Report 98-102

Train 924

derailment

near Balclutha

16 February 1998

Abstract

On Monday, 16 February 1998 at approximately 1630 hours, Train 924, a northbound Invercargill to Dunedin express freight was travelling at the maximum allowable line speed of 80 km/h when the locomotive engineer noticed a minor alignment ripple in the track ahead. The locomotive negotiated this area with only a slight lurch but 14 of the wagons in the body of the train became derailed as they traversed the misalignment. Similar occurrences could be prevented by reinforcing known procedures for identifying predictable high risk areas and destressing or applying appropriate speed restrictions. Two safety recommendations were made to the operator to effect these measures.

Transport Accident Investigation Commission

Rail Incident Report 98-102

Train type and number:	Express freight 924
Date and time:	16 February 1998, at approximately 1630 hours
Location:	Near Balclutha at 473.76 km Main South Line
Type of occurrence:	Derailment
Persons on board:	Crew: 1
Injuries:	Nil
Damage:	100 m of damaged track, 14 damaged wagons
Investigator-in-Charge:	R E Howe

1. Factual Information

1.1 Narrative

1.1.1 On Monday, 16 February 1998 Train 924, a rostered northbound Tranz Rail Limited (Tranz Rail) express freight was operating between Invercargill and Dunedin.

1.1.2 The train consist was locomotive DXR 8007 and 27 loaded wagons with an all-up weight of 1121 t. The train was crewed by a locomotive engineer (LE) and had departed Clinton (23 km to the south of the derailment site) at 1605 hours where it had crossed the southbound *Southerner*.

1.1.3 The LE stated his train was approximately 12 km south of Balclutha and travelling at 80 km/h (the maximum allowable line speed) when he observed a "wriggle" in the track 25 m ahead. He realised that it could be a heat misalignment but was not unduly perturbed by the slight "rumble" as the locomotive negotiated the area. The LE described the misalignment as being "just a general wriggle, very slight and very short" and he did not reduce speed.

1.1.4 The LE was in the process of noting the kilometrage for reporting purposes when he observed his train was losing speed and on looking back he saw that the wagons in the middle of the train had become derailed.

1.1.5 Fourteen wagons in the body of the train derailed, leaving six wagons at the head unaffected and seven wagons at the rear which stopped short.

1.1.6 The previous train over the area was the southbound *Southerner* at approximately 1535 hours and no abnormality was noticed by the LE of that train. However he did call up train control later to report a heat buckle he observed at 504 km shortly after leaving Clinton.

1.1.7 The local line gang were advised of the buckle at 504 km and were in the process of travelling to Balclutha to collect the equipment to repair it when they got the call to go to the derailment near Balclutha.

1.2 Track details

1.2.1 The track in the area of the derailment consisted of 91 pound/yard rail fixed by "N" type screw fastenings onto treated pinus radiata (TPR) sleepers. Twenty five percent of the sleepers had been spot resleepered as a result of derailment damage in 1991. Rails, sleepers and fastenings were in good condition. No rail anchors were fitted.

1.2.2 Tranz Rail's Code Supplement CSP/39 covered the use of rail anchors. The relevant clauses are included in Appendix 1.

1.2.3 As a result of the track damage sustained on 16 February 1998, the exact point of derailment (POD) could not be determined. Examination of the track either side showed that all fastenings were tight with no visual evidence of relative movement of the rail through the fastenings or movement of the sleepers. The POD was at 473.76 km approximately.

1.2.4 The 91 pound/yard rail had been laid in 76 m lengths in 1973. It was welded into continuously welded rail (CWR) in February 1990 at a reported rail temperature of 20°C and at an unknown stress.

1.2.5 Tranz Rail's CWR design was based on forming CWR with a neutral temperature range of 27°C to 35°C to allow for a maximum rail temperature of 67°C.

1.2.6 The CWR track had not been destressed. In 1995 it had been assessed as requiring destressing but it was not in the 600 km of high priority destressing identified in an 1800 km programme at that time.

1.2.7 The ballast in the area of the derailment consisted of clean crushed metal and conformed to Tranz Rail Code requirements for CWR.

