



Report 97-103

Train 3656

collision with motor vehicle

Trentham

22 March 1997

Abstract

On Saturday, 22 March 1997, at approximately 1848 hours Train 3656, a northbound suburban electric multiple unit service, collided with a car on Sutherland Avenue level crossing, Trentham. The three occupants of the car suffered minor injuries. The level crossing protection was not activated until the train was almost on the crossing.

The cause of the incident was the failure of Train 3656 to stop at a signal displaying a red aspect.

Safety issues identified were the locomotive engineer's failure to observe and act on the signal indications, the pattern of signal indications for up trains stopping at Heretaunga, and the risk of collision with road vehicles arising from signals sited close to protected level crossing being passed at danger.

Transport Accident Investigation Commission

Rail Incident Report 97-103

Train type and number:	Suburban electric multiple unit service 3656
Date and time:	22 March 1997, 1848 hours
Location:	Trentham, 28.88 km Wairarapa Line
Type of occurrence:	Level crossing collision
Persons on board:	Crew: 2 Passengers: 9
Injuries:	Crew: Nil Passengers: Nil Others ¹ : 3 Minor
Nature of damage:	Motor vehicle extensively damaged, minor damage to Unit
Investigator-in-Charge:	R E Howe

¹ The three occupants of the motor vehicle.

1. Factual Information

1.1 Narrative

- 1.1.1 On Saturday 22 March 1997 Train 3656 was the scheduled 1805 Tranz Metro suburban service from Wellington to Upper Hutt. The two-car electric multiple unit (EMU) comprised ET 3079 (leading) and EM 1079, and was crewed by a locomotive engineer (LE) and a guard.
- 1.1.2 As Train 3656 approached Heretaunga on the Up Main for its scheduled passenger stop, Signal 2786 controlling the approach to Heretaunga was displaying yellow over red. This was the normal indication for a train stopping at Heretaunga and told the LE to “Proceed at normal speed, prepared to stop at next signal”. The next signal was Signal 29, approximately 1000 m ahead and 20 m before Sutherland Avenue level crossing.
- 1.1.3 Signal 29 was the Up Home signal at Trentham and controlled up trains on to the bi-directional main line at Trentham commencing approximately 320 m north of the signal. This signal was a “stop and stay” signal which meant the LE could not take the train past the signal without formal authority.
- 1.1.4 Heretaunga has an island platform. North of Signal 2786 the two tracks diverged and the LE could not see Signal 29 ahead as the Up Main curved left to the platform. Figure 1 shows a diagram of the layout.

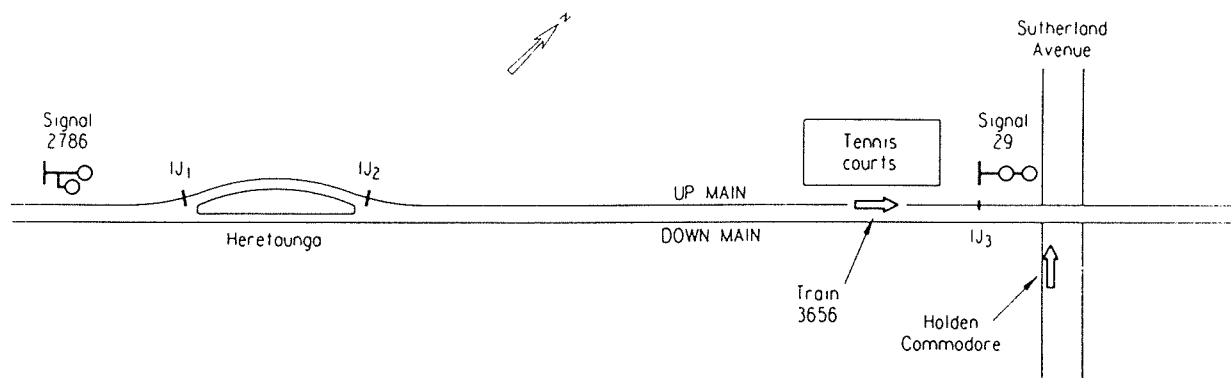


Figure 1
Locality diagram (not to scale)

- 1.1.5 Train 3656 completed its passenger stop and left Heretaunga with nine passengers.
- 1.1.6 North of Heretaunga the Up Main curved back to parallel the Down Main and the LE could see Signal 29 when Train 3656 was approximately 450 m from the signal. The LE stated “I noticed it was red, which it normally is, and you get down a bit and it normally goes to green”.
- 1.1.7 The LE stated he had passed Train 3655, the 1830 hours down train from Upper Hutt, between Silverstream and Manor Park and he “. . . knew there were no trains around”.

