of this tamping machine.

1.13 The PO of 8M71 had over 48 year’s railway employment experience with most of that time in charge of safeworking operations such as in the role of a PO. He was qualified for the safeworking system applicable for the route being traversed (TOA) as required by ANWT 316. Throughout the journey the PO was also training the tamping machine operator in the duties of a PO, as the tamping machine operator was preparing for PO certification.

Before the Incident

Sign On
1.14 Both crews signed on at 6:00am and went about preparing the machines for departure. Part of the preparation included a Pre-Work Brief. After all formalities were completed the convoy departed Dubbo at 7:00am.
Pre-Work Brief
1.15 A Pre-Work Brief is written up and delivered verbally to a work crew prior to the commencement of operational duties by the person in charge of an activity. The Brief identifies anticipated hazards, rates the associated risks and records safety controls to be implemented in response to the identified risks. The Pre-Work Brief for the track machine transfer, prepared by the trainee PO under the supervision of the PO, did not identify any specific hazards associated with running in convoy or of travelling in virtually unknown territory. The Brief better suited the usual requirements of a track machine work site, identifying no particular site-specific operational risks.

Conditions
1.16 Both crews described the weather conditions as fine and clear and reported the track as dry and clean throughout the journey. The Bureau of Meteorology recorded a temperature of 15°C at 9:00am at Parkes with zero cloud cover. Prevailing environmental conditions were therefore excluded as possible contributory factors.

At Peak Hill
1.17 The trip from Dubbo to Peak Hill was uneventful. At Peak Hill the trainee PO (located on the tamping machine) contacted the NCCS Network Controller, advised their arrival time of 9:01am and requested permission to continue. The Network Controller issued a TOA, gave permission for 8M71 to continue and to travel in possession of the electric staff. He also gave instructions that both machines had to be within Goobang Junction Yard limits by 10:30am, and that they might be required to wait at signal GJ144 at Goobang Junction due to shunting operations within Goobang Junction Yard.

1.18 The trainee PO confirmed the instructions received by repeating the information back to the Network Controller and gave the Network Controller the staff number and their time of departure as 9:06am. He then relayed the information by two-way radio to the ballast regulator operator, including the instructions about the time constraints and the shunting operations within Goobang Junction Yard.
1.19 On departing Peak Hill, the operator of the leading ballast regulator accelerated to the permissible maximum speed of 50km/h out of a concern that there was insufficient time to reach Goobang Junction by 10:30am. The crews were not aware that Goobang Junction was located approximately 50km from Peak Hill so did not realise that just under an hour and a half would be ample time to cover the distance.

Route Knowledge

1.20 The only prior knowledge the crew members had of the route was gained when they travelled to Dubbo as passengers on the machines on 1 May 2009. Given that this was in the opposite direction and on only the one occasion, it was of limited benefit to them, particularly so for the PO who was responsible for safeworking and the passage of 8M71, as well as the ballast regulator operator who was in the lead performing the role of signal recognition.

1.21 Being unfamiliar with the route and with the inference of a tight time constraint relayed to him by the trainee PO, the ballast regulator operator relied on sighting a location sign to alert him that they were in close proximity to Goobang Junction.

1.22 ARTC Network Rule ANSG 606 Responding to Signals and Signs requires that “Qualified Workers who observe, operate or maintain fixed signals must know the locations and purposes of signals in their areas of work”. The fact that 8M71 was travelling with, and relying on, a qualified worker who did not have the requisite route and locality knowledge, appears not to have been identified by any parties associated with the activity.

1.23 On occasions when a train crew is routed through an area with which the driver is not fully conversant, the crew will be accompanied by a pilot driver. A pilot driver possesses the required route knowledge and assists the crew by guiding them through the unfamiliar section. Despite the limited route knowledge possessed by the crew of 8M71, a pilot driver was not used in this instance.
Landmark and Location Signs

1.24 Train drivers are not permitted to operate trains unless they can fulfil the requirements of a road knowledge test. This examination tests a driver’s ability to recall all posted speed boards, signals and area locators such as landmark and location signs (see Figure 2). It also includes the requirement for an understanding of the local procedures for the passage of trains through various railway localities.