1.2.8 Apart from the area of track damaged by the derailment, the alignment and level of the track either side was to a high standard. The last track recording car run on 10 February 1998 (six days prior to the derailment) showed track parameters were well within allowable tolerances at that time.

1.2.9 The Tranz Rail track inspection diary for the gang length showed that no corrective action had been logged for the area. The Code requirement for a twice weekly patrol of the gang length to ensure the safety of track for the passage of trains had been carried out.

1.2.10 On 24 December 1997, the local ganger noticed a "kick in the track" approximately 450 m north of the POD which was taken to be a heat buckle. To correct this, approximately 40 mm was cut out of the rail (in CWR track) after 50 m either side had been locally stress relieved. This limited stress relieving was achieved by loosening the rail-to-sleeper fastenings 50 m either side of the cut and allowing the rail to expand to its free length at an unrecorded rail temperature.

1.2.11 The last time the track had been disturbed prior to this was when it had been ballast tamped on 6 December 1997.

1.3 Site details

1.3.1 The derailment occurred 1.4 km down a 2.0 km long nominal 1 in 70 down grade and near the exit of a 700 m radius left hand curve (in the direction of travel).

1.3.2 A public level crossing (Stonehouse Road) was situated at 473.27 km, approximately 500 m north of the POD and 50 m north of the December 1997 buckle.

1.4 Temperature conditions

1.4.1 As with all east coast areas, the area around Balclutha had been experiencing hot, dry conditions for some weeks and air temperatures had been consistently high over a considerable length of time.

1.4.2 The nearest Meteorological Services of New Zealand Limited (MetService) temperature recording station to the derailment site was at Finegand, Balclutha, where a maximum air temperature of 29.5°C had been recorded on Monday 16 February 1998. The temperatures recorded for February 1998 were the warmest on record since the setting up of the recording station in 1990.

1.4.3 Tranz Rail advised that the rail temperature at McNab (60 km to the south) was measured as 44°C at mid afternoon on Monday 16 February 1998.

1.4.4 When the local line gang arrived at the derailment site they recorded a rail temperature of 38°C at approximately 1715 hours. This was taken at the 473 km, some 760 m north of the POD, at a less sheltered site. The ganger stated the rail temperature at the POD would have been "one or two degrees higher".

1.4.5 Tranz Rail advised that the rail temperatures over the gang length had exceeded 44°C in recent years with no visible track alignment problems, and no requirement for heat speed restrictions. Track staff stated they were aware of the special requirements associated with CWR and precautions to be taken in hot weather. In their opinion they considered that no precautionary actions were necessary at this site as a result of the unusually high temperatures that were experienced in February 1998.

1.4.6 Tranz Rail had automatic rail temperature sensors at various locations to alert train control of excessive heat. The nearest sensor to the POD was at Herbert, some 197 km to the north, which was too far away to be useful.

1.5 Personnel

1.5.1 The length ganger had 20 years rail experience, the last eight years as ganger with all of that time being spent in the Balclutha area. His area of track responsibility was from Stirling (458.5 km) to near Waipahi (544.3 km), a total length of 85.8 km.

1.5.2 The track patroller had 13 years railway experience, having had service at Palmerston, Oamaru, Waitati and for the last three years as track patroller based on Dunedin. His area of patrol covered from Dunedin south to Invercargill and all branch lines. He was responsible to the Track and Structures Manager.

1.5.3 The Line Inspector started with New Zealand Railways in 1970 as a drafting cadet, progressing to Senior Engineering Officer, Senior Engineer and for the last four years as Line Inspector. All of his time had been spent in Dunedin. He was responsible to the Manager, Track Maintenance (Wellington) for inspecting all track on a yearly basis south of Rakaia, a total of approximately 650 km. At the time of the derailment he had been acting for two weeks as the Track and Structures Manager in the area.

1.5.4 The Track and Structures Manager had 25 years rail experience in various track gang positions in a number of locations with the last seven years in Dunedin as Track and Structures Manager (or equivalent). His area included all main line and branch track south of Temuka covering approximately 600 km.

