RAIL SAFETY INVESTIGATION REPORT

DERAILMENT OF PACIFIC NATIONAL SERVICE 6BA6 EULA BALONG WEST – MATAKANA RAIL SECTION

14 JANUARY 2007
RAIL SAFETY INVESTIGATION REPORT

DERAILMENT OF PACIFIC NATIONAL SERVICE 6BA6
EUABALONG WEST – MATAKANA RAIL SECTION

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

Investigation Reference: 04344
THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

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ACRONYMS AND ABBREVIATIONS

ARTC .......... Australian Rail Track Corporation
ATSB .......... Australian Transport Safety Bureau
BOM .......... Bureau of Meteorology
CSC .......... Cobar Shire Council
CWR .......... Continuously Welded Rail
DCC .......... PN’s Divisional Control Centre, Adelaide
DEC .......... NSW Department of Environment and Conservation
DIP .......... Directly Involved Parties
DIRN .......... Defined Interstate Rail Network
DMS .......... Defects Management System
ITSRR .......... Independent Transport Safety and Reliability Regulator
MoU .......... Memorandum of Understanding
NRAMS ...... NSW Rail Access Management System
OTSI .......... Office of Transport Safety Investigations
PN .......... Pacific National Limited
SMS .......... Safety Management System
TCI .......... Track Condition Indices
TOCO .......... Train Order Control, Orange
WTSA .......... Welded Track Stability Analysis
EXECUTIVE SUMMARY

At 2:53pm on 14 January 2007, both Pacific National Limited (PN) and the Australian Rail Track Corporation (ARTC) notified the Office of Transport Safety Investigations (OTSI) Duty Officer that, at 2.32pm, PN’s ‘Super-Freighter’ service 6BA6 had derailed at high speed in the Euabalong West – Matakana section of the Defined Interstate Rail Network (DIRN). The Australian Transport Safety Bureau (ATSB) was notified and OTSI investigators deployed to the derailment site following advice from the ATSB that it would not be investigating the incident.

6BA6 consisted of two NR class locomotives and 26 container wagons conveying 63 containers and was en route from Brisbane to Adelaide when it derailed approximately 4kms West of Euabalong West, in Central Western NSW. The 15th and subsequent wagons derailed resulting in substantial damage to the track, wagons and their cargo. Fortunately, the crew were not injured and there were no other persons involved in the derailment.

A hazardous materials (Hazmat) team from the NSW Fire Brigade responded to the site because hazardous materials spilled from several containers following the derailment.

The investigation found that instability and misalignment of the track structure at 623.452kms caused the 15th and subsequent wagons of 6BA6 to derail.

The instability of the track was attributable to a lack of structural rigidity resulting from non-conformance with ARTC Engineering Standards as evidenced by the following:

- poor condition of timber sleepers;
- ineffective timber sleeper fastenings;
- poor rail anchorages;
- inconsistent ballast depth and compaction under steel sleepers;
- non-conforming placement pattern of steel sleepers, and
- minor additions of rail in welding processes.

No operating constraints had been put in place to compensate for these conditions.
There was no evidence to indicate that the way in which 6BA6 was marshalled, loaded or handled contributed to its derailment.

ARTC has technical standards which, if applied correctly, should have identified a variety of track-related defects and their potential impact. However, because the related inspection, maintenance and documentation requirements were not undertaken effectively, those responsible for analysing the condition of the track and determining maintenance priorities worked with information that was erroneous in some instances and incomplete in others. As a consequence, they did not comprehend the extent to which the track in the area in which the derailment occurred had become compromised.

Reporting actions subsequent to the incident revealed an apparent lack of knowledge or understanding of:

- the responsibility for contacting emergency services and the information to be provided;
- the location of dangerous cargo records (including by emergency service organisations), and
- the importance of reporting (or questioning) the presence of dangerous cargo.

Consequently, the train crew put themselves at risk and, subsequently, incident response personnel were placed in positions of potential risk and their tasks made more difficult and time consuming.

Control difficulties at the site were also encountered but, despite this, the Hazmat operation was handled professionally and effectively.

As a result of the key findings of this investigation, the primary remediation is recommended for implementation by ARTC and includes the following safety action:

- ensure its rail safety workers involved in the inspection, repair and management of track have a thorough understanding of the engineering standards, inspection regime, repair procedures and documentation requirements which are specified for their various rail safety tasks;
- ensure that the results of all track inspections and maintenance work carried out are recorded accurately, using current authorised documentation;
• ensure quality assurance practices are being implemented effectively through regular scheduled walking inspections of the track condition and diligent adherence to its Defects Management System, and

• review those of its engineering standards concerned with the inspection and maintenance of continuous welded rail, steel sleeper guidelines and assessments made in relation to speed restrictions during high temperature conditions, to ensure that they are consistent with industry best practice.

In addition, it is recommended that both ARTC and PN review their emergency management policies and procedures, particularly as they relate to the handling, carriage and documenting of dangerous goods, to ensure the safety of all train crews and emergency response personnel involved in a dangerous goods incident.

The full details of the Findings and Recommendations of this rail safety investigation are contained in Parts 3 and 4 respectively.
PART 1 FACTUAL INFORMATION

Accident Synopsis

1.1 At 2:53pm on 14 January 2007, both Pacific National Limited (PN) and the Australian Rail Track Corporation (ARTC) notified the Office of Transport Safety Investigation’s (OTSI) Duty Officer that, at 2.32pm, PN’s ‘Super-Freighter’ service 6BA6 had derailed at high speed in the Euabalong West – Matakana section of the Defined Interstate Rail Network (DIRN).

1.2 6BA6 consisted of two NR class locomotives and 26 flat top container wagons conveying 63 containers from Brisbane to Adelaide when it derailed approximately 4kms West of Euabalong West, in Central Western NSW. A hazardous materials (Hazmat) team from the NSW Fire Brigade responded to the site because hazardous materials spilled from several containers following the derailment. Fortunately, the crew were not injured and there were no other persons involved in the derailment.

Accident Narrative

Before the Derailment

1.3 6BA6 arrived at Parkes Yard (Goobang Junction) from Sydney shortly after midday on 14 January 2007 with three locomotives hauling the train. A crew changeover was effected here and one of the locomotives (NR25) was detached from the train. As the consist of 6BA6 had been altered, the outgoing crew then conducted a safety inspection of 6BA6 in accordance with ARTC Network Rules. They then requested an authority (train order) from the ARTC Train Order Control Centre at Orange (TOCO) for travel towards Broken Hill. During the issue of the train order by TOCO, the crew also requested advice as to any temporary heat related speed restrictions imposed along the corridor and were advised that none were in place.

1.4 6BA6 departed Parkes at 12:40pm and, as required by Train Order 40046, the crew reported to TOCO when they passed through Condobolin and Euabalong West, at 1:50pm and 2:29pm respectively.

1 Subsequent to this incident, all functions of the ARTC Train Order Control Centre at Orange have now been transferred to the Network Control Centre North at Broadmeadow.
The Derailment

1.5 Shortly after passing Euabalong West, the crew felt the train surge and the emergency brakes automatically apply. They then observed a large volume of dust in the rear vision mirrors of the leading locomotive and what appeared to be containers and wagons separating from 6BA6. Having been involved in a similar incident previously, the driver responded to the application of the emergency brakes by applying additional power and releasing the independent brakes on the locomotives as the train came to a stand. These actions were intended to prevent the train from bunching, thereby reducing the risk of the derailed portion of the train colliding with that portion of the train that was ahead.

After the Derailment

1.6 The leading locomotive came to a stand at 624.900kms³. (See Appendix 1 for a diagrammatic layout of the site). The crew immediately notified both TOCO and the Pacific National Divisional Control Centre (DCC) in Adelaide of the derailment. They then secured the locomotives and commenced to walk towards the rear of 6BA6 to assess the extent of damage.

