Australian Government
Australian Transport Safety Bureau

Derailment of freight train 3PS6

Yunta, South Australia | 17 January 2013

Investigation

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Addendum

Page	Change	Date

Safety summary

What happened

At about 1453[1] on Thursday 17 January 2013, train 3PS6 derailed on the main line at the north eastern end of the Yunta passing loop, after a track buckle formed under the train. No injuries resulted from the incident; however, a number of wagons were derailed and approximately one and a half kilometres of track was damaged. Two months prior to the derailment new rail had been placed on both legs of the track.

Derailed 3PS6 at Yunta

Source: ATSB

What the ATSB found

The ATSB's investigation found that the buckle that caused the derailment was the result of excessive compressive stresses in the newly installed rail and a lack of lateral track stability through the derailment site. No records were available to demonstrate that the new rail had been destressed at the derailment location, and a *Track Stability Management Plan* did not exist for the section of track through the derailment site.

It was evident that the works provider's quality assurance process and documentation was inadequate in relation to the re-railing works through Yunta, especially in the area where train 3PS6 subsequently derailed. In addition, project oversight was inadequate, given that both the infrastructure owner and works contractor had signed off on practical completion of the track work, even though the quality documentation was incomplete and, in some cases, suggested that work had not be undertaken.

What's been done as a result

Transfield Services have revised their quality system for re-railing projects to include a *Rail Adjustment Plan* which will list all required stressing required for the project. They have also introduced or updated the *De-stress Pull Form*, *In Process Checklist*, and *Inspection and Test Plan/Checklist* to improve the robustness of their quality system.

ARTC has developed a *Track Stability Plan* for the section of track where the derailment occurred and revised the plans for the rest of its network. These plans will be reviewed annually and include inputs from regular rail stress tests. The *Track Stability of Concrete Sleepered Track* procedure will also be reviewed annually and changes are being considered for the rail stressing standards and procedures. ARTC have updated their project management procedures and are undertaking a review of procedures relating to scopes of work.

Safety message

To ensure the safety of rail operations during and after capital upgrade projects, project quality assurance processes and documentation should be fully developed and utilised. Oversight by clients should be robust and the completion of critical activities verified. Documents addressing the ongoing management of track infrastructure should be developed, used, and maintained in accordance with mandated standards.

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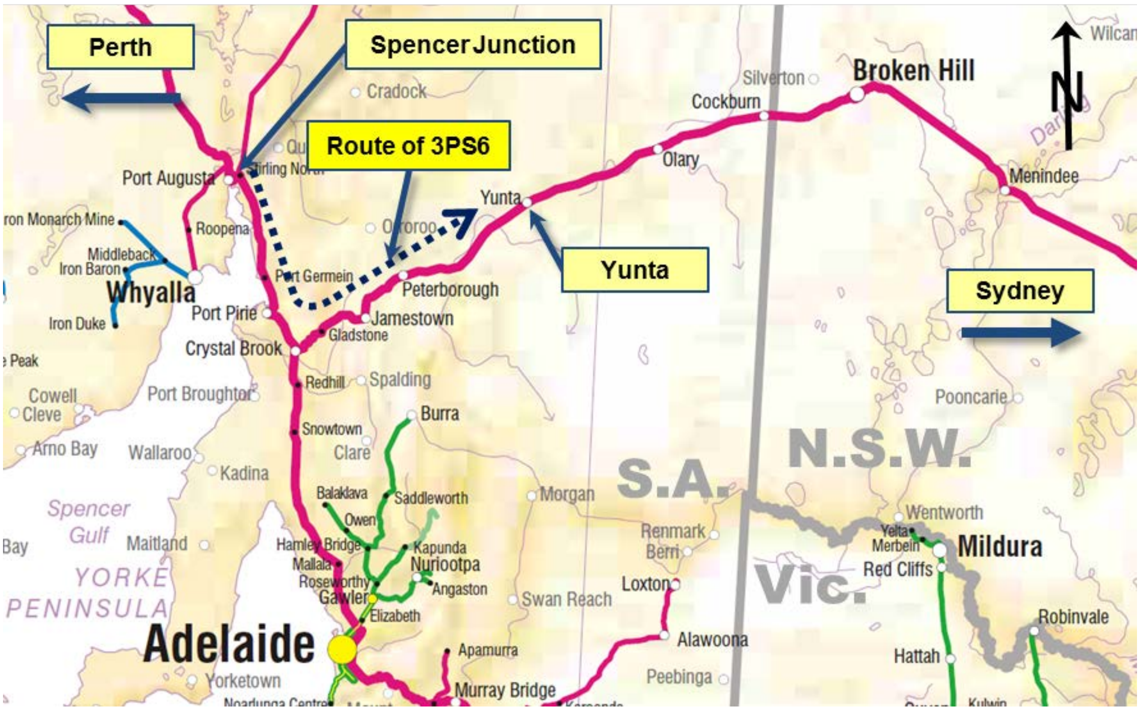
1 The 24-hour clock is used in this report. Local time was Australian Central Daylight Time (CDT), UTC +10:30 hours.

Contents

The occurrence

At 0945 on 17 January 2013, train 3PS6, a Pacific National (PN) intermodal service from Perth to Sydney, departed Spencer Junction (Port Augusta, SA). Train 3PS6 had taken on a fresh train crew at Spencer Junction and travelled south to Crystal Brook before joining the track to Broken Hill (Figure 1). About an hour after departing Crystal Brook, the train was put in the loop at Gladstone to cross train 4SA8. During the cross, the crew of train 4SA8 did a roll-by inspection of stationary train 3PS6 and reported nothing unusual.

Figure 1: Location of Yunta and route of 3PS6.



