Australian Government
Australian Transport Safety Bureau

Rolling stock irregularity on train 3YN2

Kiacatoo, New South Wales, on 6 January 2021

ATSB Transport Safety Report
Rail Occurrence Investigation (Short)
RO-2021-001
Final – 28 June 2021

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Addendum

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Safety summary

What happened

On 6 January 2021, loaded Pacific National freight train 3YN2 was operating between Broken Hill and Newcastle, New South Wales.

Just before 0914, a contractor working near the rail line, noticed a wagon on train 3YN2 was dragging on the rail. This was reported to representatives from the rail infrastructure manager and the crew of 3YN2 were directed to stop their train.

The train stopped between Euabalong West and Kiacatoo with a crack found through the underframe of the 32nd wagon. The air tank was resting on the rail and it was later found that three level crossings had been struck by the wagon. There was superficial damage at the level crossings and no reported injuries.

What the ATSB found

Train 3YN2 departed Broken Hill with an existing crack in the underframe of wagon NDHX14836G. This crack progressed during the journey with the underframe of the wagon striking three level crossings.

The underframe of NDHX14836G likely fractured due to a fatigue crack at a weld on the lower edge of the sill. This defect was likely detectable for a period of time prior to the occurrence.

The train had undergone the required maintenance inspections however these were not sufficient to identify the cracking at a location of known risk prior to the structural failure.

What has been done as a result

Following the occurrence Pacific National released a rolling stock safety notice detailing the failure and requiring an inspection of all affected wagons within the class wagon.

Pacific National advised the following actions have been planned to prevent recurrence:

- Develop a lifecycle asset management strategy for affected class of wagons (NDHX/ICX) with a butt weld.
- Complete a risk assessment to assess the limitations of NDHX wagons and requirements for ongoing use.
- Review the wagon maintenance manual associated with the inspection of the wagon underframe to include details for ICX class wagons.
- Review and adjust the current non-destructive strategy applied across Pacific National's fleet of wagons.

Safety message

The incident highlights the importance of managing ageing assets to ensure continued safe operation through the lifecycle of the asset. Rolling stock operators should ensure that their maintenance and inspection regimes effectively monitor and detect conditions that might escalate and contribute to accidents.

The investigation

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope investigation was conducted in order to produce a short investigation report, and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

The occurrence

On 5 January 2021, two Pacific National (PN) train drivers (crew 1 and crew 2) were assigned to shunt and attach 17 wagons from within the CBH Resources - Rasp Mine at Broken Hill to the rear of freight train 3YN2.

During the shunting movement, a roll-by inspection[1] was performed by crew 1. Between 1905[2] and 2020, crew 1 completed a general examination (GX) of the 17 wagons. The inspection was completed without incident and a brake certificate was issued.

On 6 January 2021, train 3YN2 departed Broken Hill bound for Newcastle, New South Wales. The train consisted of three locomotives and 44 wagons with a total length of 977 m. The train departed Broken Hill at 0149 and a roll-by inspection was performed from both sides by crew 1 and crew 2 without incident.

Just before 0914, a contractor working near the rail line noticed a broken wagon on 3YN2 was dragging on the rail. This was reported to a track worker located at Parkes, who passed the message on to the network controller at Junee. At 0915, the network controller contacted the crew of train 3YN2 and directed them to stop and inspect their train.

The crew stopped to inspect the train between Euabalong West and Kiacatoo. The crew identified that the wagon frame on the 32nd wagon (NDHX14836G) had failed and the air tank was resting on the rail near 583.900 km[3] (Figure 1 and Figure 2). The wagon was loaded with two containers carrying zinc (Zn) concentrate at the time which remained secured to the wagon.

Inspection post incident identified superficial scrape marks on the rail and at three level crossings between 595.518 km and 583.900 km. There was no reported damage to the sleepers or rail fasteners from the failed wagon. There were no reported injuries.

Figure 1: Path of 3YN2

Source: Geoscience Australia, modified and annotated by OTSI

[1] Roll-by inspections are a visual inspection of moving rail traffic to identify equipment, loading security or other defects or failure.

[2] Times shown in 24-hour time as Australian Eastern Daylight Time (AEDT).

[3] The kilometre distance is measured from Platform 1, Central Station, Sydney, New South Wales.

