NO. 93-124

TRAIN 248

TE KAUWHATA

6 DECEMBER 1993

ABSTRACT

On 6 December 1993 an express freight train operated by New Zealand Rail Limited derailed when it entered a crossover at the south end of Te Kauwhata while travelling too fast. The locomotive and all twelve wagons in the train were derailed, with substantial damage to all vehicles and the track. The Locomotive Engineer had encountered a signal he did not expect, interpreted it wrongly, and failed to slow the train for passage through the crossover. The safety issues identified in this report are the use of radio communication to advise Locomotive Engineers of infrequent or unusual train movements and the maintenance of locomotive event recorders.

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

RAIL INCIDENT REPORT NO. 93-124

Train Type and Number:	Express Freight 248
Locomotive:	DF6300
Date and Time:	6 December 1993, 1740 hours
Location:	Te Kauwhata 591.52 km North Island Main Trunk
Type of Occurrence:	Derailment
Persons on Board:	Crew: 1
Injuries:	Crew: Nil Others: Nil
Nature of Damage:	Substantial damage to locomotive, wagons, and track.
Information Sources:	Transport Accident Investigation Commission field investigation
Investigator in Charge:	Mr W J D Guest

1. NARRATIVE

1.1 Train 248 on 6 December 1993 was an express freight train from Huntly to Mission Bush near Waiuku. It consisted of a single DF class locomotive and 12 wagons, all but one of which contained coal from the mines at Huntly for the steel mill at Mission Bush. The gross weight of the train was 660 tonnes.

1.2 The train was operated by a Locomotive Engineer on his own. He had been a Locomotive Engineer for four years, was qualified first grade and certified to operate express freight trains in the Te Kauwhata section.

1.3 On the day of the derailment, the Locomotive Engineer booked on duty at his headquarters at Westfield Yard at 1305 hours, and drove a train from Westfield to Huntly. He transferred to operate train 248 to Mission Bush. He had not been driving trains for a week, and did not feel fatigued. He was fit for duty.

1.4 Train 248 departed from Huntly at 1720 hours, a short time after another northbound train, number 200. The Locomotive Engineer expected to follow 200 all the way to Paerata, and thence to Mission Bush.

1.5 Intermittent rain was falling, but the visibility was good.

1.6 About 16 km north of Huntly, the Locomotive Engineer approached a colour light signal designated 59006 by New Zealand Rail Limited (NZRL). The aspect it displayed was yellow over green i.e. the upper of the two light combination was yellow, and the lower one was green.

1.7 The yellow over green aspect was defined in the Signalling Regulations of New Zealand Rail as:

Meaning	Name
Proceed at normal speed, prepared to reduce to medium speed at next signal - Section is clear and signal in advance is at "Caution" or "Clear" for medium speed only	Caution normal speed: Prepare to reduce to medium speed signal.

1.8 Medium speed was defined in the Signalling Regulations as:

> "Medium speed means train must not exceed 25 kilometres per hour unless a speed board authorising a higher speed is exhibited. Medium speed must be maintained up to the Advanced Starting signal, the Starting signal, or the Departure signal where provided; or where any such signal is not provided, until the train is clear of all points to which the signal applies."

1.9 The wording of the meaning of the yellow over green aspect was ambiguous. The words "prepared to reduce to medium speed at the next signal" did not specify clearly whether the reduction was to commence at or to be completed by the arrival of the train at the next signal. However, in the training of Locomotive Engineers and in normal operations the meaning of this aspect was taken to require Locomotive Engineers to reduce from normal speed to medium speed so that the next signal was passed at medium speed.

1.10 The common use of medium speed was to regulate the speed of trains through points and crossings (track structures where tracks connect together; the simplest and most common type was also called a turnout). Most points and crossings had a safe traversing speed of 25 km/h, although there were some higher speed designs. In most locations where these higher speed designs were installed, a train speed board was erected beside the track increasing the authorised speed from 25 km/h to the higher speed. This was the case at the north end of Te Kauwhata (see 1.30 et seq.).

