Report 07-115, express freight Train 533, derailment, 103.848 kilometres, near Tokirima, Stratford – Okahukura Line, 7 November 2007

Report 07-115

express freight Train 533

derailment

103.848 kilometres, near Tokirima
Stratford – Okahukura Line

7 November 2007

Abstract

On Wednesday 7 November 2007, at about 0140, the trailing bogie of wagon UK10696, on Auckland to New Plymouth express freight Train 533, derailed at 103.848 kilometres (km) on the Stratford – Okahukura Line. The derailed wagon was dragged a further 2.75 km until the leading bogie also derailed. The wagon tipped on its side, derailing the wagon immediately in front and behind it.

There were no injuries.

The cause of the derailment was not conclusively established, but the circumstances point to dynamic interaction between the track and the wagon, with the condition of both being at the upper limits of their working tolerances being a factor.

Safety issues identified included:

- recurrent derailments resulting from a combination of track geometry and wagon bogie condition at or near current maintenance limits
- the quality and consistency of documented standards, rules and codes relating to the handling of derailed wagons conveying liquid petroleum gas tanks
- the emergency response to the derailment.

Three safety recommendations have been made to the Chief Executive of the New Zealand Transport Agency to deal with these safety issues.

Derailment site

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Abbreviations

ISO	International Organization for Standardization
km	kilometre(s)
km/h	kilometre(s) per hour
LPG	liquefied petroleum gas
m	metre(s)
mm	millimetre(s)
NIMT	North Island Main Trunk
ROCOCD	Rate of change of cant deficiency
SOL	Stratford – Okahukura Line
Toll Rail	Toll NZ Consolidated Limited
UTC	coordinated universal time

Data Summary

Train type and number:	express freight Train 533	
Date and time:	7 November 2007 at about 0140[1]	
Location:	103.848 kilometres, near Tokirima Stratford – Okahukura Line	
Persons on board:	crew:	2
Injuries:	crew:	nil
Damage:	extensive damage to track and wagons	
Operator:	Toll NZ Consolidated Limited (Toll Rail)	
Investigator-in-charge	D L Bevin	

[1] Times in this report are New Zealand Daylight Times (UTC+13) and are expressed in the 24-hour mode.

1 Factual Information

1.1 Narrative

1.1.1 On Wednesday 7 November 2007, Train 533 was a westbound express freight train travelling from Auckland to New Plymouth (via Okahukura). When departing from Okahukura, Train 533 consisted of a DCP class locomotive and a DFB class locomotive in multiple and 25 wagons for a total gross weight of 546 tonnes and a total length of 432 metres (m). Of the 25 wagons, 16 were loaded and 9 were empty. The freight included 2.9 m high containers. The train was driven by a locomotive engineer who was assisted by a rail operator.

1.1.2 The crew arrived at Taumarunui at 2238 on Tuesday 6 November 2007 on Train 524 from New Plymouth. They took over the running of Train 533 at Taumarunui for their return to New Plymouth. Train 533 departed from Taumarunui at 2354.

1.1.3 At about 0120, the locomotive engineer made a brake application as Train 533 was exiting Tunnel 17 to slow the train to the restricted speed of 25 kilometres per hour (km/h) through Tunnel 16 and Tunnel 15, about 500 m ahead. After exiting Tunnel 15 he made a further brake application to hold the train on the descending grade approaching Tokirima. He estimated the speed of the train was about 45 km/h when it reached the road over-bridge at the bottom of the grade, at which point he released the brakes.

1.1.4 The locomotive engineer saw that the speed of the train had reduced more quickly than usual and he thought that he had perhaps extended the brake application for longer than he normally did, so he applied power to keep the train stretched until the speed stabilised. However, the train continued to slow, coming to a gradual stop, at which point he checked the head end unit[2] for the train end monitor and saw that there was no reading for air pressure in the brake pipe on the last wagon of the train.

1.1.5 Both crew members walked towards the rear of the train, expecting to find either a burst hose or that the train had parted, but instead they found the last 3 wagons on the train had derailed. The locomotive engineer returned to the cab and notified train control of the derailment.

1.2 Route information

1.2.1 The Stratford – Okahukura Line (SOL) branched off the North Island Main Trunk (NIMT) at Okahukura and ran through remote country to Stratford, where it joined the Marton – New Plymouth Line. Train 533 travelled from Auckland to Taumarunui on the NIMT line and on the SOL from Okahukura towards Stratford.

1.2.2 The kilometrage on the SOL was designated from Stratford at 0.00 km to Okahukura at 143.30 km. The maximum authorised line speed between Stratford and 68.50 km was 70 km/h. The track between 68.50 km and Okahukura was classified by Ontrack as speed category 3, whereby the line speed was restricted to a maximum of 50 km/h.

1.2.3 Because of the topography and 24 tunnels on the SOL, radio coverage on the route was not continuous so did not meet Alternative Train Crewing standards for single-person crewing. Therefore, under Toll Rail's crewing standard, trains operating on the line required 2-person crews.

1.2.4 The movement of trains on the SOL was controlled by track warrants issued from the train control centre in Wellington. Track warrant control was a method for ensuring that only one rail service vehicle had authority to occupy a section of track at any time.

[2] A head end unit displayed information transmitted from the rear vehicle, such as last wagon moving or stopped, battery status and brake pipe pressure.

1.2.5 The track from Stratford to Okahukura was single track. Crossing loops were provided at regular intervals to enable trains travelling in opposite directions to pass. Crossing loops for this purpose were provided at Te Wera, Whangamomona, Tangarakau and Ohura.

1.3 Site information

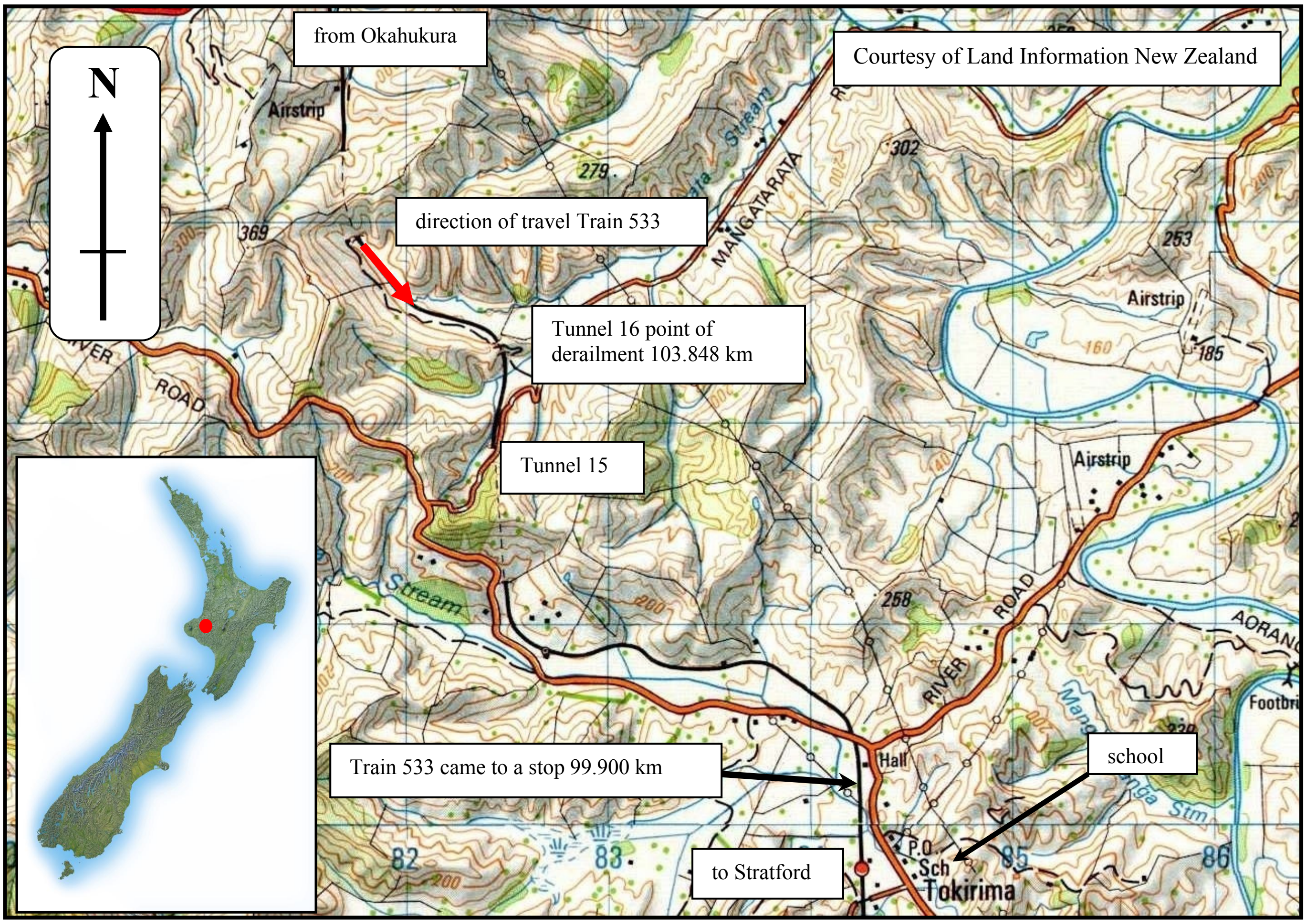

Figure 1
Map of derailment area

1.3.1 The point of derailment was confirmed as 103.848 km by a wheel flange mark on the left-hand rail in the direction of travel. The point of derailment was on a 250 m long, 180 m radius right-hand curve, in the direction of travel, including through Tunnel 16 (see Figure 2).

