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- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

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ATSB TRANSPORT SAFETY REPORT
Rail Occurrence Investigation RO-2010-013
Final

Collision between grain trains 3234N and 8922N at Yass Junction, New South Wales

9 December 2010

Abstract

At about 0153[1] on 9 December 2010 an Up (northbound) loaded grain train travelling from Barellan, New South Wales (NSW) to Maldon, NSW and numbered as 3234N, collided at low speed with the rear of another Up (northbound) loaded grain train, numbered as 8922N, on the Down[2] Main line at Yass Junction, NSW. The intended operation had been for both trains to wait, one behind the other, on the Down Main line at Yass Junction to enable a third northbound goods train, 4MB2, to pass them both on the adjacent Up Main line.

Train 3234N proceeded as intended past a signal which indicated that the route was not clear and that the train should proceed at caution. Train 3234N braked as soon as train 8922N was sighted but a collision nevertheless ensued. The investigation highlighted that the definition of restricted speed applying in these sorts of cases requires considerable judgement on the part of train drivers.

FACTUAL INFORMATION

Location

Yass Junction is located on the main south line between Sydney and Melbourne on the Defined Interstate Rail Network (DIRN), about 318 track kilometres from Sydney Central Station. Yass Junction consists of Up and Down bi-directional main lines[3], passenger platforms and several maintenance/goods sidings. Rail traffic through Yass Junction is managed by the Australian Rail Track Corporation (ARTC) with network controllers located at the Junee train control centre.

The track between Yass Junction platform and signal YJ8, (Figure 2) in the Up direction (the direction which the two grain trains were travelling), is situated on a rising grade of between 1 in 81 and 1 in 263. The track transitions from tangent to an 800 m radius left-hand curve as it passes under the Hume Highway overpass. This curve then eases to a 1610 m radius.

At the time of the occurrence it was dark with moderate rain.

Train information

Train 3234N

Train 3234N was owned and operated by Pacific National. It consisted of two locomotives (8136 leading and 8131 trailing) hauling 40 loaded wagons carrying grain from Barellan, NSW to Maldon, NSW. Train 3234N was 615 m long with

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Daylight-saving Time (EDT), as particular events occurred. Eastern Daylight-saving Time was Coordinated Universal Time (UTC) +11 hours

2 Up line is heading towards Sydney, down line is heading away from Sydney when in NSW. Both trains had been routed from the Up main line to the Down main line at Yass Junction.

3 This allows trains to run in either direction on either line.

a trailing mass of 3175 t and was being operated by two crew members; a driver and co-driver.

Train 8922N

Train 8922N was also owned and operated by Pacific National. It consisted of two locomotives (8162 leading and 8121 trailing) hauling 39 loaded wagons carrying grain from Red Bend, NSW to Inner Harbour at Port Kembla, NSW. Train 8922N was 600 m long with a trailing mass of 2496 t. The train was also being operated by two crew members; a driver and co-driver.

The occurrence

Shortly before approaching Yass Junction at 0111:52, the crew of grain train 8922N contacted the network controller at Junee train control centre and were advised that their train would be routed from the Up Main line at Yass Junction to the Down Main line where they were to stop at signal YJ8. The controller also advised that a second train was to be routed in behind their train and stopped to allow a third train travelling in the same direction to pass on the adjacent Up Main line.

The crew on the second train 3234N, following 15 minutes behind train 8922N, approached Yass Junction and were routed onto the Down Main line as well. When approaching the Hume Highway overpass the driver said that he extinguished the headlight in accordance with the network rules and as a courtesy to oncoming road traffic. As the train passed under the bridge the driver said he turned the headlight back on. The train continued at a lower than normal speed approximately 500 m further when both drivers noticed a reflective end of train marker ahead of them. The driver applied the emergency train brake, however train 3234N collided with the rear wagon of train 8922N at about 15 km/h.

The automatic couplers between the two locomotives of train 3234N disengaged upon impact. However, due to the short distance of separation, the jumper cable and air hoses between the two locomotives remained connected.

Post occurrence

The incident was reported to the network controller at Junee train control centre and the Pacific National operations centre at Parramatta. Both drivers of train 3234N inspected the damage and found that the automatic coupler on the leading locomotive of train 3234N was damaged and the end of train marker from train 8922N was lying on the ground. The crew of train 8922N were contacted but said they were unaware of the collision.

Figure 1: Locomotive 8136 coupler damage.