1.11 The yellow over green aspect given by signal 59006 therefore advised the Locomotive Engineer that the next signal was displaying an aspect which required the train to pass it at medium speed, and that therefore he would be required to make a speed reduction before reaching that signal.

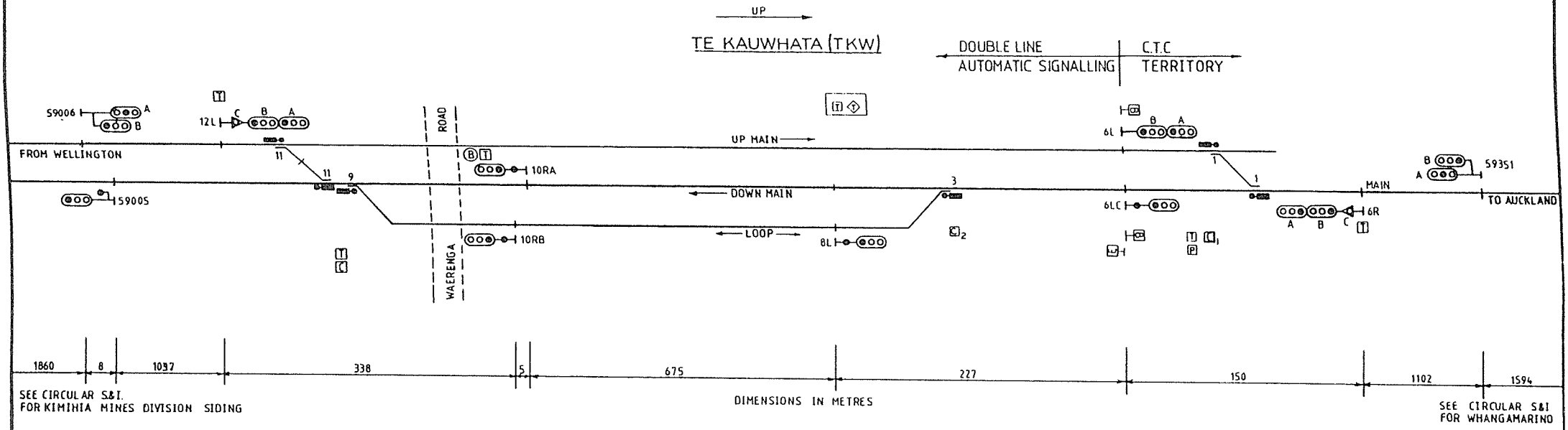
1.12 The signal after signal 59006 was signal 12L. It was located 1.045 km further along the track, close to the points leading to the crossing loop at Te Kauwhata. The medium speed aspect on signal 12L was only for movement off the main line and towards the loop. This aspect was not displayed for any other purpose at this signal.

1.13 The aspects of the signals and the layout and location of them at Te Kauwhata were shown in Signalling

CIRCULAR S & I 2063
SHEET No 3
No OF SHEETS 3

TE KAUWHATA

SIGNALLING & INTERLOCKING ARRANGEMENTS



- MOTOR POINTS
- 'C.T.C ENDS' BOARD
- 'CTC BEGINS' BOARD
- PILOT KEY
- TELEPHONE (AUTO)
- TELEPHONE (TRAIN CONTROL)
- CRANK HANDLE
- C_1 CRANK HANDLE (CODED) FOR USE WITH POINTS No 1
- C_2 CRANK HANDLE (CODED) FOR USE WITH POINTS No 3
- (B) BARRIER MANUAL CONTROL

for CHIEF SIGNALS AND COMMUNICATIONS ENGINEER

and Interlocking Circular (widely called an "S and I" Circular) No. 2063 available to all Locomotive Engineers and operating staff working over this part of the North Island Main Trunk. A copy of this "S and I" circular is attached as Appendix A.