1.3.2 Train 533 approached the point of derailment on a 900 m long descending grade of 1 in 50.

1.3.3 The track leading up to the point of derailment consisted of 75 pounds per yard continuous welded rail manufactured in 1952, fastened to mixed-age treated *Pinus radiata* sleepers with R-type fastenings. The sleepers and the fastenings were in fair condition.

1.3.4 The cribs and ballast shoulders were full with 200 millimetres (mm) of ballast under the sleepers.

1.3.5 The witness mark indicated that the leading axle of the trailing bogie of UK10696, the second to last wagon of the train, derailed with its left wheel riding up onto high-leg rail in the direction of travel. The mark indicated that the flange travelled along the railhead for a distance of about 5 m before dropping off to the outside of the high-leg rail.

courtesy of Toll Rail

Figure 2
Track formation at the point of derailment

1.3.6 Train 533 continued in this condition for a further 2.75 km to 101.100 km where the trailing axle of the same bogie also derailed. The resultant disruption tipped the wagon on its side, causing wagon UK6638 in front and wagon PK821 behind to derail as well, but these 2 wagons remained upright (see Figure 3). All wagons on the train remained coupled when the train stopped.

courtesy of Liquid Gas Services Limited

Figure 3
The ISO liquid petroleum gas tanks

1.3.7 The lead bogie of wagon PK821 became detached and was 3.7 m from the rear of the train (see Figure 4). The lead bogie of wagon UK10696 also detached but was adjacent to where the wagon came to rest.

1.3.8 While the maximum authorised line speed was 50 km/h at the point of derailment, there was a permanent speed restriction of 25 km/h in place through Tunnel 16 for clearance purposes for trains conveying 2.9 m high containers on specified classes of wagon. However, since 7 September 2007, all trains had been restricted to a maximum speed of 25 km/h because of track geometry conditions identified by the EM80 track evaluation car (EM80)[3] on 22 August 2007 (see 1.4.3).

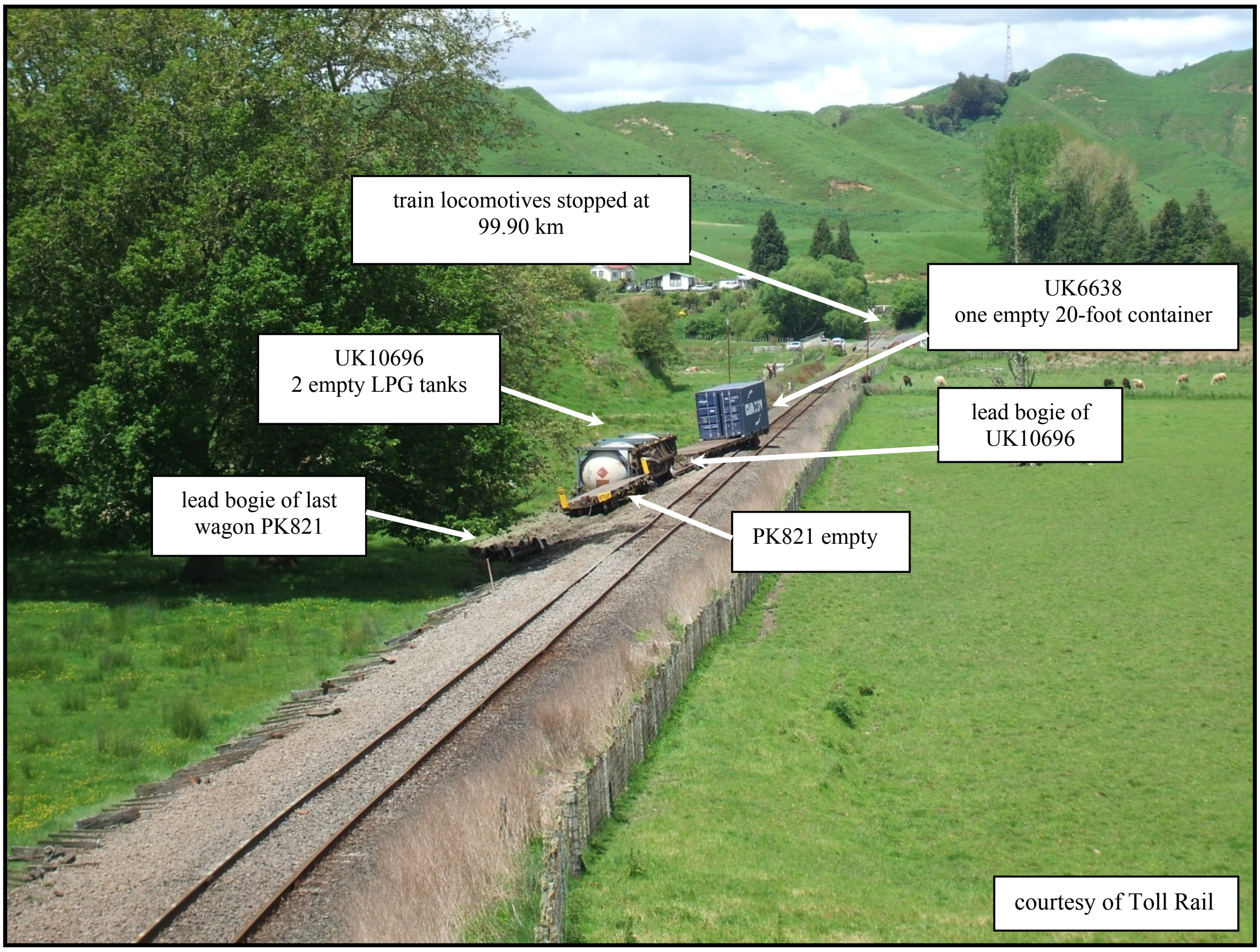

Figure 4
Derailment site detail

1.4 Code requirements for track inspections

1.4.1 Ontrack's Track Code (the Code) required that the track on the SOL be inspected once a week, with a maximum of 10 days between inspections.

1.4.2 Track conditions found during a static measure-up were prioritised and were to be actioned as follows:

Priority	Action required
Priority 1	Consider the need for a temporary speed restriction and fix within 30 days
Priority 2	Programme for maintenance
Priority 3	Note and review for action

[3] The EM80 track evaluation car measured and recorded track geometry and identified track deficiencies beyond tolerance.

1.4.3 Track inspections were supplemented by an EM80 run that measured and recorded track geometry including gauge, cant and line and compared the actual readings with predetermined Class 1, 2 and 3 track tolerance limits. An exception report was generated with details of the location, type and priority for every geometry exceedance. When measuring gauge, the EM80 applied one tonne of side pressure to simulate dynamic train forces.

1.4.4 The Code required the EM80 to run twice a year over all main lines and crossing loops. EM80 track geometry exceedances were classified and were to be actioned as follows:

Priority	Description	Action to be taken
Class 1**	Beyond maximum	To fix immediately. If not fixed within 24 hours impose temporary speed restriction – if considered necessary
Class 1	Beyond acceptable limits but below maximum	To be fixed within 4 weeks. If not fixed within 4 weeks impose temporary speed restriction – if considered necessary
Class 2	Marginally beyond acceptable limit	Infrastructure maintenance service provider to evaluate and forward supplementary list to Ganger at a later stage, directing action to be taken

1.4.5 The track geometry maintenance tolerances from a static inspection differed from those of the dynamic inspection by the EM80, and so too did the priority rating system. The reason for this was that the EM80 applied lateral loading as well as vertical loading to the rail as it was measuring, to simulate the loads created by a passing train. The Rate of Change of Cant Deficiency (ROCOCD) was the output generated by the EM80 from a formula-based calculation by Ontrack's engineering group.