![Landmark Sign and Location Sign](image)

**Figure 2:** Landmark and location signs

1.25 Landmark and location signs have a similar purpose. They are placed to warn train drivers and track machine operators that they are approaching a railway location and must be ready to respond to the first signal, stop sign, main line indicator or yard limit sign.

1.26 The crews were not provided with any diagrams, maps or instructions as to the extent of the various railway locations and railway sections on the route, nor did they seek any such material. For navigation purposes, the only markers the crews utilised to indicate the extremity of each particular rail section were location signs.

Approaching Goobang Junction

1.27 Near Goobang Junction there is a landmark sign located 869m prior to signal GJ144 which serves to warn crews to approach under caution and be
prepared to stop at the signal (see *Photograph 3*). From the landmark sign the rail line curves slightly to the left on approach to the Brolgan Road level crossing approximately 447m from the sign. The level crossing is situated on a short tangent track of approximately 500m. Signal GJ144 is located towards the end of this portion of track in clear view 422m after the level crossing.

![Brolgan Road Level crossing 447m etes in distance](image)

*Photograph 3: Landmark sign positioned 869m prior to signal GJ144*

1.28 As they approached Goobang Junction, the leading ballast regulator operator and his observer were unaware of how close they were to the Goobang Junction signal. They had passed the Goobang Junction landmark sign and not realised that its placement was similar to a location sign signifying a signal was imminent.

1.29 Had the ballast regulator operator reacted correctly to the landmark sign, he would have slowed down in anticipation of the first control signal being at stop, and communicated this information to the trailing vehicle. In the prevailing conditions, signal GJ 144 should have come into sight from a point approximately 685m out from the signal between the landmark sign and the level crossing (see *Photograph 4*).
1.30 Given his length of service in the railways, with the majority of that time performing safeworking duties, it is reasonable to expect that the PO would have identified and responded to the landmark sign. However, he was driving the tamping machine at the time and admitted being preoccupied with observing a converging parallel railway line on his right side (in the direction of travel). He commented to the trainee PO that perhaps they were getting close to Goobang Junction as he could also see some wagons with containers on them.

1.31 It appears the Track Australia crews did not understand that landmark and location signs perform a similar function. Though qualified in signal recognition, the ballast regulator operator stated that there was no location sign at Goobang Junction to give notice to them that there was a signal in close proximity. The landmark sign was not recognised by the ballast regulator operator or the PO as an indication that they were approaching a signal.
The Collision and Passing Signal GJ144 at Stop

1.32 On approaching the Brolgan Road level crossing, the ballast regulator operator slowed down in preparation to stop for the activation of the track circuit located just prior to the crossing. He recalled he then contacted the tamping machine crew by two-way radio to warn them that he was slowing and would be stopping, in accordance with ARTC Network Procedures ANPR 748. After having stopped to ensure that all bells and flashing lights were functioning, he traversed the level crossing and returned to the operating speed of approximately 50km/h.

1.33 The ballast regulator operator said that he had only travelled a short distance when he was surprised to find a signal at stop in front of him. He immediately applied the brakes and then advised the tamping machine crew by two-way radio that the signal was at stop and he was stopping. He turned around and saw through the rear window of his machine that the tamping machine was closing at speed and it appeared that it was not going to stop. He then made a decision to pass the signal at stop so that the tamping machine would not collide with his machine.

1.34 Despite five days of recent experience on this machine and his experience on similar machines, the ballast machine operator found the gearing system on this particular machine to be “awkward” to the extent that he used ‘white out’ to mark the gear positions on the cabin floor as depicted in Photograph 5. Because of the “awkwardness”, he was unable to accelerate away immediately.

1.35 Both crews agreed that at approximately 10:00am the ballast regulator operator braked as he noticed signal GJ144 at stop. The tamping machine operator observed the brake lights ahead and also braked heavily but could not avoid colliding with the rear of the ballast regulator. The ballast regulator then travelled approximately 60m past the signal before coming to a stand. The tamping machine stopped just beyond the point of impact and prior to signal GJ144. Both operators assert that they were travelling at approximately 50km/h, which is the specified track speed for the ballast regulator.
After the Collision

1.36 The ballast regulator operator alighted from his machine to see the extent of the damage. He noted there were several scratches on the rear of the machine but it was only minor damage. No crew members were injured.