1.5.5 All these track staff held the qualifications required by Tranz Rail for the duties being performed.

1.6 Event recorder

1.6.1 No locomotive log was available to confirm speed and other operating details due to a transducer fault in the event recorder.

1.7 Patrols and inspections

1.7.1 Tranz Rail Code Instruction P.22 made provision for special patrols to safeguard the passage of trains in times of possible danger, which included "when there is a possibility of a track buckle".

1.7.2 Tranz Rail Code Instruction P.90 stipulated the precautions to be taken in hot weather when rail temperatures were high, and had two categories: "areas of known risk", and "areas not of high risk".

1.7.3 For "areas of known high risk", the precautions to be taken were:

1. When temperatures are increasing and exceed 40°C reduction of train speed must be considered.
2. If rail temperatures exceed 50°C or other unstable track conditions are evident, consideration must be made to stop trains or pilot trains.
3. All trains (including passenger) should have speeds reduced to 40 km/hr, or lower depending on site conditions, when rail temperature is 40°C and still rising. This applies to track that has a high risk of buckling or that has a known problem which has not been corrected.
4. Track staff are to monitor rail temperatures and advise train control when speed restrictions are to be enforced. They will also advise train control when speed restrictions are to be lifted unless otherwise shown on a train advice.
5. Patrols are to be carried out. Refer clause P.22

Track affected:

1. That track identified and listed will have speed restrictions applied as above.
2. Other track that will be affected is:
   - track recently disturbed by tamping
   - track with a reduced number of effective fastenings due to track work being carried out or deteriorating track condition.

There were no defined high risk areas in the gang length.

1.7.4 For areas "not of high risk", Code Instruction P.90 stipulated:

> Track that is deemed to be not a high risk may also have speed restrictions applied when rail temperatures are well in excess of 40°C. This will be at the discretion of the Track and Structures Manager (T&SM) and in consultation with Manager Track Maintenance (MTM).

1.8 CWR destressing

1.8.1 Tranz Rail advised that its programme formulated prior to the 1995/1996 financial year identified approximately 1800 km of mainline track that needed destressing.

1.8.2 Of this track 600 km was assessed as having a high priority based on cumulative weighting factors given to the following items which were considered by Tranz Rail likely to affect the track stability:

Item		Weighting factor
a)	sleeper age (and type)	0 if satisfactory, 1 if considered a factor
b)	fastening type	0 to 1 as above
c)	grade	0 flatter than 1 in 80, otherwise 1
d)	single direction tonnage	allocated 0 or 1

e) history — 5 if a previous buckle had occurred

3 if no buckles but site obviously under compressive stress

1 if CWR with unknown neutral temperature
Otherwise 0

1.8.3 A rating of 4 or greater was defined as "high priority". This "high priority" group was further sub-divided so that those areas that included a previous history of buckling were given a higher priority than those areas that had no previous history.

1.8.4 The rating for the track in the area of the derailment was a total of 4, one point factor each from items a), b), c), and e) above. Because the area was recorded as having no previous buckle history, it was allocated a low priority in the "high priority" grouping.

1.8.5 Tranz Rail advised in April 1998 that of the 1800 km originally identified as requiring destressing, 1100 km had been destressed. Some of the areas destressed included adjacent low priority areas, where for practical reasons it was economic to do work in a face. Making allowance for this and the subsequent reassessment of CWR sites, 200 km of the original "high priority" list had not been addressed as at April 1998. Some of these sites had been subject to "Heat 40" temporary speed restrictions over the summer months. In addition a total of approximately 900 km of low priority sites were still to be addressed, made up of the original 500 km which had been deferred and a further 400 km identified since 1995.

2. Analysis

2.1 General

2.1.1 This derailment had a number of similarities to a heat buckle derailment near Scargill on 5 February 1998, (TAIC Report 98-101).

