Australian Government

Australian Transport Safety Bureau

Track obstruction due to loss of freight involving train 6WM2 and subsequent impact of passenger train 8615 with track obstruction

near Winton, Victoria, on 30 March 2018

ATSB Transport Safety Report

Rail Occurrence Investigation

RO-2018-008

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Addendum

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Safety summary

What happened

On 30 March 2018, a 16 t jumbo (steel) coil became unstable and fell from Pacific National freight service 6WM2 after it crossed the Seven Mile Creek Bridge near Winton, Victoria. After falling from 6WM2, the coil struck and caused damage to both tracks before coming to rest between, and obstructing both tracks at about 204.5 track km. About 10 minutes later, V/Line passenger service 8615, traveling north on the west track, struck the tail of the coil and the damaged west track at about 110 km/h, but did not derail. Two staff on the V/Line train received minor injuries.

What the ATSB found

The ATSB found that the absence of a rubber load mat from one face of the jumbo coil cradle, and the likely failure of the steel unitising straps allowed the centre of the coil to telescope (where the inner layers of the coil move laterally relative to the outer layers), adversely affecting its stability and increasing the likelihood of movement.

As Pacific National's Freight Loading Manual did not require the use of rubber load mat on cradles, there was no requirement to consider the condition of the load mat during inspections and maintenance. This allowed the continued use of cradles without load mat, decreasing their effectiveness at restraining loads.

The Freight Loading Manual also did not require a configuration of radial unitising straps on jumbo coils so that one strap was always free from contact with the cradle, which would have reduced the risk of straps breaking and therefore, the coil telescoping.

In addition, Pacific National did not demonstrate that the load restraint system provided by their demountable cradles when carrying jumbo coils provided sufficient restraint against lateral accelerations to prevent coils from moving and falling during transit.

What's been done as a result

Following the occurrence, Pacific National updated their Freight Loading Manual to require all coils to have a minimum of two radial and two circumferential unitising straps applied. In addition, PN have drafted a revision to their Wagon Maintenance Manual to include a part specific to inspection of jumbo coil cradles. The manual part relates to demountable type cradles and includes a requirement to 'consider the condition of load mat during inspection and maintenance', and repair or replace as required.

The ATSB has issued two safety recommendations to Pacific National to address safety issues identified in this investigation that have not yet been addressed. The first is to address the risk presented by continuing to allow jumbo coils to be loaded in an orientation where all the radial straps are positioned within the contact zone between the coil and cradle. The second is to review the load restraint system provided by the demountable cradle design to demonstrate that they sufficiently restrain jumbo coils against lateral accelerations and prevent coils from moving and falling during transit.

BlueScope Steel also introduced a requirement to apply a third radial unitising strap to all coils. In practice, they applied the third strap in a position diagonally opposite to the first two. Additionally, they have proposed to work with the carrier to undertake a review of the current load restraint system.

Safety message

Robust load restraint systems are required to protect against movement of loads during transport. This is particularly important for significantly heavy loads, such as jumbo steel coils, as should they fall from the train they pose a significant risk to the safety of other rail vehicles and passengers. The system should also include assessments and documentation that demonstrate appropriate load cases, design requirements, operational and loading requirements have been met, to ensure that the safety of the load restraint is maintained over time.

Contents

The occurrence

Loading of the jumbo coil

On 27 March 2018, a BlueScope Steel jumbo coil[1] (number 1H8S2486) was loaded onto the 'A-end' (trailing) cradle of Pacific National (PN) wagon number NQJF-21574, along with another coil in the 'B-end' (leading) cradle. BlueScope applied two circumferential and two radial steel straps (an example of circumferential and radial straps applied to a jumbo coil is shown in Figure 1) to each coil in order to secure them as a unit (unitise).[2] The following day the loaded wagon was inspected by PN terminal operators and moved to South Yard, Port Kembla, New South Wales (NSW).

Figure 1: Jumbo coil fitted on a wagon within a cradle, showing radial and circumferential unitising straps

Source: ATSB

[1] Jumbo coil: Unitised steel sheet or plate that is rolled into cylindrical coils for transport. The centre of the coil (the eye) is hollow. 'Jumbo' describes the size of the coil; with a minimum weight of 16 t and diameter less than 2,100 mm. Jumbo coils must be loaded on fixed cradle wagons or wagons with demountable cradles.

[2] Unitise: To make into one unit. In the context of a coil of steel, this means to secure it in such a way that the layers of the coil are prevented from moving relative to each other, the coil can then be treated as a solid 'unit'.

On 29 March 2018, the wagon was marshalled as the 35th wagon of train 6WM2 and was inspected by PN terminal operators, who provided a completed brake certificate[3] to the outgoing train crew. The train departed Port Kembla at 2354 Eastern Daylight-saving Time,[4] and received a roll-by[5] inspection from PN terminal operators with no issues reported.

Train 6WM2 journey to Melbourne

Train 6WM2 was a scheduled service carrying steel products from Port Kembla (Wollongong) to the Melbourne Freight Terminal, Victoria. It travelled north from Port Kembla to the Sydney Freight Terminal before traveling on the Defined Interstate Rail Network[6] for the remainder of its journey to Melbourne.

On 30 March 2018, at about 0300, train 6WM2 arrived at Chullora, NSW for a crew change with a two-person crew from Junee, NSW relieving the Port Kembla drivers. The disembarking crew reported that the train was running well and they conducted a roll-by inspection of the train as it departed, and did not report any issues.

At about 1055, train 6WM2 arrived at Junee for its second crew change. Again, the disembarking crew reported that the train was running well and they conducted a roll-by inspection of the departing train with no issues reported.

On its journey from Junee to Wangaratta, Victoria, train 6WM2 crossed[7] passenger train ST24 and freight train 6MC7. The drivers of both conducted roll-by inspections of train 6WM2 and observed no issues. Closed-circuit television footage captured from a platform at Wangaratta Station at about 1427 identified that all jumbo coils on train 6WM2 were present and not grossly out of place.

The occurrence

At about 1440, a jumbo coil fell off train 6WM2 as it passed 204.5 track km.[8] The train was travelling at a speed of about 76 km/h. The drivers of 6WM2 reported nothing remarkable about the train's behaviour at this location and were unaware of the coil falling off.

At about 1448, the train proceeded south and crossed the northbound V/Line passenger service 8615. The crew of 8615 conducted a roll-by inspection of 6WM2 with no issues reported. The recorded data indicated that both trains were travelling just below 80 km/h at this time, so from the driver of 8615's perspective, train 6WM2 would have passed at almost 160 km/h.

At about 1450, the driver of train 8615 saw a jumbo coil obstructing the track ahead and made an emergency brake application. Train 8615 subsequently struck the unravelled tail of the coil and associated damage to the west track (Figure 2) at about 110 km/h, but it did not derail. After traversing the damaged track, the train travelled over the Seven Mile Creek Bridge, which was less than 100 m beyond the steel coil and damaged west track, as shown in Figure 3.

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[3] Brake certificate: Also known as a Train Examiners Certificate, brake certificate is issued upon completion of pre-departure brake tests. Details of the testing requirements and certificate for access to the Australian Rail Track Corporation (ARTC) network can be found in the *ARTC Train Operating Conditions Manual – Section 6 Train Inspection.*

[4] Eastern Daylight-saving Time (EDT): Coordinated Universal Time (UTC) + 11 hours.

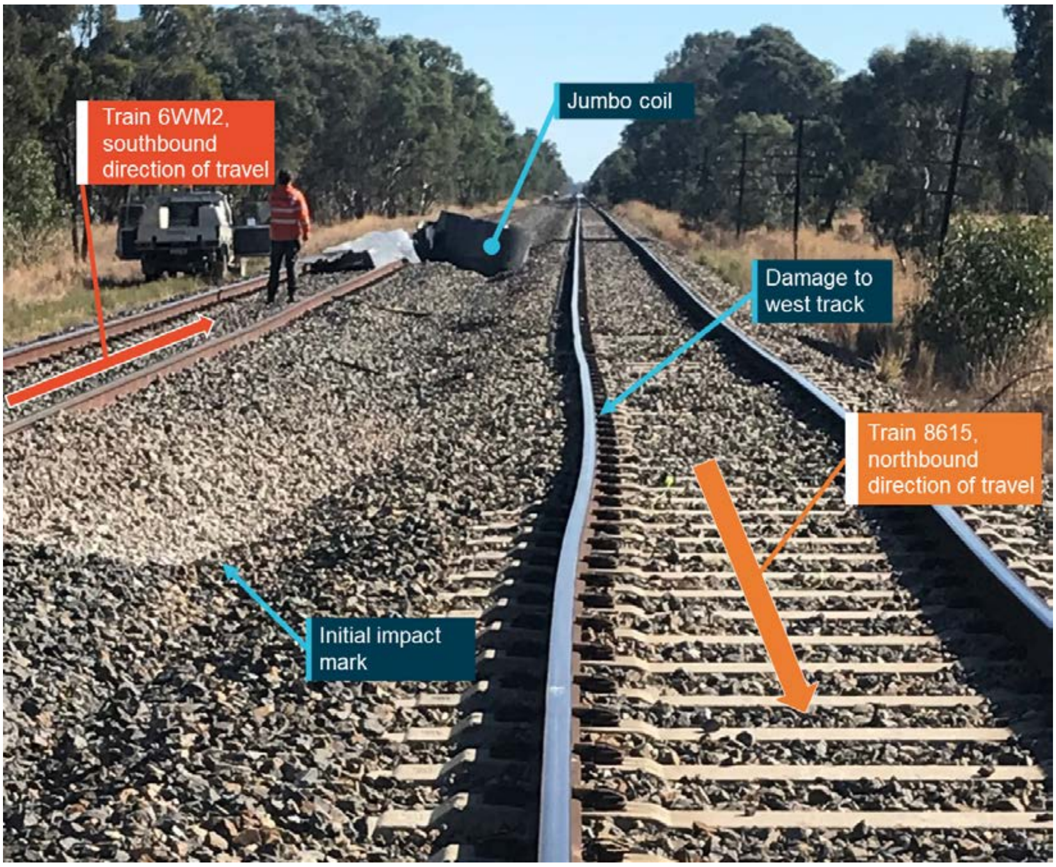
[5] Roll-by inspection: A visual inspection of moving rail traffic to identify equipment, loading security, or other defects or failure.