1.37 The operator said that when he re-entered the vehicle he spoke to the trainee tamping machine operator (PO) by two-way radio. The PO told him he should set his machine back behind signal GJ144. This was out of concern the machine could be in the path of the forecast shunting manoeuvres within Goobang Junction Yard. At that point the operator of the ballast regulator set
back behind signal GJ144 under the instructions of the PO located in the tamping machine.

**Incident Response**
1.38 The Network Controller was made aware of the collision in a telephone conversation with the PO at approximately 10:09am. At 10:22am he contacted the ARTC Safety Investigator. The Safety Investigator arrived at Goobang Junction at 10:45am and commenced a preliminary investigation. There was no requirement for an emergency response team to attend.

**The Crew**
1.39 Contrary to standard practice, the ARTC Safety Investigator only breath tested the crew of the tamping machine, the PO and the trainee PO, who both returned a negative result. He was under the misunderstanding they were the crew of the lead vehicle. When the error was identified, it was too late to rectify the matter.

1.40 An examination of the rosters of each of the Track Australia personnel did not reveal any tasking beyond industry standards. All crew members reported having had an early night, had slept well and felt fresh when signing on in the morning. Fatigue was therefore excluded as a contributing factor in the incident.

**Operator’s Visibility and Cabin Functionality**
1.41 An examination of the ballast regulator revealed that the visibility from the operators’ viewpoint (see *Photograph 6*) and functionality within the cabin to be satisfactory. As a result, impairment of the operator’s visibility and functionality within the cabin were excluded as possible causes or contributory factors.
An analysis of the sequence of events was undertaken using time recordings taken from the Network Control’s Phoenix system and distance information taken from the Section Diagram provided by ARTC. The track circuit on the Phoenix system was divided into five sections for the purpose of the analysis and numbered one to five in the direction of travel (see Figure 3).

The track machines first appeared on the Phoenix system track circuit at 9:58:37am. At that point, 8M71 had covered a distance of approximately 48km since departing Peak Hill at 9:06am. This meant that the track machines averaged 55km/h over the whole distance and would have exceeded it on occasions. The ballast regulator had therefore been driven at speeds in excess of its prescribed maximum speed of 50km/h.
1.44 It was calculated that the track machines were travelling at an average of 50.3km/h within Section 1 leading up to the level crossing. In Section 2, the track machines averaged 24km/h from a standing start at the level crossing. The leading ballast regulator averaged 43km/h within Section 3, the section of 582m in length on the approach to signal GJ144.

1.45 The leading ballast regulator passed signal GJ144 at stop in Section 4. However, the trailing tamping machine stopped before the signal as evidenced by the track circuit continuing to display the presence of a vehicle in Section 3. It is estimated that the ballast regulator passed the signal by approximately 60m as the machine entered Section 5 which commences 50m beyond the signal.

1.46 Further, when the Phoenix system and voice recordings were matched, it was discovered that the ballast regulator set back behind the signal without permission being sought from the Network Controller. This is inconsistent with the statements made by the tamping machine crew members at interview.
who both indicated permission had been given by Network Control. The action was in breach of ANWT 316 which specifically precludes the setting back of track vehicles travelling as a train and ARTC Network Rule ANSG 612 *Overrun of limit of authority* which requires a vehicle to stop immediately and notify Network Control, with further action only to be at the direction of the Network Control Officer.

**Examination of Voice Recordings**

1.47 Voice recordings were obtained of the telephone communications between the Network Controller and the track machine operators. The first recording of significance occurred at 9:01am. It confirmed that:

a. the trainee PO reported arriving at Peak Hill;

b. the trainee PO then requested permission to travel to Goobang Junction;

c. the Network Controller told the trainee PO that they might be required to stand at signal GJ144 as he had another train conducting shunting operations within Goobang Junction Yard, and

d. the trainee PO acknowledged the Network Controller’s instructions.