1.4.6 The EM80 run on 22 August 2007 had identified one Class 1 twist[4] near the point of derailment. On 7 September 2007 a 25 km/h temporary speed restriction had been imposed between 103.680 km and 105.250 km, which included the track where the derailment occurred.

1.4.7 Between 22 August and 7 November 2007 about 25 km of track, between 68 km and Okahukura, with identified track geometry exceedances had been checked by the track inspector but this did not include the section of track between 103 km and 105 km.

1.4.8 The Class 1 track geometry exceedances between 103 km and 105 km were repaired the day after the derailment.

1.5 Post-derailment track measure-up 7 November 2007

1.5.1 The measure-up of the track following the derailment identified[5] a series of reverse (cyclic) twists, the largest twists being:

- a -23 mm twist at 103.894 km, 46 m before the point of derailment (Priority 2)
- a +23 mm twist at 103.891 km, 41 m before the point of derailment (Priority 2)
- a -18 mm twist at 103.867 km, 19 m before the point of derailment (Priority 3)
- a +23 mm twist at 103.859 km, 11 m before the point of derailment (Priority 2).

1.5.2 For track restricted to a maximum operating speed of 50 km/h, Ontrack's T200 Infrastructure Engineering Handbook defined Priority 3 twists as those between 17 mm and 19 mm and required them to be noted and reviewed for action. Priority 2 twists were those between 20 mm and 23 mm and were to be programmed for maintenance.

1.5.3 The measure-up identified 4 cyclic twists, having a wavelength of about 28 m leading up to the point of derailment.

[4] The cant differential at 4 m spacing.
[5] The track metrage on the SOL increased from Stratford to Okahukura (eastbound). Because Train 533 was travelling westbound and against the rising metrage, the metrages decreased as Train 533 approached the point of derailment.

1.6 Temporary speed restrictions

1.6.1 Temporary speed restrictions were used to manage the safe operation of trains and were placed for several reasons, including general deterioration of track condition and awaiting planned maintenance or renewal.

1.6.2 The appropriate speed was determined using Table 7 of the T200 Infrastructure Engineering Handbook or by track and structures managers and/or gangers, based on their knowledge of track condition, site and normal track speed.

1.6.3 Table 7: Speed Restrictions for Track Defects, Temporary Works, allowed for a temporary speed restriction of 40 km/h for EM80-identified class 1 track geometry twists of less than 30 mm. However, a lower line speed of 25 km/h was in place at the point of derailment.

1.7 Wagon UK10696

1.7.1 Wagon UK10696 had standard 3-piece bogies that are widely used on freight wagons worldwide. The 3 main pieces were one bolster and 2 side frames. The bolster was supported by 2 sets of coil springs. The larger-diameter coil springs, known as primary suspension, provided vertical support. The smaller coil springs, known as wedge springs, applied pressure to the friction wedge to control wagon damping[6]. The distance between bogie centres on UK wagons was 12.192 m.

1.7.2 UK10696 was conveying 2 empty 20-foot-long International Organization for Standardization (ISO) LPG tanks weighing 2.5 tonnes each for a gross laden weight of 20 tonnes.

1.7.3 The under-frame of UK10696 was twisted as a result of the derailment. It was not possible to determine the float clearance[7] measurements because the damage and disturbance sustained by the wedges and float blocks would have resulted in inaccurate measurements (see Figures 5 and 6).

1.7.4 Toll Rail's Mechanical Code M2000 defined wear or damage limits beyond which rail vehicles were not permitted to operate. It also specified that all freight wagons must be inspected at the following frequency:

- a pre-departure check
- a B-Check, carried out when 2 or more brake blocks were changed, or after an incident
- a C-Check, carried out before a depot pass-out every 2 years but with an upper limit of 27 months
- a Brake Service Check, carried out every 10 years but with an upper limit of 11 years.

1.7.5 A pre-departure check was a thorough walk-around inspection undertaken by yard-operating staff immediately before a train departed from a terminal. The check included the condition of brake blocks and wheels and correct draw gear connections. The person carrying out the check signed a Train Inspection Certificate to confirm that the train was in a proper condition for safe running. This Certificate was attached to the Train Work Orders and remained in the locomotive cab until the train reached its destination.

1.7.6 Toll Rail's Wagon and Container Inspection Manual M9202 (the Manual) specified B-Check requirements for wagons. The Manual specified that the bogie suspension B-Check was to include a visual inspection of the float clearances to ensure they were satisfactory. However, the B-Check Recording Sheet required that the float clearance be measured.

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[6] Damping reduced oscillation of wagons while in motion.

[7] Float is the sum of the clearances between the side bearing pads on the bogie bolster and the corresponding blocks on the wagon under-frame.

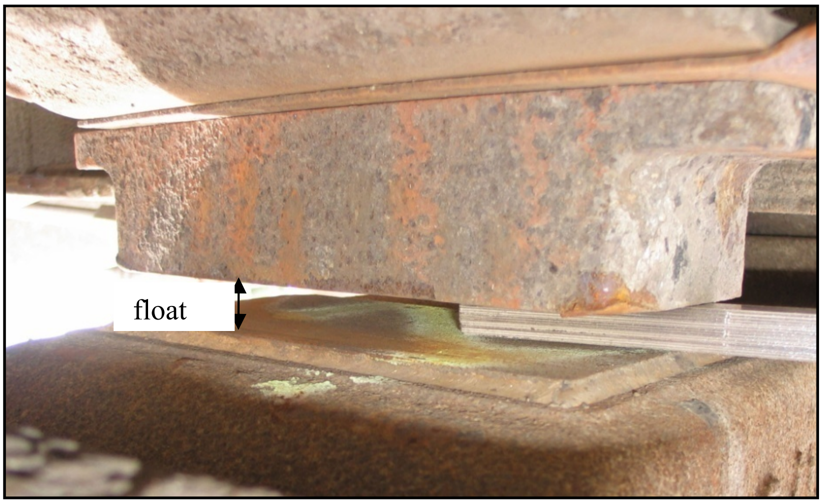

Figure 5
Measuring float

1.7.7 The most recent B-Check on UK10696 had been completed on 14 August 2007 and included a measure of the float clearance as required by the B-Check Recording Sheet. The float clearance was 7 mm at the handbrake end of the wagon and 13 mm at the non-handbrake end. These readings were both at the lower end of the Code-specified range of 6 mm to 10 mm at the handbrake end and 12 mm to 16 mm at the non-handbrake end.

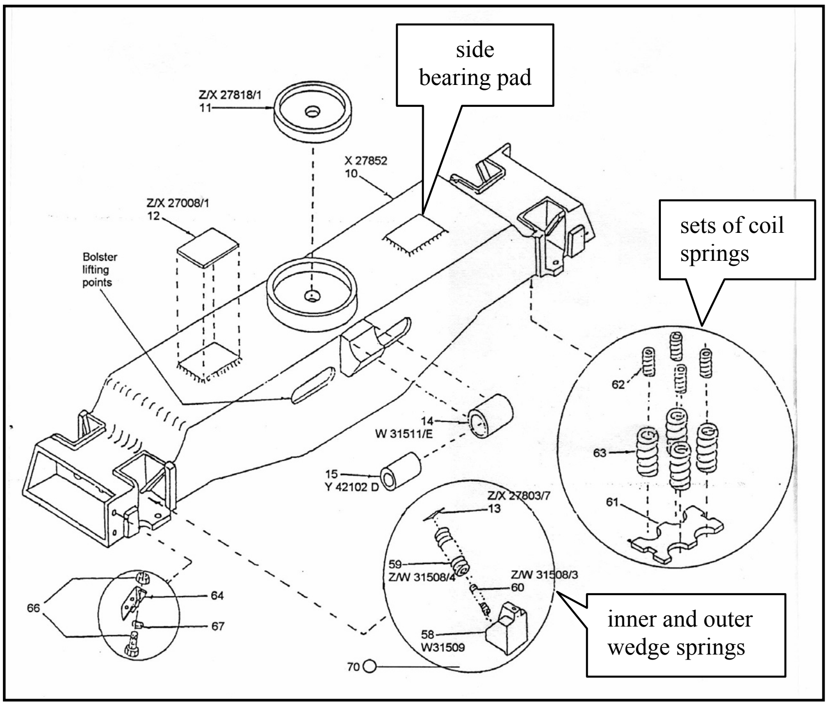

Figure 6
Exploded diagram of bogie bolster

1.7.8 The float clearance measurements had been entered on the B-Check Recording Sheet and the wagon had been signed out as a B-Check pass. Float readings from the B-Check Recording Sheet were transferred into MAXIMO[8] and the Sheet was archived. Readings were audited to find any out-of-Code measurements and these wagons were bad ordered[9] and inspected to establish if it was a data entry error or if the wagon needed to be removed from service.