Source: Geoscience Australia and ATSB

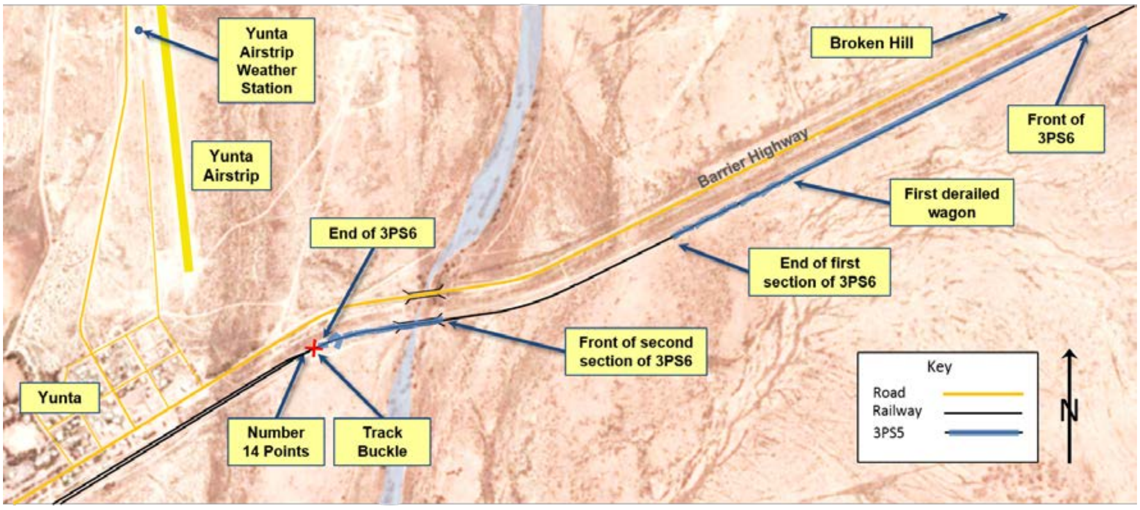
Train 3PS6 departed Gladstone and travelled unimpeded to Yunta. At about 1450, as the train passed through Yunta, the signals were clear, so the driver stepped up the throttle for a 4 km climb. Train 3PS6 passed over number 14 points at the north eastern end of Yunta at 100 km/h. At that time, the crew did not observe, or feel, anything wrong with the track or train, however approximately one kilometre out of Yunta, the driver looked in his mirror and noticed dust rising along the train. As the driver reduced power, the brake pipe lost air pressure, indicating that the train may have split or derailed. The driver brought the train to a stand and crew detrained to investigate.

Figure 2: Derailed wagons at the end of train 3PS6

Source: ATSB

The crew found that the rear 19 wagons of the 52 wagons hauled by train 3PS6 had derailed, with the last 11 of these wagons separated from the front portion of the train by approximately 800 m (Figure 3). The last wagon of the train stopped approximately 30 m past number 14 points and a notable track buckle was evident between the train and the turnout.

Figure 3: Map of derailment site showing location of 3PS6 and track buckle



Source: Google Maps and ATSB

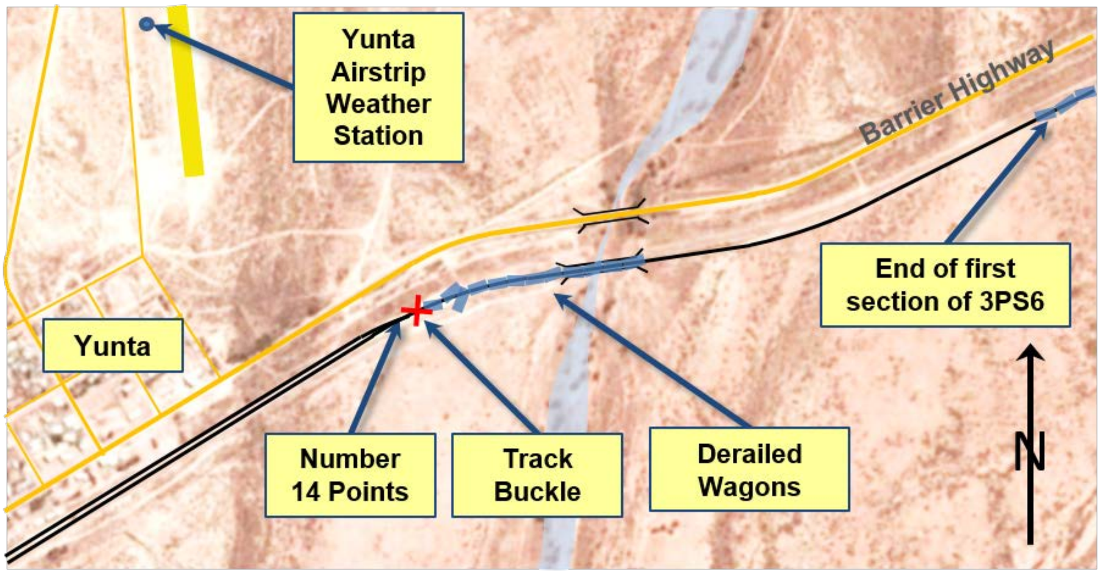
A member of the public travelling on the adjacent Barrier Highway stopped to render assistance and drove the crew along their train. The derailment had started a number of grass fires alongside the track, with the crew using a fire extinguisher from the locomotive cab to fight the fires until the Yunta Country Fire Service arrived to assist. The crew then called train control and Pacific National to report the derailment.

Context

Location

Yunta is in South Australia, approximately 280 km north-northeast of Adelaide (Figure 1). Situated at the 196 km mark[2], Yunta is the location of a crossing loop and the derailment occurred on the main line immediately after number 14 points at the north eastern end of the loop (Figure 4). Train control was provided by the Australian Rail Track Corporation (ARTC) from a network control centre located at Mile End in Adelaide.

Figure 4: Map of derailment site showing location of 3PS6 and track buckle



Source: Google Maps and ATSB

Train and Train Crew

Train 3PS6 comprised two locomotives (NR47 leading and NR84 trailing) hauling 52 wagons. The train had a gross weight of 3331.2 t and a length of 1782 m. It was primarily carrying containerised freight, but also included some structural steel wagons and louvered vans towards the front of the train. Both locomotives were equipped with operational data loggers. The data from the recorders was used when examining the sequence of events leading up to the derailment.

Train 3PS6 was crewed by a trainee driver and a mentor driver qualified to instruct the trainee. The trainee driver was appropriately qualified to be in control of the train whilst under instruction. Both were medically fit for duty. Post-derailment, the South Australia Police tested the crew for the presence of alcohol; both returned a negative result.