1.48 In the next recording, at approximately 10:02am, the trainee PO advised the Network Controller that they were standing at signal GJ144. The Network Controller then asked if they had inadvertently passed the signal at stop as he had an anomaly showing on his Phoenix system. The trainee PO replied: “*Ohhh…… I don’t think so, na*”. The Network Controller then stated that he would clear the route and signal. After doing so, he told the trainee PO that signal GJ144 was clear to proceed and they were clear to continue into Goobang Junction Yard.

1.49 According to the Phoenix system, the signal was passed at stop at 10:00:27am. The crew of the ballast regulator then finalised setting back behind the signal at 10:02:18am. During this time the ballast regulator travelled at least 120m (60m forward into Section 5 and then set back behind the signal) in 111 seconds.
1.50 At approximately 10:05am, the Network Controller rang the trainee PO and asked him if the leading ballast regulator had passed signal GJ144. The trainee said: “OK, I'll let you know as soon as I get to the staff hut”. The ballast regulator and tamping machine then continued in convoy to the staff hut.

1.51 At approximately 10:09am, the PO telephoned the Network Controller and reported that he “… did bump him [the ballast regulator] with my machine and push him over the glued joint, so that's a fact.” The phone dropped out for a moment and then the Network Controller telephoned the trainee PO. The PO answered the phone and confirmed his previous report “… didn’t think his wheels were over the glued joint but we’ve had a look and they would have been.” This explanation is inconsistent with the evidence that shows the SPAD did not occur as a direct result of the minor collision and that the ballast regulator travelled much further than the glued joint before coming to a stand.

Communications

1.52 Communication on board both machines was by way of hard-wired UHF radio sets providing non-discreet channels even though a NSW Government Radio Network (GRN) radio was installed (see Photograph 7).

1.53 The ballast regulator operator stated that, on realising he was about to SPAD, he radioed to the tamping machine operator advising that he was slowing down. The PO denied hearing the ballast regulator operator call him about slowing down and the trainee PO corroborated the claim that the radio transmission was not received in the tamping machine. The PO claimed that he would have stopped had he received such a message. However, he stated that he did hear the radio transmission just prior to the Brologan Road level crossing when the ballast regulator operator was stopping to confirm the activation of the flashing lights and bells.
1.54 With the exception of in-cab conversations and those conducted on local radio frequencies, radio and telephone communications are now recorded in all areas of train operations to permit verification of communications in relation to safeworking and related matters. Discreet radio channels are used for safety-critical work as provided for via the GRN. There appears to be no compelling reason why the same capability that is installed in trains should not be available in track machines.

Communication Protocols

1.55 It was apparent from the voice tapes of the conversations between the Network Controller and the track machine operators that at no time did they adhere to standard radio protocols. The manner of the telephone and radio communications placed them in breach of ARTC’s Network Rule ANGE 204 Network Communication and Network Procedure ANPR 721 Spoken and written communication.

1.56 Among the voice recordings is a record of the Network Controller answering a call from a train driver. During this conversation, the Network Controller generally follows correct communication protocols. However, when the call is finished, he returns a call to the track machine operators and in this reverts back to disregarding communication protocols.
Convoy Operating

1.57 The operating environment for track machine operators is as demanding as that for drivers of other rail vehicles but, as is evidenced by ANWT 316 and ANPR 748, it is made more complex in that movement between work sites is usually in convoy. Because of this, there are a number of specific requirements including:

- to “travel as closely as is safely practicable”;
- to “travel within sighting distance of the vehicle ahead” if communication is lost; and
- to close up “if the leading vehicle stops, or before entering a section, or before working over an active control level crossing”.

These requirements necessitate the exercise of sound spatial judgement on the part of individual machine operators.

1.58 Where practical and the capability exists, it would seem preferable that track machines travel drawbar connected. However, where this is not the case, operators would benefit from some assistance or guidance in gauging appropriate machine separation distances. This could be provided, for example, in the form of tables or graphs recommending minimum separation distances at various speeds for each type of machine.