Figure 2: Rolling stock irregularity

Wagon NDHX14836G shown with centre of the wagon sagging under the load of the 20 ft containers. Inset image shows the fracture in the underframe and an air tank resting on the rail.
Source: Pacific National, modified and annotated by OTSI

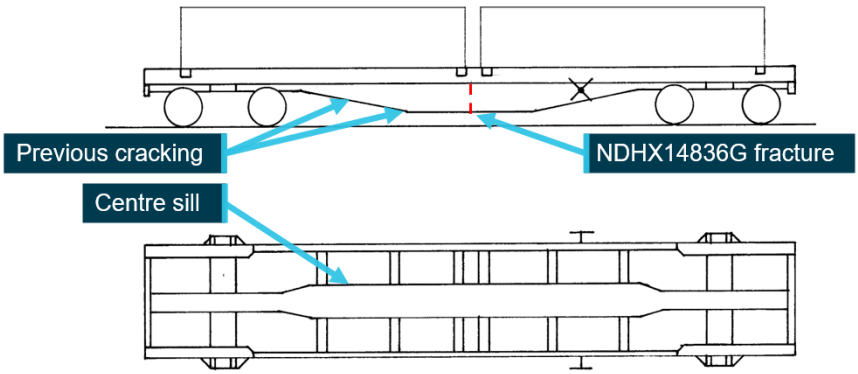
Context

Wagon

Wagon NDHX14836G was designated as a sleeper carrying wagon with a tare mass of 20 t and a maximum capacity of 60 t. Previously the wagon was designated NQHX (container flat wagon)[4] before it was converted to a sleeper carrying wagon in 2009. In 2010 this modification was reverted and the wagon returned to original use, however, this was not communicated effectively to the various rail infrastructure managers.

The wagon was manufactured as an ICX class wagon with the centre sill forming the load bearing structure (Figure 3). This class of wagon was manufactured from approximately 1968 onwards and PN had a total of 136 ICX class wagons in operation at the time of the incident (Table 1).

Figure 3: ICX class wagon underframe and cracking locations



A side and top down view of the wagon and underframe structure. The centre sill runs the length of the wagon and supports the load.
Source: Pacific National, modified and annotated by OTSI

Table 1: ICX class

Wagon code	Wagon Type	Quantity	Comment
NDHX	Sleeper carrying wagon	36	Previously NQHX container wagon
NQHX	Container	76	Previously NQIX container wagon
NQIX	Container	24	

[4] A flat wagon specially equipped with approved securing devices for the transport of freight containers. The wagon may have a full width deck, with or without apertures, or be of skeletal construction.

Historically, cracking had been detected on some ICX class wagons at butt welds along the centre sill lower flange at a change in material thickness (Figure 3). Repair procedures had been developed with doubler plates[5] fitted if cracking was detected.[6] The location of the previous cracking was along the centre sill but not at the location of the fracture on NDHX14836G.

Maintenance

Wagon NDHX14386G was under a unit train maintenance (UTM) regime requiring the wagon to be inspected every 56 days (maximum 7-day tolerance) in accordance with the Wagon Maintenance Manual (WMM 01-01 and WMM 01-18).

Additionally, the wagon required inspection at intervals of 150,000, 450,000 and 900,000 km. Both the 56 day on train inspection and kilometre-based inspection referred to the same work instruction for the inspection of the underframe (Underframes, Body Work and Load Supports WMM 04-02).

The most recent maintenance records are shown in Table 2. The wagon had operated for 51 days since the last 56 day on train inspection and was not overdue at the time of the occurrence.

Table 2: Maintenance history

Date	Inspection type	Comments
07/07/2020	56 day on train maintenance	Completed 70 days between previous inspection
24/09/2020	56 day on train maintenance	Completed 79 days between previous inspection
16/11/2020	56 day on train maintenance	Completed 53 days between previous inspection

Train examination

Prior to departure the 17 wagons underwent a GX as required by the Train Inspection Manual (TIM 01-03). The examination was limited to the major components of the wagon but included checking the wagon body for structural damage. The GX was performed by crew 1 who held the required qualifications and had three years' experience. There were no defects noted with wagon NDHX14836G.

Crew 2 who assisted with the roll-by inspection, held the appropriate qualifications and had approximately eight years' experience.

Loading

The containers were loaded on to the 17 wagons at CBH Resources - Rasp Mine. The train consist and records for container mass indicated all wagons were within the permitted loading limits (60 t).