Train 8922N departed the site at about 0245, after a visual inspection and with a replacement end of train marker. Train 8922N travelled through to Inner Harbour Port Kembla without further incident.

The driver of train 3234N was breath tested by a NSW Police officer. Once the test was complete, the driver returned to the front of the train. At about 0430 a qualified representative of Pacific National conducted further breath testing on both drivers. All three breath tests resulted in zero readings. The crew were relieved at Yass Junction at about 0445.

Train 3234N departed at about 0515. A roll-by inspection was performed by the outgoing crew. The train continued its journey to Maldon, without incident, where it was inspected by ATSB investigators.

Pacific National inspected both trains and noted minor damage to leading coupler on locomotive 8136. No other damage was noted.

Witness account

A witness situated in the Yass Junction signal box, located on the Yass Junction station platform, observed a train pass (8922N) but could not recall if the end of train marker was flashing. The

witness also recalled seeing another train pass (3234N) a short time later at low speed, with only the ditch lights on, and travel past the signal box. A short time later, the witness heard a 'very loud bang or boom'. The witness had a good working knowledge of railway operation and surmised that the two trains must have collided.

ANALYSIS

On 9 December 2010, the Australian Transport Safety Bureau (ATSB) received notification of a collision between two trains at Yass in New South Wales. Following an initial review of the incident, the ATSB decided to undertake an investigation, in particular, to identify any systemic issues that should be addressed.

As part of the process evidence was sourced from the train drivers, Pacific National, the Australian Rail Track Corporation, and the Independent Transport Safety Regulator of NSW. Evidence included interviews, train running information, voice and data logs, train data logs, engineering documentation including maintenance history, loading records, and other material.

Recorded data

Hasler tapes were obtained from trains 8922N and 3234N and analysed by the ATSB.

The Hasler tapes from both locomotives of train 8922N were used for comparative analysis. The Hasler tape from the leading locomotive 8136 of train 3234N was damaged (torn edges and creases) and could not be used for accurate analysis. Therefore, the analysis used the data contained on the Hasler tape from the trailing locomotive 8131.

Based on the analysis of data obtained from the Hasler tape from locomotive 8131, the brake cylinders started to charge about 15 seconds and 114 m before impact. Allowing for a reaction time of about 2.5 seconds, the approximate sighting distance was 140 m. Train 3234N collided with the rear wagon (NGPF35956D) of train 8922N at about 15 km/h. Table 1 shows extracts of this information.

Hasler data obtained from train 3234N also indicated that the train travelled through the cross-over at about 30 km/h. The train proceeded towards signal YJ8, and the preceding train 8922N, gradually increasing to a speed of about 38 km/h, throttle position 3.

Table 1: Data from locomotive 8131, train 3234N.

Event	Time (m:s)	Speed (km/h)	Distance (m)
Prior Stop	08:07	0.0	3296
Throttle change	07:00	21	3133
Position 1	05:41	31	2549
Throttle change	04:35	22	2062
Position 2	03:31	17	1664
Position 3	01:34	38	828
Position 4	00:38	31	317
Start braking	00:15	33	114
Point of impact	00:00	15	0

Data obtained from ARTC's Phoenix Control System showed that train 8922N travelled past signal YJ20 at Yass Junction (main line turnout indication) at 0121:57 and over the cross-over (number 56 points) at about 35 km/h before coming to a stand near signal YJ8. In this position there was room for another train of similar length to stop in-clear on the Up Main line behind train 8922N. At 0125:00 (Figure 2) the same route was set and signal YJ20 cleared to a Calling On indication.

As train 3234N approached Yass Junction, the accept signal (YJ24) was displaying a caution aspect. Train 3234N proceeded past this signal at 0142:29 before stopping short of home signal YJ20. A Calling On shunt signal was displayed on signal YJ20 which indicated to the train crew that while the route was set from the Down Main line to the Up Main line, the route was not clear. There was no verbal communication between the network controller and the crew of train 3234N regarding the status of the line ahead or requirements of the movement. Train 3234N passed signal YJ20 at 0147:33 (Figure 3), about 23 minutes after the route was originally set. Once train 3234N was clear of the cross-over, the route was reset so signal YJ20 could be cleared for the following train 4MB2 (Figure 4) which was to pass the two grain trains stopped on the Down Main line at Yass Junction.

Figure 2: Phoenix extract at 0125:00.