Similar Incidents

1.59 Information obtained from the Independent Transport Safety and Reliability Regulator (ITSRR) revealed that there were 17 instances of track machine and road-rail vehicle collisions between February 2004 and April 2009, the consequences of which were significant in terms of machine damage, infrastructure damage and/or injuries (see Figure 4). Despite the differing circumstances of each incident, all involved one or more of the elements of lack of route knowledge, convoy working, excessive speed and poor communication.
<table>
<thead>
<tr>
<th>DATE</th>
<th>DESCRIPTION</th>
<th>LOCATION</th>
<th>CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/02/2004</td>
<td>Collision between dumper and spiker machine.</td>
<td>East Richmond</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>20/10/2004</td>
<td>Ballast regulator collides with stabilizer machine.</td>
<td>Wallerawang</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>12/12/2004</td>
<td>Collision between road/rail vehicle and rail grinder.</td>
<td>Nana Glen</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>31/05/2005</td>
<td>Collision between rail grinder and road/rail vehicle.</td>
<td>Cootamundra</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>2/06/2005</td>
<td>Collision between RR24M24 and road/rail vehicle.</td>
<td>Cootamundra</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>5/10/2005</td>
<td>Track machine collides with track machine.</td>
<td>Boggabri</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>24/03/2006</td>
<td>Collision between tamping machine and the ballast regulator.</td>
<td>Awaba</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>31/03/2006</td>
<td>Ballast regulator derails; tamping machine runs into the rear.</td>
<td>Jerrawa</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>15/09/2006</td>
<td>Track jack machine runs into rear of ballast regulator.</td>
<td>Menindee</td>
<td>Collision-Yard-Between Trains</td>
</tr>
<tr>
<td>18/01/2008</td>
<td>Track machine collides with track machine.</td>
<td>Mittagong Junction</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>11/07/2008</td>
<td>Ultrasonic testing road/rail vehicle runs into rear of chase road/rail vehicle.</td>
<td>Stuart Town</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>28/10/2008</td>
<td>Tamping machine runs into rear of ballast regulator.</td>
<td>Fish River</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>6/12/2008</td>
<td>Tamping machine runs into rear of pettibone machine.</td>
<td>Joppa Junction</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>9/12/2008</td>
<td>Excavator reverses into tamping machine.</td>
<td>Joppa Junction</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>22/01/2009</td>
<td>Ballast regulator runs into rear of tamping machine.</td>
<td>Bellambi</td>
<td>Collision-Run Line-Trains</td>
</tr>
<tr>
<td>12/03/2009</td>
<td>Road/rail vehicle runs into rear of excavator.</td>
<td>Wallerawang</td>
<td>Collision-Run Line-Trains</td>
</tr>
</tbody>
</table>

Figure 4: Track machine collisions in NSW from February 2004 to April 2009

Lochinvar Track Maintenance Vehicle Collision

1.60 A collision between track machines operating in convoy at Lochinvar in 2003 resulted in major damage to plant and injuries to seven workers, and prompted the then Ministry of Transport to commission the Rail Infrastructure
Corporation (RIC) to undertake a Level 2 investigation into the incident.\(^1\) Several of the findings of the investigation are pertinent to this investigation:

- **Safety Action No.1** “There is a need to review the requirements shown in Network Rule NWT 316 and Network Procedure NPR 748. Heavy track vehicles should not be permitted to follow each other closely and should be separated. The expectations placed upon each operator to continually travel “as closely as safely practicable” are unrealistic. The probability factor of human error is not genuinely considered.”

- **Safety Action No.2** “There is a need to consider the development and installation of an engineering device for track vehicles which facilitates the transfer of track vehicles in convoy” [Proximity sensors were envisaged.] There is an interesting discussion about the outcome of a similar recommendation from an investigation into a track vehicle collision the previous year resulting in no action because “The risk will be mitigated by coupling of machinery.”

- **Safety Action No.3** Recommended the development of a “Track Vehicle Operators Handbook” because “the current rules and procedures do not contain sufficient information for track vehicle operators.” Rules and procedures “must reflect that many track vehicles are like trains and they should not be moved through the network as though they were small pieces of plant.”

- **Safety Action No.15** Recommended “competency based training and assessment … in route knowledge for track vehicle operators” and formal maintenance of associated records.