1.14 The yellow over green aspect at signal 59006 therefore advised the Locomotive Engineer explicitly that the points at the south end of Te Kauwhata were set for the crossing loop.

1.15 The Locomotive Engineer was expecting to follow train 200 northwards. He was not expecting to be diverted into the loop. While he had driven trains into the loop at Te Kauwhata on other occasions, he had never been required to use the loop with an express freight hauling coal to Mission Bush.

1.16 The next signal after signal 12L was signal 6L, located at the north end of Te Kauwhata, 1.245 km beyond signal 12L. Signal 6L was the departure signal from Te Kauwhata.

1.17 Between Te Rapa and Auckland, the North Island Main Trunk (NIMT) railway consisted of double track except for a short stretch of single track between Te Kauwhata and Amokura where it crossed the Whangamarino swamp. Northbound trains leaving Te Kauwhata passed through points on to the single line, and signal 6L regulated this movement by displaying a medium speed aspect.

1.18 When signal 6L displayed a medium speed aspect, signal 12L preceding it would show a yellow over green aspect to an approaching train.

1.19 The Locomotive Engineer was therefore expecting to see a yellow over green aspect prior to entering the single line section of the NIMT.

1.20 After passing signal 59006 and noting the yellow over green aspect, the Locomotive Engineer overlooked signal 12L, and considered that he would pass signal 6L, following train 200. This course of action conformed with his expectation for the journey.

1.21 As he approached Te Kauwhata at a probable 80 km/h, he sighted signal 12L. It displayed red over green (proceed at medium speed), and he realised that he had made an error.

1.22 The Locomotive Engineer made a full brake application but was unable to slow the train to 25 km/h in the space available. He was unable to say what speed the train was doing when it reached the first set of points, but it was well above 25 km/h.

1.23 The speed of the train and the timing of the brake application could not be confirmed because the locomotive event recorder was not operating. It was a style of device which marked speed on a waxed paper tape, but it had run out of tape some time before the derailment.

1.24 The sighting distance of signal 12L was approximately 230 m. The train was descending a 1 in 115 grade which was easing to 1 in 435.

1.25 The policy of NZRL was to give sufficient sighting distance for a signal to provide at least 10 seconds visibility to the driver of the fastest train likely to approach it. This standard was met for trains travelling at 80 km/h.

1.26 As a test at the request of the Commission, NZRL braked a similar coal train from a speed of 80 km/h after sighting signal 12L, and recorded a speed of 62 km/h as the train reached the points. (The points for this test were set for the straight track). At this speed locomotives and most wagons would derail if directed to take the curved (turning) track through the points and crossings at the south end of Te Kauwhata.

1.27 The locomotives and wagons all derailed in the crossover and loop points. The locomotive came to rest on its side approximately 150 m beyond signal 12L, and 6 m away from the nearest track. The locomotive, wagons, and track were damaged substantially. While the speed of the train could not be determined from the post-accident positions, the opinion of operating and engineering staff was that it was consistent with an initial speed of 60 km/h.

1.28 Local residents heard the noise of the accident and advised emergency services, which attended promptly.

1.29 The Locomotive Engineer was shaken but uninjured. The locomotive's radio was still operative, and after a short delay caused by some confusion over the correct channel to use, the Locomotive Engineer advised Train Control of the derailment. The Train Control Officer stopped all trains approaching Te Kauwhata promptly, advised emergency services of the incident and called out senior staff to take charge at the site.

1.30 The turnouts at the north end of Te Kauwhata, regulated by signal 6L, were of a different design from those at the south end, and had a permissible speed of travel through them of 50 km/h. Signal 6L displayed the same medium speed aspect, and the higher permissible speed was advised to Locomotive Engineers by a painted speed board beside the track near the turnout.

