



## **Report 01-106**

### **express passenger Train 600 *Bay Express* and maintenance plant**

#### **collision**

#### **Muri**

**6 May 2001**

### **Abstract**

On Sunday 6 May 2001, at about 0838, a collision occurred between express passenger Train 600, *Bay Express*, and an excavator and front end loader working on the up main line at Muri, 31.4 km North Island Main Trunk. The maintenance plant was operating under Conditional Stop Protection when the collision occurred. Train 600 had been given authority to pass through the protected site at a time when one of the four work groups operating within an 11.9 km protected length understood they were clear to work.

There were no injuries.

Safety issues identified included the suitability of the procedures in place to control the safety of multiple work groups working over an extended protected length.

Three safety recommendations were made to the operator.



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## List of Abbreviations

CSB	Conditional Stop Board
km	kilometre(s)
km/h	kilometres per hour
LE	locomotive engineer
m	metre(s)
NIMT	North Island Main Trunk
PIC	person in charge
Tranz Rail	Tranz Rail Limited

## Data Summary

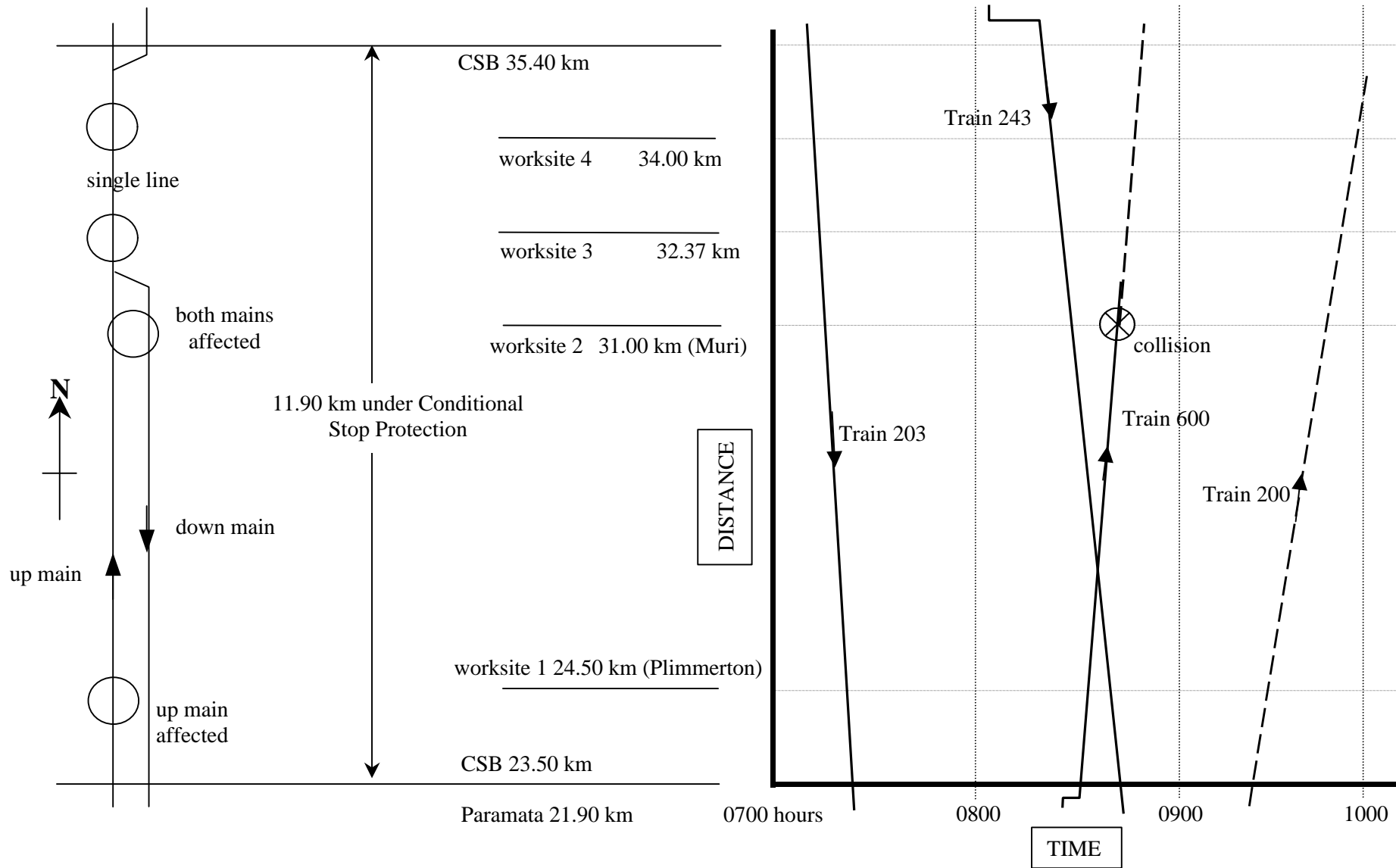
<b>Train type and number:</b>	express passenger Train 600, <i>Bay Express</i>												
<b>Other vehicles:</b>	a hi-rail excavator and a front end loader												
<b>Date and time:</b>	6 May 2001, at about 0838												
<b>Location:</b>	Muri, at 31.403km North Island Main Trunk (NIMT)												
<b>Type of occurrence:</b>	collision												
<b>Persons on board:</b>	<table><tr><td>Train 600</td><td>crew:</td><td>3</td></tr><tr><td></td><td>passengers:</td><td>23</td></tr><tr><td>Excavator</td><td></td><td>nil</td></tr><tr><td>Front end loader</td><td></td><td>1</td></tr></table>	Train 600	crew:	3		passengers:	23	Excavator		nil	Front end loader		1
Train 600	crew:	3											
	passengers:	23											
Excavator		nil											
Front end loader		1											
<b>Injuries:</b>	nil												
<b>Damage:</b>	major damage to the excavator  moderate damage to the locomotive  minor damage to the overhead traction system												
<b>Operator:</b>	Tranz Rail Limited (Tranz Rail)												
<b>Investigator-in-charge:</b>	R E Howe												