1.7 Upon reaching the 15th wagon (RRGY 7152G), the crew noticed that four of its six bogies (1st, 4th, 5th and 6th position) had derailed and that containers and bogies were missing from the next wagon (RRAY 7255W) and that all of its platforms had been dragged along the ‘Up’ side of the track after becoming uncoupled from the rear portion of the train (see Photo 1). Track damage was also readily apparent, as were bogie components, containers and their contents, scattered over 500m on the ‘Up’ side (see Photos 2 and 3).

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2 The air brakes on a diesel electric locomotive are independent of the brakes used on the rest of the train. When a (automatic) brake application is made on the train, the locomotive brake system will apply the brakes the same as any wagon. However, the driver can release (‘bail-off’) the brake application on the locomotive while maintaining braking effort on the rest of the train.

3 This is the measurement of distance by rail from Central Station in Sydney.
OTSI Railway Safety Investigation

Direction of travel 6BA6
Drag marks from derailed platforms of wagon RRAY 7255W

Photo 1: View of rear platforms of wagon RRAY 7255W

Direction of travel 6BA6
Drag marks from derailed platforms of wagon RRAY 7255W

Photo 2: View of damaged containers and contents littering the ‘Up’ side of the rail corridor
As they moved closer to the damaged containers, the crew detected the presence of odours which they assessed to be chemical in nature, and moved away from the area. The presence of the chemical odours prompted the crew to return to the leading locomotive to report the probable spillage of dangerous cargo to both TOCO and the DCC. Thereafter, the crew acted to protect their train in accordance with ARTC Network Rule ANTR 400 Protecting Trains and ARTC Network Procedure ANPR 720 Protecting Trains.

Having been advised of the likelihood that dangerous goods had spilled, TOCO contacted the Emergency Services via “Triple 0”. A unit from the NSW Rural Fire Service at Euabalong West was dispatched to the site, arriving at 3:46pm. This unit was followed by a NSW Fire Brigade Hazmat team from Lake Cargelligo, arriving at 3:50pm. At approximately 4:00pm, NSW Police Officers from Lake Cargelligo arrived on site and breath tested the assistant driver of 6BA6 at 4.10pm and the driver at 5.00pm. Both crew members returned negative results.

ARTC’s Risk and Safety Officer from Parkes arrived at 7:25pm and secured the site pending the arrival of OTSI’s investigator from Sydney and recovery gangs from Cootamundra and Broken Hill.
Location of Derailment

1.11 6BA6 derailed approximately 4kms West of Euabalong West, in the Euabalong West - Matakana rail section, in the Central West Region of NSW. Euabalong West is situated approximately 175kms West of the town of Parkes on the DIRN between Sydney and Adelaide.

![Incident Location (Central West NSW)](image)

![Figure 1: Incident Locality](image)

Track Information

1.12 The track is a standard gauge single line classified as a Class 1 line under ARTC Engineering Standard TDS 11 *Standard Classification of Lines*.

1.13 The track comprises of 53kg/m continuously welded rail (CWR)\(^4\) fixed to timber sleepers interspersed irregularly with steel sleepers.

1.14 The track, as is indicated in the Curve and Gradient Diagram at *Figure 2*, is straight but undulating in the area in which the derailment occurred.

1.15 The maximum speed for freight trains operating in the section is 115km/h.

1.16 The line is leased by ARTC under a 60 year agreement with the NSW Government. Under the terms of the lease, ARTC has responsibility for all train control and track maintenance functions on the line.

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\(^4\) The calculated mass of the steel rail weighing 53kg per metre in length.
Operations Information

1.17 The safeworking system for the line between Orange and Broken Hill is Train Order Working\(^5\), controlled under ARTC Network Rule ANSY 502 *Train Order System*. 6BA6 was in possession of the relevant authority (Train Order No. 40046) to traverse the section at the time of the derailment.

Crew Information

1.18 6BA6 was operated by an experienced two-man PN crew based out of Parkes who were both familiar with, and qualified for, the route. The driver had 27 years driving experience and held the position of Driver Specialist at Parkes. At the time of the derailment, he was also Acting Regional Operations Manager with the responsibility for management of PN’s freight terminals at both Parkes and Sydney. The assistant driver had 10 years experience driving trains and was an appointed Driver Trainer at Parkes. Both crew members were within their respective medical and competency assessment periods.

\(^5\) The Train Order Working system is a form of safeworking used in bi-directional single line territory, in lieu of rail vehicle detection systems, to give a train sole occupancy of a block and prevent other trains from entering the same block.
Train Information

1.19 As previously indicated, 6BA6 consisted of two NR Class locomotives (NR83 and NR18) and 26 flat top container wagons conveying 63 containers. Nine of the 26 wagons were articulated and consisted of two or five container platforms (see Photo 4). 6BA6 measured 1,035 metres in length and had a total train weight of 1,925 tonnes.

1.20 The 63 containers transported by 6BA6 were loaded with a variety of commodities including cars, whitegoods, household effects, furnishings, office equipment, bottled spirits and wine, refrigerated meat, bulk herbicide, bulk engine coolant, and Class 2.1 (aerosols), Class 5.1 (hydrogen peroxide) and Class 6.1 (sodium cyanide) dangerous goods.

Damage

1.21 A total of 11 wagons and 28 containers, including their contents, were significantly damaged as a result of the derailment. The locomotives and 14 leading wagons were undamaged and certified fit to continue the journey to Adelaide on 15 January 2007. The rear wagon was certified fit for return to Euabalong West and was later transferred to Adelaide. The damaged wagons were removed from the track and subsequently recovered by road to be either repaired or scrapped. Approximately 800m of track required repair before the line was re-opened on 18 January 2007.
PART 2 ANALYSIS

2.1 Derailments of the type involving 6BA6 are typically caused by one, or a combination of the following factors:

a. deficiencies in track structure;

b. inappropriate wagon loading;

c. deficiencies in the rolling stock;

d. inappropriate train management;

e. inappropriate train marshalling, or

f. incompatibilities between the track and the rolling stock.

Track Condition

Factors to be considered in assessing track condition

2.2 Continuously welded rail track is complex in its structure with high levels of co-dependence between components. Any deficiency in a component affects the strength and rigidity of the track as a whole. In the absence of strength and rigidity, thermal stresses cannot be contained within the track structure.

2.3 Keeping the track structure strong and rigid begins with the maintenance of a well drained, full depth and full width profile made up of well-graded, sharp, crushed rock ballast. The ballast, in turn, must firmly contain solid\(^6\) sleepers attached to the rails with effective, preferably resilient, rail fastenings. The track must also be kept on a designed alignment and prevented from moving longitudinally\(^7\). Any deficiencies in the track structure must be detected early and corrected quickly to prevent deleterious effects.

2.4 The most critical of the factors that can lead to a misalignment of continuously welded rail is stress within the rail and this factor is most difficult to detect. In NSW, rail is correctly adjusted if it is stress-free at a rail temperature of 35°C, which is referred to as the 'neutral' temperature. Good track structure and adjustment will resist stresses induced by rail temperatures up to 75°C.

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\(^6\) Solid sleepers may be constructed of timber, steel or concrete with bulkier types more able to contain track forces and resist movement.

\(^7\) Referred to as 'Creep' or 'Creeping' within ARTC track inspection standards.
However, without actually cutting the rail, the indicators or symptoms of excessive stress can only be detected by careful visual inspection. Trained maintenance staff will examine alignment, creep, scratch marks at anchors, anchors bearing against sleepers, bulking of ballast in cribs ahead of sleeper movement, slight gaps in loose ballast at sleeper ends or a depression in the crib ballast behind the sleeper. While some observations can be made about the condition of track from onboard a locomotive or a road-rail vehicle, detailed observations can only be made by experienced staff during a walking inspection.