2.1.2 Various factors that had to be taken into account to ensure that CWR track was kept stable within the design temperature range included:

1) the rail temperature
2) ballast grading
3) ballast profile
4) sleeper condition
5) fastening integrity (the ability of the fastenings to hold the rail firmly)
6) buckling history
7) rail bridges, level crossings, or other obstructions at which track is effectively anchored and adjacent track can bunch up if the fastenings allow longitudinal rail creep
8) presence of warning signs (misalignment in hot weather, rail creep)
9) recent track disturbances (tampers, resleepering, derailment damage)
10) weather patterns (first hot day after cool weather, exceptionally hot days, lack of wind)
11) microclimates (sheltered valleys, cuttings, windbreaks)
12) track gradient (rail creep can occur downhill, contributing to a buckle at the bottom of a grade)

13) traffic flow and braking patterns

14) track curvature

Factors 1), 5), 6), 7), 8), 10), 11), 12), 13) and 14) above all contributed to the instability of the track at the POD.

2.2 Ballast profile

2.2.1 The ballast depth, quality and profile in the general area of the POD conformed to Code requirements. The exact ballast section at the POD could not be determined because of the subsequent derailment damage. However there was nothing to indicate that the ballast section in the area of the POD was substandard.

2.3 Track gradient

2.3.1 The nominal rail gradient of 1 in 70 at the POD was relatively steep by main line standards. Over a period of time such gradients can facilitate "rail creep" down the gradient. Tranz Rail's Code Supplement CSP/39 recognised this by requiring rail anchors to be doubled from 1 in 4 to 1 in 2 on grades steeper than 1 in 100.

2.3.2 This rail creep is accentuated with the continued braking of downhill trains and acceleration of uphill trains so that "bunching" of the rail tends to occur, particularly near the base of a grade, causing greater compressive stresses to be formed in the rail than would otherwise be the case. Any stresses that were already in the rail due to the CWR being laid outside the current neutral temperature range would accentuate the problem.

2.3.3 The absence of rail anchors in the area of the derailment would have accentuated the tendency for rail creep. Although there were no signs of rail-to-fastening movement to indicate "bunching" around the derailment site such movement does not always leave visible evidence.

2.3.4 The level crossing at the base of the grade tended to anchor any downhill track movement and effectively caused the adjacent track on the uphill side to bunch up. This was also the likely cause of the "kick in the track" on 24 December 1997. The stress relief achieved in 1997 was localised and would have had no effect on the track at the POD.

2.4 Track curvature

2.4.1 The compressive forces developed in CWR track as a result of hot weather are best resisted (all other things being equal) in straight track. In this situation the track is analogous to a column and is able to accommodate greater force so long as it is kept straight. With curved track or track that has been subject to lateral movement, the ability to resist buckling is reduced.

2.4.2 This is recognised in the higher sleeper standard required for CWR track that is curved. The resistance to buckling of CWR track becomes more important on curved track as the radius of the curve reduces. The CWR at the derailment site was laid on timber sleepers in a curve of 700 m radius and met Tranz Rail Code requirements for sleepers.

2.4.3 The "wriggle" in the track alignment which the LE said he observed was not sufficient to establish whether the misalignment was to the left or the right and after the derailment it was impossible to establish in which direction the track had buckled.

2.5 Rail temperatures

2.5.1 The rail at the POD was laid in 1973 at an unknown temperature. In 1990 when the rail joints were welded it was noted that the rail temperature was 20°C but no effort was made at that stage to unfasten the rails and destress them, resulting in an unknown stress in the rail at the time of welding.

2.5.2 The rail temperature (38°C) recorded near the POD some 45 minutes after the derailment was low compared with the maximum design rail temperature for CWR of 67°C, and would not normally be associated with potential buckle condition. The ganger's experience translated this to approximately 40°C at the POD.

2.5.3 The rail temperature recorded near the POD was considerably lower than the temperature taken at McNab (44°C) earlier on the same day. The fact that there had been previous high rail temperatures in the general area of 44°C and that the air temperatures recorded for February by MetService were the highest on record since 1990, indicates the rail temperature was likely to have been higher than the single low reading taken near the POD some time after the derailment.

2.5.4 Tranz Rail's reference in the information in Code Instruction P.90 (refer paragraph 1.7.4) to rail temperatures "well in excess" of 40°C was too vague to assist the reader in assessing the need to post speed restrictions in areas which were "not of high risk".