1.61 The investigation also found that key recommendations from previous investigations into track vehicle collisions had not been implemented or had only been partially implemented, and recommended that RIC and the State Rail Authority conduct a joint audit of the status of all recommendations from previous investigations.

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1.62 The Lochinvar report makes specific reference to the investigation into a track vehicle collision at Darnick some 12 weeks prior. Several recommendations of that investigation are cited including:

“There is a need for RIC’s Safeworking Policy to be amended with regards to the route knowledge requirements of track vehicle operators.”

**Data Loggers**

1.63 The track machines were not fitted with data loggers or any similar form of data recording device. Data loggers are beneficial in that they:

- record a range of key operational information such as speed, distance travelled and braking applications; and
- assist in encouraging a culture of compliance with operating rules.

1.64 Information extracted from data loggers can be critical in incident and accident investigations. As an example of their use, in this incident, it would have been possible to verify precisely the speeds at which the machines were travelling rather than having to rely on estimates established from replays of the Phoenix system.

1.65 ARTC Engineering (Rolling Stock) Standard WOS 01.714 - *Safety Equipment* states that “track maintenance vehicles operating as a train … shall be fitted with a data recording system to record at least … time, speed and brake pipe or brake cylinder pressure” and lists an additional five “critical driving functions” considered as “desirable” to record. This is conditional on WOS 01.716 – *Track Vehicles Operating Under the Control of Track Signals* which provides that: “Track vehicles which operate the track circuits correctly may be authorised to operate under the control of track signalling.”

1.66 The two track machines were operating within a block system of working as train number 8M71 and were not authorised to operate under the control of track signalling. At the same time they were traversing approximately 130km of rail corridor between Dubbo and Parkes then continuing some 200km further on to Cootamundra. Given such a scenario, it would seem reasonable to mandate the same safety data recording capability on track
machines as there is on all passenger train, freight train and individual locomotive operations.

Remedial Actions

1.67 Track Australia advises that, in response to this incident, it has:

- revamped its risk management methodology to ensure “the Pre-Work Brief is utilised as an effective tool to control site and task specific risks in a direct manner”;
- had the two staff members operating the machines at the time of the incident competency assessed and recertified on signal recognition by an external agency;
- mandated the printing out of route maps for all operational and machine transfer activities;
- implemented a requirement that signal locations be confirmed prior to any machine movement;
- instituted a requirement to stop at all signals at Red until a positive identification of the signal is confirmed; and
- commenced developing a safety toolbox meeting format for roll out to all staff involved in Network communication.
PART 2  FINDINGS

Causation

2.1  The operator of the lead track machine of 8M71 made a conscious decision to pass signal GJ144 when it was at stop. He did so in the belief that this would serve to avoid a rear-end collision involving his ballast regulator and the following tamping machine. However, the separation between the machines was not sufficient to avoid a minor collision as the ballast regulator accelerated away.

Contributory Factors

2.2  The route knowledge of the crew members was limited to travelling the route in the opposite direction as passengers on the machines a week earlier. Not having a pilot driver or being in possession of any documentation that would assist their navigation, they relied on location signs. The crews did not respond to a landmark sign well in advance of the signal though it should have triggered the same response as a location sign.

2.3  The ballast regulator operator's signal recognition skills were inadequate for the task on which he was required to exercise them. The PO was distracted at the time of passing the landmark sign, the significance of which he would have been expected to recognise.

2.4  The Pre-Work Brief form which recorded the hazards and safety controls identified in the risk assessment for the transfer of the machines, did not address any specific risks associated with travelling in convoy or through relatively unknown territory.

2.5  The tamping machine crew denied receiving a warning via radio claimed to have been sent by the ballast regulator operator when he realised he was about to SPAD. It is also noted that non-discreet UHF radio channels were relied upon for communications between machines despite GRN radios being available.
2.6 The separation between the machines was less than that required to be safe at the speed at which the tamping machine was travelling.

**Other Safety Matters**

2.7 The following matters of safety concern were identified in the course of the investigation:

a. the convoy travelled in excess of the maximum designated speed of the ballast regulator between Peak Hill and the Brolgan Road level crossing;

b. as the train’s qualified worker to recognise fixed signals, the ballast regulator operator did not have the requisite route and locality knowledge;

c. after passing it at stop, the ballast regulator set back behind signal GJ 144 without the Network Controller’s permission; and

d. communication protocols were not used consistently.