2.5 The crew reported that they did not notice or detect any defects with the track as 6BA6 passed over the site.

**Track Inspection**

2.6 **Before the Point of Derailment.** The following observations were made during inspection of the track leading to the point at which 6BA6 derailed:

- a. the track between 621.000kms and the point of derailment (623.452kms) was laid on timber sleepers interspersed irregularly with steel sleepers. However, the placement of these steel sleepers did not conform with guidelines recommended in ARTC Engineering Standard TCS 10 *Steel Sleepers – Usage and Installation Standards*;
- b. the horizontal alignment of the track and rail top appeared satisfactory;
- c. there was no evidence of recent disturbance of the ballast formation;
- d. the ballast formation was full, clean, sharp and even in shape, with no evidence of sleepers pumping\(^8\) or bog holes\(^9\);
- e. the ballast contained under the steel sleeper pods in the area was inconsistent in compaction and depth ranging from full to a level 50mm below the top of the sleeper with lower levels limiting the capability of the ballast to constrain the sleeper and the rails;
- f. the condition of the timber sleepers and fastenings was predominantly “poor” (ineffective), as defined in ARTC Engineering Standard TMS 06 *Timber Sleepers – Maintenance Standard*. Those sleepers in poor

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\(^8\) The term used when a sleeper is not supported against vertical movement.

\(^9\) The term used for a condition caused by the pumping of sleepers in areas of poor drainage.
condition were rotten, split or shattered, or had fastenings which were ineffective. In some instances, the fastenings were either positioned under the foot of the rail or were so loose that they could easily be rotated or extracted. In addition, significant lateral movement of the sleeper plates on the sleepers was observed, indicating that the rail was not effectively attached to the sleeper (see Photo 5) and constrained to provide any required torsional resistance to buckling;

Photo 5: Typical condition of fastenings in area of derailment

g. the rail anchor pattern on the timber sleepers was irregular;
h. the effectiveness of the anchors was limited by the poor sleeper condition;
i. few timber sleepers were marked for replacement;

Photo 6: Area at 623.380kms with ineffective fastenings on four consecutive timber sleepers and lateral sleeper plate movement (Photo courtesy of Pacific National)
j. ten locations existed where four or more consecutive timber sleepers with ineffective fastenings were found within the 440m leading up to the point of derailment (see Photo 6), and

k. the track alignment had moved towards the ‘Down’ side commencing at 623.440kms.

2.7 At the point of derailment. The following conditions were observed at the point of the derailment:

a. in the five metres leading up to the point of derailment (623.452kms) the distribution of sleepers consisted of a steel sleeper, five timber sleepers, a steel sleeper, a timber sleeper then another steel sleeper. This combination of sleeper types did not conform with the guidelines contained in ARTC Engineering Standard TCS 10;

b. the ballast contained under the steel sleeper pods in the area was inconsistent in compaction and depth ranging from full to a level 40mm below the top of the sleeper with lower levels limiting the capability of the ballast to constrain the sleeper and the rails;

c. the condition of the timber sleepers in this area was predominantly “poor” (ineffective) with ineffective fastenings and anchorage;

d. the profile of both rails appeared satisfactory with previous profile grinding and no metal flow on the rail head;

e. there were marks on the ‘Up’ rail, commencing at 623.450kms, indicating that a wheel flange had climbed the gauge face for approximately 200mm before mounting the rail head (see Photos 7, 8 and 9);

f. the flange mark on the ‘Up’ rail then continued lightly along the head of the rail for approximately 2.5m before dropping off the rail and onto the fastenings on the field (outer) side of the rail. The point of drop off also coincided with a flange mark on the timber sleeper inside the rails and skid marks caused by the underside of a bogie frame (later determined as the leading bogie of wagon RRGY 7152G) on the head of the ‘Down’ rail (see Photo 10), and
g. there was a small misalignment, or 'buckle', on the 'Down' side at 623.452kms and, immediately past it, additional flange marks which indicated that a second bogie (later determined as the 4\textsuperscript{th} position bogie of wagon RRGY 7152G) had mounted and travelled along the rail head before derailing to the 'Down' side of the track (see Photos 11 and 12).
Photo 8: View of flange climb mark on the “Up” rail at the point of mounting

Photo 9: Flange marks across the head of the “Up” rail at the first point of mounting
(Photo courtesy of Pacific National)
Photo 10: Flange marks and skid marks from leading bogie of wagon RRGY 7152G on track

Photo 11: Small track misalignment after rear wagon was cleared from site
2.8 **Past the Point of Derailment.** The following conditions were noted immediately past the point at which 6BA6 derailed:

a. the condition of the timber sleepers and fastenings was predominantly “poor” (ineffective);

b. the track continued to slew to the ‘Down’ side and the rear nine wagons on 6BA6, and their containers, had come to rest over a distance of approximately 200m;

c. the track was severely damaged, especially near the 623.500kms post (see Photo 13), and

d. bogies, including bogies 2-5 on wagon RRAY 7255W, had detached from the wagon and were either stacked on, or embedded in, the embankment on the ‘Down’ side. However, the leading bogie on wagon RRAY 7255W was located near 624.000kms, approximately 500m away, indicating that the rail had snapped sometime immediately after its passage.
Photo 13: View of track damage at point where the derailed rear portion of 6BA6 came to rest

Photo 14: Track damage caused by the derailed bogies on the front portion of 6BA6
2.9 The track between 623.700 and 624.280kms was severely damaged. The profile of the ballast was severely disturbed; the foot of both rails was damaged; rails fastenings and anchors had been distorted, timber sleepers were broken and steel sleepers were distorted (see Photos 14 and Photo 15). This damage was caused by either the 1st and 4th bogies of wagon RRGY 7152G as their side frames locked over the rail head, or by wagon RRAY 7255W as it was dragged after it lost its bogies.

2.10 Measurements taken during the examination of the track established that:

a. the track gauge ranged between 1435mm and 1441mm, i.e., within specified limits;

b. 12m of track leading to the point of mount (623.450kms) had been disturbed, and

c. a 6mm dip (twist) in the rail top existed in the ’Down’ rail at 623.440kms.

2.11 The size of the dip at 623.440kms constituted a ‘Category 5’ short twist as defined in ARTC Standard TDS 13 Base Operating Condition Standard of Track
Geometry. During depression testing\textsuperscript{10} of the rail, the dip increased to 9mm. Whilst a twist of this magnitude would not have required immediate remedial action, it would have initiated some lateral and vertical movement of bogies and wagons as they passed over it.

**Track Maintenance Documentation**

2.12 OTSI examined relevant ARTC maintenance documentation in relation to the condition of the track. The results of its examination are discussed in paragraphs 2.17 to 2.22 under the heading of “Risk Mitigation Strategies and Effectiveness”, but the following observations are directly relevant to the condition of the track:

a. the section between 620.000 and 634.000kms was subject to a self imposed speed restriction of 110kmh by PN due to complaints about rough riding and load shifts;

b. there was no indication of any significant rail creep in the immediate area of the derailment. However, this did not eliminate the possibility of a localised stress concentration due to ineffective fastenings in the immediate vicinity; and

c. resurfacing and grinding of the track top had been conducted during May 2006. This work required the use of rail bending equipment to level dips in the rail top. However, due to the brittleness of the steel near rail weld areas, five rail welds were broken at different locations between 620.010kms and 623.805kms. The repair of these breaks required rail closures to be welded in place, a process in which a section of rail each side of the break is cut out and a new section is welded in. To avoid alteration to the existing track length or forces within the rail, the length of the “rail in” must accurately match the length of the “rail out”\textsuperscript{11}. However, during three welds at 620.010kms, 622.745kms and 623.350kms, there were discrepancies of up to 10mm between the amount of rail removed and the amount inserted into the closures.