[6] Defined Interstate Rail Network: The standard gauge interstate rail line linking the mainland capital cities (except Darwin) and the regional centres of Alice Springs, Darwin, Whyalla, Port Kembla and Newcastle. Managed by ARTC.

[7] Cross: To go past other rail traffic travelling in the opposite direction.

[8] Track kilometre (track km): refer to the track distance from a known location. On the Victorian section of the Defined Interstate Rail Network the 0 km reference is Southern Cross Station in Melbourne.

Figure 2: Jumbo coil and track damage at location 204.5 km



Source: ARTC, annotated by the ATSB

Figure 3: Location of track obstruction and associated track features

Source: Google earth, annotated by the ATSB

After bringing the train to a stop, the driver of 8615 advised the Australian Rail Track Corporation (ARTC)[9] train control that they had struck a steel coil from 6WM2 and that there was significant damage to the west track. In response, the ARTC train controller applied signal blocks to both tracks and requested that the drivers of 6WM2 stop and inspect their train.

At about 1454, the driver in control stopped train 6WM2 at the next suitable location. Between 1517 and 1600, the second driver inspected the train and reported to ARTC train control and PN that a jumbo coil was missing from the 35th wagon, NQJF-21574. The driver also reported that 39 trailing wagons had been damaged to varying extents. This included damage to the steps, handbrakes, brake cylinders and bearing caps. The driver advised that train 6WM2 would not be able to continue without repair.

The driver of V/Line passenger service 8615 inspected the train and determined that superficial damage had occurred to the locomotive and that there were no passenger injuries. Train 8615 continued its journey to Albury, NSW without further incident. Later, two staff reported that they had received minor injuries.

Initial inspection of the occurrence location by PN and ARTC representatives focused on identifying damage to the track and rollingstock, and planning the recovery of the coil. Both parties provided photographs and reports of the condition to the ATSB. Subsequent inspections of the track and of wagon NQJF-21574 were conducted by ARTC on 4 April 2018. A further inspection of the wagon was performed by the ATSB at PN’s West Melbourne Yard on 22 May 2018.

9 Australian Rail Track Corporation (ARTC): Commonwealth-owned Company, established to manage and develop the Defined Interstate Rail Network as a single entity.

Context

Train 6WM2 and wagon information

Train details

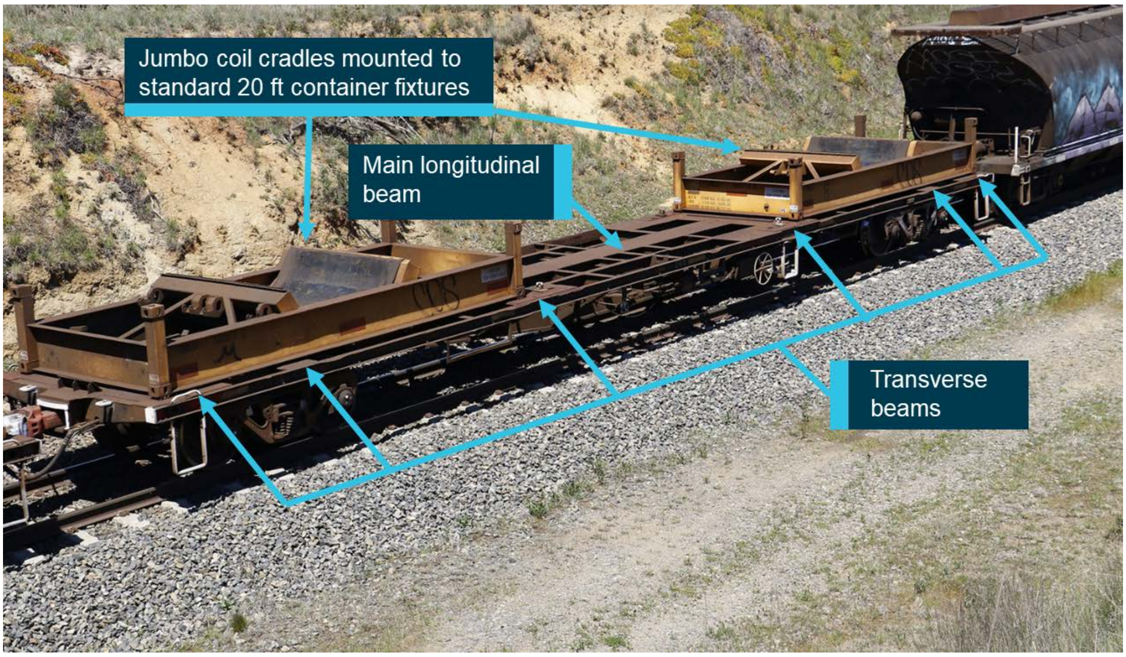
Train 6WM2 comprised four NR class locomotives, hauling 75 wagons for a combined length of 1,275 m and total weight of 5,132 t.

Wagon details

Wagon NQJF-21574 had a listed tare mass of 20 t, which did not include the mass of the demountable coil cradles (2.8 t each). Subsequently, the gross mass of the wagon loaded with two jumbo coils was 61.76 t, within the maximum allowable gross mass of 72 t.

Pacific National's NQJF class wagon was a 60 ft flat-bed wagon with mounting fixtures for accepting standard size shipping containers (20 or 40 ft containers). The main structure of this design was a large central longitudinal beam (commonly called the centre sill) that spans the length of the wagon and supports the transfer of load between both bogies and couplers. Transverse beams (also known as transoms) connect to the longitudinal beam and provide a load path from the container mounting points and bogie side-bearers[10] back to the central beam. For NQJF wagons, the transverse beams and several other components were connected with a lighter gauge steel u-section to create a fully enclosed rectangular bed. An example of these components is shown in Figure 4.

Figure 4: Structural components of an NQJF class wagon with jumbo coil cradles mounted.



Source: Brad White, annotated by the ATSB

[10] Side bearer: Brackets or assemblies on both sides of the longitudinal centre of a bogie that transfer forces to control the roll of the underframe on the bogie bolster.

Jumbo coil cradle design

Pacific National have been utilising several different designs of cradles to move jumbo coils by rail since their formation in 2002. Some designs were permanently attached to the frame of the wagon, meaning that those wagons were restricted to carrying jumbo coil only, while others could be removed (demountable). The cradles used on the NQJF wagons were designed to connect to existing 20 ft container mounting hardware (as shown in Figure 4). Although the cradles were demountable, photographic evidence indicated that the cradle involved in the occurrence, serial number DMJU-000271, appeared to have been mounted to wagon NQJF-21574 since at least January 2016.

The cradles were designed and manufactured to PN specifications by an engineering contractor and this particular cradle was manufactured in 2012. An isometric drawing of the cradle design is shown in Figure 5.

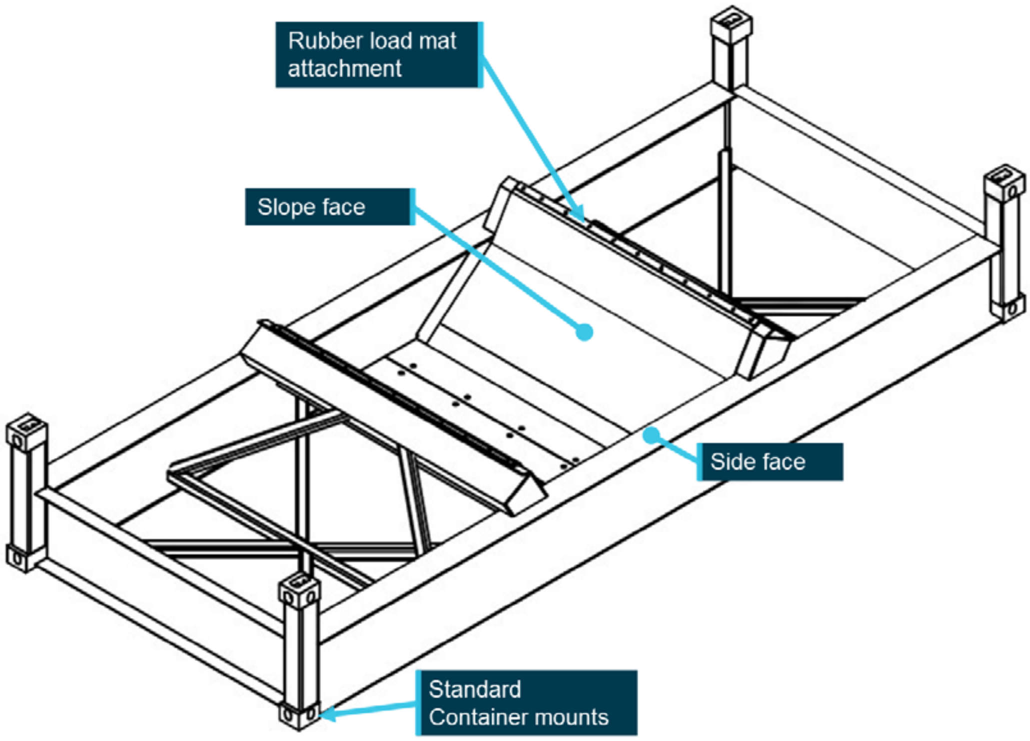
The technical specification relating to the design required that the cradles:

- be structurally sound for accelerations of, 2 g longitudinally, 1 g laterally, 1 g vertically up and 1 g vertically down
- accommodate heavy rolled steel coil up to a maximum weight of 29 t
- include rubber liners fitted to the walls (slope face) of the cradle.

While the technical specifications contained requirements for the strength of the cradle structure, they did not include any corresponding requirement for restraint of the load (refer to section titled *Load restraint requirements*) nor for tests to be performed with the actual jumbo coils used as load.

The cradle manufacturer conducted mechanical testing in accordance with the requirements of Australian Standard 3711 *Part 8: Freight containers - Platform containers*. The requirements tested the function, strength and restraint of the container. However, while this required a load to be present, the restraint of the load was not within the scope of the tests. The load used for testing was a fabricated cradle filled with steel shot (pellet) that did not replicate the dimensions or mass distribution of a jumbo coil, nor was it required to.