Loading records indicated wagon NDHX14836G was loaded with two 20 ft concentrate containers with a total mass of 59.54 t. Post occurrence the mass of the containers were weighed at 59.9 t,[7] closely matching the loading records.

Similar occurrences

ATSB investigation (RO-2018-009)

On 21 April 2018, Pacific National intermodal freight train 6MP4 derailed near Glenalta, South Australia. It was found that there was a pre-existing structural crack on platform 2 of wagon RRYY01X that had not been identified during multiple train examinations and maintenance inspections. A combination of the pre-existing structural crack, in-train forces (compression and

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5 A doubler plate is a section of steel that is welded to a larger section as part of a repair or to provide additional strength.

6 Between 1985 and 2004 two work instructions were released for the inspection and repair of centre sill fractures.

7 Containers were checked using a scale on the forklift utilised for unloading and unloading the containers post occurrence.

tension) and tight curves on a descending grade likely resulted in the derailment. A contributing factor and safety issue of this occurrence was:

> Pacific National's inspection processes did not identify key structural points for inspection on RRYY class wagons, including the susceptibility to cracking in the junction between container loading outriggers, pull rod boxed opening, and the bottom centre sill sections. This reduced the likelihood of cracks being detected. (Safety issue)

This wagon was of a different design and class to NDHX14836G, although, both were operated and maintained by Pacific National. The same work instruction was also utilised for the inspection of the underframes of RRYY and NDHX (ICX) class wagons (WMM 04-02). This inspection procedure was revised as part of the safety action to address the safety issue.

OTSI investigation (04588)

On 5 December 2012, crew performing a roll-by inspection of a SQYD wagon near Gulgong, New South Wales, detected a wagon sagging in the middle and almost dragging on the ground. The wagon struck and damaged the road surface on several level crossings before it was detected.

It was found that the underframe of wagon SQYD0060G failed at a transverse butt weld at the mid-point of the centre sill. The failure was the result of poor weld design, welding practices/techniques and inadequate non-destructive testing at the time of the weld.

The SQYD wagon was similar in design to the ICX class wagon but the two wagon classes were at different ends of the asset lifecycle. The SQYD wagons entered service in the 12 months prior to the occurrence while ICX class wagons were approaching end of life.

Safety analysis

Train 3YN2 travelled approximately 530 km before wagon NDHX14836G struck a level crossing at 595.518 km. The wagon struck two more level crossings before the train was stopped at 583.900 km. The actions of the contractor reporting the defect prevented the escalation of this occurrence.

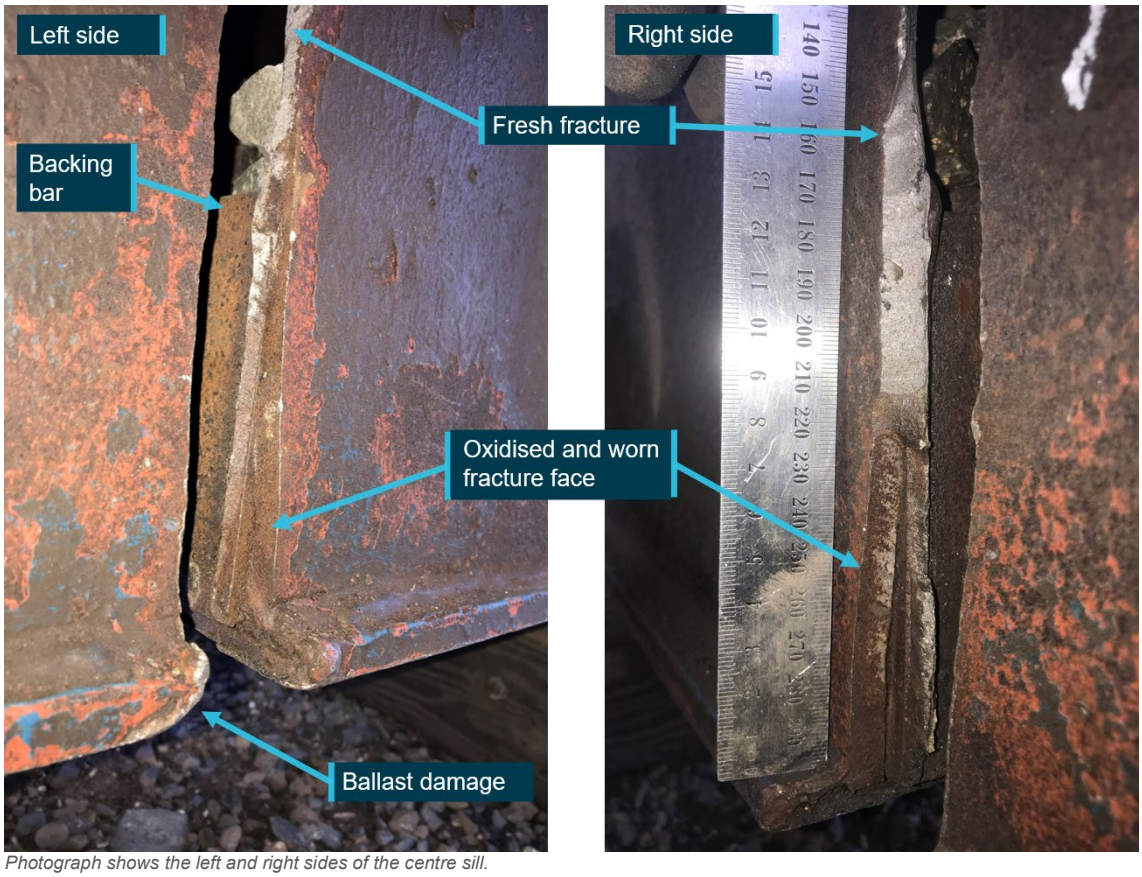
The wagon was found with a fracture extending across the bottom flange (underside) and up both vertical plates (web) at the mid-point of the centre sill. The lower portion of the fracture face was damaged by ballast strikes, particularly on the trailing edge (in the direction of travel) of the fracture.