\textsuperscript{10} Depression tests involve the use of pegs and a locomotive in order to determine the amount of vertical movement in the rail as a train passes over it. Vertical movement in excess of 11mm would have required an immediate temporary speed reduction to be placed on the line at that point.

\textsuperscript{11} The gap between rail ends after rail out may vary due to changes in ambient air temperature during the process and this requires the amount of rail inserted to be adjusted to compensate for growth or shrinkage in gap length.
**Meteorological Information**

2.13 ARTC Engineering Standard TMP06 *Temporary WOLO*\(^{12}\) *Speed Restrictions for Welded Track under Extreme Weather Conditions* states temporary WOLO speed restrictions are imposed when the air temperature is forecast to be 35°C or above before 15 November each year and 38°C or above after 15 November each year. ARTC Standard TMP 17 *Maintenance of Welded Track (Summer Period) Additional Instructions When Ambient Temperature Exceeds 38°C* additionally requires welded track to be inspected between 2:30pm and 6:00pm for the purpose of detecting signs of misaligned tracks when forecast air temperatures exceed 38°C.

2.14 The derailment happened at a time nearing the hottest period of the day with the crew describing weather conditions at the time as hot, dry and clear. Bureau of Meteorology (BOM) records show that temperatures in the region had ranged generally in the mid 30’s in the early part of the week prior to the accident, then increased to the low 40’s towards the latter part of the week. BOM records for the day showed that temperatures reached a maximum of 36.0°C at Lake Cargelligo and 36.6°C at Condobolin. These towns are located 40kms South and 80kms East of the incident site respectively. Rail temperature monitoring equipment at Kiacatoo, 40kms East of Euabalong West, recorded that the air temperature at 2.30pm was 35.3°C and that the rail (steel) temperature reached 50.8°C at that time. This equipment also recorded a maximum air temperature of 36°C and a maximum rail temperature of 51.6°C at 2.45pm.

2.15 ARTC’s documentation for the day of the derailment records that a WOLO speed restriction telegram had been authorised by the Team Leader at Parkes at 7:20am for the section between Molong (360.000kms) and Ivanhoe (816.000kms) due to an expected air temperature above 38°C. However, the Team Leader did not roster additional track inspections for the section as a precautionary response to the forecast temperature or the application of the WOLO.

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\(^{12}\) The imposition of a temporary heat-related speed restriction is referred to as a 'WOLO' in both the ARTC and RailCorp Network Rules, Train Operating Conditions and Track Engineering Standards. These temporary heat-related speed restrictions are intended to reduce the possibility of derailments caused by track buckles (misalignments).
2.16 At 11.05am, ARTC records indicate that the WOLO was lifted by the Team Leader because of increased cloud cover and lower than anticipated air temperatures at Parkes. While BOM records confirm the presence of a 7/8 cloud cover at Parkes, no enquiries were made by the Team Leader regarding forecast temperatures or cloud conditions prevailing further West of Parkes. Photographs taken at the accident site by the crew of 6BA6 approximately 10 minutes after the accident show that there was no cloud cover at Euabalong West (see Photo 16). In the absence of updated temperature forecasts West of Parkes, the Team Leader had no way of determining whether WOLO restrictions should have been applied or lifted.

Summary of Track Condition

2.17 In summary, there were a number of track conditions in the vicinity of the derailment which significantly reduced the rigidity of the track structure and increased the likelihood of a misalignment occurring, particularly during times of high air temperature. These conditions included:

- poor sleeper condition;
• ineffective fastenings;
• poor rail anchorage;
• the inconsistent ballast depth and compaction under steel sleepers;
• a non-conforming placement pattern of the steel sleepers, and
• minor additions of rail in welding processes.

No operating constraints had been put in place to compensate for these conditions.

Risk Mitigation Strategies and Effectiveness

2.18 ARTC has published standards and procedures for the construction, inspection and maintenance of the track throughout its network. The table below is an extract from Engineering Standard TEP 13 Track Examination Handbook: System Overview which stipulates the relevant inspection schedule and standards for Class 1 lines.

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency</th>
<th>Comments</th>
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| Track Patrol (TEP 14) | 3 Days (Maximum)              | Conducted by track vehicle to ensure:
|                       |                               | • There are no obstructions to train movements or signalling equipment within (or potentially within) the structure gauge  
|                       |                               | • There is continuity of rails (i.e. no broken rails or joints, or loose or foul joints)  
|                       |                               | • There are no imminent failures of track fastenings  
|                       |                               | • There are no major geometry exceedences (of derailment potential) without suitable protection  
|                       |                               | ……….  
| Front of Engine (TEP 14) | Monthly (Dependent on train running) | Non specific examination to assist in the assessment of track by enabling the reaction of trains to the track structure to be observed (preferably at maximum allowable speed) |
| Detailed Walking (TEP 06) | Every 3 Months | Thorough examination of the components of the track structure & the right of way to ensure that the components are satisfactory & contribute to a safe railway. Items examined include, but are not limited to:
|                       |                               | • Track geometry and adjustment  
|                       |                               | • Track components, including rails, fastenings, ties, joints, insulated joints, ballast profile and condition, lubricators  
|                       |                               | ……….  

2.19 Several other types of mandatory track inspections are also conducted on an annual or bi-annual basis. These include:

a. Track geometry recording on a bi-annual basis to:

i. graph the track condition and rate the ride quality of the track;\(^{13}\)

ii. identify locations where track geometry parameters are exceeded;

iii. allow the categorisation of the severity for any exceedents; and

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\(^{13}\) The ride quality rating of the track is referred to in ARTC Engineering Standards as the Track Condition Indices (TCIs). TCIs are a weighted average score calculated by dynamic measurement of the track gauge, track twists, track alignment, track top and distance with a specially equipped rail vehicle referred to as the ‘AK car’.
iv. inform the extent of any temporary speed limits to be placed on the track.

b. **Sleeper inspection and marking** on an annual basis to identify sleepers that require replacement.

c. **Ultrasonic testing** on an annual basis to identify internal defects within the rail, e.g., flaws or fractures.

2.20 The results of the above inspections form the basis for the Welded Track Stability Analysis (WTSA) conducted annually in accordance with ARTC Engineering Standard TEP 11 *Track Examination: Field Examination for Welded Track Stability Analysis*. The WTSA enables calculations to be made to identify locations with the potential to misalign or break-away which, in turn, informs maintenance and repair priorities.

2.21 ARTC’s WTSA and track inspection records for 2005 and 2006 indicated that there were no defective rail joints between 622.000kms and 625.500kms, i.e., joints which were either frozen, fully open, fully closed, stretched, or that were pumping. In addition, ultrasonic testing and a detailed walking patrol, conducted on 17 August and 1 October 2006 respectively, and track geometry recording performed on 13 November 2006 did not detect any exceedences which warranted immediate rectification. Further, a front of engine patrol and a track patrol conducted on 1 and 11 January 2007 respectively did not detect any defects.

2.22 Neither the 2005 nor the 2006 WTSA reports indicated any obvious problems with the structure or stability of the track. However, during examination of the WTSA records, OTSI noted that:

a. field staff had used superseded forms which did not provide for the recording of critical information such as rail temperatures and gap measurements;

b. despite resurfacing and welding work being carried out in May 2006, there were no references to, or allowances factored for, any recent disturbance of the ballast formation;

c. there were no comments made regarding the state of the timber sleepers or the effectiveness of the rail fastenings and anchors;
d. there were no comments regarding steel sleeper placement patterns, and

e. there were no comments regarding the ballast depth or compaction for the steel sleepers used in the section. Further, despite a specific recommendation being made to ARTC and RIC in the OTSI “Steel Sleeper Introduction on NSW Class 1 Mainline Track” systemic investigation report that ‘field inspection guidance be provided to Maintainers that would assist with steel sleeper maintenance tasks and the identification of potential problems associated with steel sleepers’, there were still no specific standards or instructions for the ongoing inspection of ballast levels or compaction in steel sleeper pods. The only reference to any maintenance requirements is contained within the initial installation requirements of ARTC Engineering Standard TCS 10.