2.6 Rail stresses

2.6.1 CWR must be formed and maintained in accordance with well proven standards to ensure that the stress generated can be kept within acceptable limits. If CWR is not formed to these standards, then there is no way of subsequently establishing whether the rail stress is within acceptable limits. The only way to ensure that rail stress is within acceptable limits is to destress the rail under controlled conditions.

2.6.2 In addition to specific requirements for the ballast, sleepers, and fastenings, it is essential that CWR is formed to be stress-free within a defined neutral temperature range.

2.6.3 The neutral temperature has been set taking into account the likely maximum and minimum rail temperatures which may be encountered, so that maximum compressive and tensile stress caused by hot and cold weather respectively, can be safely catered for within the track. With progressive research on CWR, the effective neutral temperature has been increased to decrease the compressive stresses induced by heat and the current range is 27°C to 35°C.

2.6.4 The heat induced forces in rails are significant. For every 1°C rise in temperature above the neutral temperature, a longitudinal force of 2.4 t is generated within track laid in 91 pound/yard rail. Thus at a rail temperature of 67°C (the design maximum for New Zealand conditions), a maximum force of 96 t could be experienced.

2.6.5 Buckles occur in locations where rail stresses build up to an extent that they cannot be resisted by the track structure itself. Once an excessive compressive stress is built up in the rails, buckles are initiated by some triggering factor. The most common such factors are minor misalignments in the line of the track, local weak spots, and the approach or passage of a train. However initiated, a buckle can develop almost instantaneously.

2.6.6 The "wriggle" observed by the LE at the POD was a typical indication of unstable track due to heat. Untouched, the resistance provided by the track may have been sufficient to hold the track from further movement. However the passage of the locomotive at full line speed would have reduced the resistance provided by the ballast and provided the trigger for a track buckle to occur under the following wagons.

2.6.7 The possibility that the derailment was caused by an alignment fault not associated with excessive compressive stress in the rail was considered but discounted for the following reasons:

- the LE of the *Southerner* less than an hour earlier reported no faults over this area,
- the LE of train 924 was not perturbed by the small wriggle he saw in the track, although he considered it reportable,
- the track recording car trace six days prior to the derailment showed no evidence of any alignment fault,
- the track 450 m to the north of the POD had already required local stress relief due to high rail temperatures causing misalignment just prior to Christmas.

2.7 Rail anchors

2.7.1 Tranz Rail advised the intent of Code Supplement CSP/39 was that requirements for rail anchors had to be met when carrying out any of the works defined in clause 1.2 of the Code (refer Appendix 1) but did not have to be met for existing sites until such work was carried out. This intent was not clear in the Code Supplement and requires clarification.

2.7.2 Tranz Rail advised that existing timber-sleepered CWR sites without the rail anchors required by Code Supplement CSP/39 were given a fastening rating of 1 (refer paragraph 1.8.2) when assessing sites as “areas of known risk” or “areas not of high risk” and it was the lack of rail anchors which resulted in the 1 rating under this heading for the derailment site.

2.8 Track stability

2.8.1 The track staff in the area considered the track was in good condition and this was supported by the track recording car output and riding characteristics. There appeared to be common lack of appreciation of the potential cumulative affects of rail temperature, gradient, curvature, and obstructions such as level crossings on track stability. In particular, the “kick in the track” in 1997 which required 100 m of localised stress relief some 450 m north of the POD did not result in a reassessment of the stability of the grade and effective action to ensure safe operations.

2.8.2 Tranz Rail’s priority system for destressing gave a weighting of 1 to CWR formed at an unknown temperature. This factor is considered to be too low when compared with the other weightings used to define priorities.

2.8.3 Tranz Rail’s safety system should have recognised the significance of the 24 December 1997 misalignment and reassessed the classification of the area at the foot of the 1 in 70 grade in terms of their established criteria. The limited destressing done in December 1997 would have transferred the potential weak spot up the grade. Although 450 m away from the first misalignment, the POD was in the first significant curve south of the original misalignment.