# 1. Factual

## 1.1 Narrative

- 1.1.1 On Sunday 6 May 2001, a Tranz Rail maintenance group was working on the up and down main at Muri at 31.4 km NIMT. It was one of 4 separate groups working within an 11.9 km length between Plimmerton and Paekakariki under Conditional Stop Protection.
- 1.1.2 Conditional Stop Protection was a Tranz Rail system for carrying out planned work using Conditional Stop Boards (CSBs) at each end of a single work site, or a group of worksites, to control train movements through the protected length. The principle of operation for a group of worksites was that an appointed person in charge (PIC) oversaw the safety of the protected length between the boards, and a Tranz Rail site controller controlled each worksite. Site controllers allowed planned work obstructing defined lines to proceed when authorised by the PIC, and notified the PIC when such work was clear of the line or lines concerned. Trains could not pass the CSB's and travel through the protected length without the authority of the PIC, and this authority was not given until the PIC was satisfied that all worksites were clear of the line involved. Communication between the PIC, site controllers and locomotive engineers (LEs) was either direct by radio channel or cellphone, or indirect through Train Control using radio channel 2.
- 1.1.3 The protected length, the worksites involved and the train movements through the protected length on 6 May are shown in Figure 1.
- 1.1.4 The Muri site (worksite 2) involved 2 Tranz Rail track staff and 2 contractors. The contractors were operating an excavator fitted with rail wheels which could be on-tracked when desired, and a rubber-tyred front end loader. The work involved using both machines to shift rails from the up main (west) side of the track to the down main (east) side ready for later re-railing work. The planned work obstructed both the up and down main lines and required the overhead power to be isolated for safety.
- 1.1.5 Protection was established by the PIC prior to 0600 and the overhead power was isolated.
- 1.1.6 The Muri site controller, (site controller 2), arrived on site at about 0630 and was visited by the PIC at about 0645. The day's planned work was discussed before the PIC left for worksite 4. The PIC intended to stay at worksite 4 until the work there was completed by mid morning. His decision to locate at worksite 4 was based on a request from the Plimmerton site controller (site controller 1) so that the PIC would have better communication with southbound trains, and on a need to provide a multi-channel radio at worksite 4 as site controller 4 did not have this equipment.
- 1.1.7 The contractors arrived at Muri shortly after the PIC's departure, and site controller 2 arranged for the excavator to be on-tracked on the up main, ready to commence work together with the front end loader after southbound Train 203 had passed through on the adjacent down main. Train 203 passed through at about 0715 and work started at Muri shortly thereafter.
- 1.1.8 At 0807 southbound Train 243 arrived at the north end CSB. The LE could not establish direct contact with the PIC. After some delay communication was established through Train Control and at 0817 the PIC authorised Train 243 to pass the CSB, having satisfied himself that the down main was clear at all worksites.
- 1.1.9 Site controller 2 understood from his conversation with the PIC that he could obstruct both mains after Train 243, and authorised work to restart after the train had passed through his site.



**Figure 1**  
**A time/distance plot of the worksites within the protection and the trains passed through**



- 1.1.10 The PIC checked with Train Control at 0824 to find out the next train movements. The train controller advised that Train 600 was “not too far away from your boards at the south end”. The PIC recalled that he believed he had contacted all work groups involved and was sure they were all clear of the up main before he authorised Train 600 to pass the CSB at 0829.
- 1.1.11 Train 600 was the Wellington to Napier *Bay Express*. It had departed Wellington at its scheduled time of 0800 and was running to time. The consist was DC 4628 and 3 carriages with a train weight of 91 t and length of 79 m. It was crewed by an LE and 2 train attendants and conveyed 23 passengers.
- 1.1.12 At about 0835 work was in progress at the Muri site. The excavator was on-tracked on the up main, and the front end loader was straddling the up main some 15 m to the north. They were preparing to hook up to a rail on the up main side when the excavator driver noticed a hydraulic leak at the south end of his machine. He raised the rail wheels and settled the excavator down on the ground to allow a check of the hydraulic system. He had left the cab and was standing on the up main investigating the source of the leak when he became aware of Train 600 some 30 m away and jumped down the bank beside the track.
- 1.1.13 Train 600 was travelling at 34 km/h just south of Muri around a 200 m radius left-hand curve when the LE saw machinery on the line some 50 m ahead and applied emergency braking. The train slowed to 30 km/h before striking the boom of the excavator. The excavator overturned and was pushed ahead of the train for about 20m, where it struck the front end loader. The 2 vehicles were pushed ahead of the train for a further 12m before the train stopped. The front end loader driver had seen Train 600 approaching and tried to reverse his vehicle clear, but did not have time.



**Figure 2**  
**The collision scene**

- 1.1.14 There were no injuries arising from the collision.
- 1.1.15 The excavator was extensively damaged and the front hood of the locomotive was peeled off by the impact. An overhead traction pole was jolted as a result of the collision. The overhead system sustained minor damage but remained intact.

## **1.2 Conditional Stop Protection**

- 1.2.1 The requirements for Conditional Stop Protection for planned work were detailed in Tranz Rail Rule 175 (b) to (e) which has been included as Appendix 1 to this report, and Tranz Rail Bulletin Procedures, Amendment Number 1, pages 43 and 44, which has been included as Appendix 2 to this report.

## **1.3 Planned work on the day**

- 1.3.1 The Tranz Rail system for planning work to be carried out in the Wellington suburban area was based on “Block of Line” meetings held at monthly intervals and chaired by a Network Controller. The meeting prior to the incident which pre-planned work for 6 May 2001 was held on 18 April 2001. Only one job was planned for the area, and that was distressing and welding of the track between 24.00 to 24.50 km on the up line
- 1.3.2 Work plans could change for many reasons between the Block of Line meeting and the actual day. In particular if a job required a section of traction overhead to be isolated, it was common for other work to be included to take advantage of the isolation. The “Train Advice” referred to in Rule 175 (b) which authorised the final planned work for 6 May 2001 was the Information Bulletin issued 4 May 2001. The one original job planned had increased to 4, which were:

Worksite 1	Destress and welding at 24.5 km on the up main. For practical purposes (noise affecting residents) the planned work was not going to commence until after 0900. The PIC was aware of this.
Worksite 2	Placing new rail at 31 km (Muri) affecting both the up main and the down main. Work required the overhead power to be isolated and this was arranged from 0600 to 0900. Work began at 0715 after the passage of Train 203, with under 2 hours available before work had to cease for the day when power was restored. Two scheduled trains (Train 243 down and Train 600 up) had to be controlled at the CSBs by the PIC during this period.
Worksite 3	Traction overhead staff at 32.37 km on the single line reservicing a live line isolator switch. The work required about 60 minutes of on-track time, and was carried out between Train 203 and Train 243 and completed by 0800. The PIC was advised of this, and further advised that other work was then to be carried out from ladders clear of trains.
Worksite 4	Welding on the single line at 34 km. This was the site the PIC located at from 0700 as being most suitable for communications. Welding commenced after the passage of Train 203 at about 0710 and the line was cleared for Train 243 and Train 600. A further 2 welds were to be completed after the passage of Train 600 before the gang planned to move to assist at worksite 1 at mid-morning.