2.23 The following specific matters came to OTSI’s attention during its review of the 2006 WTSA:

a. a TCI of 31 was recorded at 623.000kms, some 450m before the point of the derailment, on 13 November 2006. This was well within the maximum limit of 45 for Class 1 tracks. Two ‘Priority 2’ defects in the level of the rail top between 623.000kms and 622.000kms were also recorded during this run. However, these defects did not require immediate action and, as such, were permitted to be repaired during regular maintenance cycles;

b. there was a comment made in conjunction with the resurfacing works about “some sleepers falling off thru kilometrage” between 624.000 and 620.572kms, yet sleeper replacement records did not indicate any replacement had occurred in 2006 within the immediate area of the derailment, and

c. there was a reference to sleeper marking having occurred but no indication as to when the marking occurred, how many sleepers were needed to be replaced, or when replacement was programmed to occur.

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14 OTSI initiated investigation released in 2005 into the installation of steel sleepers on the NSW Class 1 Main Line Track by RIC. Available at www.otsi.nsw.gov.au
Audit and Compliance

2.24 ARTC’s records show that five internal audits on aspects of the company’s Safety Management System (SMS) were conducted at Parkes between May 2006 and January 2007.

2.25 In reviewing the results of these audits, OTSI noted that:
   a. none of the audit reports involved any physical inspection or sampling of the condition of the main line between Orange and Broken Hill or its standard of maintenance;
   b. none of the audits related directly to processes involved in the mitigation or control of misalignments;
   c. a desktop audit, identified as the “Parkes Engineering Performance Audit on Defect Management” was conducted in November 2006. During this audit, four observations were made relating to track defects not being entered into the Defects Management System (DMS) by teams maintaining the Broken Hill line. In response to these observations, the Team Leader at Parkes issued a Memorandum to all teams which reiterated that “every defect – found, removed or reassessed must be reported to the applicable Team Leader” who is then required to record and prioritise the defect on Form PP166F-01. The memorandum also stipulated that every defect that was remedied had to be “signed-off” in the DMS. It was noted, however, that the number and types of defects being recorded were limited and that ARTC had not specified that items recorded on this form had to be entered into the DMS in the first instance, and
   d. a follow-up audit of the defect management function, conducted on 21 December 2006, indicated that the shortcomings identified in November 2006 had been addressed.

Train Marshalling, Loading and Management

2.26 Loading and Marshalling. 6BA6’s train manifest indicated that the loading, marshalling and separation of dangerous goods on the train were in accordance with the ARTC Train Operating Conditions (TOC) Manual and
2.27 **Train Management.** Data recovered from event recorders on both locomotives of 6BA6 indicated that:

a. the train had been operated within track speed limits after its departure from Parkes;

b. although the posted maximum speed for freight trains in the area was 115km/h, the train was operating at 110km/h\(^{15}\), with a power setting of Notch 5, immediately prior to the loss of emergency brake pipe pressure at 2:32pm, and

c. as the emergency brakes applied, tractive power was increased and the independent brakes were released on both locomotives. This corroborated the information supplied by the driver, who indicated that these actions were intended to prevent the rear of the train from bunching and colliding with the front portion which was still on the track and which had a greater braking capacity because of the locomotives.

**Rolling Stock**

2.28 Damage and marks on the rolling stock indicated that the 1\(^{st}\) and 4\(^{th}\) bogies on the 15\(^{th}\) wagon (RRGY 7152G), a 5-pack, were the first to derail in the incident. There was no damage or evidence of derailment found on the locomotives or wagons forward of RRGY 7152G or on the last wagon NQSY 35027H which also remained on the track. In addition, there was no evidence of faults or defects found on these units of rolling stock which could have contributed to the derailment.

2.29 When OTSI examined wagon RRGY 7152G, it noted that:

a. all bogies, including those derailed, had remained attached to the wagon;

b. the damage to the derailed wheels on the wagon was consistent with having struck fastenings and sleepers while running in the ballast for a considerable distance (**see Photo 17**);
c. the 1\textsuperscript{st} bogie had derailed to the ‘Up’ side with its side frame straddling the ‘Down’ side rail head (see Photo 18). Marks left on the rail head were consistent with the bogie side frame having been dragged from the initial point of drop on the ‘Up’ side at 623.452kms;

d. the 2\textsuperscript{nd} and 3\textsuperscript{rd} bogies were undamaged and had not derailed;

e. the 4\textsuperscript{th} bogie, which had derailed to the ‘Down’ side, also had a bogie side frame straddling the ‘Up’ rail head (see Photo 19);

f. the 5\textsuperscript{th} and 6\textsuperscript{th} bogies both derailed to the ‘Up’ side; and

g. the derailed bogies had remained aligned to the wagon body and not rotated during the incident.
2.30 Further examination of this wagon revealed that:

a. the axle bearings were unseated from the adapters on the 1st derailed bogie, however, this condition was deemed to be a consequence of the derailment;
b. the tread and flanges on the wagon’s derailed wheels exhibited damage consistent with the derailment;
c. there were no skid or scale conditions present on the wheel treads;
d. there was no excessive hollowing on the wheel treads or wear caused by overhanging brake blocks;
e. the conicity of the wheel treads appeared normal;
f. there were no steep/high flange conditions or abnormal wear patterns on any wheel flanges on the wagon;
g. wheel flange thicknesses on the wheels of the leading bogie ranged between 27mm and 29mm - well within the specified limit of a minimum thickness of 19mm;
h. wheel rim thicknesses were within the specified limits;
i. the back to back measurements of the wheel discs were within specified limits (1357 – 1360mm);
j. there was no indication of binding or seizure of the bogie centres or platform pivot pins;
k. the constant contact side bearer units were in place and correctly set up;
l. all container locking assemblies were in place and correctly engaged;
m. there was no indication of load shift within any of the containers;
n. there was no evidence on the automatic couplings, wheel flanges, bolster gibbs or container locks to indicate that the wagon had been hunting\textsuperscript{16} prior to the derailment, and
o. the bogie side frames were properly matched and there was no evidence to indicate excessive twisting before the derailment.

2.31 Examination of the derailed wagons and bogies following wagon RRGY 7152G revealed that, while severely damaged in the derailment, the wagon equipment had been in a serviceable condition prior to the derailment. However, three wheel sets with dislodged wheel discs on the axles were identified, with the first of these being located at 623.643kms. These wheel sets were later confirmed as having come from bogies RRME00434 and

\textsuperscript{16} Hunting refers to the severe lateral (side to side) movement of a bogie as it travels along the track.
RRME00901 on the 16th wagon (RRAY 7255W) and bogie YMC 8137 on the 21st wagon (RQSY 35013N).