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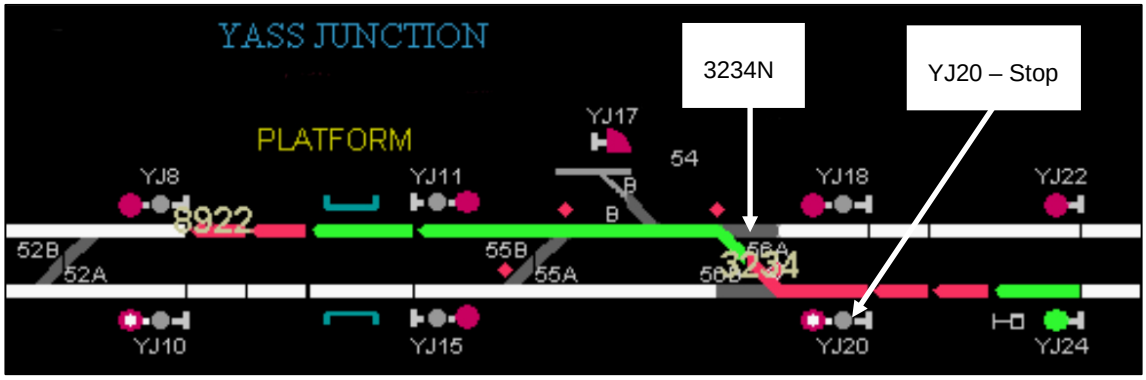
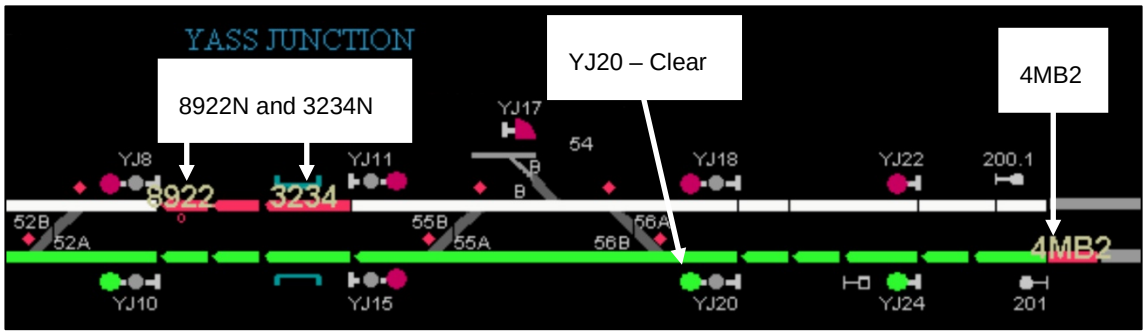
Figure 3: Phoenix extract at 0147:33.



Copyright – ARTC ©. Note – signal YJ24 set to a pre-set clearing mode.

Figure 4: Phoenix extract at 0150:12.



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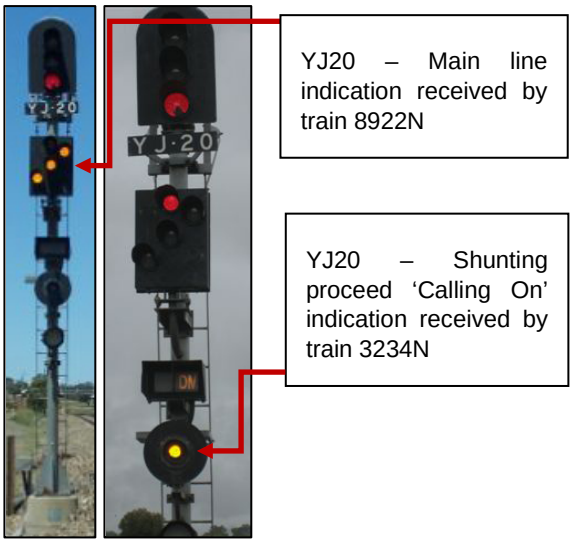
Signalling system

The fixed signals in the Yass Junction area are remotely controlled by a network controller located in the Junee train control centre. The fixed signals are interlocked, meaning conflicting movements cannot be selected or routed by the network controller during normal operations. However, signal YJ20 has the ability to indicate a number of running and shunting indications, such as:

- stop
- main line proceed through on Up Main line
- main line proceed through on Down Main line in up direction (turnout with route indicator), Figure 5
- shunting proceed through on Down Main line in up direction (turnout with route indicator), Figure 5.