Assessment of the fracture indicated that the fracture was at the mid-point of the centre sill transverse weld. A backing bar[8] was present along the length of the weld although there was no obvious weld penetration. Oxidation was visible on the lower section of both vertical plates and the fracture face was worn (Figure 4). The presence of both oxidation and wear is consistent with fatigue cracking however there were no beach marks[9] observed in this region. The remaining fracture face was free from oxidation and likely progressed quickly.

[8] A backing bar is a piece of material positioned at the root of a weld to support molten weld material allowing for complete weld penetration.

[9] Beach mark refers to markings on the fracture surface associated with fatigue cracking. Typically, the progression of a fatigue crack will leave concentric rings on the fracture surface that radiate from the point of origin.

Figure 4: Wagon NDHX14836G fracture



Photograph shows the left and right sides of the centre sill.
Source: Pacific National and OTSI, annotations by OTSI

Train 3YN2 underwent the required maintenance inspection prior to departing Broken Hill on 6 January 2021. These inspections did not detect the existing fracture on the frame of NDHX14836G.

The GX inspection scope was limited although the partial fracture would likely have been visible during close inspection of the centre sill vertical plates (web). The investigation was unable to determine when the frame was partially fractured, the oxidation indicates a fracture was almost certainly present during numerous GX and roll-by inspections.

Maintenance records (Table 2) showed two of the three most recent 56 day on inspections (UTM) were completed in exceedance of the 7-day tolerance. The UTM maintenance plan was associated with the rake[10] of wagons rather than individual wagon. If a wagon was moved from the rake it could have operated in exceedance of the maintenance plan, increasing the likelihood of a rolling stock irregularity progressing without detection.

Wagon maintenance manual WMM-04-02 provided guidance for the inspection of various wagon classes although did not specifically detail inspections of NQHX (NDHX) wagons. The guidance for inspecting the underframe was general and did not highlight the location of cracking as found on NDHX14836G. Additionally, there was no requirement for more detailed inspections of ageing assets.

The design and construction of the ICX class wagons varied with some wagons having a centre sill transverse weld at the mid-point on the lower edge of the sill. Design drawing provided as part of the investigation did not indicate the presence of the weld or provide details for the original weld

[10] Rake refers to vehicles, usually not formed as a train, moved as a unit during shunting and marshalling. In this case the 17 wagons formed the rake for the unit train maintenance purposes.

specification. A weld at this location of high stress increases the risk of fatigue cracking and presented different risk profiles within the same wagon class.

Non-destructive testing consisting of magnetic particle inspection (MPI) was only required if a crack was visually detected. Without more advanced non-destructive testing, a crack would need to propagate to be visibly detectable on the surface before it may be addressed.