The total length under the PIC’s control incorporating these worksites was 11.9 km.

## 1.4 Unplanned work

1.4.1 Some confusion over additional work to be carried out under cover of the Conditional Stop Protection affected events on the day. The circumstances were:

- A contractor had an outstanding work order to carry out sealing work at Steyne Road level crossing, some 150 m north of worksite 1.
- The Tranz Rail track and structures manager recalled mentioning to the contractor on Friday 4 May that there was a work window available on 6 May. The track and structures manager understood from that conversation that the contractor would come back to him if the contractor was able to arrange the materials and equipment in time. The track and structures manager did not hear back and took no further action
- The contractor understood from the conversation that the track and structures manager was going to arrange for his work to be included in the protected length.
- The contractor arrived at Steyne Avenue at about 0730 to carry out the work and found no protector on site. He rang the site controller of worksite 1 who advised him who the PIC was, and that any arrangements would have to be through the PIC.
- At 0740 the contractor rang the PIC requesting protection which the PIC declined as he “had his hands full already”. The memory of the conversation varied, the PIC referring to “he started yelling at me, which made me even worse”. The contractor recalled it was not an “unpleasant” conversation, but he couldn’t “control the tone” of his voice and the tone “may have been a wee bit impatient”.
- The contractor liaised further with the worksite 1 site controller to see if he could carry out the work under his site control. This liaison was abandoned after the collision and the sealing work was not carried out.

## 1.5 Communications

- 1.5.1 Three communication options were available and used by the PIC on the day: radio channel 1, radio channel 2 and cellphones. Channel 2 was recorded on the train control tape, but channel 1 was not.
- 1.5.2 Channel 1 was commonly called the local channel and used for LE to maintenance staff communication. Channel 1 was a VHF point-to-point simplex channel which did not use repeaters. Coverage for this channel was not documented by Tranz Rail unless specific site tests had been carried out, but under normal circumstances was expected to be about 5 km depending on the power output of the radio in use, the terrain and other sources of interference. It was used for both short distance train-to-train communication and track staff-to-train communication. The length of the Conditional Stop Protection on the day and the local topography meant that contact using channel 1 was unreliable, although it was used between the PIC and the LE when Train 203 passed through the protection. There were no documented procedures in place for situations under Conditional Stop Protection where communication between LEs and track gangs could not be established on Channel 1.
- 1.5.3 Channel 2 was the repeater-assisted train control VHF channel for the area. It had become common practice during work under Conditional Stop Protection for LEs to contact the PIC, and vice versa, through Train Control using channel 2 when channel 1 was unsuccessful, and this occurred on the day. Tranz Rail did not encourage the use of channel 2 for this purpose because it interfered with the availability of channel 2 for normal train operating requirements.
- 1.5.4 Cellphones were a non-formalised but accepted means of communicating from site to site, and between Train Control and the PIC, during work under Conditional Stop Protection. They were the main method used for site-to-site communication on the day.

- 1.5.5 The multi-band radio was also equipped with channel 5, an independent simplex channel for track staff-to-track staff communication, and commonly referred to as the protection channel. Its purpose was to avoid maintenance radio communication interfering with train operations. Channel 5 had the same reception limitations as channel 1. Channel 5 was not widely used during Conditional Stop Protection because a PIC needed to communicate with LEs and track staff which meant constantly changing channels. For this reason the PIC did not use channel 5 on the day of the collision.
- 1.5.6 The Train Control tape, cellphone records<sup>1</sup> and some retained voicemail messages provided a chronological sequence of known<sup>2</sup> communications on the day. These records have been included in Appendix 3 to this report.
- 1.5.7 At 0807 Train 243 was at the north CSB looking for approval to pass through the protection. Contact with the PIC was finally made through Train Control at 0815, at which time the PIC had not had clearance from worksite 2. The train controller asked the PIC if he could get clearance quickly as the LE was required to return a northbound train on arrival.
- 1.5.8 Both the PIC and site controller 2 recalled clearance being given for Train 243. Site controller 2 placed the timing at about 0818, and at that time “told (PIC) the down main was clear for Train 243 to go through, and that we were on the up main and not to let anything past our boards until he heard from me”. The PIC had no clear recollection of this call, or any other calls about this time, due to the number of different calls which occurred and the difficulty he had in dealing with them.

## **1.6 Personnel**

### **The maintenance plant operators**

- 1.6.1 The excavator driver had been involved in railway work over 6 years as a temporary worker. For the previous year he had worked as an excavator driver for a contractor mainly employed on work for Tranz Rail. He held a level C Tranz Rail certification, which enabled him to work on the track under protection.
- 1.6.2 The front end loader driver had been employed by the contractor for 6 weeks. He held a level D Tranz Rail certification, which enabled him to work on the track under protection.
- 1.6.3 Both operators stated they had worked with site controller 2 and the PIC previously, and had always felt confident at the level of protection provided.

### **Site controller 2**

- 1.6.4 Site controller 2 was a Grade 1 ganger with 26 year’s rail experience, of which the last 10 years had been as Grade 1 ganger at Porirua. He held current certification in level C rules knowledge which enabled him to work unsupervised, and to establish “planned and accidental protection” and set out temporary speed boards. He had undertaken the new Bulletin procedures training in 1999.

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<sup>1</sup> The cellphone records available provided details of outgoing calls except those to a message service.

<sup>2</sup> There are no records of any possible channel 1 or channel 5 communications.