- 1.1.8 As Train 3656 approached Signal 29 the LE stated his attention was drawn to some tennis courts on his left hand side which were between 60 m and 100 m before Signal 29. As he put it, “Something caught my eye over towards the tennis court, I was looking over there and trying to see what it was”.
- 1.1.9 He stated that when his attention returned to the track ahead he saw a white car go across Sutherland Avenue level crossing approximately 60 m ahead of him. His initial reaction was that it had gone around the barrier arms and then he looked up and saw Signal 29, by then some 10 m ahead, at red. He made an immediate emergency brake application but another car started to cross ahead of him and a collision occurred at approximately 1848 hours.
- 1.1.10 The LE stated the headlight of the train was on dim as he approached the crossing and he did not sound the warning device prior to impact. There was no requirement for him to sound his warning device in this location.
- 1.1.11 EMUs are not equipped with event recorders. The LE estimated his speed was 35 km/h as he approached the crossing before braking.
- 1.1.12 At approximately 1848 hours a Holden Commodore with three occupants was proceeding west along Sutherland Avenue towards the level crossing.
- 1.1.13 The driver was in the right front seat with one passenger in the left front seat and the other one in the left rear seat. All were wearing seat belts.
- 1.1.14 The occupants stated that the car headlights were on as they approached the crossing and on their recollection the speed of approach was approximately 45 km/h.
- 1.1.15 The driver stated the barriers were up and the flashing lights and bells were not operating as he approached the crossing. He could not see any lights coming from the direction of the railway lines. He was following a vehicle in front of him, and as the front wheels of the Holden “. . . hit the tracks” (the Down Main, some four metres from the Up Main on which Train 3656 was travelling) he heard his back seat passenger yell “Look out”. The driver said he just had time to instinctively look in his rear-vision mirror before impact occurred.
- 1.1.16 The car was struck by the train in the left rear and spun through 180° before coming to rest upright against the traffic island in the centre of Sutherland Avenue on the west side of the crossing.
- 1.1.17 The three occupants suffered minor injuries involving cuts, bruising, and whip-lash.
- 1.1.18 The front of the train came to rest approximately 50 m past the point of impact (POI). The LE was unhurt and immediately advised Train Control of the incident.

1.2 Site details

- 1.2.1 Tyre marks indicated the POI was approximately 18 m north of Signal 29.

1.2.2 Insulated joints (IJs)² were installed in the Up Main to allow trains to activate the Sutherland Avenue level crossing protection system under different operating circumstances as follows:

- IJ₁ at 28.117 km (south of Heretaunga and approximately 760 m from Sutherland Avenue crossing) activated by non-stopping trains.
- IJ₂ at 28.377 km (north of Heretaunga and approximately 500 m from Sutherland Avenue level crossing) activated by trains which stopped at Heretaunga. This avoided the undesirable end result of the alarms operating too soon for stopping trains. To ensure effective protection of the level crossing Signal 29 would not display a proceed indication under these circumstances until the barrier arms were down. This took approximately 15 seconds from the passage of a train over IJ₂.
- IJ₃ at 28.860 km (approximately 20 m from Sutherland Avenue level crossing and adjacent to Signal 29) intended to be activated by trains stopped by a red indication at Signal 29 and then given authority to proceed past the signal at stop.

The logic relating to which IJ activated the level crossing protection was determined by the route setting and signal clearing carried out by the person controlling the signal panel at Upper Hutt.

1.2.3 The view in the south-east quadrant of the level crossing was restricted by a concrete block fence and shrubs. The EMU and the Holden were each between 25 m to 30 m from the POI when line of sight was established.

1.2.4 The weather was fine and visibility was good at the time of the incident, although it was the “half light” of evening twilight.

1.3 Control of signals

1.3.1 Signal 29 marked the beginning of the Centralised Traffic Control section extending north to Featherston. The track south of Signal 29 was operated under Double Line Automatic Signalling.

1.3.2 The aspects of the signals and their layout and location at Trentham were shown in Signalling and Interlocking Circular No. 2243 available to all LEs and operating staff working over this part of the Wairarapa line. (See Figure 2)

1.3.3 The route setting and clearance of signals necessary to allow Train 3656 to continue its journey from Heretaunga to Upper Hutt were under the control of the signal panel at Upper Hutt. The signalperson operating the panel was the sales clerk in sole charge of Upper Hutt station at the time of the incident.