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.

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 rolling stock irregularity involving freight train 3YN2.

Contributing factors

- 3YN2 departed Broken Hill with an undetected crack on wagon NHDX14836G; the crack progressed and the wagon sagged under the load striking three level crossings.
- The centre sill of wagon NDHX14386G likely fractured due to fatigue cracking initiating at a transverse weld on the lower edge of the sill.
- Pacific National's maintenance and inspection regime was not sufficient to identify cracking at a location of known risk before the structural failure of wagon NDHX14836G.

Safety actions

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.

Pacific National

Maintenance and inspection

On the day of the occurrence, Pacific National issued a Rolling Stock Notice (RSN E 21-002) requiring an underframe crack inspection on NDHX, NQHX and NQIX wagons. The visual inspection required:

- checking if there was a butt weld at the midpoint of centre sill
- checking for cracks on the underside of the centre sill at the location of the butt weld
- checking the vertical web plate for the presence of crack propagation
- confirming the presence of doubler plates and any cracking associated with the doubler plates.

A total of 134 wagons were inspected as of 21 January 2021 with no cracks identified at the centre sill. The last wagon was inspected on 27 May 2021 with no cracks identified. Wagon NDHX14836G was to be scrapped, reducing Pacific National's number of ICX class wagons to a total of 135.

Pacific National advised that they have completed a risk assessment to determine the NDHX wagon limitations and ongoing monitoring program requirements and plans for ongoing use. The following actions are also planned in relation to this occurrence:

- Broken Hill maintenance depot to conduct a risk assessment associated with the inspection of underframe of ICX class wagons during time based and kilometre based inspections.
- Review facilities available at Broken Hill to provide maintenance personnel easier access to complete underframe inspections.
- Develop a lifecycle management strategy for NDHX/ICX wagon classes with a butt welds.
- Develop an asset management strategy for the identification and implementation of the appropriate wagon lifecycle strategies.
- Review wagon maintenance manual WMM 04-02 to include details for ICX class wagons.
- Review and adjust the current non-destructive strategy applied across Pacific National's fleet of wagons.

Compliance with maintenance standards

In relation to the management of trains under unit train maintenance (UTM) strategies, a Rolling Stock Notice (RSN E 21-003) was issued on 18 January 2021. The notice advised of the transition from unit train maintenance (UTM) at the rake level (group of wagons) to the individual wagon level. This notice was distributed to asset management and maintenance personnel and detailed actions to be taken. This change was to ensure that wagons receive the correct inspection when required. Pacific National's maintenance management system was updated to reflect these changes and wagons with overdue maintenance activities were identified and prioritised for inspection.

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Australian Rail Track Corporation
- Pacific National.

References

Pacific National (2015), *Train Inspection Manual, General Train Inspection Procedure, TIM 01-03_05*, 14 December 2015

Pacific National (2017), *Wagon Maintenance Manual, Maintenance of Freight Wagons, WMM 01-01_05,* 26 June 2017

Pacific National (2020), *Wagon Maintenance Manual, UTM/ Block/ OK Spare/PM Inspection*, *WMM 01-18_07*, 21 October 2020

Pacific National (2020), *Wagon Maintenance Manual, Underframes, Body work and Load Supports*, *WMM 04-02_05*, 1 July 2020

Rail Industry Safety and Standards Board (2021), *Glossary of Terms.* Accessed at: www.rissb.com.au/glossary/

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:

- Australian Rail Track Corporation
- Office of the National Rail Safety Regulator
- Pacific National

- Transport for NSW.

Submissions were received from:

- Australian Rail Track Corporation
- Office of the National Rail Safety Regulator
- Pacific National.

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

General details

Occurrence details

Date and time:	6 January 2021 – 0915 AEDT	
Occurrence category:	Incident	
Primary occurrence type:	Rolling stock irregularity	
Location:	Kiacatoo, New South Wales	
	Latitude: 33º 1.511' S	Longitude: 146º 45.701' E

Train details

Track operator:	Australian Rail Track Corporation	
Train operator:	Pacific National	
Train number:	3YN2	
Type of operation:	Freight train	
Consist:	Three locomotives and 44 wagons, 4670 t and 977 m long.	
Departure:	Broken Hill, New South Wales	
Destination:	Newcastle, New South Wales	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial damage to wagon NDHX14836G, superficial damage to three level crossings.	