Figure 5: Isometric drawing of demountable coil cradle



Source: Cradle manufacturer, annotated by the ATSB

The design of the cradles included rubber mats on the slope faces that contact the coils. The mats were attached on their top edge by bolts passed through a metal plate. The manufacturer indicated that the intended purpose of the rubber mat was to protect the coil from contacting the steel surface of the cradle.

In addition, while not shown in the drawing, the design included retractable fingers that protrude from the cradle slope faces. These were intended to provide lateral support to the coils while accommodating different coil widths. While the exact contact position is a function of the coil diameter, which varied from coil to coil, the ATSB's observation of a coil being loaded into the same cradle type (Figure 6) showed that the fingers aligned with the coil below the contact point and close to the bottom surface of the coil. Therefore, while the fingers potentially provided some resistance to lateral movement, they did not significantly restrain the load from rotation around a longitudinal axis (toppling to the side).

Figure 6: Coil cradle retractable fingers and their position relative to a loaded coil

Note: The position of the radial steel straps are below the contact location with the slope face of the cradle.
Source: ATSB

Jumbo coil information

Coils on the 35th wagon

The occurrence coil (1H8S2486) weighed 16.04 t, was 1.94 m in diameter, 0.81 m wide, and comprised a wound sheet of 3.2 mm gauge steel that was unitised with two circumferential and two radial steel straps. Coils of this size are referred to within industry as 'jumbo coils'.

The jumbo coil mounted in the other cradle of the wagon (the B-end cradle) weighed 20.12 t, was 1.91 m in diameter, 1.06 m wide, and comprised a wound sheet of 2.3 mm gauge steel unitised with two circumferential and two radial straps.

Unitising straps

According to BlueScope Steel, the primary purpose of the unitising straps is to maintain coil integrity. Pacific National's procedures and BlueScope Steel's practice called for application of circumferential and radial unitising straps to jumbo coils that were to be transported by rail. These straps are made of steel and were applied to the circumference and radius of the coil respectively. Figure 1 shows a coil with both radial and circumferential unitising straps identified. BlueScope Steel described that the purpose of the circumferential straps was to keep the outer wraps tight to prevent telescoping and unravelling. Likewise, the radial straps were for:

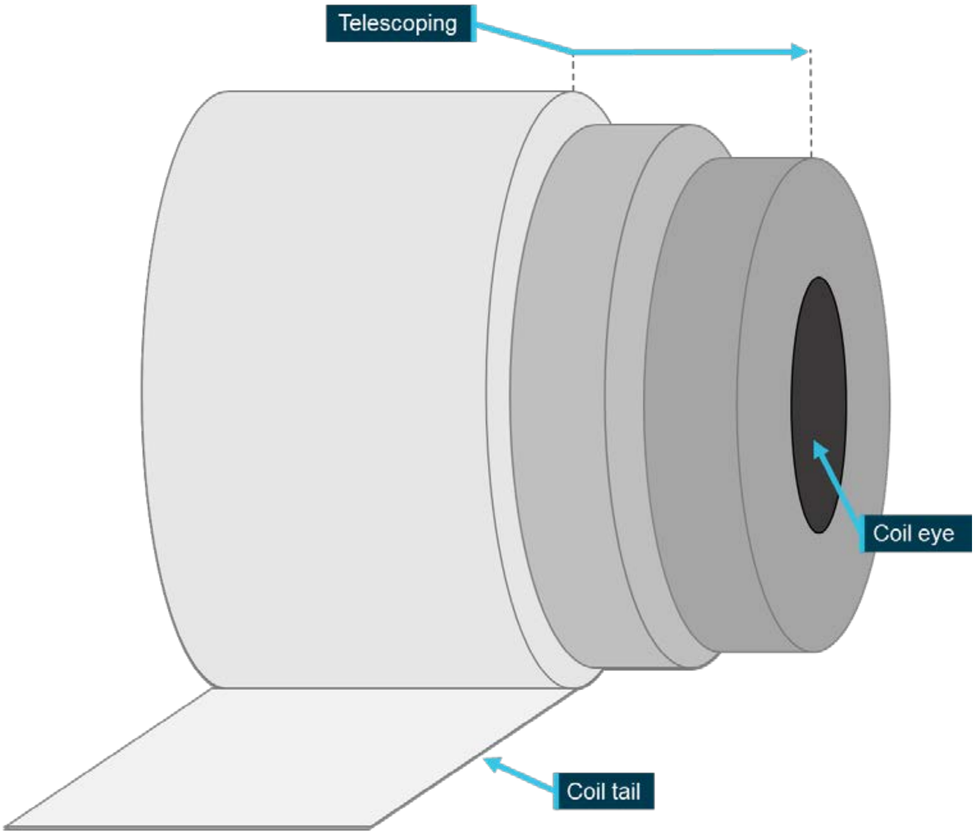
- Preventing eye wraps from unravelling during cooling
- Preventing eye wraps from telescoping or becoming damaged during coil handling with ram trucks and/or cranes
- Reducing the propensity for telescoping if the coil is dragged sideways in coil handling

- Providing support in keeping outer wraps tight to prevent telescoping or unravelling

Telescoping

Telescoping refers to a situation where the inner layers of a steel coil move laterally relative to the outer layers (Figure 7). This is undesirable as it results in a shift in the centre-of-mass to one side, reducing the stability of the coil, and making it more likely to tip in that direction as well as creating difficulty in handling. A method used to prevent this occurring is to apply multiple radial and circumferential straps to the coil. The circumferential straps keep the coil layers tight so that the resulting inter-wrap friction between the layers can resist the relative motion required for telescoping. The radial straps provide additional support to keep the wraps tight as well as resistance to relative motion of the layers as the straps themselves would have to stretch for telescoping to occur.

Figure 7: Illustration of coil telescoping



Source: ATSB

Jumbo coil preparation and loading

Jumbo coils were prepared and loaded at BlueScope Steel's facility at Port Kembla. BlueScope indicated that the coil involved in the occurrence had two circumferential and two radial steel straps applied in order to secure it as a unit (unitise). This was their standard practice at the time.

ATSB investigators attended the BlueScope loading facility on 27 June 2018 and observed the loading process used for jumbo coils. The coils were lifted and side-loaded onto cradles using a forklift with a single tine. In-line with the PN loading requirements, forklift drivers were observed to be positioning the coil so that it was oriented with the tail (the outside end of the coiled steel) positioned no higher than the contact point between the coil and cradle. Two radial unitising straps were applied on the tail of the coil, and therefore, were also positioned on or below the contact between the coil and cradle (an example is visible in Figure 6 above).

By the time of the ATSB observation in June 2018, BlueScope had also begun to apply a third radial strap to all coils being transported by rail. The third strap was being applied to the coils in a position diagonally opposite to the first two.

Track information

Track location and features

The coil came to rest at about 204.5 track km, about 100 m south of the Seven Mile Creek Bridge, and about 500 m south of the Winton Road Level Crossing in the Glenrowan to Benalla track section (Figure 3). The track at this location was tangent (straight) with minimal gradient. Further, there were no significant curves for several kilometres in either direction from the coil location.

In the location of the occurrence, trains 6WM2 and 8615 were permitted to travel up to the maximum speeds listed for their train types in the ARTC *Route Access Standard*, 80 km/h and 115 km/h respectively. There were no speed restrictions on either track at the 204.5 km location nor were there any on the east track for 40 km north of this location.

Track geometry

Track geometry measurements for the east track (used by 6WM2) were provided by both ARTC and V/Line.

ARTC's recording was captured by their AK car track recording vehicle[11] from the last scheduled measurement before the occurrence, which was 38 days prior on 20 February 2018. These values were directly comparable to the geometry defect maintenance limits utilised by ARTC.[12]

V/Line's recording came from their instrumented revenue vehicle (IRV) passenger ride comfort monitoring system that was fitted to one carriage of train 8615. While this system did not measure gauge or lateral alignment, it had recorded the vertical geometry of the occurrence location on the east track on the morning of the occurrence (30 March 2018). Due to differences in the data capture method, the V/Line results were not directly comparable to ARTC's geometry defect maintenance limits.

The recorded track geometry was reviewed for about 1 km of track preceding the occurrence location (204.5 km to 205.5 km on the east track). There were no track geometry defects exceeding ARTC's maintenance limits. Further, while some variation in the vertical alignment of the rails was evident in proximity to the Winton Road Level Crossing (204.968 km), this was also within the limits.

Variation in track geometry is common around features such as level crossings and bridges due to the change in track structure and support. Due to this, vehicle dynamic motion often increases at these locations, although in this case the geometry at the Seven Mile Creek Bridge and Winton Road crossings (Figure 3) were within ARTC limits.

The V/Line IRV data was not directly compared to the ARTC limits, as it was not measured using the same method as the ARTC AK car. However, since it was recorded on the day of the event, it

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[11] AK car track recording vehicle: The AK car is part of a three-car train that records track geometry on the standard-gauge network.

[12] ARTC Code of Practice, Track Geometry Section 5.

showed that no significant track fault or deterioration (such as a track buckle[13] or mud hole[14]) had developed in the 38 days between the ARTC recording and the occurrence.

In addition to the track geometry measurements, ARTC provided track condition reports, and records of track defects and maintenance conducted for a track section 5 km either side of the occurrence for 12 months prior. The records did not indicate any pre-existing issues or recent maintenance associated with the occurrence location.

Train handling

During interviews, neither driver recalled any issues with train handling during the journey, nor feeling any in-train force[15] events that could have contributed to the coil coming loose.

Analysis of the event recorder fitted to the lead locomotive of 6WM2 showed that the driver had used partial throttle (between notch 2-5) to maintain speed (between 75-80 km/h) for about 2 minutes prior to the estimated time when the coil was lost, which was appropriate for the relatively flat track grade in this area. They continued with this strategy afterward. While the in-train forces for the 35th wagon may have differed to what the drivers had experienced, the recorded data showed that the train handling was appropriate and did not likely induce any significant in-train force events while approaching the location of the occurrence.