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[8] A computerised asset lifecycle and management program.
[9] Identified as needing attention.

1.7.9 Toll Rail advised that the specific requirement to record wagon float information on the B-Check Recording Sheet was a formal "beyond the Code" requirement and had been initiated to provide more up-to-date data in the wagon maintenance system. Toll Rail acknowledged that the investigation had raised an issue of variance in B-Check float inspection requirements between the Manual and the B-Check Recording Sheet, which would be addressed by the company's technical committee.

1.7.10 The most recent C-Check inspection had been completed on 23 August 2007, 9 days after the B-Check inspection and 11 weeks before the derailment. This inspection recorded combined float clearances of 6 mm on the handbrake end bogie and 12 mm on the non-handbrake end. Both of these clearances were at the Code-defined limit of the specified ranges of 6 mm to 10 mm at the handbrake end and 12 mm to 16 mm at the non-handbrake end.

1.7.11 The C-Check inspection also included measuring the wedge heights to ensure they were within limits. At that time wedge heights were recorded as 23 mm on the handbrake end bogie of the wagon and 25 mm on the non-handbrake end. These measurements were within the Code limit of 39 mm. The wheel measurements were also within the Code limit.

1.7.12 The float had not been adjusted during the B-Check or C-Check inspections, as 6 mm and 12 mm were regarded as within Code for pass-out during a maintenance check as the expected change in float, more commonly attributed to centre-bowl wear, was minimal during a 2-year period. The float would be checked again during subsequent B-Checks and adjusted should it have moved beyond Code limits.

1.7.13 Toll Rail maintained that although the float clearances on UK10696 were at the lower end of the specified ranges, it would normally be expected that each bogie would negotiate a compliant section of track. However, the track twists before the point of derailment were relevant and could result in a bogie reacting differently by altering its rotation forces.

1.8 Locomotive event recorder

1.8.1 The locomotive event recorder was downloaded and made available for analysis, which confirmed Train 533 had been travelling at less than the maximum authorised speed of 25 km/h at the time of the derailment.

1.9 Movement of hazardous substances

General

1.9.1 Hazardous substances were classified according to the predominant type of risk involved. The class definitions were listed in international and domestic publications as follows:

- Class 1 Explosives
- Class 2 Gases
- Class 3 Flammable liquids
- Class 4 Flammable solids

LPG on rail

1.9.2 LPG tanks, whether empty or loaded, were classified as Dangerous Goods Class 2.1 and restrictions relating to their conveyance were included in Toll Rail's Rail Operating Code Section 1 "Rolling Stock Restrictions" clause 1.45 "Dangerous Goods on Trains". Wagon UK10696 was correctly marshalled on Train 533 in accordance with these restrictions.

1.9.3 The train documentation carried in the locomotive cab included a train information sheet, which identified wagons conveying hazardous goods, including the class of goods and the position of the wagon on the train. UK10696 was correctly listed and identified on the train manifest documentation as conveying Class 2 dangerous goods.

1.9.4 Toll Rail used the certification relating to the conveyance of dangerous goods, the "Transport of Class 1 Dangerous Goods – AH6 Approved Handler certificate". Attaining the certificate was a legal requirement for a person in direct charge of the transportation of Class 1 Dangerous Goods but there was no certification specific to the conveyance of Class 2.1 Flammable Gas. Locomotive crews were required to complete a computer-based theory paper approved by a dangerous goods test certifier for the AH6 certificate. The locomotive engineer of Train 533 held current AH6 certification.

1.9.5 There were 2 AH6 Approved Handler Class 1 tests from which one would be selected for the applicant locomotive engineer. Both tests contained 10 questions, 9 of which in each paper made direct reference to Class 1 Dangerous Goods. Toll Rail advised that AH6 certification was necessary for locomotive engineers anyway because Class 1 Dangerous Goods were regularly carried on scheduled express freight train services.

LPG on road

1.9.6 A road transport company involved in the distribution of bulk LPG was approached for information regarding the certification of its truck drivers. The company advised that drivers engaged in the transportation of LPG required a "D" endorsement on their Class 5 licences and an "approved handler" qualification[10]. Both of these certifications were obtained through an external industry-approved training facility.

1.10 Occurrence management

1.10.1 The National Rail System Standard Section 5 Occurrence Management Principles clause 2.1 "Illustration of Macro Process" (see Figure 7) provided that when an incident or accident occurred on the controlled network, those involved (such as locomotive engineers) were to notify train control who was to advise the network control manager. The network control manager was responsible for:

- notifying other parties
- appointing a rail incident controller
- notifying regulatory agencies
- initiating a recovery plan.

1.10.2 Ontrack's Rail Operating Rules (General) Rule 133 "Damaged or Derailed Tank Wagons Containing Hazardous Freight" stated in part:

> Any employee who notices that a tank wagon containing hazardous freight is damaged or derailed must immediately advise:
>
> - Fire Service
> - Police (if required)
> - Ambulance (if required)
> - Officer in Charge.
>
> If the wagon is on a train which is not at an attended station, the Locomotive Engineer of the train must give Train Control full details. They will advise all concerned.
>
> If an LPG tank is involved the **Labour Department Inspector of Explosives** [Transport Accident Investigation Commission's emphasis] must also be advised immediately. Special mention that LPG is being conveyed must be made to all emergency services.
>
> All personnel, naked lights and other means of igniting fire or explosion must be cleared to a safe distance (for LPG, 200 m).

[10] This was required because drivers were often delivering to numerous sites en route, which required them to operate the valves etc for this purpose.

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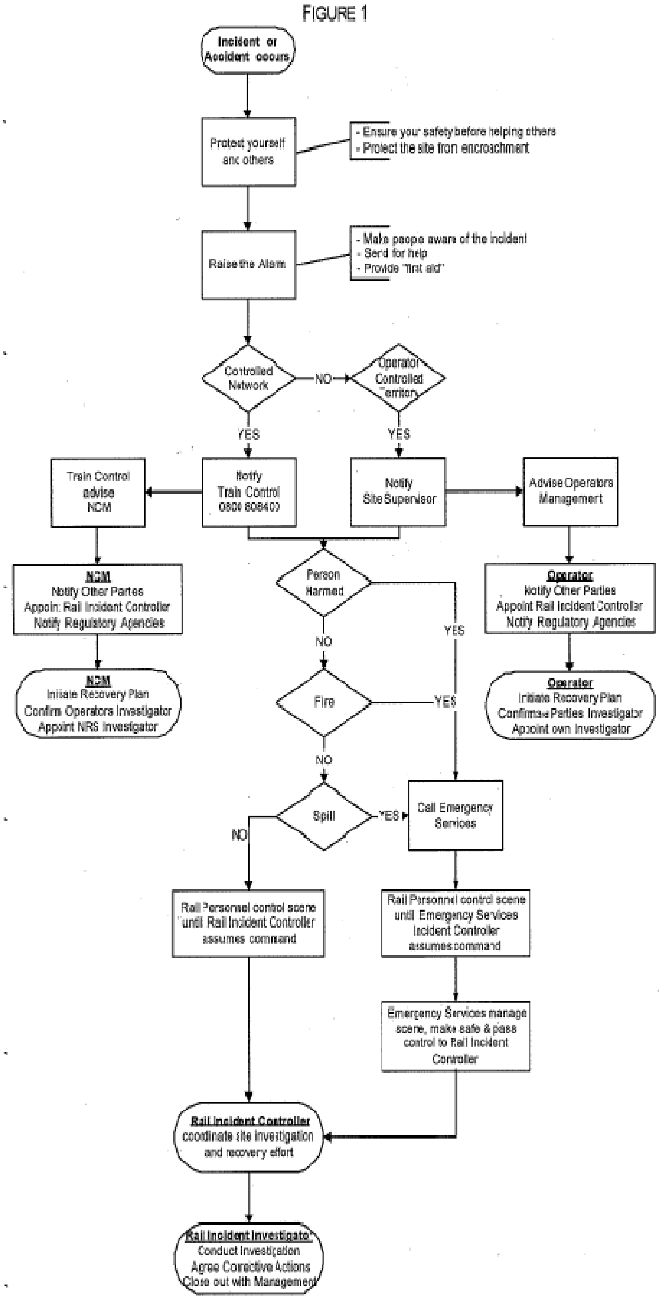
2 OCCURRENCE MANAGEMENT PRINCIPLES

2.1 Illustration of Macro Process

These principles of occurrence management are illustrated in Figure 1.

FIGURE 1



Effective Date: 12 July 2004 All printed copies are uncontrolled

Figure 7
Illustration of Macro Process

1.10.3 Ontrack advised that, as Rule 133 had not been applied in this instance, it had no record of the Labour Department Inspector of Explosives being advised of the occurrence.