1.3.4 At 1829 hours the signalperson directed Train 1614, the Wellington to Masterton passenger train, to the main platform at Upper Hutt.

1.3.5 Train 3655, the next south-bound EMU train, was standing at the dock road awaiting authority to depart at its scheduled time of 1830 hours.

1.3.6 As Train 1614 pulled in the signalperson reset the route for Train 3655, cleared the appropriate signals and went to the respective platforms to dispatch each train.

² Insulated joints are joints in the rails which are electrically insulated to contain current flow. When the passage of a train interrupts the current flow relays are activated which control such facilities as signals and level crossing protection.

- 1.3.7 In the normal course of events the signalperson would have returned to his office and monitored the progress of Train 3655 on his panel. As soon as it was clear of the section he would have reset the route and cleared the signals, including Signal 29, to bring Train 3656 into Upper Hutt.
- 1.3.8 On the evening of the incident the signalperson stated that following the departure of Train 1614 he was delayed on the platform dealing with three inebriated passengers who had disembarked and were harassing other passengers and placing themselves at risk.
- 1.3.9 His attempts to defuse the situation on the platform and get the three to leave the station continued for some time and were eventually interrupted when he was required to return to his office to answer the Train Control telephone. The call was to advise him of the incident which had just occurred at Sutherland Avenue level crossing.

1.4 Level crossing protection

- 1.4.1 Control of route setting and the clearance of the signals from Upper Hutt determined the location of the initiation of the protection at Sutherland Avenue level crossing.
- 1.4.2 As part of the signal panel control the signalperson had to distinguish between stopping and non-stopping trains entering his panel limits on the Up Main. Since most trains were EMUs required to stop at Heretaunga, setting the route and clearing Signal 29 had been designed to set up the circuitry to operate the level crossing protection at Sutherland Avenue based on a train which had stopped at Heretaunga activating the protection when passing over IJ₂.
- 1.4.3 For the less frequent through trains the signalperson had to push a button following the clearance of Signal 29. This activated the circuitry for IJ₁ operation.
- 1.4.4 Tranz Rail Limited (Tranz Rail) advised that the system controlling Sutherland Avenue level crossing at Trentham is unique as it is:
- The only installation where a special selection control is provided to enable the signalperson or train control officer to discriminate between stopping/non-stopping trains leading up to a signal controlled from a signalbox or a train control office.
 - The only place where a controlled signal protecting a level crossing is delayed cleared for most trains on the move and approaching the level crossing. Tranz Rail estimated approximately 85% of all trains would be classed as stopping trains and therefore would be subject to moving towards the signal waiting to delay clear.
- 1.4.5 At the time of the incident the route had not been set for Train 3656 and Signal 29 had not been cleared. The signal was displaying a red indication and Sutherland Avenue level crossing protection did not need to be activated. The circuitry ensured the passage of Train 3656 up to the signal did not activate the level crossing protection as it passed over IJ₁ and IJ₂.
- 1.4.6 Having set the route for an up train the signalperson could attempt to clear Signal 29 at any time. If he attempted this while a train was occupying the track between IJ₁ and Signal 29 the signal would not display a proceed indication until sufficient time had elapsed to allow the barriers at Sutherland Avenue level crossing to come down.

1.4.7 IJ3 was the last IJ where the passage of a train could activate protection at Sutherland Avenue. It was located at Signal 29 and was designed to be activated by a train authorised to pass Signal 29 at stop. Normal practice in such circumstances was for a train to inch forward, activate the protection, and wait for the barrier arms to drop before proceeding. Reports indicated the flashing lights and bells were activated by the passage of Train 3656 over IJ3 prior to the collision.

1.5 Personnel

1.5.1 The LE held a current operating certificate for the duties concerned.

1.5.2 The LE joined New Zealand Railways in 1961. He gained his Grade 1 engine driver's certification in 1981 and since that time had been based in Wellington where his rostered duties included driving EMUs over the Wairarapa line.

1.5.3 During the fortnight preceding the incident the LE had worked 12 shifts totalling 98 hours and 25 minutes. His maximum shift length was 10 hours and 10 minutes and his minimum was six hours. He had elected to work two of his four rostered days off during this period to cover the unavailability of other rostered staff. He stated that filling in, in this manner, was standard practice and that he felt no particular fatigue, for that or any other reason, on the day of the incident.