## **The person in charge**

- 1.6.5 The PIC had been involved with rail work in the Wellington area since 1990. In 1995 he had joined the Wellington yard gang and worked as a track worker until 1999, when he accepted an offer to become a protector. This involved protecting contractors during the week and protecting worksites such as those under Conditional Stop Protection at weekends. The PIC stated that most of this work had involved small groups working together in one area, where he had direct liaison with all concerned. Although some Conditional Stop Protection work he had carried out had been over extended lengths it was the first time he had “people that spread out working in different work groups”.
- 1.6.6 The certification requirements for protectors were the same Level C knowledge held by site controller 2. The PIC had been initially certified in Level C knowledge in 1995 and was currently certified to level C. He had undertaken the new Bulletin procedures training in 1999.
- 1.6.7 The PIC was not involved in planning the work, neither at the Block of Line meeting, nor with the changes that followed. His first involvement was on the morning of Friday 4 May when his controlling ganger (who was site controller 1 on the day) briefed him at a meeting with site controller 2. The PIC then liaised with the Network Controller on the details of the Bulletin, which was then issued late on 4 May.
- 1.6.8 The PIC’s protection work required frequent weekend working, with time off taken during the week. Commencing 26 April, after the Anzac break, he had worked 9 days (70 hours) before a day off on Saturday 5 May. On Friday night and Saturday 5 May the PIC spent time with his family, but also spent time going over the Bulletin “trying to work out everything in my head and trying to prepare myself for quite a big job”. He retired early on Saturday night, woke early on 6 May (0415) and went through his Bulletin again before leaving home about 0530.
- 1.6.9 The PIC was in good health, under no external stress and did not feel he was unduly fatigued when his shift commenced.

## **1.7 Locomotive event recorder**

- 1.7.1 The locomotive event recorder was extracted following the incident. The log showed a train speed of 34 km/h, before an emergency brake application some 7 seconds (60 m) before the point of collision which reduced the train speed to about 30 km/h at collision.

## **2. Analysis**

### **2.1 Introduction**

- 2.1.1 The collision occurred due to a misunderstanding between the PIC and site controller 2. A number of factors directly or indirectly contributed to this misunderstanding and these are discussed in turn.

### **2.2 Work planning**

- 2.2.1 The work carried out on the day comprised 4 jobs instead of the single job planned at the meeting some 2½ weeks earlier. While it was common for last minute jobs to be inserted in a work plan to make best use of weekend windows, the number of jobs inserted, and the total length of track they covered, was on this occasion unusual. In addition the PIC had no previous experience of protecting such an extended site involving so many separate work groups.

- 2.2.2 Final work planning before issuing the Bulletin did not occur until the Friday 2 days before the incident, and this was the first time that the PIC was aware he would be involved in the protection and was involved in the planning process.
- 2.2.3 There was no indication that the suitability of Rule 175 (b) protection for the final track length and proposed worksites had been reassessed, even though Tranz Rail were aware of the known radio reception problems in the area. There were no guidelines or procedures for protecting such long lengths of track containing multiple worksites, so those involved had applied what was a good rule for one application to an application that it did not fit without an appropriate supporting process.

### **2.3 Events on the day**

- 2.3.1 The PIC started the day aware that he had a particularly big job ahead of him and had familiarised himself with the Bulletin and its implications.
- 2.3.2 Most staff involved were aware of channel 1 reception problems in the area due to the terrain, and the PIC initially located himself at worksite 4 with this in mind.
- 2.3.3 Events had proceeded normally until Train 203 passed through the protection on the down main. The only work fouling the track prior to this was machinery on the up main at Muri awaiting the passing of the train.
- 2.3.4 At about 0715, after the passage of Train 203, worksites 2, 3 and 4 started work that meant them fouling the track, each with the PIC's knowledge and approval. At this stage the PIC was at worksite 4, aware that worksite 3 should finish for the day before Train 243, and aware that worksite 1 should not be fouling the track until after 0900. Worksite 2 was therefore the only worksite remote from the PIC definitely requiring on-track time after the passage of Train 243 at about 0830, and before power was restored at 0900. Consequently communication with worksite 2 was of particular importance, although the PIC still needed to be sure that the other sites were clear as well before Train 243 was permitted to pass.
- 2.3.5 The progressive effect the day's operations and communication problems had on the PIC are best expressed in his recollection of events after the incident. The following covers the period from about 0735:

All of a sudden I just got a ( ) load of phone calls. I think (site controller 2) rung me first on my cellphone, then (site controller 3) rung and then I think I rung (site controller 1), losing signal, they were fading in and out. In between that (contractor) popped up and said (PIC) we want to do some work at Plimmerton road crossing. No, I think (site controller 1) told me that first, that (contractor) was going to ring me about doing some work at Plimmerton road crossing. I just said to (site controller 1), look I've just got too much on my plate. I don't think I can handle another guy being there. (site controller 1) had no sooner hung up then (contractor) came in and he said, (contractor) here wanted to do some work at whatever crossing it was, it was at Plimmerton road crossing and I said to him, no sorry, I can't go down and protect you because I've got my hands full here. He started yelling at me, which made me even worse, because I couldn't, I had so much trouble with ringing everybody and I was trying to give them all the information that I had. Rung (site controller 2), talking to (site controller 2), he was fading in and out, looked at my phone and he hung up on me, so I scrolled through my phone book to try to get (site controller 2) back. (site controller 3) cut in, people were cutting me off and on. I was starting to stress because I was trying to get everybody all the information I possibly could give them and hopefully they got it all clearly, to the best of my ability that I made sure that everybody understood what was happening on our next movement on the up. Because by this time the signal was getting even worse, people were cutting in, I was trying to scroll through my phone book in my phone to try to get to everybody, people cutting in off and on, people tell me I used the other guy's

phone, which I don't even remember using, and to the best of my abilities, my understanding was that everybody would be clear for 600 on the up.

and...

I was trying to deal with one person at a time and get to the next person. But then call waiting would kick in again. I think I had call waiting four or five times, I think on the day. Then when I was going through my phone book, I was searching for one person and then the other person would cut me off.

2.3.6 From communication with worksite 2 up to 0735 the PIC was aware that work had started after Train 203. It was shortly thereafter (0740) that communication regarding the contractor requiring protection commenced with the PIC. This continued, taking most of his call time, until 0754 when a long (4 minute 25 seconds) discussion with site controller 1 ended. The PIC was by then stressed and displaying the signs of information overload, where he was unable to effectively process the information coming to him and maintain a clear picture of what was happening, all hampered by the communication difficulties.

2.3.7 From 0754 until the PIC rang site controller 1 at 0808 there was no record of any radio or cellphone communication involving the PIC. He recalled he was assisting to complete a weld during this time, but judging by the calls he made either side of this lull in activity it is likely his mind was on the complications of the contractor looking for protection at Steyne Avenue.