Figure 5: Signal YJ20



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On the day of the collision, train 8922N received a main line proceed from signal YJ20 to travel over number 56 points and continue on the Down Main line up to signal YJ8 where the train would stand and wait. Train 3234N received a shunting proceed indication from signal YJ20 called a Calling On to travel over number 56 points and continue on the Down Main line and stop short of the preceding train 8922N. The signalling system worked correctly and as designed.

Rules

The ARTC network rule *ANSG 602 Shunting Signals* describes and illustrates a Calling On signal. It also notes that Calling On signals:

> are fitted as subsidiary signals to home signals, and
>
> authorise a movement past the running signal, and
>
> indicate that the points in the route are locked, but do not indicate that the line ahead is clear.

The ARTC network rule *ANSG 606 Responding to Signals and Signs,* used in NSW, defines how train drivers should respond to signal indications. The rule states that:

> A shunting signal authorises a movement at *restricted speed* past that signal.

The rule warns that:

> Shunting signals can be cleared if the line beyond the signal is occupied. Drivers and track vehicle operators must proceed as if the line is already occupied.

The rule also states that:

> A PROCEED indication by a shunting signal does not indicate that the block ahead is unoccupied.

This means that, when a Calling On indication is given, drivers should assume that the line ahead is occupied and operate the train accordingly, at restricted speed.

The ARTC *Glossary* defines restricted speed as:

> A speed that allows rail traffic to stop short of an obstruction within the distance of clear line that is visible ahead.

This allows drivers to determine what is a safe speed; according to other factors such as track features, weather, and train braking performance.

The Rail Industry Safety and Standards Board (RISSB) of Australia are currently developing standards for the rail industry in Australia to adopt. The current draft document ANRP *Glossary* defines restricted speed as:

> Restricted speed is a speed that allows rail traffic to stop short of an obstruction within half the distance of clear line that is visible ahead.
>
> Restricted speed must not exceed 25 km/h.

The most notable difference between the two definitions is the distance required to stop and the

speed. The current ARTC definition of restricted speed does not specify a maximum speed and therefore requires considerable judgement on the part of the train driver. Had the draft RISSB definition been in use at the time of the collision, the speed of the train would have been limited to 25 km/h and the collision may not have occurred.

In their submission, the ARTC noted that:

> This is an element of the New South Wales Rule Book and does not apply across the entire ARTC network.
>
> Specification of, or compliance with a maximum speed is not a totally viable defence against a collision, recognition of the fact that the section ahead is occupied and proceeding with due care should more than suffice.
>
> "A speed that allows rail traffic to stop short of an obstruction within the distance of clear line that is visible ahead" would appear to be a clear concise instruction yet the crew involved were unable to comply.

Although the Calling On signal indication meant that the section ahead was most likely occupied by another train, the definition of restricted speed used by the ARTC still relies on the judgement of individual drivers. Drivers must use their experience to judge a range of factors, in particular the sighting distance and train braking characteristics in the prevailing conditions. That judgement may also vary significantly between different drivers depending on the level of risk perceived and accepted by that driver. While the definition of restricted speed may be a 'clear and concise instruction' its application is not precise and it is something that cannot be measured unless an incident, such as a collision, occurs. It should be noted that any final amendment to the rule, if any, should be subject to a thorough risk analysis, including human factors analysis.

Driver actions

The recorded data shows that the driver of train 3234N had passed signal YJ20 and travelled over number 56 points at a constant speed consistent with the posted limit. The driver proceeded at between 38 and 32 km/h, a lower than normal speed, from 820 m to 113 m respectively from the point of impact. This reduced speed was probably considered by the driver to be a 'restricted speed'. On sighting train 8922N the driver of 3234N reacted almost immediately however, the train did not stop within the available distance, a sighting distance of 140 m, before colliding with the rear of train 8922N.

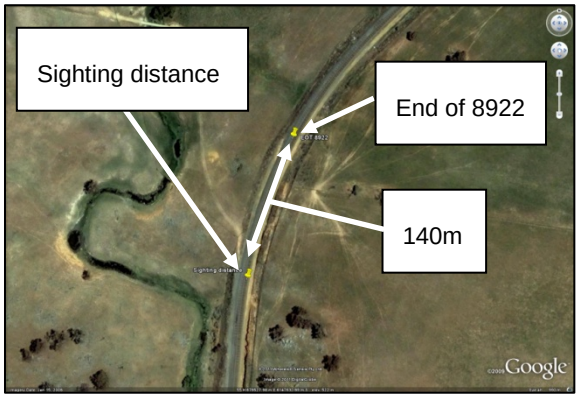
Factors affecting driver actions

Environment

At the time of the collision it was dark with moderate rain. Sighting distance was limited by the curvature of the track, embankments, and the effective illumination of the train's headlight. There is a strong correlation between these factors, the driver's statement, and the recorded data from the train. Based on measurements in (Figure 6), the actual sighting distance is consistent with the driver's actions, and the driver reacted almost immediately once he saw the train stopped ahead.