Closed-circuit television footage

V/Line provided closed-circuit television footage from cameras mounted at both ends of the Wangaratta Station platform that recorded train 6WM2 as it passed. Wangaratta Station was located about 15 track km before the occurrence location. The cameras' primary purpose was to monitor the platforms, and therefore, the passing train was away from the main focus of the lens. Subsequently, while the occurrence coil was identified in the footage, and was not grossly out of place or unwound, the images were not clear enough to determine whether the unitising straps were present.

A comparison of still shots from the footage (Figure 8) showed differences in the silhouette of the side face between the occurrence coil and the coil from the B-end cradle of the same wagon. In particular, there was a clear (sharp edged) transition between the top and side faces of the coil in the B-end cradle. In contrast, the transition for the occurrence coil was less well defined (more gradual). This observation for the occurrence coil was consistent with a coil that had begun to telescope.

13 Track buckle: A substantial misalignment contributed to by longitudinal thermal stresses overcoming the lateral or vertical resistance of the track.

14 Mud hole: A mud-hole is a generic term used to describe a condition where the sleepers appear to be surrounded by mud rather than ballast. Mud-holes occur when the ballast becomes contaminated (or fouled) with fine materials. The fouled ballast retains water (appears like mud), prevents effective drainage and can result in poor track geometry.

15 In-train force: forces propagated longitudinally along a train due to changes in relative speed and acceleration of adjacent locomotives and wagons. These forces occur during braking (run-in or buff), where the rear of the train may compress toward the front, or acceleration (run-out or draft), where the front stretches away from the rear of the train.

Figure 8: Comparison of closed-circuit television footage at Wangaratta Station - occurrence coil (top) and other coil (bottom)

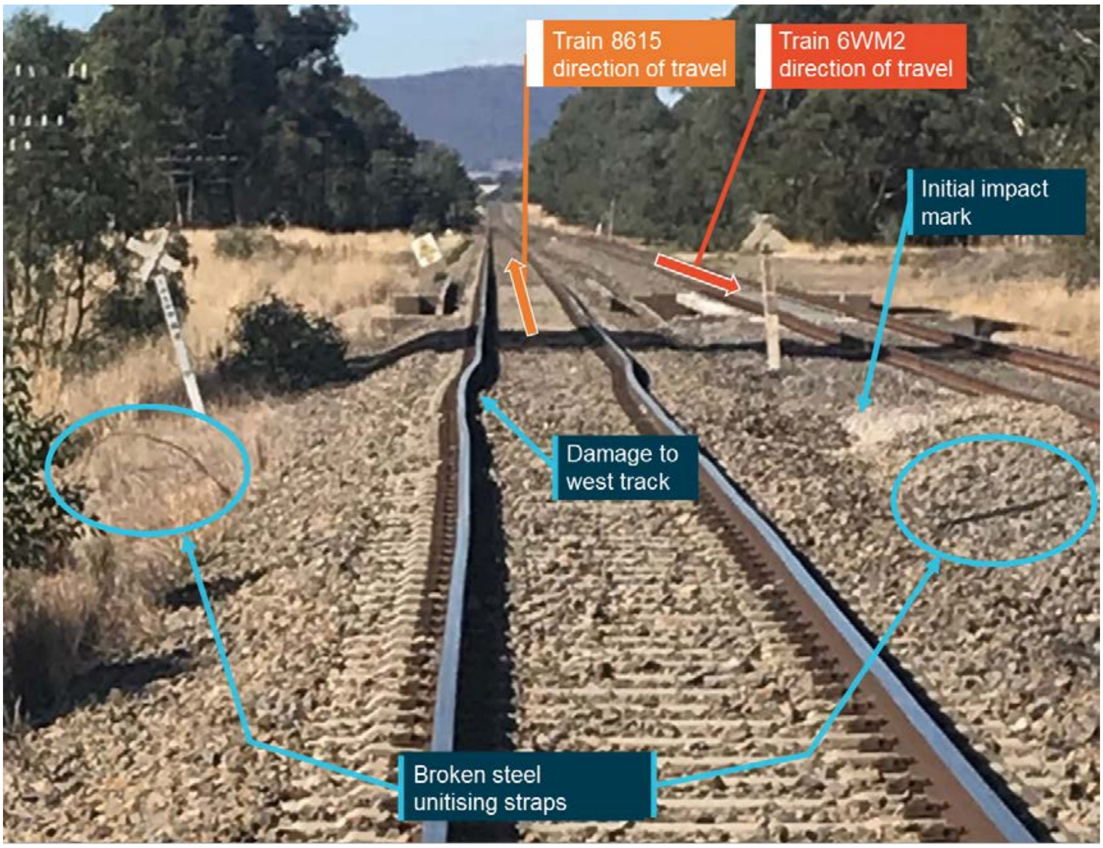
Source: V/Line

Post-occurrence inspections

Track and coil site inspection

While the ATSB did not attend the occurrence location, ARTC and PN representatives provided information, including photographs of the site and the coil. Impact marks were present indicating that the coil had significantly impacted the ballast between the two tracks at least twice. The initial impact to the ballast between the tracks was sufficient to shift the rails and sleepers of the west track, resulting in the misalignment that is visible in Figure 9 below. The force of the second impact dug through the ballast layer and exposed the formation below while also displacing the rails and sleepers on the east track. The coil came to rest immediately next to the second impact location (Figure 10). The steel unitising straps were not present with the coil though two were observed in close proximity. A broken steel strap was also found on the ballast between the two tracks about 1 km before this location at 205.5 km. However, it could not be determined if this strap had been fitted to the occurrence coil.

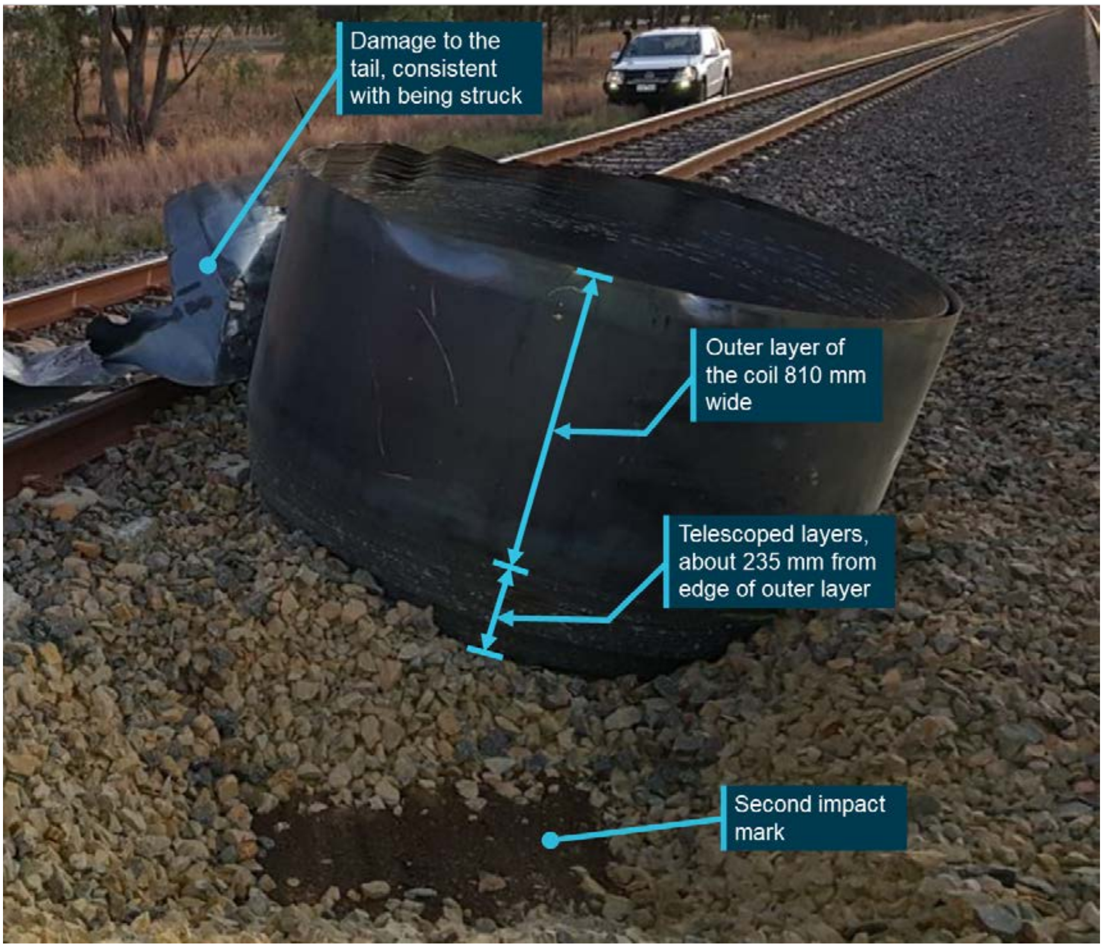
Figure 9: The initial impact location, track damage, and location of the broken steel unitising straps



Source: ARTC, annotated by the ATSB

The outer layers (the tail) of the coiled steel had unrolled and was observed in a final position on top of the east track (Figure 2). The unrolled section showed significant damage consistent with the reported impacts with the trailing wagons of train 6WM2. The tail's position on the east track was consistent with it having been struck by the locomotive of train 8615 on the west track and pushed across. There was no evidence to suggest that train 8615 struck the main body of the coil. The rest of the layers remained coiled, however, the centre of the coil (the eye) had moved relative to the outer layers (telescoped) by about 235 mm. In Figure 10, the layers of the coil are clearly visible at the top and bottom, with the centre of the coil having moved downward relative to the outside. This is effectively the same as a coil, in its normal orientation, having telescoped sideways.