2.3.8 At about 0815 when Train Control contacted the PIC regarding Train 243 he was already under pressure regarding the intrusion of the unplanned work. An additional operational pressure was then placed on the PIC to obtain clearance for Train 243 as soon as possible. His concern to achieve clearance may be reflected in the succession of short duration cellphone calls recorded shortly thereafter. During one of these calls site controller 2 told the PIC that the down main was clear for Train 243 and that the up main was blocked until further advice. Site controller 2's decision to allow work to proceed after the passage of Train 243 was based on this conversation.

2.3.9 The last discussion between the PIC and site controller 2 occurred when site controller 2 rang the PIC at about 0825, apparently just after the PIC had been updated on Train 600. Site controller 2 rang the PIC to let him know that Train 243 was through his worksite. Site controller 2's memory of this call was that it related only to the passage of Train 243, and no other train movements were discussed. He was aware that Train 600 was the next train through his worksite, but understood it would be held at the South CSB until he gave clearance. He knew power was to be restored at 0900 and believed he had 30 minutes clear to work.

2.3.10 The PIC believed from the conversation that work at worksite 2 was clear of the up main. This was most likely because the PIC, under stress, chose the information that best suited his needs at the time. He wanted a clear path for Train 243 through the protection and probably gathered from the conversation with site controller 2 what he wanted to hear without giving due consideration to information that was inconsistent with his plan. This behaviour is a characteristic recognised in the study of human factors, and known as confirmation bias.

## **2.4 Procedures for planned work**

2.4.1 Procedures for planned work should have been sufficiently resilient to allow for foreseeable difficulties, and included defences to ensure that they did not lead to an unacceptable risk exposure.

2.4.2 The procedures for Conditional Stop Protection were based on a single worksite. There was no formal recognition of the established practice of multiple work groups using one set of CSB protection, and no defined procedures to assist the PIC to manage work load arising from the safe integration of multiple work groups within such protection.

2.4.3 The lack of a recognised cut-off for any additional planned work that could be carried out under such protection resulted in the PIC having to deal with the unexpected intrusion of the contractor. This placed unnecessary stress on the PIC and contributed to the misunderstanding on the day.

2.4.4 Three communication restraints contributed to the stress felt by the PIC on the day:

- The unreliability of channel 1 reception.
- The quality and integrity of cellphone communications.
- The discouragement of the use of channel 2.

All of these restraints were known and their effects predictable. However, there was no indication that these factors had been critically assessed before proceeding with the extended multiple worksite protection in this area of known poor reception.

2.4.5 The use of radio communication had advantages for controlling work of this nature as it had the potential to allow all parties to hear all communications. As well as improving the situational awareness of all parties it opened the door to better crew resource management. However, radio communications were restricted. The use of cellphones had its own limitations, as the PIC found on the day. Procedures are required which recognise the difficulties associated with both forms of communication.

2.4.6 The effect of work load and communication difficulties on operations was exacerbated by the relative emphasis given to avoiding train delays. While such delays are undesirable, the pressure to avoid such delays should not compromise site safety. It is likely that pressure to avoid delays was a factor in the sequence of events leading up to the collision.

## **2.5 Training and experience of the PIC**

2.5.1 The PIC had been used as a specialist protector for a year based on his C level certification, and was well familiar with Conditional Stop Protection. There was no indication that his training or experience was lacking for Conditional Stop Protection as set out in the Tranz Rail Rules and Bulletin procedures. However, there were no procedures covering extended multiple worksites, and the PIC had not had training in such practices. This, together with the PIC's lack of experience at protecting such extended sites, meant he was not appropriately prepared and supported to safely manage the protected length on the day.



### 3. Findings

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

- 3.1 The collision occurred because Train 600 was authorised to pass through a protected work site before all work was clear of the line.
- 3.2 The PIC established correct Rule 175 Conditional Stop Protection in accordance with the Bulletin requirements, but procedures under the rule were lacking as they made no allowance for the demands of extended multiple worksites, and did not take into account known communication weaknesses.
- 3.3 The presence of 4 different worksites, and the need to pass 2 trains in opposite directions through the protected length within a short period, created an informational overload for the PIC, given the limitations of the procedures supporting Rule 175 and the poor radio reception in the area.
- 3.4 The PIC and site controller 2 did not establish a clear understanding before the PIC allowed Train 600 to pass through the protection.
- 3.5 Factors contributing to the misunderstanding that resulted in the PIC authorising Train 600 to pass the CSB while the line was obstructed were:
  - the workload and informational overload generated by 4 separate worksites over an extended length
  - the intrusion of unplanned work
  - the poor reliability of communications available
  - the inappropriate emphasis placed on operational requirements at the cost of safety within the work area
  - the stress felt by the PIC due to the lack of adequate procedures to effectively manage these factors.
- 3.6 There were no procedures in place to control the addition of extra work into a protected length, either from a Block of Line meeting stage or from the finalisation of the daily Bulletin.
- 3.7 Although the PIC was adequately trained and experienced in Rule 175 Conditional Stop Protection, he was not trained or experienced in protecting multiple workgroups over extended lengths, and was not appropriately prepared and supported to safely manage the protected length on the day.
- 3.8 The accumulation of factors which contributed to the misunderstanding were either known or foreseeable.

## 4. Safety Actions

4.1 As a result of actions arising from the Tranz Rail internal investigation of this incident, and the safety recommendations in Section 5 made to Tranz Rail in preliminary form on 29 May 2001, the following safety actions have been completed:

- On 18 June 2001 Tranz Rail issued revised Engineering Rules and Bulletin procedures which included revisions which addressed the control of Conditional Stop Protection involving extended multiple worksites.
- Safety Recommendations 027/01 has been classified by the Commission as “closed-acceptable”.
- Safety Recommendation 028/01 has been classified by the Commission as “closed-acceptable”.