1.31 The Locomotive Engineer was aware that he had to reduce speed to 50 km/h by the time he reached the north end of Te Kauwhata, but at no time had he contemplated a reduction to 25 km/h. Even at 50 km/h, the probability of derailment in the turnouts at the south end of Te Kauwhata would still have been high. This raised the issue in this investigation of whether a different signal aspect should be used to distinguish between a requirement to reduce speed to 25 km/h and to 50km/h at Te Kauwhata.

1.32 In some locations NZRL had introduced an aspect for a speed of 50 km/h, called intermediate speed. The aspect used the same colours as for medium speed, but the lower light flashed. If Te Kauwhata had been equipped with this system, then signal 59006 would have been the same, but signal 12L would have been a yellow over flashing green aspect to advise Locomotive Engineers that the next signal, 6L, was showing an intermediate speed aspect.

1.33 NZRL introduced the new aspect to deal with a specific problem at Westfield Junction in Auckland, where two closely spaced turnouts from the straight track had different permissible speeds. It would have been safe to have restricted all trains to the lower speed, but it was more efficient to permit trains to operate at the higher speed where possible. The use of a trackside sign was unsatisfactory because Locomotive Engineers had to reduce speed until they could observe the points on the turnouts. The new aspect enabled them to select the correct speed much earlier.

1.34 At Te Kauwhata, the situation was different in that no ambiguity existed. The yellow over green aspect on signal 59006 meant only one thing: that the points at the south end of Te Kauwhata were set for the loop, and that signal 12L required medium speed.

1.35 The automatic signalling system on NZRL was a speed signalling system, whereby the colour lights gave instructions about the section of track ahead, and also about the aspect of the next signal.

1.36 The philosophy behind the provision of automatic signals required that the Locomotive Engineer act upon the aspect of every signal, using his or her knowledge of train handling, and of the route, to control the train so that the aspect at the next signal could be obeyed.

1.37 Essential elements of route knowledge were the locations of signals, the location and steepness of grades, the location and sharpness of curves, and the authorised speeds.

1.38 Essential elements of train handling knowledge were the braking characteristics of trains on straight and curved tracks, and on grades, in both wet and dry weather.

1.39 Intermediate signals were not intended simply to shape the expectation of a driver prior to observing the next signal, but to provide information which had to be acted upon.

1.40 The signalling system would have had to be considerably more complex to give information about two signals in advance rather than one, and there were no identifiable benefits of doing so.

1.41 If the Locomotive Engineer had been expecting a yellow over flashing green aspect prior to reaching signal 6L, he may have been alerted by the yellow over green of signal 59006 that something was out of line with his expectation.

1.42 Train 248 was being diverted to the loop at the request of signals staff in order to "de-rust" the track. The loop and the crossover at Te Kauwhata were not used very often, and rust could develop on the surface of the rails. The rust could prevent reliable detection of trains on the track circuits, leading to faulty signal indications. The remedy was to ensure that the occasional train, preferably a heavy one, passed over the affected tracks.

1.43 The Train Control Officer noted the request of the signals staff, and set signal 12L accordingly. Signal 59006 automatically adjusted to the setting of 12L.

1.44 NZRL did not require the Train Control Officer to advise the Locomotive Engineer by radio that his train was to be diverted via the loop at Te Kauwhata, and the TCO did not do so. It was late afternoon, and he was busy controlling other train movements in the Auckland area. The automatic signalling system predated the installation of radio communications between Locomotive Engineers and Train Control, and had always worked without supplementary advice by radio.

1.45 The TCO did not consider the possibility that the Locomotive Engineer might have expected to proceed straight through Te Kauwhata.

1.46 The Locomotive Engineer was alone in the cab and did not have the assistance of a Train Operator who might have noticed his error.

1.47 The use of the radio to advise the driver that he would be diverted through the loop at Te Kauwhata to de-rust the rails may have averted this derailment.