From the evidence available, there were no defects or issues with the rolling stock that could have been considered as contributory to the derailment. Similarly, there was no evidence to suggest that train handling had contributed to the derailment.

Track Information

The track to Broken Hill was a single, bidirectional, standard gauge[3] track with crossing loops at strategic locations. The Yunta crossing loop was largely tangent (straight) in alignment, with a pair

2 The zero km reference for this track is at Coonamia, near Port Pirie (SA).
3 The name given to track with a gauge of 1435 mm

of large radius curves at the north eastern end of the loop (Figure 4). The first curve started before the end of the crossing loop and number 14 points were located approximately 1/3 into this curve, forming a short tangent in the curve.

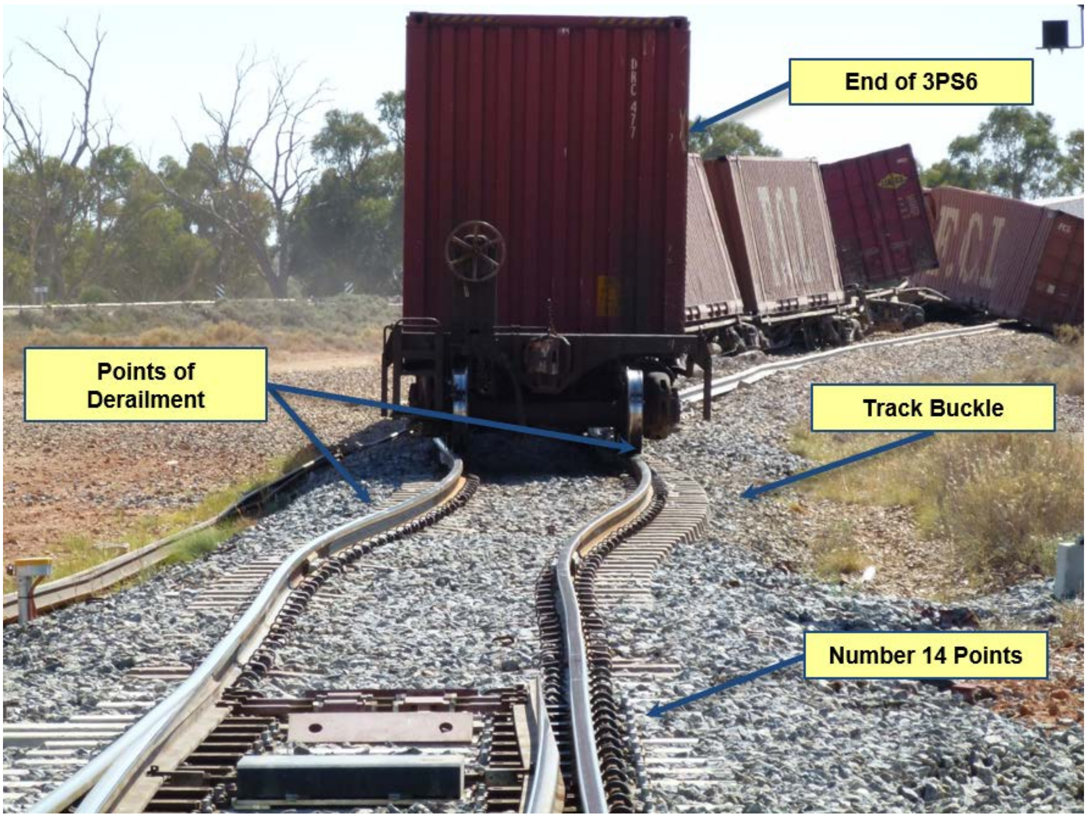
In 2012 the track between Crystal Brook and Broken Hill underwent a capital upgrade, including a re-railing programme to replace the existing 47kg/m rail with new 60 kg/m rail. In November 2012 new rail was placed in track through Yunta. The rail was delivered to site as long-welded 110 m and 165 m lengths. The long lengths were then positioned onto existing concrete sleepers, welded into place and fastened using resilient clips. A month prior to the re-railing works the existing turnout (number 14 points) was replaced with a new turnout.

The track was owned by the ARTC, with the capital upgrade works and ongoing maintenance undertaken by Transfield Services until 1 January 2013, when the ARTC took over the maintenance activities. The track maintenance standards were documented in a suite of Infrastructure Standards that make up the ARTC Code of Practice (CoP).

Examination of the track post-derailment

An examination of the derailment site found over 1500 m of damaged track. Between number 14 points and the rear of the derailed train, about 10 m of track was displaced to the right[4] in a crescent shape (Figure 5). The geometry of the displaced track was consistent with the development of a lateral track buckle. No vertical displacement of the track was evident.

Figure 5: Track Buckle in front of Number 14 Points



Note: The perspective of this photograph makes the track defect appear shorter than it was.
Source: ATSB

Witness marks present on both rails and the sleepers through the track buckle indicated that wheels had derailed to both sides of the track through the buckled area. There was no evidence of

4 In the direction 3PS6 was travelling.

derailed wheels having run-through number 14 points or over the 10 m of track between the turnout and the track buckle.

Based upon the evidence available, the ATSB concluded that the derailment of train 3PS6 had been initiated by this localised track misalignment (buckle) at the 196.577 km mark. The ATSB also concluded that the track had most likely "kicked" or buckled under train 3PS6 during its passage, as the drivers did not see or feel anything unusual when the locomotives passed over that section of track, and the derailment had initiated part-way along the train length.

Rail Stress and Track Stability

Track geometry is reliant upon the interrelationship between the track components. The rail, fastenings, sleepers, ballast, formation, and the interactions between these components all contribute to the stability of the track. CWR (Continuously Welded Rail) provides significant maintenance advantages and impact load mitigation compared to jointed rail. However, the removal of rail joints means rail stresses must be managed to ensure excessive tensile or compressive forces do not accumulate; potentially resulting in broken rails or buckled track.