## 5. Safety Recommendations

5.1 On 4 July 2001 the Commission recommended to the managing director of Tranz Rail that he:

5.1.1 revise Engineering Rules and supporting procedures and training to:

1. include requirements for multiple work groups within Conditional Stop Board Protection
2. define procedures to be followed when protecting multiple work groups, such procedures to include repeat-back requirements similar to those used in issuing track warrants, and an auditable Site Control Sheet to be held by the person in charge covering all approved work groups within the protection
3. structure the Site Control sheet to allow such key information as:
  - the time a particular work group is authorised to work on a line or lines, and the person authorised
  - the time at which each work group reported clear of a line or lines, and the person reporting
  - the time at which particular trains are authorised to pass the Conditional Stop Board
  - whether work groups are authorised to resume on-track work on any line after the passage of any train

to be entered

4. enforce a cut-off for planned work which may be carried out under Conditional Stop Protection to that pre-planned and defined in the bulletin (026/01)

5.1.2 issue instructions to reinforce to all operating, maintenance and protection staff that the safe operation of any protected worksite must take precedence over any operational delays arising from complications on the day, including communication difficulties associated with E band or cellphone use (027/01)

5.1.3 implement procedures to ensure that the length of a protected site under Conditional Stop Protection, and the number of separate work groups within the protection, are adequately supported by the communication resources available, the procedures in place, and the known communication reception history of the area. (028/01)

5.2 On 25 July 2001 the managing director of Tranz Rail replied, in part:

5.2.1 **026/01: Items 1 to 3**

Tranz Rail accept Items 1 to 3 of this recommendation. As a result of our internal investigation the following actions have been completed or are in progress:

1. On 18 June 2001 Tranz Rail revised the Engineering Rules. The following specific rules define the requirements for all work groups and apply to multiple work groups within Conditional Stop Protection:
  - Rule 900(e) provides a definition of a Person in Charge.
  - Rule 901(a) specifies the communication tools and how communication is to be made.
  - Rule 902 specifies the procedure for ensuring it is safe for protection to be passed.
  - Rule 905(e) defines the procedure for obstructing the line with Conditional Stop Protection and for the Person in Charge to authorise work within the protection.

The rules listed above are written to provide specific requirements for the safe operation of all work, irrespective of and not limiting the number of work groups included under one set of protection. These rules allow for only one Person in Charge of protection. This ensures all work is protected and authorised in a safe and consistent manner.

2. Engineering Rule 902 has defined the procedure to be followed when protecting multiple work groups and covers the intent of the first part of this recommendation. Tranz Rail has developed a draft "Site Control Sheet" to assist the Person in Charge in managing all staff under his control. This was initiated on 28 May 2001 as a result of the company's internal investigation.
3. A draft "Site Control Sheet" has been developed and includes the items listed. Tranz Rail are currently working to define and document a process for its use.

**026/01: Item 4** – Tranz Rail are still reviewing this recommendation.

A key consideration will be the safety advantages gained by introducing an enhanced pre-planning regime. Regardless of the outcome of Tranz Rail's review, Tranz Rail see it would be prudent to at least move away from the full literal interpretation that can be placed on this recommendation and at the very least allow emergency work to be undertaken within a protected area.

A cut-off time is currently established for work requests that require the issue of daily information bulletins. The process for requesting Conditional Stop Protection and issuing bulletins does not prohibit a bulletin from being amended to cater for a short notice request.

5.2.2 **027/01:** Tranz Rail accept this recommendation.

The following briefing items have been promulgated for staff:

**Infrastructure Staff:**

“Work Site Protection Safety – Infrastructure work sites often involve a large number of people to perform a task. As a result, one Person in Charge may have a large number of staff to co-ordinate over a long area. The safety of Infrastructure and train operating staff is the most important concern for all the people connected with the protection of a work site.

Persons in Charge should manage their work site by maintaining regular communication with Train Control and being conscious not to be pressured to let trains pass at the expense of ensuring all staff are clear and track is safe. Should communication between all persons on a work site be difficult, this must not prevent the Person in Charge from ensuring the site is completely safe for a train to pass.

It is accepted on occasion delays will be unavoidable due to work complications and the necessity to ensure the line is safe and clear.”

This item is due to be issued in a newsletter week commencing 6 August 2001.

**Train Control Staff:**

“Infrastructure Work Sites – Infrastructure work sites often involve a large number of people to perform a task. As a result, one Person in Charge may have a large number of staff to co-ordinate over a long area. The safety of Infrastructure and train operating staff is the most important concern for all the people connected with the protection of a work site.

Train Controllers can assist Persons in Charge to look after their work site by maintaining regular communication and being conscious not to pressure Infrastructure staff to let trains pass at the expense of ensuring all staff are clear and track is safe. It should also be appreciated at times communication between all persons on a work site can be difficult. On occasion delays will be unavoidable due to work complications and the necessity to ensure the line is clear.”

This item was issued on Friday 20 July.

5.2.3 **028/01:** Tranz Rail accept this recommendation.

This issue was identified when reviewing track occupancy rules and related incidents for the new Rail Operating Rules.

On 18 June 2001 Engineering Rule 905(a) and Bulletin Number 498 were introduced to confine work sites to one kilometre in length unless authorised by bulletin. To support the bulletin exceptions to this rule, Tranz Rail have included a specific section of the track protection application form including confirmation of telephone/radio coverage. This form has been in use since 20 June 2001.

# Appendix 1

## Rule 175

Extract from Tranz Rail Rules and Regulations Rule 175, paragraphs (b) (c) (d) and (e), which relate to protection under Conditional Stop Board Protection.

**175** (b) **Protection For Planned Work** – Planned work (authorised by Train Advice) will be protected by Conditional Stop Protection using Conditional Stop Boards and Advance Warning Boards. This method of protection is to be used whenever planned work is going to involve breaking the track or is likely to interfere with the safe operation of trains; e.g. welding, rerailing (including short closer rails) and other such activities. Planned work is that which is known at least one day in advance so that the appropriate train advice can be arranged. Protection MUST be provided before any work is started which may obstruct the line, except

- In a TWC area when a Track Warrant has been issued for the work giving sole occupancy of the section of line involved.
  - At an interlocked station and under the instruction of Officer in Charge.
  - When otherwise authorised by the Officer Controller Train-running.
- i) *Establishing and Removing Protection* – Before work starts Advance Warning Boards must be erected alongside the line 1500 metres in advance and Conditional Stop Boards 200 metres in advance of the outer limits of the work area in each direction.
- They must be removed by the finish time stated in the Train Advice unless the line is still obstructed in which case the employee in charge must advise Train Control.
- ii) *Permission to obstruct line* – Work involving obstruction of the line must only be carried out between the times shown in the train advice and the employee in charge must personally obtain permission from Train Control before the line is obstructed. If the line is to be cleared temporarily for train movements the employee in charge must on each such occasion contact Train Control and obtain permission before the line is again obstructed.
- iii) *Line to be cleared before train due* – The line must be cleared at least 5 minutes before a train is expected. Once the line is clear and safe for traffic the employee in charge must advise Train Control accordingly. Advance Warning and Conditional Stop Boards are not to be removed when the track is cleared temporarily for train movements.
- iv) *Conditional Stop Board not to be passed unless authorised* – Trains must not pass a Conditional Stop Board until authorised by the employee in charge of the work. This authorisation will normally be given by radio communication.
- v) *Conditional Stop Protection not appropriate* – When the employee in charge considers Conditional Stop Protection is not appropriate then protection for Accidental Obstruction is to be used. In this instance the intermediate detonators at 500 and 1000 metres are not required.