Figure 10: The coil in its final position with telescoping evident

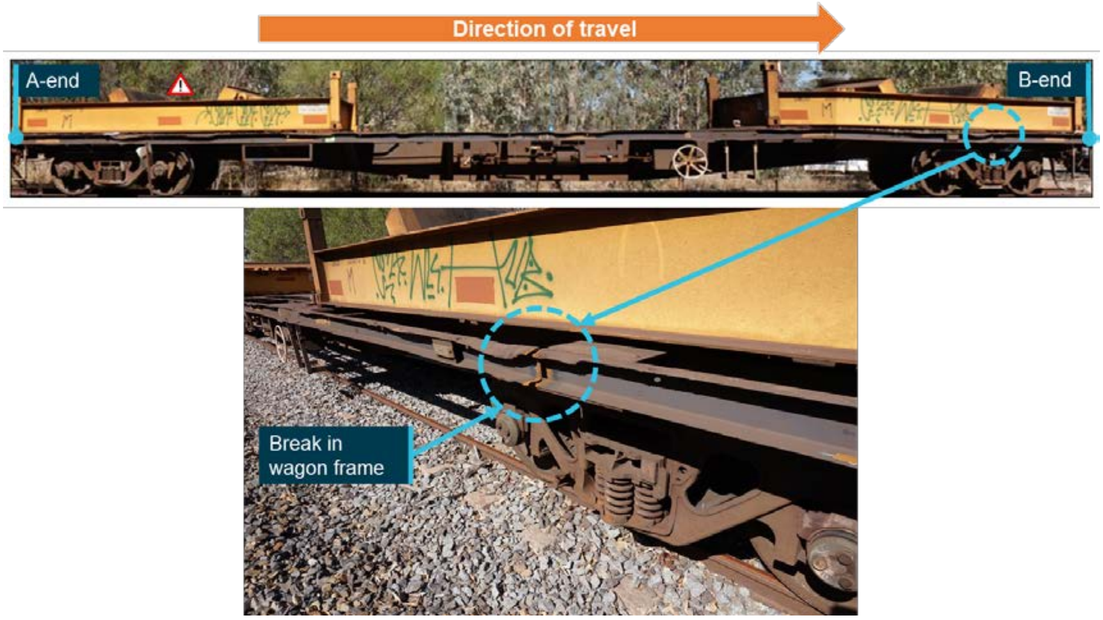


Source: Pacific National, annotated by the ATSB

Wagon inspection

An inspection of wagon NQJF-21574 was conducted by ARTC on 4 April 2018 (4 days after the occurrence) and a further inspection was performed by the ATSB at PN's West Melbourne Yard on 22 May 2018. Those inspections identified a break in a portion of the frame (Figure 11). The break was in a piece of U-section steel on the outside of the frame under the B-end cradle.

Figure 11: Inspection of wagon NQJF-21574 showing location of break in wagon frame



Source: ARTC, annotated by the ATSB

ATSB photographic analysis of the break from the ARTC inspection indicated that it was a brittle fracture[16] at a previous weld repair. However, the fracture surface showed significant rust and no conclusion could be made about the age of the fracture due to the four days that had elapsed since the occurrence, providing time for surface oxidation to form.

The wagon's orientation within the train meant that the B-end was leading the A-end during this journey. As such, the break in the wagon frame could not have been a result of impact from the coil that fell from the A-end cradle. Pacific National reported that maintenance of the wagon occurred on 22 February 2018. The maintenance record indicated this was a 'minor repair' to a 'broken or cracked' part of the frame. However, it could not be confirmed if this was the same location as the break that was present after the occurrence.

The broken part was not part of the main structure of the wagon frame that transmitted load from one bogie to the other, and was between the attachment points for the B-end cradle. As such, the break location did not affect retention of the A-end cradle nor was it likely to have significantly affected the torsional stiffness of the wagon frame. Due to these factors, no link between the break and the loss of the coil from the A-end cradle could be established.

The inspections also identified that all wheels mounted to the A-end bogie of the wagon showed high wear, although none exceeded the wear limits for maximum flange height or minimum width when measured. Asymmetric wear was not occurring, with wheel wear observed to be even from side-to-side on each axle. Wheel tread hollowing[17] and diameter were not measured, however, photographs of the wheelsets indicated that hollowing and tread wear were not a concern.

[16] Brittle fracture is the separation of a solid accompanied by little or no plastic deformation, typically occurring by rapid crack propagation.

[17] Wheel hollowing: The vertical difference in rolling radius between the end of the tread and the minimum point around the middle of the tread.

Photographs of the bogies taken on 4 April 2018 showed no indication of recent severe wear on bogie contact surfaces. This indicated that it was unlikely that the bogie had experienced significant hunting[18] motion leading to the occurrence.

Figure 12 shows ballast observed on the right side-frame (in direction of travel) and bolster of the A-end bogie, which was consistent with ballast being sprayed on the wagon from the coil striking the ground immediately beside it.

Figure 12: Residual ballast rocks on the A-end bogie

Source: Pacific National

Jumbo coil cradle

The inspections of the wagon conducted by ARTC and the ATSB also assessed the jumbo coil cradles. They identified that a rubber mat was missing from one face of the A-end cradle. The mat had dislodged from its mounts and fallen to the floor of the cradle (see Figure 14 below).

A photograph (Figure 13) obtained from a member of public, taken in June 2017, showed that the rubber mat was also dislodged at that time. This was eight months prior to maintenance conducted on the wagon in February 2018. The maintenance record did not note the condition of, or indicate that any maintenance to the mat had been performed. This suggested the mat had not been replaced since at least June 2017 and was likely to have been missing for this entire 9-month period of operation.

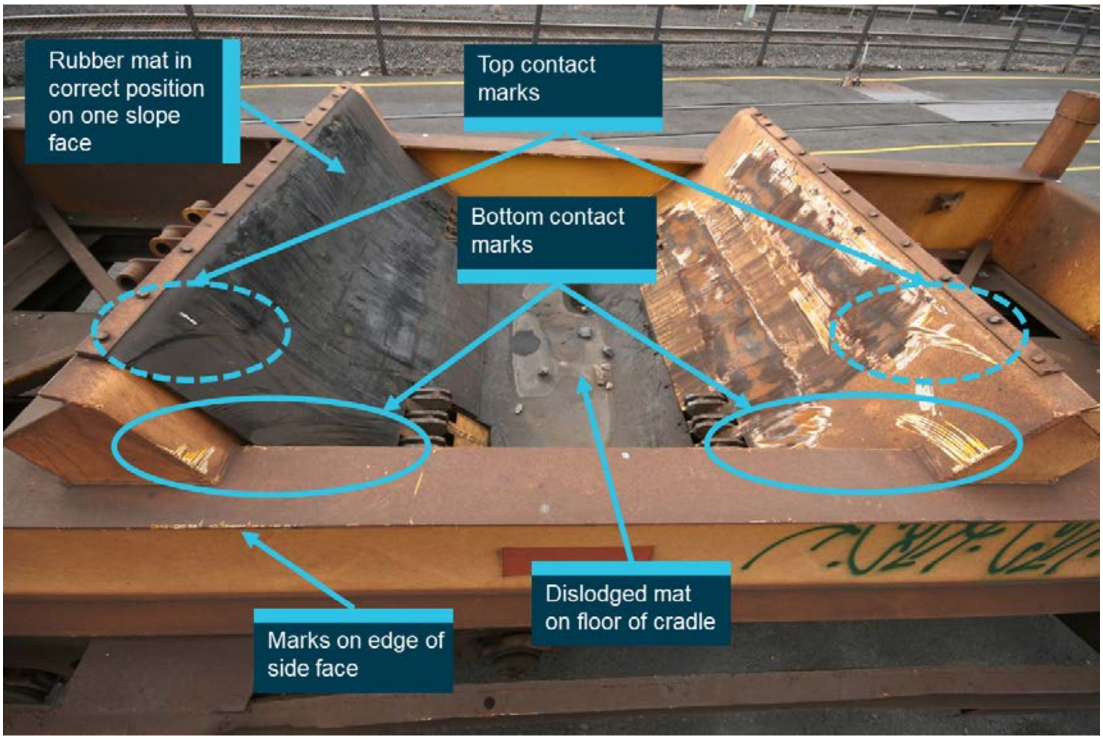
[18] Hunting: Uncontrolled and undesirable cyclic lateral and yaw displacements of the wheelsets of a vehicle, generally worsening with increasing speed. The movement of the wheelsets under the wagon imposes significant lateral accelerations and displacements on the wagon components and load.

Figure 13: Rubber load mat missing from the cradle face in June 2017

Source: Brad White

Photographs of both slope faces of the cradle (Figure 14) showed two distinct sets of witness marks consistent with a coil that had toppled to the right side of the cradle. The marks closest to the side of the cradle (bottom of the image) had a distinct layered pattern, which indicated that separate layers of the coil had contacted the cradle at the same time as it toppled. A close-up image of this detail on one face is provided in Figure 15. There were also some indications of contact on the edges of the side face of the cradle, but not on the top, indicating that the coil made minimal contact with the side as it toppled.

Figure 14: Witness marks on cradle slope faces and side



Source: ATSB

Figure 15: Detail of witness marks on cradle slope face

Source: ARTC

V/Line train 8615 data

Train 8615 was a V/Line scheduled passenger service from Southern Cross Station, Melbourne, Victoria to Albury, NSW. The train had three crew on-board; a driver and two other staff in the passenger area.

Train 8615 had two on-board data logging systems, an event recorder fitted to the locomotive and a continuous ride monitoring system fitted to one of the passenger carriages (IRV). The IRV included measurement of speed and location from GPS, and measures of track vertical geometry and passenger comfort derived from accelerometers. While the IRV did not measure locomotive parameters such as brake or throttle, the event recorder measured these items and the two data sources were cross-referenced.

Both data logging systems showed that train 8615 was traveling about 115 km/h immediately prior to decelerating. The deceleration was due to an emergency brake application occurring at about 1450 and indicated that train 8615 took about 957 m and 53 seconds to stop. During the deceleration, the IRV system recorded a significant jerk[19] response of 5.4 g/s at about 110 km/h, which was consistent with the train transitioning the area of damaged track shown in Figure 9 above. To provide context, the response was more than four times the highest passenger safety severity threshold identified in a paper by Monash University (Thompson, 2018). The paper indicated that a 'high' jerk motion, of greater than 1.2 g/s 'forces a total loss of balance, instinctive grasping for hand supports or multiple steps' for a standing passenger.

Such a large response was consistent with reports from the staff in the passenger area who were standing at the time and reported that the lateral motion of the train threw them into the benches and sides of the buffet car from which they received minor injuries. The number of passengers on-board was not provided to the ATSB and no injuries to passengers were reported.