Track buckles typically occur when the longitudinal compressive forces in the rail produce a lateral buckling force that exceeds the passive restraining strength of the track structure. The longitudinal compressive forces in the rail are generated by thermal expansion, rail creep[5], and dynamic vehicle loads. Passive restraining forces are provided by the rail stiffness, fastener rigidity, sleeper mass, and ballast condition and profile. Track buckling is normally associated with;

- High longitudinal compressive rail forces (often associated with high ambient temperatures):

  Longitudinal rail forces, those that work parallel with the rail, can be considerable and are cumulative. Longitudinal forces are generated as the rail tries to expand and contract due to temperature.

- Dynamic rail forces (due to rail traffic):

  Longitudinal rail forces can also develop as the rail tries to move (creep) due to external forces (resulting from train braking and traction loads), and migration forces due to the passing of each wheel. It is not uncommon for a track buckle to occur immediately in front of, or under, a train as the dynamic forces (both longitudinal and lateral) from the passing train provide the final impulse or track disturbance necessary to cause the buckle.

- Low (or reduced) lateral track resistance:

  Longitudinal and lateral movement of the track is resisted by the rail, fastenings, sleepers, and ballast. If the resisting force is insufficient to prevent movement, then any high longitudinal compressive forces will be released by the lateral movement of the track, resulting in a buckle.

Management of rail stress

Accepted practice in managing longitudinal rail forces is to maintain a rail neutral temperature[6] (NT). The NT of rail is the rail temperature at which the longitudinal stress in the rail is zero. That is, the rail is neither in compression nor tension.

There are two important NTs to be considered for the management of rail stress;

- DNT Design Neutral Temperature; the NT calculated to ensure the track can withstand the stresses in the rail due to the expected maximum and minimum ambient temperatures of a region. DNT is typically the median working rail temperature

[5] The permanent or progressive longitudinal movement of rails in track caused by expansion or contraction of the rail or the action of traffic.

[6] Also referred to as Stress Free Temperature (SFT).

and will be mandated in track standards. The ARTC CoP states that the DNT for its network is 38 ° ± 5 °C (note this is rail temperature).

- ANT Actual Neutral Temperature; the NT of rail in the field. This can only be determined through field measurement.

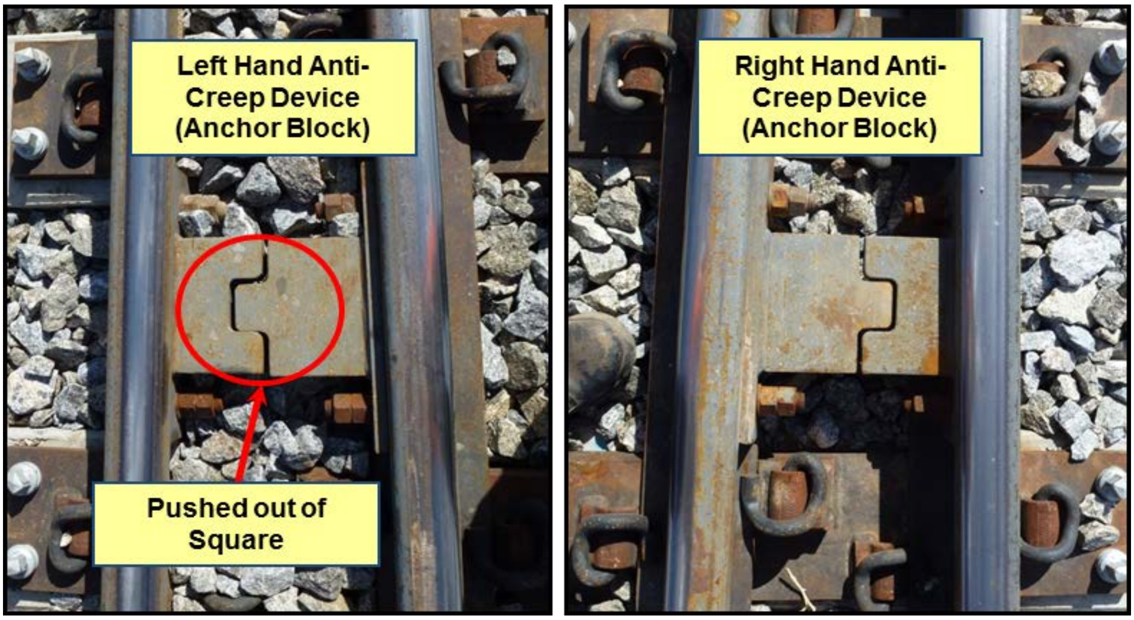
It is desirable that the ANT value should be equal to the DNT value. If the ANT and track stability are maintained, then the rail and track should withstand the forces that are generated as the rail heats and cools.

Over time, rail and track may creep longitudinally. There are locations in the track where the track structure prevents or offers greater resistance to track or rail creep. These locations are referred to as fixed points and include level crossings and turnouts. Internal stresses in the rail may accumulate adjacent to fixed points, effectively causing the ANT value to move away from the DNT, though this typically takes many years.

Destressing of rail is the process of cutting and adjusting rail length to reset the rail's neutral temperature. The process involves determining the existing ANT value, then adjusting the rail to bring the ANT back to the DNT. With current technology, the most accurate method of determining the ANT value is to free the rail,[7] cut it and then measure the change in length. When rail is unrestrained, i.e. not clipped up, its NT value is equal to the current rail temperature. With no restraint the rail is free to expand and contract; thus no internal forces will accumulate. When new rail is installed, the ANT value will be the temperature of that rail when it was installed in track and clipped up[8]. Typically, unless the rail temperature at installation was equal to the DNT, the rail will need to be adjusted (post installation) to ensure the ANT equals the DNT.

In this case, the derailment site was adjacent number 14 points, which is a fixed point in the track. Examination of number 14 points found that the switch area had been pushed out of square, with the blocks in the left switch anti-creep devices pushed hard up against each other (Figure 6). This suggested that the rail adjacent to the turnout was probably under excessive stress.

Figure 6: Left and right hand[9] anti-creep devices Number 14 Points



Source: ATSB

[7] By removing the rail fastenings the rail is free to move along the track structure.
[8] Clipping up is the application of rail fasteners.
[9] Handing references relative to direction of train 3PS6 through site.