2. FINDINGS

2.1 The signalling system worked correctly.

2.2 The aspect of signal 59006 informed the Locomotive Engineer unequivocally that he was required to slow to medium speed by the next signal which was signal 12L, and that the points were set for the loop at Te Kauwhata.

2.3 The Locomotive Engineer had an expectation that he would be following another train straight through Te Kauwhata and on to the single line section of track.

2.4 The Locomotive Engineer's expectation that he would proceed directly through Te Kauwhata was based on his experience of operating trains through Te Kauwhata.

2.5 The Locomotive Engineer interpreted the aspect of signal 59006 incorrectly to conform with his expectation.

2.6 The Locomotive Engineer did not realise his error until he saw signal 12L, by which time he was too close to the signal to slow the train sufficiently to conform with it.

2.7 The train entered the crossover at approximately 60 km/h rather than the authorised speed of 25 km/h, and derailed as a consequence.

2.8 The Train Control Officer was not required to advise the Locomotive Engineer of the intention to divert the train via the loop even though this was an unusual event.

2.9 If the Locomotive Engineer had been advised of the diversion to the loop, the derailment may not have occurred.

2.10 If signal 12L had been capable of displaying an intermediate speed aspect, the Locomotive Engineer may have realised that signal 59006 did not give information about signal 6L at the north end of Te Kauwhata.

2.11 The speed of the train and the timing of the brake applications could not be confirmed because the locomotive event recorder was not working.

3. SAFETY RECOMMENDATIONS

3.1 It was recommended to New Zealand Rail Limited that they:

Set guidelines for Train Control Officers to advise Locomotive Engineers by radio of unusual movements or circumstances which may be significantly different from the expectancy of the Locomotive Engineer (037/94)

Investigate the practicability of introducing an intermediate speed aspect for the signals 12L and 6L at Te Kauwhata and other similar locations (038/94)

Introduce inspection and maintenance procedures to ensure that the event recorders where installed on locomotives are operative while travelling on main lines (039/94)

3.2 New Zealand Rail Limited responded:

The provision of intermediate speed aspects for the signals 12L and 6L at Te Kauwhata and other similar locations should be considered at a future time as part of a resignalling or major upgrade to the signalling system in relating to meeting business objectives. (038/94).

29 June 1994

M F Dunphy
Chief Commissioner

SIGNALS21!AQ

NEW ZEALAND RAILWAYS

Circular S&I No. 2063
Sheet No. 1
No. of Sheets 3

TE KAUWHATA

DIAGRAM AND INSTRUCTIONS FOR SIGNALLING AND INTERLOCKING ARRANGEMENTS

At a time and date to be advised by Train Advice, the Signalling and Interlocking arrangements shown on the attached diagram will be brought into use.

This Circular shows the position and use of all signals and cancels Circular S&I No. 1923.

The Regulations for Automatic Signalling will apply.

All Stop and Stay signals and motor points are remotely controlled from Auckland.

All signals are normally unlit and will light on the approach of a train or the clearing of a signal. Marker lights are permanently lit.

R.G. Averell
REGIONAL TRAFFIC MANAGER

NORTHERN REGION

March 1987

Please acknowledge receipt to Controlling Officer

I hereby acknowledge receipt of Circular S&I No. 2063, re Signalling and Interlocking Te Kauwhata.

I understand that signal No. 6L is a Departure signal.

Name:_____ Station:_____

Designation:_____ Date:_____

NS - Normal Speed
MS - Medium Speed
LS - Low Speed

DESCRIPTION OF SIGNALS AND LEVERS

TE KAUWHATA

12LABC	Up Home	NS to Up Main MS to Loop LS to Up Main and Loop
10RA	Down Starting from Main	
10RB	Down Starting from Loop	
8L	Up Starting from Loop	
6LAB	Up Departure from Up Main	
6LC	Up Departure from Down Main	
6RABC	Down Home	NS to Down Main MS to Loop LS to Down Main and Loop