Load restraint

Load restraint requirements

Pacific National maintained a document suite called the Freight Loading Manual (FLM), which provided instructions on the loading and carriage of rail freight on their rolling stock. The FLM included a section for the basic requirements of load restraint (FLM 01-07), general loading and lashing principles (FLM 02-01), and a specific section for loading and unitising jumbo coils (FLM 05-09).

Basic requirements of load restraint

The basic requirements of load restraint section of the FLM stated that a load restraint system must be 'designed, constructed and used in such a way to prevent [movement of the load]'. It also provided requirements for load restraint systems including:

- Avoid steel-on-steel loading due to the low friction between the two surfaces. Rubber load matting or similar should be used between the steel contact points to increase friction.
- Every type of load must be positioned and secured so that the structure of the container/wagon or the securing devices will prevent the load from becoming displaced or falling from the wagon in transit.

General loading and lashing principles

The general loading and lashing principles section included statements indicating that it was provided as guidance material only and the specific load restraint requirements were provided in the load specific FLM. However, this section did provide general requirements for load restraint, including that:

- a load restraint system must ensure:
    - the load does not dislodge from the container or wagon

[19] Jerk: a measure of the rate of change in acceleration over time (m/s^3 or g/s), which can be used as a measure of passenger comfort.

    - load movement does not occur.
- the load restraint system should be capable of providing each of the following:
    - restraining forces equal to 200 per cent of the weight of the load to prevent the load shifting forwards or backwards (e.g. during braking, accelerating or shunting)
    - restraining forces equal to 100 per cent of the weight of the load to prevent the load shifting sideways (e.g. during cornering, hunting)
    - restraining forces equal to 100 per cent of the weight of the load to prevent the load moving vertically and ensure the load always remains in contact with the container/wagon (e.g. over rough sections of rail).

Note that 'forces equal to 100 per cent of the weight of the load' are equivalent to an acceleration of 1 g (9.81 m/s^2) being applied to the coil.

Loading and unitising jumbo coils

The FLM specific to loading and unitising jumbo coils did not explicitly reference load restraint or indicate the minimum acceptable condition of wagons or coil cradles for use in transporting jumbo coils. However, it did require that:

- The width of a coil must not be less than one-third of the diameter (height), any coil that did not meet this requirement was required to be attached to the wagon with chains or straps secured through the coil eye.
- For coils with steel less than 2 mm thick, a minimum of two radial and two circumferential straps were required to unitise the coil. The radial straps were not a requirement if the steel was greater than 2 mm thick.
- Where radial straps were utilised, they were to be positioned near the tail of the coil.
- The tail of the coil must be positioned below the cradle contact point to prevent the tail from lifting if the unitising straps fail.
- The maximum amount of telescoping allowed was 150 mm if only two circumferential straps were fitted and 250 mm if two radial straps were also used.

Code of Practice for the loading of rail freight

The Rail Industry Safety Standards Board provide a Code of Practice (CoP) for the loading of rail freight. While compliance with the requirements of the CoP was not mandatory, it represented common practice for the loading of freight on rail vehicles. When discussing the loading of coils on coils wagons, the CoP stated that:

> Coil steel should be carried, wherever possible, on specially equipped vehicles fitted with cradles designed to accommodate coils of various widths and diameters. Cradles are lined with rubber or timber to minimise the risk of coil movement during transit.
>
> Coil protectors such as rubber or synthetic strips or mats should be fitted between the coil and the securing devices to prevent damage to the coil.

The CoP further included a section on restraint and retention systems, which contained requirements for the minimum forces that a restraint system should withstand. The values in the CoP were consistent with those provided by PN in the general loading and lashing principles section of the FLM, including a requirement for restraint against 1 g lateral load.

However, the CoP also recognised that alternative load cases may be more appropriate for some types of loading, and allowed that an operator may choose to use different forces where they could 'demonstrate that the alternative values are safe and fit for purpose for that particular application'. Pacific National's FLM did not indicate that alternative load cases were being used for the carriage of jumbo coils and PN did not provide any other evidence of calculation or use of alternative load cases.

Load restraint calculations

In response to ATSB questions about how load restraint was managed for jumbo coils, PN indicated that the 'cradles are designed to provide the containment (not restraint) of coils during transit'.

They also provided calculations, which indicated that the jumbo coil involved in the occurrence could topple sideways when subjected to a lateral acceleration of 0.42 g. The method adopted by PN in deriving this figure was conservative when compared to the actual condition of the occurrence coil in the cradle, as it assumed the coil pivoted on its bottom surface rather than the cradle slope faces.

A subsequent calculation by the ATSB indicated the figure was about 0.55 g when the actual contact location between the coil and cradle slope faces was used as the pivot point (with the coil unitised). In either case, the lateral acceleration required to topple the coil was below 1 g.

The ATSB also repeated the calculation for a telescoped coil approximating the condition of the coil as it was observed post-occurrence. An estimate of 235 mm telescoping over the outer 30 layers of the coil was derived by scaling Figure 10 against the known coil width (810 mm). This allowed the mass distribution of the telescoped coil to be estimated and the lateral acceleration required to topple the coil to be recalculated. The result was an acceleration of about 0.30 g required to topple the coil toward the side that had telescoped, a 46 per cent reduction in stability compared with the unitised coil.

ATSB simulations of coil–cradle contact marks

As discussed previously, distinct contact marks were observed on the cradle, left by the coil as it fell. The ATSB used multibody simulation software to evaluate the contact path of a coil that was forced to topple from the cradle. The results indicated that a unitised coil (without any telescoping) would have only had one edge in contact with the cradle slope face as it toppled. The path of the contact represented an arc up and outward toward the top edge of the cradle, which was consistent with the path of the upper inboard contact mark ('top contact marks' shown in Figure 14). When the simulation was repeated with a telescoped coil (using 235 mm estimated telescoping) a second contact path was also observed, consistent with the lower outboard marks ('bottom contact marks' shown in Figure 14).

Similar occurrences

A search of the ATSB and Office of the National Rail Safety Regulator shared occurrence database was conducted for similar events where it had been reported that a jumbo coil had fallen or moved during transit or upon arrival at the destination. The search was limited to occurrences within NSW from 20 January 2013 and Victoria from 19 May 2014[20] until the date of the occurrence on 30 March 2018. Where available, supplementary detail of the occurrences were provided by PN. The search returned seven related records, details of which included:

- Four records confirmed as jumbo coils that were found out of position in their cradle. Pacific National advised that they were unable to determine whether the load had moved in transit or had been incorrectly loaded at the departure point.
- A coil that was reported to have fallen over, however, it could not be confirmed if this was a jumbo coil. Pacific National could not provide any further detail on this event.

[20] The different start date for each state reflects the difference between when each state joined the national rail safety regulation scheme, including reporting to the national reporting database. Prior to these dates, operators reported to state based reporting schemes, which were not reviewed.

- A wagon at the Melbourne Freight Terminal, when inspected, was found to have steel straps broken on coils in both cradles. The straps were subsequently sticking out of gauge.
- A jumbo coil was found out of position in its cradle at the Melbourne Freight Terminal. In this occurrence, the jumbo coil had been carried in a demountable cradle on an NQJF wagon. The occurrence record described that the coil was found to have moved to one side of the cradle, was tilting heavily, and that the rubber matt was detached from one cradle face. Pacific National advised that they replaced the rubber mat and wheels on this wagon as corrective actions before it was returned to service.

In addition, the ATSB were made aware of two subsequent occurrences where coils had been found to have moved. In the first, on 25 August 2018, multiple jumbo coils were found to have moved to one side of their cradles upon arrival at the Melbourne Freight Terminal. PN advised that they had conducted an internal investigation into this occurrence and could not determine whether the load had moved in transit or had been incorrectly loaded at the departure point.

In the second, which occurred on 12 April 2020, a roll-by inspection conducted en-route detected a jumbo coil that had shifted to one side of its cradle. As a result, the train was stopped and the affected wagon was removed. PN advised that they had reviewed closed-circuit television footage of the wagon as it departed Port Kembla, which confirmed that the coil had been correctly loaded and had subsequently moved in transit.

Safety analysis

Introduction

While on the journey from Port Kembla, New South Wales to Melbourne, Victoria, a 16 t jumbo steel coil fell from the trailing cradle of the 35th wagon on train 6WM2 after passing the Seven Mile Creek Bridge near Winton, Victoria. After falling from the wagon, the coil impacted the ballast twice and the trailing wagons, causing damage and affecting the alignment of the east and west tracks. The coil subsequently came to rest between the two tracks at about 204.5 km. Train 6WM2 received damage to 39 of the trailing wagons to varying extents.

Soon after, a scheduled passenger service (train 8615) travelling in the opposite direction impacted the unravelled tail of the coil and associated track damage at a speed of about 110 km/h, but did not derail. As it travelled over the damaged track, the train was subjected to large lateral accelerations sufficient to throw members of staff into benches and the sides of the buffet car resulting in minor injuries. No injuries to passengers were reported. The locomotive of train 8615 received superficial damage.

The driver of train 8615 had performed a roll-by inspection of 6WM2 as it passed after the jumbo coil had fallen off. However, given the relative speed of the trains (about 160 km/h), a roll-by inspection would only be effective at detecting the presence of gross errors such as smoke or sparks and loose items moving in the wind, none of which were reported on 6WM2. Therefore, it was not unreasonable that the driver of the passenger train did not detect the absence of a single coil.

The evidence did not suggest that the handling of 6WM2, the condition of the wagon, or the track geometry contributed to the occurrence.

This analysis will examine the condition of the demountable cradle the coil was carried in, and the steel straps used to unitise the coil. Further, it will discuss the requirements for load restraint of freight when carried by rail and whether the load restraint system used for the carriage of jumbo coils had been assessed against these requirements.

Unitising straps broke

Closed-circuit television footage captured as the train passed Wangaratta Station was not of sufficient quality to determine whether the unitising straps (both radial and circumferential) were present at that time. Although it did indicate that the coil had not unwound and was not significantly leaning. There was, however, some evidence consistent with the coil having begun to telescope near to its outside diameter.

Pictures of the coil in its final position showed that all four straps were missing and that the outer layers of coiled steel were telescoped by about 235 mm. Two broken straps were found near the initial impact location and another broken strap was on the ground about 1 km prior to the occurrence location. As the broken straps were not recovered, the mechanisms of failure could not be determined.