1.5.4 On 22 March 1997 his shift commenced at 1230 hours. He was on his last run to Upper Hutt and back before he would have completed his shift at Wellington at approximately 2030 hours.

1.5.5 The LE's recreation and sleep patterns were normal. His health was good and he had no requirement for any medication that might affect performance.

1.5.6 He had not attended Tranz Rail's recently introduced Alertness Management Program. As at March 1997 approximately 20% of Tranz Rail's LEs had attended the program.

1.5.7 The LE was part of the Tranz Metro Wellington roster. For the last four years LEs on this roster had only driven EMUs. (Before that Wellington LEs could be rostered on a variety of shifts and were not necessarily restricted to EMUs.) As a result of this the LE was always driving trains which were required to stop at Heretaunga.

1.5.8 He stated his normal expectation was to see a yellow indication on Signal 2786 and to see Signal 29 showing a red indication as the train entered the straight track after leaving Heretaunga. He also stated that during off-peak periods this red invariably changed to green as he approached it "... prepared to stop".

2. Analysis

2.1 Speed of impact

2.1.1 The reported speed of the train, and its reported position at the time of brake application, were supported by the derived stopping distance of 73 m. This indicated a train speed at impact of approximately 30 km/h.

2.1.2 The level crossing layout and speed of approach meant that the maximum possible visual warning to the respective drivers was two to three seconds before impact, by which time the train had already started to brake. There was insufficient time for the driver of the car to take any evasive action.

2.1.3 The relatively low speed of the collision and the fact that all three car occupants were wearing seat belts limited the potential severity of this incident.

2.2 Signalling

2.2.1 The integrated signalling and level crossing protection design at Trentham specifically addressed the frustration associated with early activation of level crossing alarms by stopping trains. This factor had been identified in Occurrence Report 95-119 concerning a fatal accident at Metcalfe Road level crossing, Ranui, on 17 November 1995.

2.2.2 A consequence of the solution adopted was that EMU drivers approaching Heretaunga to stop always received a yellow indication on Signal 2786 regardless of whether the route ahead was set or whether Signal 29 had been cleared.

2.2.3 When the route ahead had been set and Signal 29 cleared by the signalperson at Upper Hutt Signal 29 would not display a proceed indication until approximately 15 seconds after the passage of a train over IJ₂. This was the time necessary for the barrier arms to be fully lowered at Sutherland Avenue level crossing.

2.2.4 The normal speed of departure from Heretaunga meant Signal 29 would not usually change to a proceed indication until the approaching train was approximately 150 m past IJ₂, and therefore on the straight with Signal 29 in view. This was the LE's reported normal expectation in the off-peak period.

2.2.5 During peak periods it was more likely that conflicting train movements, or demands on the Upper Hutt signalperson, would result in the route ahead not being set for an up train and Signal 29 not being set to clear. In such cases Signal 29 would remain at red and trains were required to stop at the signal.

2.2.6 Tranz Rail's protection details for Sutherland Avenue level crossing avoided the frustration, and related safety hazard, associated with some other passenger stops where trains stopped at platforms had already activated adjacent level crossing protection. However this meant that Signal 29 always initially displayed a red indication to approaching up trains which had stopped at Heretaunga unless the train made an exceptionally slow departure. This initial indication usually changed to proceed as the train approached the signal.

2.3 Causal factors

2.3.1 The cause of the incident was Train 3656 passing Signal 29 at danger.

2.3.2 Factors contributing to the LE's failure to observe and act on the signal indications displayed were:

- The LE's knowledge that he had passed down Train 3655, and his belief that there were no other trains in the vicinity.
- The LE's expectation that during off-peak periods with no opposing trains a yellow indication on Signal 2786 would be followed by a red indication on Signal 29 which turned to green as he approached it.
- The LE's distraction as Train 3656 approached Signal 29.
- The fracas at Upper Hutt which prevented the signalperson from carrying out route setting and signal clearing within the usual time frame.

- 2.3.3 Although there was nothing in the LE's work or recreation pattern to suggest fatigue was a contributing factor his alertness may have been reduced on the last return run of his shift.
- 2.3.4 Despite the particular circumstances relating to Signal 2786 and Signal 29, the signal indications displayed to the LE were standard indications which his training and experience told him to expect at any time. The ability to observe and respond to such indications at all times are fundamental requirements of train operation.
- 2.3.5 The integration of signals and insulated joints as used at Sutherland Avenue level crossing is a common and acceptable use of the signal system. Its demands on the LE are consistent with his expected knowledge of the rules and specific route knowledge.