1.10.4 Toll Rail's Rail Operating Code Supplement CS 3.3 Conveyance of Dangerous Goods Instruction 9 was a copy of Ontrack's Rail Operating Rules (General) Rule 133 as detailed in 1.10.2 above, except that the penultimate paragraph read:

> If an LPG tank is involved the **Commerce Commission Inspector of Explosives** [Commission's emphasis] must also be advised immediately. Special mention that LPG is being conveyed must be made to all emergency services.

1.10.5 Toll Rail had no evidence of any notification to the Commerce Commission Inspector of Explosives recorded on the line-haul services manager's[11] incident check sheet.

1.10.6 Toll Rail's Rail Operating Code Supplement CS 3.3 Conveyance of Dangerous Goods Instruction 10.1.5 stated:

> Finally, it should be remembered that the precautions and actions taken with loaded wagons apply equally to empty wagons returning to Kapuni. There is a residual gas contained in these wagons and they are pressurised before being available for lifting.

A copy of this Code Supplement was kept at the train control desks for access by train controllers.

1.10.7 Ontrack's Rail Operating Procedures section 10.1 Operating Instructions for Train Control quoted the following procedure when contacting emergency services:

> 23.1 When contacting the Emergency Services the following points will assist them to effectively deal with an emergency.
>
> - State that you are calling from the National Train Control Centre.
> - State the nearest town to the emergency.
> - Use crossroads near the railway to identify location where possible.
> - Use a map grid reference if necessary for clarification.
> - State the exact nature of the emergency.
> - Advise what type of train is involved i.e.:
>   Passenger
>   Freight
>   Freight with Dangerous goods
>
> 23.2 Police Communications Centre
> In situations where accidents or emergencies occur and Train Control is notified or deems that the emergency services are required, the direct emergency number for the respective Police Communications Centre should be used to notify Police who will mobilise Fire and Ambulance resources.

1.10.8 Ontrack's Rail Operating Procedures Supplement 10.3 section 3.10 Transport of Class 1 Dangerous Goods – AH6 certificate stated in part:

> This is a legal requirement for a person in direct charge of the transportation of Class 1 Dangerous Goods. Toll Rail requirement is that locomotive engineers will complete the computer based test paper approved by a Dangerous Goods Test Certifier.

[11] The Toll Rail line-haul services manager was responsible for the management of all rail line-haul services on a daily basis, ensuring service and operating incidents were immediately actioned and network recovery was managed effectively.

1.11 Personnel accounts of events

Locomotive engineer and rail operator

1.11.1 The locomotive engineer and the rail operator expressed surprise at the apparent lack of concern from the train controller when they advised him that 2 empty LPG tanks had been involved in the derailment and were tipped on their sides. They said that cell phone coverage was non-existent at the site so they relied on the train controller to notify the appropriate parties. They said they felt they had been left on their own as they had received no further instructions on what action they should take.

Rail incident controller

1.11.2 The Toll Rail employee designated as the rail incident controller lived in Stratford. He said he was first notified of the derailment at 0157 on Wednesday 7 November by the Toll Rail line-haul services manager, but that he was not told at that time that empty LPG tanks were involved. He travelled to the derailment site, about 100 km from Stratford, and arrived at 0440.

1.11.3 As the rail incident controller walked towards the derailed wagons, he became aware of the 2 empty LPG 20-foot demountable tanks on their sides beside the track. He contacted the line-haul services manager and notified him of the need for the LPG tanks to be inspected for safety by an inspector[12] to certify the tanks were safe before any recovery work could start. He also contacted the network control manager[13] to confirm with him the presence of the 2 LPG tanks amongst the derailed wagons.

1.11.4 A relief locomotive crew arrived on site at 0631 and at 0927 took the front portion of the train that had not derailed to Stratford.

1.11.5 The rail incident controller was aware that the central services manager from United Group Rail Limited[14] had received permission at 0832 from the inspector prior to the derailed wagons being uncoupled and moved.

1.11.6 At 0731 the rail incident controller imposed a 200 m safety zone around the LPG tanks to keep people on site away and notified the principal of a nearby school of the situation. Although it was some distance from the derailment site, the principal decided to close the school for the day.

1.11.7 The fire service arrived on site at 0915 and, after satisfying themselves that there was nothing further they needed to do, they departed at 0940.

1.11.8 The rail incident controller said the inspector arrived on site at 1300 and, after examining the tanks, gave permission at about 1340 for them to be moved as part of the recovery of the derailed wagons.

Network control manager #1

1.11.9 Network control manager #1 was a train controller with 7 years' experience. He had been a relief network control manager during the previous 12 months. His training consisted of on-the-job training, with another of the network control managers taking him through the processes involved in the role.

[12] A competent person contracted by the gas company to certify the safety of tanks involved in derailments or other unsafe situations.
[13] The network control manager was responsible for taking control of coordination of incidents and accidents in accordance with the occurrence manual and other codes.
[14] A company contracted by Toll Rail responsible for the inspection and maintenance of wagons and locomotives.

1.11.10 He had been advised of the derailment by the train controller and saw that LPG tanks were involved after referring to computer printouts of the train consist and talking with the Toll Rail line-haul services manager. Once he knew that the LPG tanks were empty he considered they were not hazardous so did not contact emergency services. He was aware of Rule 133 but did not think it applied to empty LPG tanks. He thought that his training for his role in train control may have covered hazardous goods procedures, but not in depth.

1.11.11 At 0600 network control manager #1 handed over the shift to network control manager #2. During the handover he told the incoming network control manager (network control manager #2) of the derailment, the staff in attendance and the arrangements for clearing the site once it was daylight, but not that empty LPG tanks were involved.

Network control manager #2

1.11.12 Network control manager #2 had been in the role since January 2005, prior to which he had extensive operational experience in signal boxes, shunting etc dating back to 1984. He had come to the role on a relief basis and had not received any formal training prior to taking up the role other than on-the-job training from other network control managers. He had not been through any certification process prior to taking over the role. He said he had learned about derailment recovery procedures during his training and from reading through the rules and regulations.

1.11.13 During the handover he had been told by network control manager #1 that Train 533 had derailed near Tokirima and that Ontrack and Toll Rail staff were in attendance. He could not recall if he had been told that empty LPG tanks were involved in the derailment, but he didn’t think he had. He only became aware of this when the rail incident controller contacted him by telephone and told him that because of the presence of the LPG tanks arrangements had been made for a nearby school to be closed for the day.

1.11.14 The network control manager then notified the Toll Rail line-haul services manager and Ontrack staff. He had not notified the emergency services as he was unaware that empty LPG tanks were classified as dangerous goods and he was unfamiliar with the procedures for dealing with derailed LPG tanks and the requirements of Rule 133.

Train controller

1.11.15 The train controller had been in the role for about 26 years. He had started duty on 6 November 2007 at 2300 and was due to finish at 0700 the following day. His duties included controlling trains on the NIMT, the East Coast Main Trunk and the SOL.

1.11.16 The train controller was notified of the derailment by the locomotive engineer of Train 533, who also advised him of the empty LPG tanks on one of the derailed wagons. The train controller said that as far as he was aware Ontrack’s Rule 133 did not cover empty LPG tanks. He was unaware that empty LPG tanks were classified as dangerous goods and had therefore not considered it necessary to contact the emergency services. It was only in hindsight following the incident that he found a Toll Rail instruction that stated that empty wagons en route to Kapuni were to be treated as if they were loaded.

1.11.17 He said he had, however, advised the network control manager and the Toll Rail line-haul services manager of the derailment and the presence of the LPG tanks and suggested to the line-haul services manager that he might need to organise a relief locomotive crew.

1.11.18 Topographical maps produced by Land Information New Zealand were available in the train control centre for reference purposes in emergency situations, and each kilometre of the rail route was endorsed on them. Map 260 R19 showed the rail route and State Highway 43 from a point 36 km east of Stratford to Tokirima, including the derailment site.

1.11.19 Train controllers were trained in map reading as part of their initial training, and proficiency in this task was tested as part of the safety observation process as follows:

> Ensure the employee is able to locate and read "Lands & Survey"[15] maps of the area being observed.
> Ensure employee can provide grid reference to a selected location on a "Lands & Survey" map.

1.11.20 Ontrack's Incident Reporting and Investigation System confirmed that the train controller had been advised of the derailment at 0145. The train control audio recording also confirmed this, and that he had been advised at that time that the derailed wagons included UK10696, which was conveying empty LPG tanks.

1.11.21 The emergency procedures incorporated into the train control training school were already included in Rail Operating Procedures section 10.1. However, the training did not encompass actions on how to deal with a dangerous goods emergency.