- (c) **Positioning of Stop Signals and Boards** – Track Worker’s Stop Signals, Advance Warning Boards and Conditional Stop Boards must be placed on the side of the line which will give Locomotive Engineers the best view of them. In single-line sections, this will normally be on the right hand side facing in the direction of travel. The minimum side clearance is to be 2.15 m from the centre-line of track.

In double-line sections they should generally be placed on the left hand side of the line facing in the normal direction of travel on the line affected. A second Stop Signal or Board should be placed on the right hand side midway between the lines at a level such that it does not project more than 850 mm above rail level.

In multiple track areas or where any confusion may arise as to which line is affected, Stop Signals and Boards should be placed on both sides of the line at a level such that they do not project more than 850 mm above rail level where the distance between adjacent track centres is less than 5 metres.

- (d) **Variations to Location to Stop Signals and Boards** – When special circumstances apply, the distance of 1500 metres from the obstruction or work area for the location of Track Worker’s Stop Signals and Advance Warnings Boards and 200 metres for Conditional Stop Boards must be varied as follows to provide for safe protection of the obstruction.

- i) *Obstruction Near Tunnel* – If placing the protection would cause it to be inside or just beyond a tunnel, the Track Worker’s Stop Signal and detonators, Advance Warning Board or Conditional Stop Board must be placed at a greater distance from the obstruction or work area and whenever possible at least 400 metres beyond the tunnel where the Locomotive Engineer will have a good and distant view of it.
- ii) *Obstruction Near Controlled Signal* – If controlled signals governing the entry of trains into the obstructed section are located between the obstruction and the point at which protection is to be placed, the employee establishing the protection must also communicate with the Signalman and arrange for the signals to be held at “Stop” to prevent confusion. The Signalman must maintain the signals in that position until advised by the employee in charge that the line is clear and safe for traffic to proceed through the work area.
- iii) *Protection placed to Ensure Good and Distant View* – If placing the Track Worker’s Stop Signal and detonators or Advance Warning Board at 1500 metres, or the Conditional Stop Board at 200 metres from the obstruction or work area would cause it to be obscured from the view of the Locomotive Engineer for any reason the protection must be placed at a greater distance from the obstruction or work area where the Locomotive Engineer will have a good and distant view of it.
- iv) *Minimum Distance between Advance Warning Board and Conditional Stop Board* The distance between the boards must not be less than 1300 metres.

- (e) **Attendance at Protection** – Continuous attendance is not required at Track Worker’s Stop Signals, Advance Warning Boards and Conditional Stop Boards, except:

- i) If the employee in charge has reason to believe they are liable to be interfered with.
- ii) If the employee who is to establish Detonator Protection is not in possession of a Track Worker’s Red Disc or Red Flat, then he must remain at the place where the three pairs of detonators are placed on the rails and exhibit a Danger hand signal.
- iii) If Track Worker’s Stop Signals, Advance Warning Boards or Conditional Stop Boards are not clearly visible to Locomotive Engineers owing to fog, falling snow, or other causes, then a Protectionman must be appointed at each such Stop Signal or Board to stop approaching trains or to control their speed according to the nature of the signal or board which is exhibited.

## Appendix 2

### Bulletin Procedures

#### ENGINEERING RULES

##### 175. Method of Protecting Obstruction on Line

**(b) Protection for Planned Work:** The protection is usually Conditional Stop Protection except in certain specified conditions:

**Additional Exception:** When a Track and Time Permit has been issued for the work giving sole occupancy of the section of line involved.

##### Safeworking Arrangement During Major Work

###### Work Arrangements

When a person has been appointed to be in charge of a site where major maintenance work is being undertaken involving various groups of track maintenance/mobile track equipment and/or work trains, that person will also be responsible for their safeworking in conjunction with one another. This person will be the sole addressee for the Track Warrant or Track and Time Permit as the case may be and will be responsible for ensuring the provisions of the Track Warrant or Track and Time Permit are carried out.

*Once the addressee has obtained the Track Warrant or Track and Time Permit, he will verbally authorise the track maintenance groups, mobile track equipment and/or work trains to either enter the affected area, or if already in the area, to enter onto the main line.*

***The Person in Charge of the machines/equipment and/or the Locomotive Engineer of the work trains must be advised by the addressee of the number of the Track Warrant or Track and Time Permit that is held, together with the other particulars on the Track Warrant or Track or Time Permit.***

NOTE: The addressee can not authorise the passing of signals/points indicators in the Stop position unless otherwise authorised on the appropriate Track and Time Permit.
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The addressee will then instruct the track maintenance machine groups, mobile track equipment and/or work trains to proceed cautiously to a specific location advising of any work that may be encountered en route and on arrival at that location if required, call for further instructions.

The addressee will advise each work group their work site limits and that they must not move from these limits without the addressee's permission.

The addressee must ensure that any changeover crews are advised the details of the Track Warrant or Track and Time Permit together with any other associated arrangements.

The Person in Charge will also be responsible for any safe working of Track Maintenance Machines/Mobile Track Equipment and/or work trains when operating in conjunction with other work.

### **Communications**

*When the work area is extensive, the restricted range of the radio channels 1 and 5 may make communication impossible between the addressee and the Locomotive Engineer of a work train or other persons in charge of various equipment. In these cases, permission from Train Control may be obtained to use the Train Control radio system to contact those persons.*

Where the various work locations are in different repeater areas, Train Control may be required to pass on messages. However so as to keep communication through the Train Control radio system to a minimum, cellphones are to be used wherever possible.



## Appendix 3

### Chronological sequence of communications

Note: There was no direct correlation available between Train Control time and cellphone records time. However, reconciliation of the records available with staff recollections indicated cellphone times provided were about 4 minutes ahead of Train Control time. A 4 minute correction factor has been applied to all cellphone calls in this Appendix. Cellphone calls are in italics, and timings must be read as approximate only, based on best estimates.