2.8.4 It is of concern that the southbound *Southerner* travelled over the area less than one hour before the heat buckle derailment of Train 924.

3. Findings

Findings and safety recommendations are listed in order of development and not in order of priority

3.1 The train was being operated normally prior to the incident.

3.2 Rails, sleepers and fastenings were in good condition and well maintained.

3.3 The ballast depth and cross section was to Code requirements.

3.4 The rail temperature at the time of the derailment was within the design temperature range for CWR had the track been laid stress free within the neutral temperature range.

3.5 The stress in the rails when the CWR was formed in 1970 was not known.

3.6 The particularly high air temperature on the day of the derailment almost certainly resulted in a rail temperature at the POD in excess of 40°C, with associated high compressive stress due to heat.

3.7 Although there was no visible evidence of downhill bunching it is likely that this contributed to the compressive stress in the rail.

3.8 The combination of compressive stresses present in the track were at a maximum in a curve near the foot of a grade prior to the anchorage provided by the level crossing.

3.9 The minor track "wriggle" seen by the LE was a typical indication of track under severe compressive stress.

3.10 The track buckled under the train because it could not contain the compressive stress over the misalignment when the ballast resistance was lowered by the passage of the train over the section.

3.11 Action should have been taken to upgrade the area to "high risk" following the local action necessary to correct a "kick in the track" to the north of the POD on 24 December 1997.

3.12 A discretionary speed restriction should have been in force in accordance with Tranz Rail Code Instructions P.22 and P.90 as a result of the unusually hot weather and rail temperatures in the area.

3.13 Rail creep would have been more effectively resisted if rail anchors had been fitted.

3.14 Despite their qualifications, experience and recent training, track staff lacked sufficient knowledge of the factors affecting stability at the site and the need for the precautionary actions that were detailed in the Tranz Rail Code.

3.15 The factors for assessing priorities for destressing were not sufficiently weighted to reflect the potential instability of those areas of CWR track that had been installed at an unknown neutral temperature.

3.16 The method of rating and prioritising track with buckling potential was inadequate to protect a predictable weak site.

4. Safety Actions

4.1 The Commission's investigation into a heat buckle derailment at Edendale on 13 December 1994 (Railway Occurrence Report 94-127) led to a number of safety actions and safety recommendations. Some were specific to the Edendale site but others were more general.

4.2 Actions taken by Tranz Rail (then New Zealand Rail Limited [NZRL]) immediately following the Edendale derailment included:

- A new national priority list was compiled for destressing 38 m and 76 m rail lengths and longer lengths of CWR based on age and type of components and factors such as grade, buckling history and particular local maintenance problems. NZRL's intent was to complete action on this list in priority order within two years.
- NZRL reviewed training needs and introduced a specific retraining programme for Track and Structures Managers and Gangers, which included consideration of track buckles.

4.3 The Commission made four safety recommendations to NZRL as a result of the Edendale derailment. These were for NZRL to:

- Review the training, knowledge and experience of track and structures managers, gangers, and those required to act in such positions, in respect of their ability to identify and understand the factors leading to track buckles and to make timely and safe decisions about the application of speed restrictions in hot weather. (021/95)
- Ensure systems are in place to assess the competency of any appointed or acting track and structures manager or ganger concerned to make such decisions. (022/95)
- Review the adequacy of existing codes and procedures and amend as necessary to ensure they include unambiguous guidelines as to:
    - When, how and where to measure rail temperatures.
    - A check list of conditions which identify clearly track which may be prone to buckling.
    - How to interpret the results of rail temperature measurements, and apply them to the immediate actions to be taken in respect of track which may be prone to buckling in order to ensure train safety when critical conditions are identified.
    - The follow up actions to be taken to ensure on-going safety. (023/95)
- Undertake a review of the current safety management system relating to the installation, maintenance and operation of CWR track, and take appropriate steps to address those failings in the system which were identified as contributory to Edendale, prior to the 1995-96 summer season. As part of this review, particular attention should be paid to:
    - The adequacy of standards and procedures relating to the installation and maintenance of CWR track.
    - The compliance with standards and procedures relating to the installation and maintenance of CWR track.
    - The adequacy of instructions and procedures for patrolling track buckles in hot weather.