Ganger

1.11.22 The ganger had been notified of the derailment at about 0205. He said that he could not recall if he had been advised of the empty LPG tanks at that time, but when he arrived on site his first thought was to inspect the damaged track to try to establish the point of derailment.

Line-haul services manager

1.11.23 The line-haul services manager was located in Toll Rail's head office in Takapuna and was responsible for the management of all rail line-haul services on a daily basis, ensuring service and operating incidents were immediately actioned and network recovery was managed effectively. His training for the role had included emergency response procedures.

1.11.24 He had been notified of the derailment by the network control manager at about 0150 but could not recall if the LPG tanks had been mentioned at that time. He contacted the Toll Rail manager for Taranaki and requested him to travel to the site and assume the role of rail incident controller. He then notified the central services manager of United Group Rail Limited[16].

1.11.25 The line-haul services manager was later contacted by the rail incident controller and was advised of the LPG tanks needing an inspection by a recognised inspector. He then contacted the Toll Rail operations risk and compliance manager, who confirmed that that was required, although his memory of these calls was scant and they were not recorded on his incident check sheet. It could not be established what action the line-haul services manager took in response to this information.

1.11.26 The line-haul services manager said he had not contacted any emergency services. He had maintained regular contact with the network control manager during the recovery and, as far as he was aware, it was the network control manager's responsibility to contact emergency services if a derailment occurred on Ontrack's controlled network[17].

Liquid Gas Services Limited

1.11.27 Liquid Gas Services Limited was a company that provided services such as installations and general maintenance to the LPG industry. The company was contracted to Nova Gas[18], the owner of the LPG tanks, to work on the tanks.

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[15] Land Information New Zealand.
[16] United Group Rail Limited had commenced rolling stock servicing and maintenance responsibilities for Toll Rail in September 2005.
[17] That part of the rail network that was under the control of Ontrack's train controllers.
[18] Nova Gas was a specialist supplier of natural gas to industrial and commercial users throughout the North Island through its transport network, which included rail- and road-transportable ISO units.

1.11.28 A representative of Liquid Gas Services, who lived in Feilding, was notified of the derailment at 0845 by the central services manager of United Group Rail, who requested that he travel to the site and inspect the tanks prior to recovery as part of clearing the site.

1.11.29 When he arrived on site at 1300, the emergency services had attended the site and departed and he noticed the recovery gangs were standing outside the 200 m exclusion zone around the derailed LPG tanks. He examined the tanks to ensure there was no damage or leakage before supervising their being righted and lifted clear of the railway tracks. He left the site at about 1700.

1.12 Previous similar rail occurrences investigated by the Commission

Report 02-116

1.12.1 The issue of train control response to emergency situations was raised by the Commission during an investigation into the derailment and rollover of Train 533 at Te Wera, a remote location on the SOL, on 26 July 2002, which resulted in the death of the locomotive engineer.

1.12.2 The training of train controllers to respond to emergency situations was also raised and led to a safety recommendation being made to the Managing Director of Tranz Rail[19] on 6 June 2003 that he:

> redevelop the current emergency response training programme for train controllers and network control managers, in conjunction with appropriate external agencies, to include but not limited to:
>
> - responding to emergency notifications
> - dealing with potentially distraught people reporting emergencies
> - procedures for ensuring emergency sites are identified and confirmed
> - the use of maps and map grid references when establishing such sites
> - procedures for contacting emergency services
>
> and ensure that such a course is mandatory prior to initial certification of a train controller and is part of ongoing train controller re-certifications (020/03).

1.12.3 On 20 April 2005 the safety recommendation was redirected to the Chief Executive of Ontrack[20].

1.12.4 On 1 December 2006 Ontrack provided evidence to the Commission that emergency training procedures had been incorporated into the train control school syllabus. The Commission was satisfied that this action met the intent of the safety recommendation, which was subsequently changed in status to "closed acceptable".

Report 03-114

1.12.5 On Friday 21 November 2003, Train 220 was a scheduled northbound express freight service travelling through Shannon on the NIMT line when PK2295 derailed.

1.12.6 Following the derailment, an examination of PK2295 identified that the friction wedges were worn but were within Code. The float limit at the handbrake end of the wagon was 2 mm outside the limit, but Tranz Rail (now Toll Rail) considered that this was not enough on its own to cause the derailment.

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[19] At that time Toll Rail was responsible for the train control function.
[20] Ontrack took over the train control function from Toll Rail (previously Tranz Rail) in September 2004.

1.12.7 The measure-up of the track following the derailment identified 2 opposing track twists about 12 m and 2 m respectively before the point of derailment. The twists were within acceptable maintenance tolerances at the time of the derailment and Tranz Rail (now Ontrack) considered that on their own they would not have caused the derailment.

1.12.8 It was concluded that the derailment was probably caused by dynamic interaction between PK2295 and the track.

Report 04-107

1.12.9 On Tuesday 23 March 2004, Train 220 was a scheduled southbound express freight service travelling through Kopaki on the NIMT line when USQ7663 derailed.

1.12.10 Following the derailment, an examination of USQ7663 identified that the A2 wheel bearing adaptor was both damaged and distorted and had been running in a displaced position for some time. The locating lug was broken on the adaptor and there was a crack on the inside face. When the adaptor was placed on the bearing, it could be slightly rotated about a vertical axis, and also rocked and slid backwards and forward axially. Although the bearing adaptor was not a secure fit and appeared to have been running in a displaced manner for some time, the condition of the adaptor on its own was probably not sufficient to cause the bogie to derail.

1.12.11 All bogie adaptor pockets were checked for dimensional compliance but all except that at the A2 wheel were within the acceptable tolerances. The A2 pocket was worn to an extent that it allowed 3 mm more longitudinal movement than the upper tolerance limit.

1.12.12 When the springs supporting the friction wedges were removed from the bogie side frames, it was found that 2 of the inner springs on the B-side were broken at the same position, about one and a half turns from the bottom. The fractured springs would have prevented the friction wedges being effective in damping out the rolling effect. Rolling oscillations would thus continue for longer durations, increasing the risk of these oscillations compounding should there be any small cyclic changes in track geometry.

1.12.13 From the post-derailment measure-up of the track geometry at one-metre intervals for 120 m leading up to the point of derailment and the subsequent derailment analysis, there was no standout track condition that alone would have caused the derailment. The gauge, cant and curvature were reasonably regular within the body of the curve and within the network provider's[21] established maintenance tolerance limits. However, there was evidence of some cyclic wavy top leading up to the point of derailment. Although the track geometry at the point of derailment was within maintenance tolerances, the wavy top may have contributed to the derailment when combined with a wagon at the limit of acceptable maintenance tolerances.

Report 05-103

1.12.14 On Thursday 20 January 2005, Train 237 was a southbound express freight service travelling through Hunterville on the NIMT line when UK3083 derailed.

1.12.15 A post-derailment examination of the bogies on UK3083 found that 2 of the 4 inner wedge springs from each bogie were up to 2 mm less than the minimum length and one outer wedge spring from the leading bogie was on the minimum required length required for reuse, if the bogie was to be overhauled at the time. The combined effect of the springs being below, or right on, the minimum length did not mean either bogie was out of Code, but rather that the springs were out of specification for reuse.

[21] New Zealand Railways Corporation assumed responsibility for the long-term operation and maintenance of the mainline and designated portions of operator-controlled territory on 1 September 2004.

1.12.16 An internal report compiled by Alstom Transport New Zealand Limited[22] for Toll Rail concluded that the condition of the bogies and the load configuration of UK3083 could not have caused the derailment on their own.

1.12.17 The site investigation found that the rail joint at 206.266 km, 20 m before the point of derailment, had a battered head of rail, and the fishplate on the field side[23] of the right-hand rail had a developing fracture. The 2 halves of a discarded fishplate that had a fracture in about the same place were laying trackside close to this joint.

1.12.18 The measure-up of the static track geometry following the derailment identified 2 track conditions within 67 m of the point of derailment. Both track condition sites had previously been identified as having exceedances by the EM80 car on 3 November 2004.

1.12.19 On their own, the track conditions would probably have not caused the derailment. The track measure-up after the derailment did not identify any track conditions that required the imposition of a temporary speed restriction on the 100 m of track leading to the point of derailment.

1.12.20 The derailment was probably caused by dynamic interaction owing to a combination of track and wagon conditions, either of which on its own was unlikely to have caused the derailment.

1.12.21 In response to this series of investigations it was recommended to the Chief Executives of Ontrack and Toll Rail that together they critically review current track and mechanical code standards and maintenance tolerances to ensure they were compatible and minimised the potential for derailments caused by dynamic interaction (009/05 and 010/05). Both parties advised that they accepted the respective recommendations.