Management of track stability

Lateral track stability refers to the track's ability to resist lateral or buckling forces (perpendicular to the track centreline). All track components contribute to lateral track stability. Typically rail, fastening type, and sleepers are common along a length of track. Consequently, variations in the stabilising qualities of the ballast are most likely to result in variations in a track's lateral stability.

Ballast stabilising qualities can vary due to the quality of the ballast, the ballast profile, and the level of consolidation. Stable ballast relies upon its mass and mechanical interlock to hold the track in place. The mechanical interlock is the interaction between individual ballast stones and between the ballast stones and the sleepers. Section 4 of the ARTC CoP requires that the shoulder ballast profile for this track to be level with the underside of the rail for a width of 300 mm outward from the sleeper ends.

Track disturbing works such as tamping temporarily reduce the ballast's mechanical interlock. The effect of disturbing work is typically short term and the interlock is usually restored as rail traffic traverses the track. Repeatedly working ballast, such as repeated tamping or where track is pumping[10] will result in rounding of the ballast stones, permanently reducing its interlocking ability.

In this case, the track through the derailment site had not experienced any track-disturbing works immediately prior to the derailment, and 300 tonnes of new ballast had been added to the track during the installation of the new turnout (number 14 points). Examination of the inspection reports for the new turnout installation found an entry listed for 'boxing up and levelling' the ballast as activities needing to be completed. While fresh ballast was evident on the left hand side[11] ballast shoulder, no new ballast was evident on the right hand side of the track. The shoulder ballast on the right hand side had been disturbed by the displacement of the track during the derailment, but the ballast profile on this side did not appear as full as that on the left hand side of the track (Figure 7). It is possible that the sleeper ends had been partially exposed prior to the passage of train 3PS6, reducing lateral track stability and creating an increased risk of track displacement.

Figure 7: Shoulder ballast and exposed sleeper ends adjacent to the derailment site.

Source: ATSB

[10] Pumping is cyclic vertical movement of the track structure under the passage of trains. The name comes from the migration of fines to the surface of the ballast, particularly as a slurry when wet.

[11] In the direction 3PS6 was travelling.

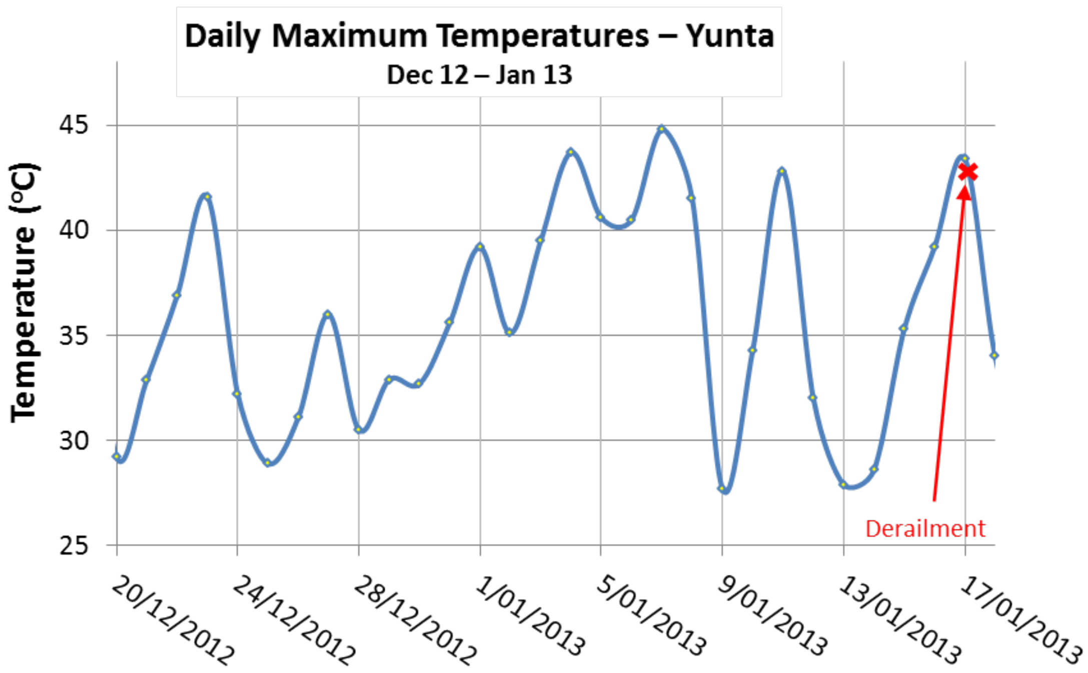
Weather

Observations from the Yunta Airstrip weather station (Figure 4) indicated that on 17 January 2013, the ambient temperatures ranged from 18 °C to a maximum of 42.2 °C at 1400. Approximately one hour later, as 3PS6 passed though Yunta, the temperature was about 40 °C.

Yunta's climate is typically hot and dry. The BOM climate data for Yunta lists a mean January maximum temperature of 33 °C and shows that the daily maximum temperature will exceed 40 °C for about 10% of each year. The temperatures on the day of the derailment were high but not exceptional for the area.

Figure 8 illustrates the maximum temperatures for Yunta over the month leading up to the derailment. Eight days in that period had daily maximums higher than 40 °C. The graph shows the daily maximum temperatures climb over a number of days then drop quickly. A succession of progressive temperature increases followed by sudden drops can result in the accumulation of compressive force in the rail, effectively reducing the track's ability to remain stable at higher temperatures. This process is progressive and can take many years to have an impact upon the rail's neutral temperature. However if the rail's neutral temperature was not set correctly, then this temperature pattern may be enough to increase the risk of a track buckle.

Figure 8: Daily maximum temperatures at Yunta (December 2012 - January 2013).



Source: BOM and ATSB

Safety analysis

The evidence collected on site indicated that the track buckled at the 196.577 km mark, adjacent number 14 points. The formation of this track buckle was considered to be the principal cause of the derailment. As the train crew did not see or feel the buckle, and wagons did not derail until the rear of train 3PS6, it was considered likely that the track buckled under 3PS6 as it passed over the site.