The inspection of the cradle showed that there were two separate bands of witness marks left on the cradle from the coil as it toppled. These marks showed a distinct pattern consistent with multiple layers of the coil coming in to contact with the cradle at the same time, indicating the coil had already telescoped before it toppled. This was supported by the ATSB's simulations, which indicated that the contact path for toppling of a similarly telescoped coil was consistent with the witness marks observed on the cradle.

Therefore, while it could not be conclusively determined when the unitising straps broke, it was likely that at least some broke (either radial or circumferential) during transit, reducing the ability of the remaining straps to maintain the coil as a unit. Subsequently, the remaining straps either also broke due to the forces imposed on them or were insufficient to prevent the coil from telescoping.

ATSB calculations showed that the observed amount of telescoping would have resulted in an estimated 46 per cent reduction in the coil's stability when compared with a unitised coil. Consequently, the lateral stability of the coil was reduced increasing the risk of it falling from the cradle.

Rubber load mat missing

The demountable cradles were designed to carry jumbo coils and included the use of rubber load mat on the surfaces that were normally in contact with the steel coil (the angled 'slope faces'). Inspections of the jumbo coil cradle after the occurrence identified that there was no rubber load mat present on one side of the cradle and it was likely that this had been the case for some time. This was evident from the photographs obtained from a member of public showing the mat had been missing since at least June 2017. Further, Pacific National's (PN) maintenance records indicated that the wagon had been maintained about 1 month prior to the occurrence, but the missing mat, which had fallen to the floor of the cradle, was not noted or repaired.

The use of rubber load mat (or other soft materials such as wood) to prevent steel-on-steel contact is common practice in freight loading. The Rail Industry Safety Standards Board Code of Practice for the loading of rail freight, PN's Freight Loading Manual (FLM), and the cradle manufacturer, stated that the use of rubber load mat served the purposes of increasing friction between the surfaces and protecting the load from damage.

Therefore, the absence of the mat resulted in steel-on-steel contact between the coil and the cradle on one face. This reduced the friction between the contact surfaces making relative movement of the two surfaces more likely. In turn, this increased the likelihood of wear on the unitising straps, particularly if the radial straps were positioned within the area in contact, which was permitted by the loading rules. This increased the risk of the unitising straps breaking during the journey.

Rubber load mats not required in the Freight Loading Manual

The Rail Industry Safety Standards Board Code of Practice, representing common practice, recommended that coil cradles be lined with rubber, synthetic or timber. The PN FLM included several references to the use of rubber load mats to prevent steel-on-steel contact. However, these were contained within the general sections of the FLM that were not load-specific. The section specific to the loading of jumbo coils did not mention rubber load mat nor did it contain any guidance, or requirements for the minimum acceptable condition for use of jumbo coil cradles.

Therefore, as there was no specific requirement in the FLM to have rubber load mat fitted to jumbo coil cradles, there was no subsequent obligation for PN to check for the fitment of, and the condition of the mats during inspections and maintenance activities. This allowed the continued use of cradles without matting or with damaged matting. This diminished the effectiveness of having rubber load mats fitted as a means for restraining loads and minimising load damage.

The absence of a requirement to check was evident at the recent maintenance inspection where there were no records indicating the condition of the mat had been considered. This was a missed opportunity to replace the mat and thereby reduce the risk of the coil moving during the journey.

Radial unitising straps contacting the cradle

When using radial unitising straps on jumbo coils (for steel with thickness less than 2 mm), PN's FLM indicated that the straps were required to be positioned together 'near the tail of the coil'. The FLM also required that 'the tail end of the coil must be positioned below the cradle contact point'. Applying these requirements together allowed a coil to be loaded in an orientation where both of the radial straps were positioned within the contact zone between the coil and cradle. The ATSB's observations of the loading of jumbo coils at Port Kembla was consistent with these requirements. This increased the risk that, if one strap broke due to relative movement between the coil and cradle, the other strap would likely also fail, having been subjected to the same contact conditions.

However, if a strap was always free from contact with the cradle, this would ensure that the coil remained unitised and thereby prevent telescoping.

After the incident, BlueScope implemented a practice of applying a third strap in a position diagonally opposite to the first two. This practice ensured that, regardless of orientation of the coil when placed in the cradle, there would always be one strap free from contact. However, the practice was not a requirement in the PN FLM.

Load restraint system

PN and ATSB calculations established that the occurrence jumbo coil would topple when subjected to less than 1 g lateral acceleration and PN provided information that the cradle 'provided containment (not restraint)'. Yet both PN's FLM and the Rail Industry Safety Standards Board Code of Practice indicated that a load restraint system should restrain a load against an applied lateral acceleration of 1 g. The Code of Practice also provided operators the discretion to nominate their own values of acceleration 'where they can demonstrate that the alternative values are safe and fit for purpose for that particular application' but PN had not done so.

Technical specifications relating to the design of the jumbo coil cradles required that the cradles 'be structurally sound for acceleration of 1 g laterally'. However, the specifications did not require the cradle to provide restraint of the load (jumbo coil) when subjected to the same acceleration. Further, there was no guidance on how to maximise the load restraint provided by the cradle. PN did not require any additional restraints such as tie down straps or chains, as long as the width of a coil was greater than one-third of its diameter.

However, the occurrence cradle had been in-service transporting jumbo coils since 2012, and PN had been regularly transporting jumbo coils using other similar cradle designs since their formation in 2002. A search of the reportable occurrence database, from 20 Jan 2013 to the date of the occurrence, found only two other instances where a jumbo coil was known to have tilted (toppled). Since the occurrence, the ATSB have been notified of two further occurrences where jumbo coils have been found out of position in their cradle, however none of these resulted in a loss of freight. The low number of other occurrences suggested that the cradles, in their current state, may have provided sufficient restraint for jumbo coils for normal in-service loads when coils are prevented from telescoping.

However, PN did not include any assessment of the suitability of the load restraint provided by the cradle designs, nominate an alternative value of acceleration, or have related requirements in either of their technical specification for the cradle design or in the FLM. Therefore, although there had only been a low number of reported load shifts, PN had not demonstrated that the load restraint system of the demountable cradles carrying jumbo coils was safe and fit for purpose.

Radial unitising straps not required in the Freight Loading Manual

BlueScope Steel indicated that the jumbo coil involved in the occurrence was fitted with two radial and two circumferential straps, and that this was their standard practice regardless of steel thickness. However, the jumbo coil section of PN's FLM did not require the use of radial unitising straps when the steel thickness was greater than 2 mm. This implied that there was no significant risk of coil telescoping occurring when the steel was greater than this thickness.

It was likely that the coil, comprised of 3.2 mm thick steel had telescoped after the unitising straps broke. Therefore, this suggested that the PN FLM limit of 2 mm was not effective at controlling the risk of coil telescoping. While this did not contribute to the occurrence, as the coil was fitted with straps, a latent risk existed, as there was no directive to prevent similar jumbo coils from being transported without radial straps.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

Safety issues are highlighted in bold to emphasise their importance. A safety issue is a safety factor that (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.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the loss freight involving train 6WM2 and subsequent track obstruction, near Winton, Victoria, on 30 March 2018. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- A jumbo coil on the 35th wagon of the train became unstable and fell from its cradle in transit and came to rest between the east and west tracks. A passenger train travelling the opposite direction struck the coil and associated damaged track.
- It was likely that the steel straps used to unitise the jumbo coil broke, allowing the centre of the coil to telescope, which adversely affected its stability.
- A rubber load mat had become detached from one side of the jumbo coil carrying cradle. The resulting metal-on-metal contact between the cradle and coil both increased the likelihood of coil movement, and the risk of the unitising straps breaking.
- **Pacific National's Freight Loading Manual, specific to the loading and unitising of jumbo coils, did not require the use of rubber load mat on cradles. Consequently, there was no requirement to consider the condition of load mat during inspection and maintenance. This allowed the continued use of cradles without load mat, which decreased their effectiveness at restraining loads. [Safety issue]**
- **Pacific National's Freight Loading Manual did not require a combination of radial unitising straps on jumbo coils positioned such that a strap was always free from contact with the cradle. The provision of straps in this configuration would have reduced the risk of the coil telescoping in the event of strap breakage due to contact with the cradle. [Safety issue]**

Other factors that increased risk

- **Pacific National did not demonstrate that the load restraint system provided by demountable cradles carrying jumbo coils was safe and fit for purpose. [Safety issue]**
- **Pacific National's Freight Loading Manual did not require the use of radial unitising straps to prevent telescoping on jumbo coils where the thickness of the steel was greater than 2 mm. [Safety issue]**

Safety issues and actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the rail industry, the ATSB may issue a formal safety recommendation or safety advisory notice as part of the final report.

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.

The initial public version of these safety issues and actions are provided separately on the ATSB website, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website as further information about safety action comes to hand.

Rubber load mats not required in the Freight Loading Manual

Safety issue description

Pacific National's Freight Loading Manual, specific to the loading and unitising of jumbo coils, did not require the use of rubber load mat on cradles. Consequently, there was no requirement to consider the condition of load mat during inspection and maintenance. This allowed the continued use of cradles without load mat, which decreased their effectiveness at restraining loads.

Issue number:	RO-2018-008-SI-01
Issue owner:	Pacific National Pty Ltd
Transport function:	Rail: Freight
Current issue status:	Closed – Adequately addressed
Issue status justification:	The routine inspection of rubber load mats fitted to cradles carrying jumbo coils will allow Pacific National to maintain the condition of the mats sufficient to reduce the risk of the load restraint capabilities being compromised.

Proactive safety action taken by Pacific National

Action number:	RO-2018-008-NSA-039
Action organisation:	Pacific National Pty Ltd
Action status:	Closed

On 10 November 2020, Pacific National advised that, in response to this occurrence, they:

> have been completing jumbo coil cradle inspections for some time and have a robust program in place (via our Maximo system) to inspect and replace missing or defective rubber matting as part of the routine steel wagon fleet programmed maintenance schedule.

In addition, they have drafted a revision to their Wagon Maintenance Manual (WMM) to include a part specific to inspection of jumbo coil cradles. The WMM part is specific to demountable type cradles and includes a requirement to 'consider the condition of load mat during inspection and maintenance' and repair or replace as required. Pacific National indicated 'it is anticipated that the WMM document will be finalised and approved for formal inclusion into the Pacific National safety management system by 31 December 2020'.