2 Analysis

The derailment

2.1 Most of Train 533 had passed over the 103.848 km point before the leading axle of the trailing bogie of the second to last wagon on the train derailed. The train continued for a further 2.75 km until the rear axle of the trailing bogie struck a farm access level crossing, where it derailed. The impact tipped UK10696 on its side, pulling the wagons immediately in front and behind from the tracks. The derailed wagons were pulled a further 250 m before the train stopped.

2.2 There are 3 parameters that influence the ability of a wagon to negotiate the dynamic effects of track with cyclic twists: the wheel base, the torsional stiffness and the speed. When the wheel base is about half the wave length of the cyclic twist, as was the case with this derailment, the unloading is high even at low speeds. The wagon stiffness has a significant influence on the unloading but speed has minimal effect. The unloading was due to the inability of the wagon to follow the track twist through torsional deformation. For this wheel base/cyclic wavelength ratio, the rear and trailing bogies were rolling out of phase.

2.3 From the post-derailment measure-up of the track geometry at one-metre intervals for 120 m prior to the point of derailment, and the subsequent derailment analysis, there was no standout track condition that alone should have caused the derailment. The maximum amplitudes of the cyclic track twists leading up to the point of derailment were classed as Priority 2 and 3, meaning that each twist on its own was unlikely to cause a derailment, but the cyclic nature of the twists when combined with a wagon with float at lower limits could cause that wagon to derail if the speed of the train was coincidentally just right for it to do so.

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[22] Alstom was contracted to supply the inspection and maintenance of rolling stock to standards set by Toll Rail.
[23] Field side referred to the outside face of the rail.

2.4 The B-Check recorded the float measurement on each bogie of UK10696 as being within one millimetre of the low end of the ranges specified in the Manual. The C-Check, undertaken 9 days later, recorded the float measurements as being right on the lower limit of the specified range. However, it would be unusual for float measurements to deteriorate by one millimetre over 9 days between checks. Because of the post-derailment damage to the bogies, it could not be determined which set of float measurements was correct.

2.5 The Manual provided that float measurements of 6 mm and 12 mm were within tolerance limits, so UK10696 was returned to service without the float measurements being adjusted. The return to service of the wagon with float measurements on the low end limit was based on Toll Rail's expectation that any change in float was minimal during a 2-year period and that the float would be checked during subsequent B-Checks and adjusted should it have gone beyond tolerance limits.

2.6 The acceptance of lower end float measurement was also based on a belief that each bogie would run on Code-compliant track. However, compliant track over all the routes the wagon would travel once it was returned to service could not be guaranteed; indeed the track leading up to and at the point of derailment was not compliant, although the track geometry was within acceptable maintenance tolerances with an imposed 25 km/h temporary speed restriction. The acceptance by Toll Rail maintenance of placing wagons in service on the premise that all track was compliant significantly increased the risk of derailment owing to dynamic interaction.

2.7 To illustrate this point, the EM80 had identified a Class 1 twist before the point of derailment on 22 August, but the static track measure-up immediately following the derailment had identified 3 Priority 2 twists but each one being only one millimetre away from being classified as Priority 1. Following the derailment, had the track been measured under load, it was likely that all 3 twists would have been determined as Class 1 geometry exceedances. This indicated that the track condition was not improving.

2.8 Of the track geometry exceedances identified during the EM80 run on the SOL, only about 17% of the route had been checked by the track inspector and endorsed accordingly on the respective M125 Track Inspection reports.

2.9 The train passing over the 4 cyclic twists on its approach to the point of derailment would have initiated rolling oscillations within UK10696. It is feasible that the float clearances at both ends of the wagon being right on the lower tolerance limits prevented the wagon rolling freely, making the wagon "stiff", and preventing it compensating for the oscillations.

2.10 The distance between the initial track twist and the point of derailment was 46 m. With the train travelling at 25 km/h, UK10696 would have taken about 7 seconds to traverse the 4 separate track twists. There was not likely to have been sufficient time for the wagon to stabilise after traversing each track twist before passing over the next twist. What precise impact this stiffness had could not be quantified, but when coupled with the cyclic track twists it is feasible that it contributed to the derailment.

2.11 The light load being conveyed by UK10696 should not have caused the float clearances to exceed the tolerance limit, so from this aspect it is unlikely that the load on the wagon contributed to the derailment.

2.12 Dynamic interaction describes a derailment where the track geometry, wagon condition, wagon loading and train speed are individually within tolerance limits, or only marginally in excess, but to the extent that each variation in itself is not sufficient to be a prime cause of derailment. However, in combination these conditions can result in a derailment.

2.13 An analysis of the locomotive event recorder confirmed that Train 533 was not exceeding the temporary speed restriction of 25 km/h at the time of the derailment. With dynamic interaction, the speed of the train does not necessarily mean the train is travelling too fast. The publication Train Derailment Cause Finding – stemming from an international government/industry research programme on train/track dynamics – quoted the usual speed range for a "rock and roll" type derailment as being 10 to 25 miles per hour (16 to 40 km/h). This means that while speed is a factor in derailments involving dynamic interaction, this is not necessarily a reflection of driver technique but more an unfortunate culmination of the condition of the track, the state of the wagon and the speed at which the wagon was travelling.

2.14 Derailments caused by dynamic interaction with wagons at or near tolerance limits and track geometry at or near maintenance tolerance limits have not been uncommon on the New Zealand controlled rail network. Indeed the Commission has conducted numerous investigations into such derailments, the outcomes from some of which are included in this report yet, despite proposed combined actions by KiwiRail (formerly Toll Rail) and Ontrack, these derailments continue to occur.

2.15 On 23 March 2005, the Commission made a safety recommendation to the Chief Executives of Toll Rail and Ontrack following an investigation into the derailment of Train 220 at Shannon in November 2003 that, in conjunction with each other, they:

> critically review current track and mechanical code standards and maintenance tolerances to ensure they are compatible and minimise the potential for derailments caused by dynamic interaction. (009/05 and 010/05).

Both Chief Executives accepted the safety recommendation in April 2005.

2.16 On 26 January 2006, the Manager Track Engineering for Ontrack advised that Ontrack and Toll Rail had agreed to jointly sponsor an independent study to model aspects of wheel/rail interaction based on a specific derailment or derailments to confirm the suitability of their respective current codes to minimise the potential for derailments caused by dynamic interaction.

2.17 On 26 June 2007, Ontrack's Risk and Safety Manager advised that in April 2007 Toll Rail and Ontrack had jointly engaged an independent specialist company to perform the following professional services:

1. Develop guidelines for the measurement of wagon and track suitable for the analysis of VAMPIRE modelling for the Studholme[24] derailment. (Ontrack to then modify existing measurement forms and procedures for track and arrange training for staff for all mainline derailment investigation.) Ontrack and Toll Rail to perform the measure-up to the required standards and formats.
2. Model (using VAMPIRE) the Studholme derailment to simulate the circumstances of this derailment and to establish a cause (includes investigating new – worn friction damping and the effects).
3. Determine the effect of constant side bearers – investigate if they would have helped in prevention of the derailment.
4. Validate the track and wagon data against measured test data on the network.
5. Investigate the effect of varying the standards on the track and wagon input and tolerance to avoid derailment.

[24] Derailment of Train 934 between Glenavy and Studholme, 6 March 2007.

> 6. Develop the model for mainline track for various speed categories on the New Zealand Network and using typical worst case current rolling stock and maintenance tolerances review the track geometry tolerances in particular for twist, ROCOCD and cyclic fault types.
>
> Stage one is complete for track. The measure-up of the wagon data is still to be completed. It is anticipated that Stage 2 will be completed by August and that Stage 6 will hopefully be completed by the end of the year so the recommended tolerances can be tested, implemented and codified in 2008[25].

On 21 November 2008 KiwiRail advised that it considered the findings of the independent report inconclusive and expressed concerns about the robustness of the methodology. As a result KiwiRail had developed a separate procedure to record wagon behaviour over extended sections of track and expected that merging this data with the enhanced Ontrack track data from the independent study should provide an increased understanding of the dynamic interaction issue.

2.18 On 10 August 2009, Ontrack's National Operational Safety Co-ordinator stated:

> ONTRACK have engaged Interfleet to assist with review to its track standard measures as recorded by EM80 and whether changes to measures would be beneficial in reducing dynamic interaction derailments and compatibility of any suggested new limits with the rolling stock.
>
> This study was engaged in August 2008.
>
> It has been broken into 5 stages which summarised briefly look at:
>
> Stage 1: Review of track standards applied outside NZ compared to NZ Standards applied to EM80 recorded track data, NZ vehicle types, NZ wagon loading guidelines, NZ wagon maintenance standards.
>
> Stage 2: Calibration and testing of EM80
>
> Stage 3: Vampire model validation of freight wagons fitted with 3 piece bogies
>
> Stage 4: Proposed revision to the assessment criteria applied to EM80 recorded track data, impact of proposed track new assessment criteria on track fault numbers and track maintenance.
>
> Stage 5: Compatibility of new criteria with NZ vehicles drawing on validation work from Stage 3.
>
> Introduction and review of new criteria.
>
> Stages 1 & 2 have been completed but Stage 3 requires work with PSG.
>
> Next steps are to embark on Stages 3 & 4 concurrently if possible.