2.32 The possibility that the derailment may have been initiated by a wheel disc becoming dislodged on the axle (see Photo 20) was subsequently discounted on the basis that:

a. there were no visible indications on any of the wheel treads to suggest prior movement of the wheel disc;

b. flange marks measured on the sleepers at the point of mount indicated that the gauge of the wheel sets had remained constant;

c. marks from the bogie side frames on the rail head at the point of mount (623.452kms) indicated that wagon RRGY 7152G had already derailed by the time the wheel set with the loose wheel from wagon RRAY 7255W reached the point on mount;

d. there were no circumferential marks within the bore or on the surface of the axle seats to indicate movement of the wheel disc prior to the derailment. Marks found on those wheel sets with moved wheel discs indicated that the discs had either moved after a single, sudden and direct impact with the ground at high speed or during collision with other rolling stock components (see Photo 21);

e. the three affected wheel discs were intact and there were no signs of cracks or fractures which would have caused them to have come loose on the axles. There was also no indication that the wheels had expanded as a result of heat generated by defective brakes, and

f. maintenance records indicated that the diameters of the axles and wheel disc bores were within the specified tolerances and provided a proper 'interference fit' between the wheel discs and the axles. The records also confirmed that appropriate hydraulic pressures were achieved when the wheel sets were assembled and similar pressures were also confirmed during back-pressing tests.\(^\text{18}\)

\(^{17}\) This is consistent with the findings contained in the ATSB report into the derailments at Koolyanobbing and Booraan (WA) on 30 January 2005.

\(^{18}\) Back-pressing tests measure the hydraulic pressure required to press the wheel opposite to that which had moved off the axle to give an indicative measurement of the pressure required to fit it to the axle in the first instance. During these tests, measurements of the bore of one wheel disc which had moved on the axle indicated that the bore was elliptical. On the basis that the contact surface within the bore was consistent with full contact on the axle seat, the elliptical measurement was attributed to the magnitude of the impact forces sustained by the wheel during the derailment.
2.33 If there had been movement on an axle/s, some indication of the decreasing width of the wheel set, e.g., markings on the rail head or inside on the timber
sleepers would have been evident prior to the point of derailment. Accordingly, particular attention was paid to the condition of the timber sleepers which had been used to make a level crossing at 622.800kms, some 600m before to the point of derailment. These sleepers were at the same level as the railhead. No marks were found between the crossing and the point of mount, confirming that the wheel discs had dislodged during the derailment.

2.34 Rolling Stock Summary. Examination of the rolling stock post incident established that its condition did not contribute to the cause of the derailment. The significant damage that was caused to the containers, wagon bodies and bogies was attributed to the speed at which the derailment occurred and the magnitude of the impacts received during the resulting collisions.

Mechanism of Derailment
2.35 In the absence of inappropriate train handling techniques, inappropriate marshalling or loading, or defective rolling stock, OTSI considers that lateral forces applied to the unstable track structure by the rolling vehicle movement of 6BA6 and elevated air temperatures exceeded its ability to resist such movement and caused a kink or track misalignment to develop. In the absence of any sighting of a misalignment by the crew of 6BA6, it is considered that the misalignment propagated under the train after the passing of the leading locomotive and increased until the leading bogie of wagon RRGY 7152G was unable to negotiate its curvature and derailed after climbing the rail head. The following two bogies were however able to negotiate the misalignment before the 4th and subsequent bogies also derailed.

Emergency Response

Incident Notification
2.36 The derailment was notified through the communications chain as follows:

a. at 2:32pm, the assistant driver of 6BA6 reported the derailment to the Train Controller at TOCO;

b. at 2:37pm, the Train Controller notified the Shift Manager at Broadmeadow;
c. the Train Controller then informed the track maintenance staff at Condobolin and requested staff to attend the derailment site', and

d. at 2:45pm, the Train Controller notified the DCC in Adelaide of the derailment.

2.37 Although the train manifest for 6BA6 identified the fact that it was conveying dangerous goods, there was no mention of dangerous goods in the course of the four notification conversations that were exchanged between 2:32pm and 2:45pm.

2.38 The first reference to dangerous goods was included in an update report at 2:54pm when the crew returned to the cab of 6BA6, following their inspection of the derailed wagons and their detection of chemical odours, and advised the Train Controller that dangerous goods had been spilled.

2.39 At 3:07pm, ARTC’s Risk and Safety Officer at Parkes, who had been alerted to the derailment by track maintenance staff, called the Train Controller to ascertain the details of the incident. During this call, the Train Controller indicated that he was unsure who had responsibility for calling the emergency services despite the responsibility being listed as his in ARTC’s Incident Management Manual Document TA44. The Train Controller then called the Shift Manager at Broadmeadow at 3:11pm, to seek clarification where the Shift Manager indicated that he had already liaised with the Risk and Safety Officer and agreed that the Safety Officer would call the emergency services.

2.40 At 3:14pm (some 20 minutes after the presence of dangerous goods had first been reported), the Train Controller notified the NSW Fire Brigade via “Triple 0” that 6BA6 had derailed at Euabalong West and that it had dangerous goods onboard. The voice tapes of this conversation indicate that the Train Controller had difficulty in explaining to the operator, when questioned, where Euabalong West was located, what major towns were nearby, how to access the derailment site and the type of dangerous goods involved. It is significant that, following a shift change, the new Train Controller at TOCO referred directly to the type of dangerous goods being carried by 6BA6 and the wagons upon which they were located during a phone conversation at 3:24pm with ARTC’s Manager, Train Operations (South), located at Junee. This
indicated that the Train Controller had accessed ARTC’s NRAMS\textsuperscript{19} for information regarding 6BA6.

**Incident Response**

2.41 Having been alerted to the spillage of dangerous goods, the Euabalong West unit of the NSW Rural Fire Service and the Lake Cargelligo NSW Fire Brigade (NSWFB) Hazmat team arrived at the site at approximately 3.50pm where they then established control and commenced a risk assessment. They subsequently advised the NSWFB’s Zone Commander for the region that the incident involved a major spillage of dangerous goods.

2.42 NSW Police officers from Lake Cargelligo arrived at the site at approximately 4.00pm and remained overnight to assist in the provision of security.

2.43 At approximately 5.45pm, the NSWFB Zone Commander from Leeton arrived and took charge of the site. After being briefed, he then arranged a meeting of the involved emergency agencies at Lake Cargelligo Fire Station to consider a range of issues. Significantly, no contact details were sought or given for rail representatives on site to attend this meeting. The issues considered included:

a. the depletion of resources due to deployment to an overheated wheat silo at Cootamundra in danger of exploding;

b. the type and quantity of, and access to, the hazardous materials on the train, and

c. various other logistical issues.

2.44 At 6:00am the following day (15 January), the site was quarantined by the Hazmat team and divided into four working zones. Of primary concern were two 22,000 litre tanks on the 12\textsuperscript{th} wagon which contained sodium cyanide (Class 6.1 dangerous goods) in slurry form. It was later determined that these containers had not been damaged in the derailment. There was also significant concern over Class 2.1 (aerosols) and Class 5.1 (oxidising solids and hydrogen peroxide solutions) goods that were loaded onto the 16\textsuperscript{th} wagon (RRAY 7255W). The containers on this wagon were severely damaged and dangerous goods from both classes had spilled and intermingled as a

\textsuperscript{19} NSW Rail Access Management System.
consequence. Other chemical compounds which posed a threat to the responders and the environment were also found; including bulk herbicide, and engine coolant, fuel, and lubricating oil from damaged motor vehicles (see Photo 22).

2.45 The discovery of these chemicals and substances resulted in the Hazmat Team declaring the four zones closed to all persons other than those approved by the Zone Commander. Those who were permitted to continue to enter or work in these zones were required to be escorted by Fire Brigade officers, to wear respirators and to be monitored by ambulance officers.

2.46 Because the Hazmat team did not have a complete understanding of the detail on the train’s manifest, they therefore commenced a systematic search of all damaged containers. This involved the righting or repositioning of containers for access and ventilation using heavy lifting and recovery equipment which had arrived from Cootamundra.

2.47 Having established that the sodium cyanide tanks were safe, and with the increasing arrival of repair gangs and equipment, the Hazmat team released two zones for clean-up and repair. Because of a growing number of rail agencies represented at the site, this quickly created liaison difficulties for the Zone Commander as each agency had its own incident commander and differing priorities. The Zone Commander therefore directed that he would only liaise with incident commanders from PN and ARTC while he controlled the site.
2.48 The Hazmat team took approximately 24 hours to complete its search of all of the containers and, where applicable, to render them safe. During this period, additional hazardous materials that did not appear on the train manifest were found, including a number of LPG cylinders amidst a consignment of household effects.