#### Train Control tape

Method	Time	Speaker	Transcript
Radio	07:15:16	TC	64724 Train Control
	07:15:52	PIC	(TC) It's (PIC) here the NIMT, at the - between Mana Paekakariki Up and Down lines 23.50 to the 35k, - just calling on 243 over.
		TC	Yea he's ... looking towards the 08:00 mark down at Peakak over
	07:16:03	PIC	Roger thank you out (TC) over
		TC	Yea Roger give us a call after that, let you know what else is around.
		PIC	Roger thank you out (TC).

#### Cellphone

Approximate Time	Parties	Duration of call
<i>0714</i>	<i>PIC to site controller 2</i>	<i>16 sec</i>
<i>0720</i>	<i>PIC to site controller 2</i>	<i>45 sec</i>
<i>0731</i>	<i>site controller 2 to PIC</i>	<i>33 sec</i>
<i>0740</i>	<i>contractor at Steyne Avenue to PIC</i>	<i>&lt; 1 min</i>
<i>0745</i>	<i>PIC to site controller 1</i>	<i>13 sec</i>
<i>0748</i>	<i>PIC to site controller 2</i>	<i>55 sec</i>
<i>0750</i>	<i>site controller 1 to PIC</i>	<i>4 min 25 sec</i>

Method	Time	Speaker	Transcript
Radio	08:07:18	TC	243 243 go ahead (LE)
	08:07:28	LE 243	Yea (TC) who's in charge on these conditional stop boards at south North Junction over.
		TC	Ah, Ah you talking about the wrong place.
	08:07:46	LE 243	Were actually at North End Junction, got a conditional stop board in front of me over.
		TC	Oh Ok, well they know you are coming, I said around about 08:00 at Peakak so I hope they call you up very shortly, have you tried them on channel 1?
	08:08:05	LE 243	Not as yet I was just wondering who was looking after these boards, the Traction guy's or the Track Gang over.
		TC	Yea just call him up should be (PIC) in charge of it
	08:08:23	LE 243	Yea roger that, I'll go to channel 1 and see if I can hear him from here.

Method	Time	Speaker	Transcript
	08:08		<i>site controller 1 to PIC</i> <span style="float: right;"><i>1 min 21 sec</i></span>
Radio	08:10:13	LE 243	Control 243 (TC) I can't reach him I think he's a bit too far away on channel 1 over.
		TC	Yea 243 you can't get hold of him on channel 1
	08:11:10	LE 243	Na negative he's on the other side of the hill down at Plimmerton so I think he's too far away over.
		TC	I'll see if I can call him up told him, he knows you're coming, stand by.
	08:11:21	LE 243	Yea Roger
Phone	08:11:??		(TC) calls (PIC) cellphone and gets voicemail.

08:12 *PIC to site controller 2* *21 sec*  
08:13 *site controller 4 (for PIC) to site controller 2* *24 sec*

Phone	08:15:??	TC	Is that you (PIC)?
		PIC	Yes
		TC	OK I got a train waiting at your north end boards mate
		PIC	Yea I'm going to have to use your channel here I just can't hear them on channel 1
		TC	OK well call him up on channel 2
		PIC	I got (site controller 2) fouling the main line at Muri at the moment, I'm just waiting to hear back from him.
		TC	OK well see if you can get him off pronto because this train is actually due to run another one out.
		PIC	Yep no worries I gotta get him... Thanks (TC) catch you later

08:17 *PIC to site controller 2* *9 sec*  
08:18 *PIC to site controller 2* *14 sec*

Radio	08:17:27	TC	64724 64724 Train Control
	08:17:40	LE 243	Yea 243 Maintenance gang over.
	08:17:48	PIC	...couldn't pick you up on channel 1 so I'll be using channel 2, you got permission to pass my conditional stop boards over.
	08:17:55	LE 243	OK to pass the boards at the North Junction here, whereabouts are you actually situated over.
	08:18:13	PIC	We actually at the bean fence just north of tunnel 6 over.
		PIC	Got that 243 over.
	08:18:18	LE 243	Na negative I got nothing of that transmission over.
	08:18:33	PIC	Actually at the north end of tunnel 6 by the bean fence, got (site controller 2) working at the - south of Muri over.
		LE 243	(Sellcall tones only)
Radio	08:23:59	TC	64724 Train Control
	08:24:13	PIC	Morning (TC) it's (PIC) here, 243 has just gone past me at the bean fence, how we looking for 600 over.
		TC	Yea well 600 left there on time, 600 left there on time he's the next up not too far away from your boards at the south end, then you got 200, and then 240 later on, ... toss up whether he's going to make it ahead of the 09:00 unit 'cos that drivers still coming down.
	08:24:52	PIC	Roger that (TC) so we got 600 coming to my boards and then we got 200 shortly behind him is that correct over.
		TC	Yea that's affirmative.

Method	Time	Speaker	Transcript
	08:25:03	PIC	... 200 over
		TC	Yea that's it 600 then 200 ah ETA at your boards around about just 5 past 9.
		PIC	Roger Thank you over

	08:25		<i>site controller 2 to PIC</i>	<i>1 min 50 sec</i>
Radio	08:28:54	LE 600	(TC) I'm at these conditional stop boards at the 23.50, - I can't get hold of the welding gang on channel 1 can you let them know I'm here please.	
		TC	Stand by, 67424, 67424 Train Control	

08:28 *PIC to site controller 1* 45 sec

	08:29:24	PIC	Scanning channel 1 (TC) I just couldn't pick them up where I am, Driver 600 you got permission to pass my conditional stop boards, you got some guy's working south of Muri, got Traction about 200 m away from tunnel 3, and us working north of tunnel 6, you got permission to pass over.
	08:29:32	LE 600	Yea roger thank you pass the conditional stop boards you got guy's at ah outside tunnel 3 and tunnel 6 over.
	08:29:35	PIC	That is correct over.
	08:29:56	LE 600	... thanks.
		TC	... you going to be too far away for channel 1 all the time over.
		PIC	Repeat that again please over.
		TC	Yea where you are now is just too far for channel 1 and ah otherwise you be using this channel all day and I don't really want you to do that over.
	08:30:19	PIC	Roger that (TC) we got 2 welds to drop, once we drop those 2 welds we're going to move down to Plimmerton over.
		TC	Yea OK, go with that for now.

08:37 *PIC to site controller 2* (left a message)  
08:39 *site controller 1 to PIC* 2 min 47 sec  
08:41 *site controller 3 to PIC*<sup>3</sup> < 60 sec (advice of the collision)

<sup>3</sup> Site controller 3 was on cellphone to site controller 2 when he heard the collision and was the first to advise the PIC shortly thereafter.