2.4 Signals passed at danger

- 2.4.1 Signals passed at danger (SPADs) are a recognised world-wide problem on railway systems relying on driver response.
- 2.4.2 The consequences of a SPAD can vary from an operating irregularity as a result of a short overrun due to a late signal recognition or a late brake application, to a high speed collision between two trains. Nearly all SPADs are in the former category. However when signals are positioned immediately before protected level crossings, as at Sutherland Avenue, an additional risk of collision with road vehicles is introduced.
- 2.4.3 The Commission is aware of four SPADs which have occurred on the Tranz Rail system since June 1996 which have involved signals located in this manner. In the first case a diesel multiple unit passed a signal at stop at Woodward Road level crossing near Avondale. A low speed non-injury collision resulted. The second is the subject of this report. In the third incident at High Street, Rangiora, no road vehicles were using the level crossing at the time. The fourth incident is currently under investigation and again no road vehicles were using the level crossing at the time.
- 2.4.4 Tranz Rail advised that approximately one eighth of the 3300 fixed signals on their system are subject to some form of level crossing alarm time delay clearing because of the proximity to protected level crossings. As a result of this any significant overrun due to a SPAD would remove effective protection.
- 2.4.5 Tranz Rail also advised that they had approximately 14 SPADs reported each year of which four occurred in the Wellington EMU operated commuter area. The numbers of SPADS which included late activation of level crossing protection averaged 1.5 per year nationally, and 0.2 per year in the Wellington EMU area which has the highest rail density of the network.
- 2.4.6 There is no evidence to suggest that the four incidents since June 1996 reflect an unacceptable interface between level crossing protection and signalling design. For this reason no general recommendations relating to the relative position of signals with respect to protected level crossings have been made as a result of this incident.
- 2.4.7 There is potential to decrease the possibility of a recurrence of a similar incident at Sutherland Avenue by restricting train speed, installing audio activated level crossing protection or other low cost improvements.

3. Findings

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

- 3.1 The Tranz Rail signalling system was operating as intended.
- 3.2 The Tranz Rail system to protect trains authorised to proceed across Sutherland Avenue level crossing was operating as intended.
- 3.3 The signalperson at Upper Hutt acted appropriately in response to the events on the platform.
- 3.4 The failure of the LE of Train 3656 to observe and act on the indications of Signal 2786 and Signal 29 resulted in Signal 29 being passed at danger at a speed of approximately 35km/h.
- 3.5 The speed of Train 3656 precluded any warning to approaching road traffic on Sutherland Avenue by means of the flashing lights and bells and barriers installed.
- 3.6 The approach speed of the car was consistent with the normal speed of road traffic over Sutherland Avenue level crossing when the protection was not activated.
- 3.7 The LE of Train 3656 was appropriately certified for the duties concerned.
- 3.8 Train 3656 was not being operated in accordance with the signals when the LE permitted it to pass Signal 29.
- 3.9 The LE's standard operating pattern involving stopping at Heretaunga had created a mindset, that Signal 29 would change to a proceed indication as he approached it, which contributed to his failure to observe and act on the stop indication displayed.
- 3.10 The LE's knowledge that Train 3655 had passed him south of Heretaunga heightened his expectation of receiving a proceed indication.
- 3.11 The diversion of the LE's attention just prior to Signal 29 contributed to his failure to observe and act on the stop indication display.
- 3.12 SPADs involving a limited overrun create a high risk of collision with road vehicles at adjacent protected level crossings.
- 3.13 The use of Signal 29 linked to Sutherland Avenue level crossing protection in such a way as to always give the LE of a stopping passenger train an initial stop indication which generally turned to proceed had the potential to weaken the intent of the indication.

4. Safety Recommendations

4.1 It was recommended to the Managing Director of Tranz Rail Ltd that he:

4.1.1 Review the design and operation of the signalling and integrated level crossing protection at Trentham for up trains, with a view to reducing the possibility of a stopping train with correct route setting and signal clearance receiving an initial red indication on Signal 29 after departing from Heretaunga. (080/97)

4.2 The Managing Director of Tranz Rail responded:

4.2.1 The review and intent of safety recommendation 080/97 has already commenced.

12 December 1997

Hon. W P Jeffries
Chief Commissioner