2.19 Despite the original safety recommendations regarding the establishing of compatible standards being accepted by the Chief Executives of Toll Rail and Ontrack in April 2005, there has been to date no changes to the track and wagon maintenance tolerances, and derailments continue to be attributed to dynamic interaction.

Emergency response

2.20 The train control centre was the receiving point for all notifications of emergencies on the rail network and this derailment revealed a number of areas where improvement could be made. When the train crew notified the train controller of the derailment, they emphasised that empty LPG tanks were involved, which should have resulted in a full emergency response to the derailment, but instead immediate action was focused on making arrangements with Toll Rail staff to relieve the train crew.

[25] Ontrack advised that Stage 6 was on time and it expected validation of the new tolerances to commence in 2009.

2.21 The train controller was not familiar with the documented procedures for dealing with derailed LPG tanks and had not therefore appreciated the potential seriousness of the situation. Equally, neither of the respective network control managers was familiar with the appropriate response to the accident. This lack of appropriate response mirrored concerns raised in the Commission's rail occurrence report 02-116.

2.22 There were differences in how staff were instructed to respond to an accident involving LPG tanks, depending on what set of procedures were followed: those contained in the National Rail System Standards, those in Ontrack's operating rules and procedures, or those in Toll Rail's operating codes and supplements. Some examples were:

- the Macro Process contained in the National Rail System Standard (see Figure 7) required that the train controller notify the network control manager of any accident or incident and the network control manager was responsible for notifying all other parties. However, Ontrack's in-house rail operating rules required that if a derailed wagon containing hazardous freight was on a train that was not at an attended station the train controller, once they were notified, was responsible for advising all concerned
- Ontrack's Rule 133 required that when an LPG tank was involved in a derailment, the Labour Department Inspector of Explosives was to be advised immediately, yet Toll Rail's code directed that in such circumstances the Commerce Commission Inspector of Explosives was to be notified. As it happened, neither was called and had the central services manager of United Group Rail not contacted Liquid Gas Services and asked a representative to attend prior to recovering the tanks and derailed wagons, it is possible that no such expert would have been involved
- Toll Rail's Conveyance of Dangerous Goods Code Supplement clause 10.1.5 stated that the precautions and actions required to be taken with loaded LPG wagons applied also to empty LPG wagons, but there was no such reference in Ontrack's documentation. Copies of this Code Supplement were available in the train control centre but the train controller was unaware of this, as were both involved network control managers.

2.23 The train controller reported the derailment to the line-haul services manager. The line-haul services manager did not notify emergency services, nor was there a requirement to. Both Rule 133 and the Occurrence Management Principles line diagram from the National Rail System Standard showed that when a derailment occurred on the controlled network the responsibility for notifying emergency services rested with the train controller and, through them, the network control manager. These documents stipulated that it was the responsibility of the network control manager to appoint a rail incident controller, but on this occasion this was done by the line-haul services manager instead.

2.24 The fact that copies of the Conveyance of Dangerous Goods Code Supplement were available on the train control desks for reference but that the train controller and both of the network control managers, 3 of 35, were unaware of the instruction relating to empty LPG tanks involved in derailments suggested that the presence of the Code Supplement, or at least this clause, was not well known amongst the train control centre staff. This was of concern given the regular movement of loaded and empty LPG tanks across the rail network. A safety recommendation has been made to the Chief Executive of the NZ Transport Agency relating to rules and procedures for the conveyance of dangerous goods in general and LPG in particular.

2.25 The response to the derailment was disjointed, with both Ontrack and Toll Rail staff being unaware of their respective responsibilities and working from either conflicting or no documentation. This resulted in critical notifications and actions, such as notifying emergency services and an LPG expert, not being taken until several hours after the derailment.

2.26 A factor contributing to this failure to follow the correct procedures was the fragmented way in which the relevant rules, procedures and instructions were documented through 3 reference manuals, namely the Rule Book, the Conveyance of Dangerous Goods Code Supplement and the National Rail System Standard.

2.27 The Commission has previously made reference, in report 07-110, collision between express freight Train MP2 and Work Train 22, Ohinewai, 19 June 2007, to the importance of having a clear set of unambiguous rules with which all participants are familiar. The report commented that simply having a set of rules is not enough. The implementation of those rules, staff knowledge of them and, more importantly, when the rules change, then all staff need to be made aware of those changes, not simply by issuing bulletins and then assuming that all staff read and understand the content.

2.28 Report 07-110 also commented that having the national standards under the control of the participants, with minimal oversight from the regulator, added another level of risk and that his could have been one reason for the poor standards of training, poorly written procedures, inadequate documentation, and unclear rules and violations of those rules going unnoticed by the regulator and Ontrack for some time.

2.29 A recommendation was made at that time for the Chief Executive of the NZ Transport Agency to address the safety issue whereby the rules-based system adopted by the rail industry in New Zealand was overly complex and relied heavily on employees' knowledge of it and that the training and assessment programme for ensuring compliance did not in that case result in a safe operation. The lessons about rule complexity learned from the Glenbrook inquiry, and the similarities to the New Zealand railway rules system, suggested that the rule complexity issue might be widespread throughout the New Zealand rail system.

2.30 The inconsistencies of the rules and standards in this case show some similarity to those identified in report 07-110, so the recommendation is equally applicable to this incident.

3 Findings

3.1 Express freight Train 533 was being operated within the temporary speed restriction maximum authorised speed and the actions of the locomotive engineer did not contribute to the derailment.

3.2 The derailment was probably caused by dynamic interaction resulting from a combination of the floats on the bogies of UK10696 being at the lower end of code limits, the cyclic twists in the track and the speed at which the train happened to be travelling, each of which on its own would not have been sufficient to cause the derailment.

3.3 The float clearances on both bogies of UK10696 had been measured as at Code limit during the C-Check but the floats had not been adjusted. Had the wagon floats been adjusted, the risk of this derailment would have been reduced.

3.4 The Class 1 track geometry exceedances identified by the EM80 had not been fixed at the time of the derailment, but a temporary speed restriction of 25 km/h for all trains had been imposed across that section of track.

3.5 The individual track twists were only at the mid range of the maintenance tolerance limits, but because each ran into the next in a cyclic manner they created a higher risk of a derailment. Had they been fixed, the derailment would probably not have happened.

3.6 Ontrack's train controller and network control managers on duty were unaware that empty LPG tanks were classified as dangerous goods and therefore did not follow the notification procedures as documented. As a result emergency services were not initially notified.

3.7 There were shortcomings in the knowledge and training for dangerous goods emergency response rules and procedures by staff in both Ontrack and Toll Rail. This, together with the fragmented documentation, contributed to the disjointed response to the derailment as staff from both Ontrack and Toll Rail was unaware of their respective responsibilities. The result was that some critical notifications and actions were not taken.

4 Safety Recommendations

4.1 On 19 August 2009, it was recommended to the Chief Executive of the NZ Transport Agency that he address the following issues:

4.1.1 The current track and mechanical code standards and maintenance tolerances are not compatible and there remains a high risk of derailments caused by dynamic interaction (029/09).

4.1.2 The response to the derailment was disjointed, with both Ontrack and Toll Rail staff being unaware of their respective responsibilities, with the result that critical notifications and actions were not taken immediately and some, such as notifying emergency services and an LPG expert, not being taken for several hours following the derailment (030/09).

4.1.3 There were discrepancies between the Rail Operating Rules and Procedures, the Rail Operating Code, the Conveyance of Dangerous Goods Code Supplement and the National Rail System Standard in how to respond to a derailment involving empty LPG wagons, and staff were not appropriately trained and familiar with the correct procedures to follow. (031/09).

4.2 On 14 September 2009, the Chief Executive of the New Zealand Transport Agency replied in part as follows:

> We intend to work closely with KiwiRail with an aim to implementing and closing these recommendations as soon as practicable.
>
> Discussions on them will commence on Wednesday 16 September and will be ongoing. Any outstanding Transport Accident Investigation Commission (TAIC) recommendations also form an integral part of our annual safety assessments of the rail industry.

Approved on 20 August 2009 for publication

Hon W P Jeffries
Chief Commissioner

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05-115	Empty passenger Train 2100, train parting and improper door opening, Ranui, 1 April 2005

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