Even though the driver was operating at a speed that he considered appropriate, a 'restricted speed' of 32 km/h for the prevailing conditions, it is evident that an even lower approach speed was necessary. Based on the actual deceleration rate of the train, the maximum speed for it to be able to stop short of the train ahead within the available sighting distance with an emergency brake application, was 30 km/h. Using the same deceleration rate and the draft ANRP definition of a restricted speed of 25 km/h, it is likely that train 3234N would have been able to stop before colliding with train 8922N.

Figure 6: Sighting distance.



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Expectation

The driver of train 3234N had been driving trains through Yass Junction for a many years. During this time he had rarely been routed onto the Down Main line behind another train. However, he had

been routed onto the Down Main line with a main line proceed indication about five times previously, in some cases with another train following in behind. The driver had expected to be told by the network controller (as he stated had happened previously) if a train was stopped ahead (or that his train was clear of 56 points) so he could reasonably anticipate the location of the rear of the train and drive accordingly. However, the network controllers are not currently required to communicate this 'close quarters' information to the train driver. It follows that a low expectancy of being routed onto the Down Main line behind another train may have resulted in driving behaviour that may not have reflected the intent of the Calling On signal indication and merely the presence of an indication to proceed, and the driver responded in a way consistent with his past experience.

Notwithstanding this, the driver accepted that the Calling On proceed authority indicated that, by definition, the section ahead was already occupied.

In submission, the ARTC stated that:

> The actions of the network controller clearly fulfilled the documented requirements, the actions of the crew of train 3234N failed to meet the documented requirements.

The ARTC also stated in submission in response to the suggestion that network controllers should consistently communicate 'close quarters' information to train drivers:

> This is correct and the seemingly simple safety action has a number of potentially significant impacts and implications on the network these include;
>
> - It implies that the use of visually differing signal aspects alone is no longer an adequate means of ensuring safety.
> - It requires the network controller to interpret the operating environment for the driver and issue verbal advices accordingly, if this line of thinking is expanded verbal advices cannot be limited to "close quarters" situations but must be expanded to include any out of course running or changes to the natural or operating environment.
>
> Implementation of this requirement would increase the workload on the network controller and possibly affect overall network safety and efficiency.

The ARTC asserts that the signalling system is the primary defence to maintain train separation and communicate the status of the block ahead. Furthermore, the ARTC is of the opinion that drivers being told about the status of the block ahead by network controllers (whether mandatorily or as a courtesy), may unintentionally diminish the significance of the signalling system.

Summary

The driver accepted a shunting proceed authority and operated train 3234N at a speed, albeit a difference of 2 km/h, from which it could not be stopped before colliding at low speed with the rear of train 8922N.

FINDINGS

Context

At about 0153 on 9 December 2010 two trains collided at low speed on the Down Main line at Yass Junction, NSW.

From the evidence available, the following findings are made with respect to the collision between trains 3234N and 8922N and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The driver of train 3234N was operating the train at a speed too fast for the prevailing conditions and intent of the Calling On signal.
- At the time of the collision it was dark with moderate rain. Sighting distance was limited by the curvature of the track, embankments, and the effective illumination of the train's headlight.
- The driver had expected to be told by the network controller if a train was stopped ahead so he could anticipate the location of the rear of the train and drive accordingly.

Other safety factors

- The current ARTC definition of restricted speed requires considerable judgement on the part of train drivers. *[minor safety issue]*

Other key findings

- Train 3234N collided with the rear wagon of train 8922N at a speed of about 15 km/h.

- The signalling system worked correctly as designed.
- The driver of train 3234N reacted immediately upon sighting the end of train marker on the rear of train 8922N and appropriately made an emergency application of the train brake.

SUBMISSIONS

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the Independent Transport Safety Regulator of New South Wales, Pacific National, the Australian Rail Track Corporation, and a number of individuals.

Submissions were received from the driver of train 3234N, the Independent Transport Safety Regulator of New South Wales, and the Australian Rail Track Corporation. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.