2.8 It was necessary to rely on the Phoenix system and voice recordings from Network Control to assist with much of the evidence gathering and analysis. The extent and accuracy of evidence would have been enhanced if the track machines had been fitted with data loggers and voice recorders. However, it was not mandatory, in accordance with Engineering (Rolling Stock) Standard WOS 01.714, for the track machines to be fitted with a basic data recording system as train 8M71 was not authorised to operate under the control of track signalling as provided for by Engineering (Rolling Stock) Standard WOS 01.716,

2.9 Findings and recommendations from the 2003 Lochinvar and Darnick track machine collision investigations are relevant to the circumstances of this accident and warrant reiterating with the safety outcomes of this investigation.
3.1 In order to prevent a recurrence of this type of accident, the following remedial safety actions are recommended for implementation by the specified responsible entities.

**Track Australia**

3.2 Institute a requirement that track machine operators driving the leading vehicle in track machine convoy movements possess sound knowledge of the routes on which they are to operate, similar to that required of train drivers.

3.3 Ensure its track machine operators are provided with the necessary training to gain and maintain route knowledge certification, and establish mechanisms to check that operators sourced from labour hire and subcontracted organisations also possess necessary route knowledge certifications.

3.4 Use pilot drivers when the available track machine operators do not possess the necessary route knowledge for the sections in which they will be travelling.

3.5 Review risk management training for operators with a view to improving the adequacy and effectiveness of their Pre-Work Briefs or equivalents.

3.6 Reinforce with all their track machine operators the requirement to use correct communications protocols in accordance with current rules and procedures and, in doing so, stress the safety implications of poor procedures.

**Australian Rail Track Corporation**

3.7 Prepare and issue clear rules or guidelines in relation to track machine separation when travelling in convoy, e.g., minimum separation of Xm for (machine/type of machine) when travelling at Ykm/h.

3.8 Institute a requirement that track machine operators driving the leading vehicle in track machine convoy movements possess sound route knowledge of the routes on which they are to operate, similar to that required of train drivers.
3.9 Ensure its track machine operators are provided with the necessary training to gain and maintain route knowledge certification, and establish mechanisms to check that operators sourced from labour hire and subcontracted organisations also possess necessary route knowledge certifications.

3.10 Require that pilot drivers be used when available track machine operators do not possess the necessary route knowledge for the sections in which they will be travelling.

3.11 Reinforce with all operators, drivers and controllers the requirement to use correct communications protocols in accordance with current rules and procedures and, in doing so, stress the safety implications of poor procedures.

3.12 Implement a program of installing voice and data recording devices in all track machines that operate at speeds in excess of 25km/h\(^2\).

**Independent Transport Safety and Reliability Regulator**

3.13 Publish a safety notice alerting the rail industry to the key findings and recommendations of this investigation together with those of the 2003 Lochinvar and Darnick investigations listed at paragraphs 1.60 and 1.62.

\(^2\) This speed criterion is contained in guidance developed by ITSRR. Refer to ITSRR Information Alert: ITSRR - Guidance Material: Train Data Loggers dated 2 July 2007.
PART 4 APPENDIX

Appendix 1: Sources, Submissions and Acknowledgements

Sources of Information

- ARTC Network Controller (NCCS Junee)
- ARTC Risk and Safety Officer (South)
- Bureau of Meteorology
- Crew members of the track machines which formed train number 8M71
- Independent Transport Safety and Reliability Regulator (ITSRR)
- Operations Manager, Track Australia.

References

- ARTC Engineering Standards
- ARTC Network Rules and Procedures
- ARTC Train Operating Conditions Manual
- Glossary for the National Codes of Practice and Dictionary of Railway Terminology
- Rail Safety Act 2008 (NSW)
- Transport Administration Act 1988 (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:

- Track Australia
- Australian Rail Track Corporation
- Independent Transport Safety and Reliability Regulator
Submissions were received from all three DIPs.

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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