- The effectiveness of the training of track staff responsible for the safety of CWR track. (024/95)

NZRL accepted all the safety recommendations and indicated action would be taken, and would be ongoing.

4.4 The following information supplied by Tranz Rail details reported track buckles and resulting derailments since 1994:

1994/95	175 buckles	8 derailments at track buckles
1995/96	66 buckles	3 derailments at track buckles
1996/97	61 buckles	2 derailments at track buckles
1997/Feb 98	54 buckles	2 derailments at track buckles

Notwithstanding seasonal factors there has been a marked improvement in reducing the number of occurrences since 1994.

4.5 For the 1998/1999 financial year, Tranz Rail stated that it planned to destress up to 200 km of track to deal effectively with outstanding high priority work.

4.6 Although it is evident that Tranz Rail took effective action on safety recommendations arising from the 1994 incident, there are still significant gaps in the rationale for assessing sites at risk (safety recommendations 021/95 and 022/95) and protecting those sites until suitable improvements can be made (safety recommendation 023/95).

5. Safety Recommendations

5.1 On 3 April 1998 it was recommended to the Managing Director of Tranz Rail that he:

5.1.1 Review the programme for destressing all CWR laid at unknown neutral temperatures to ensure that potential buckle sites such as curves on steep grades are given greater priority and that appropriate heat speed restrictions are imposed until destressing is achieved, (013/98); and

5.1.2 Review the criteria for instituting heat patrols to take account of the unknown factor of safety associated with CWR formed under uncontrolled conditions. (014/98)

5.2 On 23 April 1998 the Managing Director of Tranz Rail responded as follows:

5.2.1 **013/98** The issues raised in your safety recommendations have been identified by Tranz Rail and their implementation along with other inputs are being managed as part of our on going CWR management process.

5.2.2 **014/98** The review is planned as part of our management of CWR.

Approved for publication 5 August 1998

Hon. W P Jeffries
Chief Commissioner

Appendix 1

Extract from Tranz Rail Code Supplement CSP/39.

Rail Anchors

1. General

1.1 Rail anchors are to be installed in certain locations to prevent rail creep through the fastenings. This is caused mainly by train traction and braking forces. They are also for installing adjacent to bolted joints in welded track sections to reduce rail-end movement.

This Code Supplement advises where rail anchors are to be installed.

The most important locations are:

a) At termination joints and level crossings.

b) On the approaches to turnouts (unstrengthened).

c) On steep gradients.

d) On lines where there is mainly heavy train loadings in one direction, or double-track sections with one way running of trains.

e) In all other places where train braking occurs regularly, or rail creep is a known problem.

1.2 The criteria for establishing effective anchoring is detailed in the following sections.

It is a requirement to effectively anchor rail when either of the following are being done:

- Installing insulated joints
- Rerailing
- Rail destressing
- Resleeper with TPR sleepers
- Rail transposing
- Crop and drift work

2. Where to install

2.1 C.W.R

Rail anchors are to be installed in CWR such that effective anchoring is of at least 1 in 4 sleepers is achieved.

However, there is a need to have a transition from 100% anchoring to 1 in 4 anchoring. This must be as follows:

From 100% anchor, 40 sleepers 1 in 2 effective anchoring, 1 in 4 effective anchoring.

There will also be an anchoring pattern at the end of CWR lengths. This will apply to termination joints, sealed level crossings, other hard crossings more than 5 metres wide and some bridges.

For termination joints and applicable level crossings the following will apply:

> *40 sleepers 100% anchored, 40 sleepers 1 in 2 effective anchoring, 1 in 4 effective anchoring.*

This would apply to both sides of the joint or crossing.

2.2 Non C.W.R

Minimum requirements for anchoring in non CWR is 1 in 4 sleepers effectively anchored.

For track adjoining CWR the criteria in 2.1 are to be met.

2.3 All track on grades

On grades steeper than 1 in 100, anchor ratios are to be doubled from 1 in 4 to 1 in 2.