2.49 Despite being notified on the afternoon of the incident, Environmental Officers from Cobar Shire Council (CSC) and the NSW the Department of Environment and Climate Change (DEC) did not arrive at the site until 16 January, two days after the recovery operations had commenced. This was occasioned by the Hazmat team’s uncertainty about the arrangements and
location for the disposal of contaminated goods and soil. However, on arrival, they assumed control for the disposal and environmental cleanup.

2.50 The Hazmat operation was concluded at 4:40pm on 16 January 2007, after which OTSI’s investigator conducted a final inspection of the site before handing the site back to ARTC’s Incident Commander at 5:10pm. The line was re-opened at 1:30pm on 18 January 2007 with a 20km/h temporary speed restriction imposed.

**Summary of Emergency Response**

2.51 The location and extent of the derailment, the spillage of dangerous goods, high temperatures and the number of agencies that were involved contributed to making the emergency response a complex operation. The situation was further complicated by a concurrent response at Cootamundra.

2.52 While the incident notification procedures contained in ARTC’s *Incident Management Manual* were generally followed, time was lost during the initial communications because:

a. the crew did not immediately notify the Train Controller that the train was conveying dangerous goods;

b. there was confusion between the Train Controller, Shift Manager and the Risk and Safety Officer regarding responsibility for calling the emergency services;

c. the Train Controller did not provide important information relating to the incident to emergency response organisations. For example, information that the train was conveying dangerous goods was available to the Train Controller through NRAMS and should have been used to alert other agencies of the possibility that they might have to take it into account when planning their emergency response, and

d. the Manual does not list specific procedures for dealing with dangerous goods, particularly at times of possible crew incapacitation.

2.53 Notwithstanding these process and communication limitations, those at the scene performed their duties efficiently, under trying conditions, to achieve an effective outcome.
Other Safety Matters

2.54 Although 6BA6 was hauling dangerous goods, the driver and his assistant elected to inspect 6BA6 at close range following the derailment. The inspection was conducted without the benefit of protective equipment since it is not carried as standard safety equipment on freight trains like 6BA6. Nevertheless, the crew acted appropriately to withdraw to a safe place as soon as they detected chemical odours.

2.55 The dangerous cargo carried on 6BA6 had been appropriately separated and segregated in accordance with requirements specified for rail in the Australian Dangerous Goods Code (Edition 6) and the classification codes were listed in the train’s manifest. Inspection of the containers carrying dangerous goods confirmed that, where visible, they carried the required safety signage. However, it was not possible to confirm the contents of all containers carrying dangerous goods because some safety signage was obscured by the damage and the position at which they came to rest.

2.56 A copy of the cargo manifest was available in the cabin of the leading locomotive but it was clipped onto a timetable on the back wall of the cabin. As there is no standard position for dangerous good documentation on locomotives, it may have gone unnoticed by emergency responders in the event that they had been forced to rely on information at the site only.20

2.57 Regulatory control for the transport of dangerous goods in NSW is the responsibility of the DEC. DEC advised that they had a wide-ranging program for audits of the carriage of dangerous cargo by road, but indicated that their auditing of such carriage by rail was limited. They also advised that the NSW Environmental Protection Authority (EPA) had previously entered into a Memorandum of Understanding (MoU) with the NSW Ministry of Transport (MoT) to conduct audits and compliance inspections on operators on the NSW rail system. However, with the restructuring of the EPA and MoT, this MoU had become obsolete. As a consequence, DEC was unsure who had responsibility for this function. Further, the authority for MoT officers to conduct such inspections and audits had been rescinded. DEC

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20 NSW Fire Brigade officers were unaware of, and had no formal information as to the location of, the train manifest on trains carrying dangerous goods.
acknowledged that, as a result, little formal compliance auditing pertaining to the carriage of dangerous goods on the rail networks in NSW was occurring.

2.58 During recovery operations at the site on the morning of 16 January 2007, a contractor associated with the operation of the cranes that were being employed to lift containers was struck by a reversing utility. The contractor was treated by on-site ambulance staff but later required hospitalisation. The identity of the utility driver or the organisation to which he/she belonged was not established because the driver immediately drove off the site.

2.59 OTSI observed that, while there were arrangements to control the large number of personnel and equipment on site, these did not include a register of personnel or vehicles arriving at or departing the site.

Remedial Actions

2.60 A follow-up inspection of the track between 620.000kms and 626.000kms by OTSI on 31 January 2007 revealed that ARTC had commenced a program to replace poor quality timber sleepers in this area. ARTC report that this program has subsequently been completed.

2.61 On 17 January 2007, as a consequence of the derailment, ITSRR posed a number of questions to ARTC in relation to the rate at which sleepers had been replaced on the line between Orange and Broken Hill and to its Timber Sleeper Maintenance Standard TMS 06. ARTC responded to ITSRR on 8 February 2007 but ITSRR was not satisfied with the response. On 17 July 2008, ITSRR issued ARTC with a consolidated list of outstanding issues arising out of this and other similar derailments. At the time of release of this report, discussion between the parties continues.

2.62 In May 2008, a new MoU, with regards to the audit of dangerous goods on the NSW Rail networks, was negotiated between ITSRR and DEC.
Summary

2.63 The instability and misalignment of the track structure at 623.452kms caused the 15th and subsequent wagons of 6BA6 to derail. The less than optimum track conditions were exacerbated by the assumption that the track was properly maintained; by high prevailing air temperatures in the area on the day of, and in the days prior to, the derailment; and by the absence of temporary WOLO speed restrictions which had been imposed, then lifted without a full and proper understanding of the prevailing conditions.

2.64 ARTC has technical standards which, when applied correctly, should have identified a variety of defects and their potential impact. However, because the related inspection, maintenance and documentation requirements were not undertaken effectively, those responsible for analysing the condition of the track and determining maintenance priorities worked with information that was erroneous in some instances and incomplete in others. As a consequence, they did not comprehend the extent to which the track in the area in which the derailment occurred had become compromised.

2.65 PN had registered its concerns with ARTC regarding the condition of the track between Orange and Broken Hill in response to rough riding and a number of load shifts in the corridor and had self imposed a maximum speed of 110km/h on its trains in the Euabalong West to Matakana section.

2.66 There was no evidence to indicate that the way in which 6BA6 was marshalled, loaded or managed contributed to its derailment.
PART 3 FINDINGS

Causation
3.1 In relation to those matters prescribed by the Terms of Reference as the principal lines of inquiry, OTSI finds that instability and misalignment of the track structure at 623.452kms caused the 15th and subsequent wagons of 6BA6 to derail.

Contributing Factors
3.2 The instability of the track was attributable to a lack of structural rigidity resulting from non-conformance with ARTC Engineering Standards as evidenced by the following:

a. poor condition of timber sleepers,
b. ineffective timber sleeper fastenings,
c. poor rail anchorages,
d. inconsistent ballast depth and compaction under steel sleepers,
e. non-conforming placement pattern of the steel sleepers, and
f. minor additions of rail in the welding processes.

3.3 No operating constraints had been put in place to compensate for these conditions.

Anticipation and Management of Risk
3.4 In anticipation of high temperatures on the day, ARTC had imposed temporary speed restrictions in accordance with ARTC Standard TMP 06 Temporary WOLO Speed Restrictions for Welded Track under Extreme Weather Condition). However, the decision to lift the WOLO temporary speed restrictions was not made on the basis of a risk-based assessment; rather, it was assumed that:

a. the cloud cover at Parkes extended for the full section between Molong and Ivanhoe as listed on the WOLO telegram;
b. the temperature would not exceed 38°C for the entire section, and
c. the track had been maintained to standard.
3.5 Despite predicted high air temperatures on the day, no additional track patrols, as required by ARTC Standard TMP 17, were scheduled.