As there was no evidence to suggest that train handling or any latent defect in the rolling stock had contributed to the derailment, the investigation focused its analysis on the management of rail stress and track stability.

Rail stress and track stability

The management of rail stress and track stability was documented in the ARTC CoP. The ARTC procedure *Managing Track Stability – Concrete Sleepered Track* (ETM-06-06) described the requirements for managing the stability of track with concrete sleepers, and required that:

> 'a Track Stability Management Plan must be in place for each section of concrete sleepered track'.

A *Track Stability Management Plan* is a tool to assist track maintainers and track inspectors to manage track buckling forces and track buckle resistance, to identify what to do in instance of high temperature, and to identify areas of high track buckle risk. The document should be generated for each track section and be regularly updated.

The ETM-06-06 defines a *bunching point* as:

> A section of track where stress-free temperature may reduce due to an accumulation of rail resulting from creep, including on the approaches to fixed points, bottoms of gradients, signals where trains regularly stop, train braking zones, or where there is a change in track type.

The document required that potential bunching points to be listed in the *Track Stability Management Plans.*

The new turnout (number 14 points) had only been in track for three months and was of a heavy track structure – producing a strong fixed point in the track. The derailment site was at the bottom of a four kilometre long grade and immediately adjacent to number 14 points. The site was also in the braking zone for the signals and loop at Yunta. These aspects were all known factors that can contribute to the development of a bunching point as documented in the ARTC CoP. However, given that the rail at the derailment site had been in track for less than two months, there had likely been insufficient time for the accumulation of significant rail creep forces arising from these factors.

Per the ARTC CoP, a *Track Stability Management Plan* should have identified the location as adjacent to a bunching point and specified the ballast condition, including ballast profile, to ensure the track's buckle resistance was managed. The ATSB investigation, however, was unable to locate or identify a *Track Stability Management Plan* for this section of track at the time of the derailment.

Works records showed that up to 300 tonnes of new ballast was delivered to site for the replacement of number 14 points. Fresh ballast was evident on the left hand shoulder of the track where the track buckle occurred, but not on the right. The track deflected to the right under train 3PS6.

Evidence suggests that the right hand ballast shoulder lacked depth and width, resulting in the sleeper ends being partially exposed. Normally track buckles will kick to the outside of a curve since a kick to the inside would require greater force to overcome the natural compressive strength of the curve. In this case however, the track buckled right (inside the curve) – probably due to the sound ballast profile on the left hand side and deficient ballast profile on the right.

In areas where ballast profile is reduced, the ARTC CoP requires the application of a temporary speed limit to reduce the possibility that operational loading compromises the track alignment due to track instability. In instances where a half depth / half width ballast profile exists (as may have been the case at Yunta), the CoP requires that a temporary speed limit to be applied, or the ballast profile to be repaired prior to the passage of the next train. Reducing the train speed reduces the forces the train exerts upon the track and reduces the consequences of a derailment. The ATSB investigation was unable to locate any records of a speed restriction being applied through the Yunta area.

Had a *Track Stability Management Plan* been in place for this location, it is possible that the importance of adequate ballast profile may have been highlighted and a speed restriction been applied or the ballast deficiency rectified before the passage of train 3PS6.

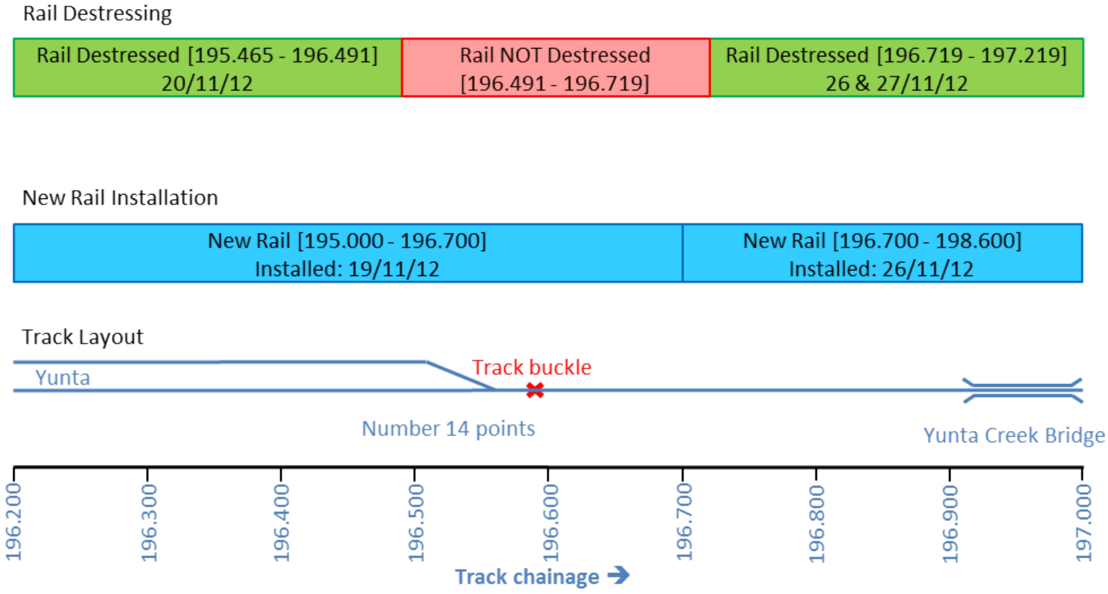
Destressing operations

Physical evidence identified after the derailment suggested that the switch area of number 14 points had been pushed up to 6 mm out of square (Figure 6). For this to have occurred within two months of the turnout installation, it was concluded that significant rail stresses had developed and were present in the adjacent newly laid rail at the time of the derailment. Such a rapid accumulation of stress in new track work was consistent with the post-installation destressing operation being omitted or applied ineffectively.