Radial unitising straps contacting the cradle

Safety issue description

Pacific National's Freight Loading Manual did not require a combination of radial unitising straps on jumbo coils positioned such that a strap was always free from contact with the cradle. The provision of straps in this configuration would have reduced the risk of the coil telescoping in the event of strap breakage due to contact with the cradle.

Issue number:	RO-2018-008-SI-02
Issue owner:	Pacific National Pty Ltd
Transport function:	Rail: Freight
Current issue status:	Open - Safety action pending

Response from Pacific National

Pacific National issued a safety notice to drivers on 8 June 2018. This included a requirement that all coils, regardless of steel thickness, shall be fitted with a minimum of three radial unitising straps.

On 18 September 2020, Pacific National also advised that:

> Pacific National Engineering Team have conducted joint risk assessment with BlueScope Steel Engineering, regarding the unitisation of jumbo coil for transportation by rail. During this collaborative review process, BlueScope Steel reviewed the maintenance strategies and confirmed that the maintenance processes for the automatic unitisation strapping machines are being completed and operating to supplier's specifications.
>
> Pacific National continue to work with BlueScope Steel to ensure the strapping integrity applied to jumbo coils are maintained and reflect the requirements in FLM 05-09. The FLM for Hot Rolled Steel Coil has been updated (FLM 05-09 version 16).

The update to the Freight Loading Manual included a requirement for all coils to have a minimum of two radial and two circumferential unitising straps applied. The manual further required that coils that pass through an additional processing step, called the skin-pass mill, must have three radial straps fitted.

ATSB comment

The ATSB acknowledges that Pacific National has taken action to require two or three radial unitising straps on all jumbo coils. However, Pacific National should also consider the positioning of the radial straps to ensure that they do not come into contact with the cradle, which increases the risk of breakage.

The ATSB is issuing the following recommendation.

Safety recommendation to Pacific National

The ATSB makes a formal safety recommendation, either during or at the end of an investigation, based on the level of risk associated with a safety issue and the extent of corrective action already undertaken. Rather than being prescriptive about the form of corrective action to be taken, the recommendation focuses on the safety issue of concern. It is a matter for the responsible organisation to assess the costs and benefits of any particular method of addressing a safety issue.

Recommendation number:	RO-2018-008-SR-040
Responsible organisation:	Pacific National Pty Ltd
Recommendation release date:	10 December 2020
Recommendation status:	Released

The ATSB recommends that Pacific National address the risk presented by continuing to allow jumbo coils to be loaded in an orientation where all the radial straps are positioned within the contact zone between the coil and cradle.

Load restraint system

Safety issue description

Pacific National did not demonstrate that the load restraint system provided by demountable cradles carrying jumbo coils was safe and fit for purpose.

Issue number:	RO-2018-008-SI-03
Issue owner:	Pacific National Pty Ltd
Transport function:	Rail: Freight
Current issue status:	Open - Safety action pending

Proactive safety action taken by Pacific National

Action number:	RO-2018-008-NSA-041
Action organisation:	Pacific National Pty Ltd
Action status:	Closed

On 18 September 2020, Pacific National advised that they have adopted additional containment strategies and continue to look for opportunities to mitigate the risk of a load shift event, for the transporting of steel jumbo coils. Tasks undertaken include:

- review of the current jumbo coil cradle design
- design of a physical barrier to prevent coils leaving the cradle in the event of a strapping failure and telescoping event
- implementation of a provisional load form that requires all jumbo coils with a width to outer diameter ratio of greater than 2.39 to be carried in modified fixed cradles that have the physical barrier fitted
- a reduction in the permissible telescoping limits for rail transport to less than 75 mm for all coils.

ATSB comment

The ATSB acknowledges the proactive safety action taken by Pacific National. However, it is noted that the focus is on the containment (mitigating the consequence of movement) of jumbo coils rather than restraint (preventing movement from occurring). Pacific National should consider the requirements for the restraint or containment systems and how they are met by the demountable cradle design.

The ATSB is issuing the following recommendation.

Safety recommendation to Pacific National

The ATSB makes a formal safety recommendation, either during or at the end of an investigation, based on the level of risk associated with a safety issue and the extent of corrective action already undertaken. Rather than being prescriptive about the form of corrective action to be taken, the recommendation focuses on the safety issue of concern. It is a matter for the responsible organisation to assess the costs and benefits of any particular method of addressing a safety issue.

Recommendation number:	RO-2018-008-SR-042
Responsible organisation:	Pacific National Pty Ltd
Recommendation release date:	10 December 2020
Recommendation status:	Released

The ATSB recommends that Pacific National review the load restraint system provided by the demountable cradle design to demonstrate that they sufficiently restrain jumbo coils against lateral accelerations and prevent coils from moving and falling during transit.

Radial unitising straps not required in the Freight Loading Manual

Safety issue description

Pacific National's Freight Loading Manual did not require the use of radial unitising straps to prevent telescoping on jumbo coils where the thickness of the steel was greater than 2 mm.

Issue number:	RO-2018-008-SI-04
Issue owner:	Pacific National Pty Ltd
Transport function:	Rail: Freight
Current issue status:	Closed - Adequately addressed
Issue status justification:	The ATSB is satisfied that the use of a minimum of two radial unitising straps on jumbo coils will reduce the risk of telescoping during transit.

Proactive safety action taken by Pacific National

Action number:	RO-2018-008-NSA-043
Action organisation:	Pacific National Pty Ltd
Action status:	Closed

Pacific National issued a safety notice to drivers on 8 June 2018. This included a requirement that all coils, regardless of steel thickness, shall be fitted with a minimum of three radial unitising straps.

On 18 September 2020, Pacific National also advised that they have updated the Freight Loading Manual to include a requirement for all jumbo coils to have a minimum of two radial and two circumferential unitising straps applied. The manual further requires that coils that pass through an additional processing step, called the skin-pass mill, must have three radial straps fitted.

Safety action not associated with an identified safety issue

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

Additional safety action by BlueScope Steel

From 12 April 2018, BlueScope Steel introduced a requirement for a third radial strap to be applied to any jumbo coils to be transported by rail wagon to Western Port, Victoria. On 11 May 2018, they extended this requirement to all jumbo coils transported by rail wagon.

In addition, BlueScope Steel indicated that they have proposed to:

> Undertake a review of the current load restraint system, working with the carrier to refine a representative load case for jumbo steel coil. This review will cover the physical aspects of the coils

being transported, combined with the carrier transport cradle(s) to determine the total load restraint system.

Additional safety action by Pacific National

Pacific National issued a safety notice to drivers on 8 June 2018 requiring jumbo coils be unitised with a minimum of three radial and two circumferential straps, the notice also indicated that they:

- Had conducted ride performance tests between Port Kembla and Melbourne, which identified that, when passing through some locations steel trains were experiencing vertical accelerations above 1 g. Consequently, drivers were instructed to implement speed restrictions in these locations (including a 70 km/h restriction that included the occurrence location) until further notice.
- Reduced the maximum allowed aspect ratio of jumbo coils (diameter/width) from 3:1 to 2.39:1.
- Reduced the maximum allowed telescoping of jumbo coils to 75 mm, and only when two circumferential and three radial straps were fitted.

Further, Pacific National have undertaken the following safety actions relating to this type of occurrence:

- Established the Freight Load Irregularity Prevention Network Group with a defined charter to reduce the number of load irregularity events for all freight product types including the review and analysis of Pacific National load irregularity events.
- Reviewed and updated the load incident management procedure to ensure all load irregularity events are accurately identified, captured and investigated by Pacific National.
- Implemented a third party freight loading assurance auditing program of customer sites to monitor Freight Loading Manual compliance and performance. This has included joint audits by Pacific National and BlueScope Steel in relation to jumbo coil transport by rail.
- Implemented a routine testing program to monitor in-train forces associated with the transportation of steel products. This included constantly reviewing data to identify routes that contribute to elevated in-train forces and monitor self-imposed speed restrictions to minimise track related factors that could reduce the effectiveness of current containment measures for steel product.
- Installation of closed-circuit television at key locations to assist in the identification of Freight Loading Manual non-compliant loads prior to departure (including Morandoo, New South Wales, Port Kembla and the Melbourne Freight Terminal). closed-circuit television has also been installed at Junee, New South Wales, to provide additional ability to monitor potential load shift issues in transit.

General details

Occurrence details

Date and time:	30 March 2018	
Occurrence category:	Incident	
Primary occurrence type:	Collision with obstruction – Railway-related object	
Location:	near Winton, Victoria	
	Latitude: 36° 30’ 24.13” S	Longitude: 146° 04’ 33.17” E

Train 1 details

Train operator:	Pacific National	
Train number:	6WM2	
Type of operation:	Intermodal Freight (Steel)	
Persons on board:	Crew – 2	
Injuries:	Crew – 0	Passengers – 0
Damage:	Minor	

Train 2 details

Train operator:	V/Line	
Registration:	8615	
Type of operation:	Passenger – regional	
Persons on board:	Crew – 3	Passengers – Unknown
Injuries:	Crew – 2	Passengers – 0
Damage:	None	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Australian Rail Track Corporation
- Pacific National
- V/Line
- Rail Industry Safety Standards Board
- BlueScope Steel.

References

Australian Rail Track Corporation 2018, *Route Access Standard DIRN Section Pages D53 - Albury to Somerton,* p4, version 1.8.

Rail Industry Safety and Standards Board 2017, *Code of practice – Loading of rail freight,* version 1.0.

Thompson, C., et-al 2018, *Continuous measurement of passenger ride comfort and track condition on the V/Line network*, CORE 2018, Railway Technical Society of Australia.

Submissions

Under 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. That section 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 following directly involved parties:

- Pacific National
- Australian Rail Track Corporation
- V/Line
- BlueScope Steel
- the Rail Industry Safety Standards Board
- the engineering contractor
- train crew of 6WM2
- the Office of the National Rail Safety Regulator.

Submissions were received from:

- Pacific National
- BlueScope Steel
- the Office of the National Rail Safety Regulator.

The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- 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, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

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

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining 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. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.