Organisational, Operational and/or Logistic Matters which Relate To Safety Management which had a Bearing on the Circumstances of the Accident

3.6 Although ARTC has established standards, processes and an ‘Exceedent Control System’ to identify and manage the risks associated with track defects and/or failures, track maintenance records indicated the following:

a. that track maintenance staff were entering little or incomplete information on inspection sheets despite its maintenance system being reliant on such information to accurately monitor the state of the track;

b. accuracy was not maintained during rail welding processes, and

c. the WTSAs conducted in 2005 and 2006 were flawed due to the lack of accurate information regarding the state of the track.

3.7 Despite a specific recommendation being made in the OTSI “Steel Sleeper Introduction on NSW Class 1 Mainline Track” that “field inspection guidance be provided to Maintainers that would assist with steel sleeper maintenance tasks and the identification of potential problems associated with steel sleepers”, there were no specific standards or instructions for the ongoing inspection of ballast levels or compaction in steel sleeper pods.

3.8 The ARTC internal audit and compliance program was deficient as it did not include any audits which visually inspected or sampled the condition of the main line in the Orange to Broken Hill Corridor.

Assess the effectiveness of the emergency actions in response to the derailment

3.9 The crew of 6BA6 reported the derailment to TOCO at 2.32pm, immediately after seeing the incident occur in the rear vision mirrors of the locomotive. However, while reporting the incident to TOCO, there was no discussion about dangerous goods being listed on the train manifest. It was not until 2:54pm, after the crew had conducted the first inspection of the train, that TOCO was alerted to the presence of dangerous goods.

3.10 Despite being alerted to the presence of dangerous goods at 2:54pm, the Train Controller did not immediately notify the emergency services. The Train Controller was unsure who had responsibility for calling the emergency.
services and 20 minutes elapsed while he sought clarification from the Shift Manager at Broadmeadow and the Risk and Safety Officer. Although agreement was reached that the Risk and Safety Officer would call the emergency services, it was the Train Controller who eventually called “Triple 0” but he was unable to provide information to the NSW Fire Brigades in relation to the incident location, the nearest major township, how to access the incident site or the types of dangerous goods involved.

3.11 While the incident notification procedures contained in ARTC’s *Incident Management Manual* were generally followed, they were implemented without a complete understanding of the roles, responsibilities and requirements, for those involved. Further, there is little, if any, specific information for dealing with dangerous goods incidents, particularly at times of possible crew incapacitation.

3.12 Both the train crew and incident response personnel were placed in a potentially dangerous situation with regards to dangerous goods without conducting a proper risk assessment and without any personal protection equipment.

3.13 There were no processes implemented at the incident site to register rail recovery personnel or vehicles arriving at or departing the site, particularly whilst Hazmat operations and site inspections associated with this investigation were still being conducted.

3.14 Documentation carried on 6BA6 confirmed that the dangerous goods had been appropriately separated and segregated in accordance with requirements specified for rail in the *Australian Dangerous Goods Code* (Edition 6) and the classification codes were listed in the train’s manifest. However, the placarding on a number of containers was not able to be confirmed because of the damage and position at which they came to rest.

3.15 NSW Fire Brigades handled the Hazmat operation professionally and efficiently despite interface issues with the rail agencies involved.
PART 4 RECOMMENDATIONS

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

**Australian Rail Track Corporation**

a. Ensure that all rail safety workers involved in the inspection, repair and management of track are properly qualified for their roles and have a thorough understanding of the engineering standards, inspection regime, repair procedures and documentation requirements which are specified for their various rail safety tasks.

b. Ensure that the results of all track inspections, track maintenance work and other track remediation measures are recorded accurately, using current authorised documentation.

c. Ensure quality assurance practices are being implemented effectively through regularly scheduled walking inspections of line condition and diligent adherence to the Defects Management System.

d. Review and amend ARTC Engineering Standards TMP 06 *Temporary WOLO Speed Restrictions for Welded Track under Extreme Weather Conditions* and TMP 17 *Maintenance of Welded Track (Summer Period) Additional Instructions When Ambient Temp Exceeds 38°C* to ensure heat related temporary speed restrictions are imposed or removed on the basis of a risk-based assessment. This review should include the investigation and, where suitable, the employment of new or improved rail temperature monitoring equipment.

e. Review and amend ARTC Engineering Standard TEP 11 *Track Examination: Field Examination for Welded Track Stability Analysis*, particularly its timing, frequency and data inputs, to improve its predictive capabilities for track misalignments.

f. Review and amend relevant ARTC Engineering standards to ensure that, in accordance with the recommendations in OTSI's report “Steel Sleeper Introduction on NSW Class 1 Mainline Track”, track maintainers are provided
with “field inspection guidance that would assist with steel sleeper maintenance tasks and the identification of potential problems associated with steel sleepers”.

g. Review and amend ARTC’s Incident Management Manual Document TA44 to ensure incident reporting responsibilities are clearly specified and provide Emergency Service agencies with, as a minimum, the following information in a timely fashion:

i. exact location of an incident, including nearest major township, and GPS co-ordinates (where available);

ii. nearest public road details and access point to the incident site;

iii. details of casualty numbers and injuries;

iv. details of any hazardous materials or dangerous goods listed on the train documentation, and

v. contact details for key ARTC persons attending the incident site.

h. Review and amend the Incident Management Manual to ensure that the processes for dealing with dangerous goods incidents and possible crew incapacitation are defined.

**Pacific National Limited**

a. Reinforce the requirements for its train crews to immediately alert Train Control to the presence of dangerous goods involved in rail safety incidents and avoid placing themselves at risk immediately after such an incident.

b. Advise Emergency Services organisations and combat agencies about the location of dangerous goods documentation on its trains and the hazards on or about the track.

c. Continue the current PN policy of reducing train speeds in areas considered detrimental to safe operations. Ensure that such track conditions continue to be communicated to the track owner in an expeditious manner.
PART 5  APPENDICES
Appendix 1: Incident Layout Diagram

Diagram courtesy of ARTC

NOTE: WAGON & CONTAINER DETAILS AT THIS LOCATION NOT OBTAINED BECAUSE OF RESTRICTED ACCESS DUE TO CHEMICAL SPILL.

Diagram courtesy of ARTC

Derailment of Pacific National Service 6BA6, Eualalong West – Matakana Rail Section, 14 January 2007
Appendix 2: Sources and Submissions

- Bureau of Meteorology (NSW)
- Crew members of 6BA6
- ARTC Network Controller (Orange Control)
- Members of the Parkes Track Maintenance Team
- Officers of the NSW Fire Brigades, Zone West 7
- Officers of the NSW Police, Lachlan Local Area Command
- Officers of the NSW Police, Central West Emergency Management District
- NSW Department of Environment and Conservation (Bathurst)

References

- Rail Safety Act 2008 (NSW)
- Passenger Transport Act 1990 (NSW)
- ARTC Network Rules and Procedures
- ARTC Infrastructure Engineering Standards
- Dangerous Goods Code (Edition 6)
- Pacific National Engineering Report

Submissions

The Chief investigator forwarded a copy of the Draft Report to the DIP’s 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 DIP’s were invited to make submissions on the Draft Report:

- Australian Rail Track Corporation
- Independent Transport Safety and Reliability Regulator
- Pacific National Limited
Submissions were received from the following Directly Involved Parties:

- Australian Rail Track Corporation
- Independent Transport Safety and Reliability Regulator
- Pacific National Limited

The Chief Investigator considered all representations made by DIP’s 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.

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