Welding and destressing of newly-installed rail

An examination of project documentation indicated that number 14 points were renewed in early October 2012, with 220 m of existing rail adjacent to the points being destressed a month later. On 19 November 2012, new rail was installed on both legs of the main line for the length of Yunta Yard, and also on the track between the number 14 points and Yunta Creek Bridge. Documentation indicates that the track through the crossing loop was destressed on the following day. Five days later, on 26 November 2012, 1900 m of new rail was installed abutting the rail installed on 19 November extending beyond the Yunta Creek Bridge. The left hand rail between number 14 points and the Yunta Creek bridge was also destressed on 26 November, with the right hand rail destressed the following day. Notably however, the works documentation did not contain any records of destressing operations on the 228 m of rail between 196.491 km and 196.719 km. It was this area where the buckle occurred under train 3PS6 on 17 January 2013. The activities described above are illustrated in Figure 9, with the red section indicating the length of track where no destressing documentation was available.

Figure 9: Track layout, rail installation and destressing diagram



Source: ATSB

ARTC has advised that Transfield Services practice after the destressing operation was to apply fasteners to every fourth sleeper (a one in four pattern) and apply a temporary speed restriction of 80 km/h if there was insufficient time to fully clip up the rail. This occurred in the area in question, with the remaining clips installed and the speed restriction removed on 5 December 2012 – seven days after destressing was completed. The ARTC CoP Section 2, Sleepers and Fastenings, states that where a cluster of three consecutive ineffective fastenings are found, an appropriate increase in the monitoring and follow up action is to be applied. Where there are adjacent or multiple clusters of ineffective fasteners, the CoP requires that an assessment should be undertaken by a competent worker to determine if a more restrictive response is required. In this instance, the temporary speed restriction was applied. However, ARTC's Standard Work Instruction ETW-01-01 *Stressing Plane Line CWR with Rail Suspended on Rollers* requires rail to be initially fastened to every *second* sleeper to hold the rail and prevent additional movement of the destressed rail length.

Transfield Services actions for this project after destressing did not meet the requirements of ARTC's CoP, nor Transfield Services Re-railing CWR Methodology – leaving the rail at risk of creep and loss of control of the rail's NT. A test of the rail's NT was made at 196.980 km on 14 December 2012 and was found to be within the defined NT tolerances at this location.

Project management and quality assurance

A re-railing project of this magnitude requires a robust logistical plan to coordinate the welding and delivery of the long welded rail to site, re-railing, and stress management, to ensure the project meets the client's requirements efficiently with minimal impact on train operations. For the re-railing programme through Yunta, the ARTC had entered into a contractual agreement with Transfield Services for the provision of key project activities. For this project, Transfield's systems and documentation was adopted for day-to-day works, with both parties required to sign off on practical completion. The *Transfield Services Re-railing PIP* (Project Implementation Plan) was the principal document used to programme the re-railing activities, with Transfield's quality system and associated field documents intended to ensure that all works were undertaken and to standard.

With respect to rail destressing, there were three documents used to record details of all rail welds, rail stressing calculations, and to verify that the required works had been completed.

- Weld Return and Rail Adjustment form (TMF-5003-QA-0048)

  Weld Return forms were used to record the location of the weld, the weld batch number, who performed the welds, and the reason for the welds. If weld defects were discovered, or welds started to fail, the Weld Return form information allows other potentially affected welds to be located and examined.

- Destress Pull form (AR001-AT-FRM-WE0003)

  Destress Pull forms were used to assist with the calculations and to record the rail adjustment information when destressing rail.

- Weld Map Plan (AR0001-AT-FRM-WE-0002)

  The Weld Map Plan lists all welds on both rails in kilometrical order with the chainage[12] of each weld noted.

The ATSB examined the documentation relevant to re-railing works for the track between one kilometre before, and two kilometres after[13] the derailment site. A number of discrepancies and completion errors were found.

- On 19 November 2012, both rails of a 1.7 km length of track were re-railed, which included the location where the train 3PS6 derailed two months later. This work would have required the joining of a number of lengths of long welded rail (typically 110 m or 165 m lengths) with a corresponding number of welds. However, there were only *five* welds recorded on the weld return and rail adjustment forms.
- On 26 November 2012, a similar operation was undertaken on the next 1.9 km length of track. Again, this work would have required the joining of a number of lengths of long welded rail with a corresponding number of welds. However, in this case only six welds were recorded on the weld return and rail adjustment forms.
- Of the destress pull forms examined, only half showed anchor pull through[14] information. Anchor pull through must be checked as any movement of the rail through anchor blocks during destressing will have a direct impact upon the final rail stress and neutral temperature. The absence of this information prevents the verification of destressing effectiveness.
- There was evidence of only four welds being completed for the purpose of destressing the 7.2 km of new rail through the area where train 3PS6 derailed in January 2013. Similarly, there was no destress pull form data for the 228 m of track where the track buckled under 3PS6. The lack of information on both forms would suggest that rail destressing did not occur.

An audit of the re-railed track found that the locations of the welds and lengths of rail that had been destressed did not match that recorded on the destress pull forms. The destress pull forms indicated that the destressed lengths of rail abutted each other, however evidence in the field indicated that the lengths of destressed rail were actually separated by 30 to 50 m lengths of rail that had not been destressed. Furthermore the length of rail not destressed in front of number 14 points may have been less than that indicated by the project documentation.

Transfield Services' documentation required that all rail welds must be recorded on the weld map plan. While the weld map plan supplied to the ATSB was dated 15 November 2012, other documentation showed that there had been a number of welds completed on 26 November 2012 and inspected in January 2013, and these were not recorded on the weld map plan. The

12 Chainage is the distance along the track in kilometres from a defined zero point.
13 In the direction3PS6 was travelling.
14 Anchor Pull Through is where the rail pulls through the anchor block during rail stressing.

subsequent uncertainty over the completeness of the weld map plan and the inconsistent weld data further reinforced the doubt that Transfield Services' quality system had been used correctly.

In summary, it was evident that implementation of the quality assurance process was inadequate in relation to the re-railing works through Yunta. Some of the quality documentation was incomplete and, in some cases, suggested that work had not been undertaken, especially in the area where train 3PS6 subsequently derailed.

Competencies and Training

The ARTC CoP requires all staff undertaking rail welding and supervising rail destressing activities to hold appropriate competencies. In this case, Transfield Services put its responsible field staff through project specific training prior to commencing works.

In March 2011, track work staff attended a *Rail management and Destress* presentation in preparation for the re-railing works. The presentation addressed the importance of rail neutral temperature and the consequences of not controlling (setting correct) neutral temperature. It also demonstrated where rail destressing information was to be recorded in the Weld Return and Rail Adjustment form, and gave a worked example of the calculations undertaken on the destress pull form. The presentation noted the importance of tell-tale points[15] and recording rail movement measurements at the tell-tale points.

Examination of the training package found discrepancies between the presentation and the forms used in the field for calculating and recording rail destressing information. The worked example presented in the training was laid out in a different manner to the forms used in the field. As had been noted previously, the forms subsequently completed in the field contained a number of omissions, and while those omissions were not able to be directly associated with the training discrepancies or the subsequent derailment of train 3PS6, they demonstrated a weakness in the training and implementation of the rail destressing quality assurance processes and would certainly have increased the risk of inadequate rail stress management during the project.

[15] Marks on the rail and adjacent sleeper to indicate if the rail pulls through anchor blocks during rail stressing.

Findings

From the evidence available, the following findings are made with respect to the derailment of Pacific National freight train 3PS6 at Yunta, South Australia, on 17 January 2013. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- ARTC and Transfield Services' quality assurance processes were not adequately implemented or overseen during the 2012 re-railing work through Yunta, SA.
- There was no evidence to indicate that the re-railed track through the area of the derailment had been destressed to limit the development of excessive lateral (buckling) forces associated with the high temperatures of the region.
- The derailment occurred due to passage of the train across a local track misalignment (buckle) at the 196.577 km mark.
- It is likely that the right hand ballast shoulder lacked depth and width where the misalignment occurred; reducing the track's ability to resist the lateral (buckling) forces generated as the rail tried to expand due to high temperature on the day.
- The track maintenance inspections did not identify the inadequate ballast shoulder profile at the derailment site.
- **There was no Track Stability Management Plan in place for the section of track where the buckle developed – as was required by the ARTC's CoP. [Safety Issue]**

Other factors that increase risk

- The documentation used to record the rail destressing process differed to that presented in the training, which could increase the risk of inadequate management of rail stresses.

Other findings

- It is unlikely that the rolling stock condition or the train handling contributed to the derailment.

Safety issues and actions

The safety issues identified during this investigation are listed in the Findings and Safety issues and actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the directly involved parties were provided with a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Track Stability Maintenance Plan

Number:	RO-2013-002-SI-02
Issue owner:	Australian Rail Track Corporation
Operation affected	Rail infrastructure
Who it affects:	All track maintainers

Safety issue description:

There was no Track Stability Management Plan in place for the section of track where the buckle developed – as was required by the ARTC's CoP.

Proactive safety action taken by The Australian Rail Track Corporation

Action number: RO-2013-002-NSA-92

> ARTC now have Track Stability Management Plans for all of our respective Provisioning Centres, these highlight any areas of concern relating to potential rail stress issues. We also continue to undertake rail stress checking over our network, which then feeds in to the Track Stability Management Plans.
>
> The Track Stability of Concrete Sleepered Track procedure is reviewed annually.
>
> Changes are being considered for the rail stressing standards and procedures.

Current status of the safety issue

Issue status: Adequately addressed

Justification: The ATSB is satisfied that the action taken by the Australian Rail Track Corporation will adequately address the safety issue.

Additional safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence

Proactive safety action taken by Transfield Services:

Action number: RO-2013-002-NSA-090

Any future re- railing projects undertaken by Transfield Services will now include a Rail Adjustment Plan which lists all required stresses completed over the re-rail section.

The Destress Pull form TMF-8004- WE-0019 has been amended to include a destress number system which will align with the Rail Adjustment Plan to ensure that all required stresses over the section being re-railed have been completed and correctly recorded.

Transfield Services have also introduced / updated the following forms:

- In Process Checklist form TMF-5032-OP-0001
- Inspection and Test Plan /Checklist TMF-5032 QA-0002

Proactive safety action taken by The Australian Rail Track Corporation

Action number: RO-2013-002-NSA-91

ARTC have updated their project management procedures and are undertaking a further review of procedures relating to scopes of work.

General details

Occurrence details

Date and time:	17 January 2013 – 1453 CDT	
Occurrence category:	Incident	
Primary occurrence type:	Derailment	
Location:	Yunta, South Australia	
	Latitude: 32° 34.744’ S	Longitude: 139° 34.131’ E

Train details

Train operator:	Pacific National	
Train number	3PS6	
Type of operation:	Freight – Intermodal	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Minor	

Track details

Track owner:	ARTC	
Track maintainer:	Transfield Services	
Track type:	Main	
Track name:	Crystal Brook – Broken Hill Railway	
Section:	Yunta - Mannahill	
Track structure:	Rail size – 60 kg	Sleeper type – Concrete
	Fastening type – Mackay & Pandrol e clips	Ballast profile – Varies
	Turnouts – nil	
Damage:	Major	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Asciano Ltd (Pacific National)
- Bureau of Meteorology
- The Australian Rail Track Corporation
- Transfield Services
- Australian Transport Safety Bureau

References

ARTC Track and Civil Code of Practice section 4 - Ballast

Transfield Services Re-Railing CWR Methodology Revision 4

Transfield Re-railing project documentation Broken Hill to Whyalla

ARTC Engineering (Track & Civil) Procedure ETM-06-06 Managing Track Stability – Concrete Sleeper track

Bureau of Meteorology Data Services Website

Modern Railway Track (second edition) Coenraad Esveld

RISSB Glossary of Railway Terminology Ver 1 Dec 2010

Transfield Rail Management and Destress March 2011

ATSB report RO-2010-015 - Derailment of train 1MP5 at Goddards, WA, 28 December 2010

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 Australian Rail Track Corporation, Transfield Services, Pacific National, and the Office of the National Rail Safety Regulator

Responses and/or submissions were received from all parties. These were reviewed, and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation

Derailment of freight train 3PS6, Yunta, South Australia
17 January 2013

RO-2013-002

Final – 26 May 2015