NO. 93-128

TRAIN 573

ELTHAM

23 DECEMBER 1993

ABSTRACT

As train 573 approached the London Street level crossing near Eltham on 23 December 1993 the crossing alarms did not activate until the train was very close to the roadway. The Locomotive Engineer reported the incident as an alarm malfunction, but the investigation revealed that the alarms should have been reset manually after a train crossing at nearby Eltham Yard. The safety issues identified in this investigation were a deficiency in the route familiarisation certification of Locomotive Engineers, an incorrect instruction in the Working Timetable, and a deficient safety culture among operating staff.

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

RAIL INCIDENT REPORT NO. 93-128

Train Type and Number:	New Plymouth-Wellington freight, 573
Date and Time:	23 December 1993, 1720 hours
Location:	Eltham 151.80 km, Marton-New Plymouth Line
Type of Occurrence:	Incorrect operation of crossing alarms
Persons on Board:	Crew: 1
Injuries:	Crew: Nil Others: Nil
Nature of Damage:	Nil
Information Sources:	Transport Accident Investigation Commission field investigation
Investigator in Charge:	Mr W J D Guest

1. NARRATIVE

1.1 On 23 December 1993 train 573 was a New Plymouth-Wellington freight.

1.2 The Marton-New Plymouth Line is operated under Track Warrant control, using radios and telephones to give occupation of track sections to only one train at a time. The Track Warrant also specifies where trains are to cross at loops.

1.3 Train 573 had a warrant from Stratford to Eltham, and had an instruction to berth on the main line at Eltham Station, and cross Shunt Service 57 in the loop.

1.4 573 halted on the main line at Eltham. 57 was already at the south end of Eltham, about to enter the loop.

1.5 The Locomotive Engineer of 573 saw the Train Operator of 57 leave his train and alter the points so that 57 could enter the loop. The Locomotive Engineer was then occupied obtaining a Track Warrant by radio from Train Control to pass through Eltham and continue southwards once the points were reset for the main line. He had no contact with the crew of 57.

1.6 Two local streets cross the railway just to the south of Eltham. Bridge Street is 25 m from the end of the loop, and London Street is 175 m distant (see diagram).

1.7 The Locomotive Engineer drove 573 slowly from Eltham, carefully observing the points which had been reset by the Train Operator of 57. He noticed that traffic was stopped at Bridge Street, and he assumed that the Train Operator of 57 had failed to cancel the crossing alarms after 57 had entered the loop. He thought that the vehicles may have been stopped needlessly for some time, and as he was travelling slowly, he tried to wave the stopped vehicles over the crossing. None moved, so he continued driving 573 closer to the crossing, and waved again. Still the vehicles remained stationary, and he then noticed that the alarms were not working.

1.8 The Locomotive Engineer realised that the alarms should probably have been started manually, which would have required him to stop the train and walk to a control box . However, he was aware of another way to start the alarms, and he moved the train slowly towards the crossing. Just as the train reached the crossing, the flashing lights and bells began to operate.

1.9 This method of starting the alarms is not approved by NZRL.

1.10 The Locomotive Engineer accelerated 573 towards London Street. As he approached London Street he saw a car cross over the track. He blew the horn and saw the motorist look startled. He then noticed that the crossing alarms were not working, and he applied the train brakes. As he reached the crossing, the alarms commenced operating, so he released the brakes and continued south.

1.11 The Locomotive Engineer promptly reported the incident to Train Control as an apparent mal-function of the crossing alarms.

1.12 Level crossing alarms (and automatic signals) operated by NZRL are activated by the presence of a train on the rails, i.e. occupying a track circuit. A track circuit is made up by isolating a section of track with insulated joints in the rails. A low voltage is then applied across the rails. When a train passes the insulated joints and enters the track circuit, it closes the circuit by allowing a current to flow from one rail to the other through its wheels and axles. This current is detected by the signalling equip-ment, and the alarms are activated.

1.13 When the train leaves the crossing, the alarms are cancelled.

1.14 Level crossing alarm circuits and control equipment (on single lines) have a standard design feature which enables the alarms to operate for trains in either direction. This permits alarms to be

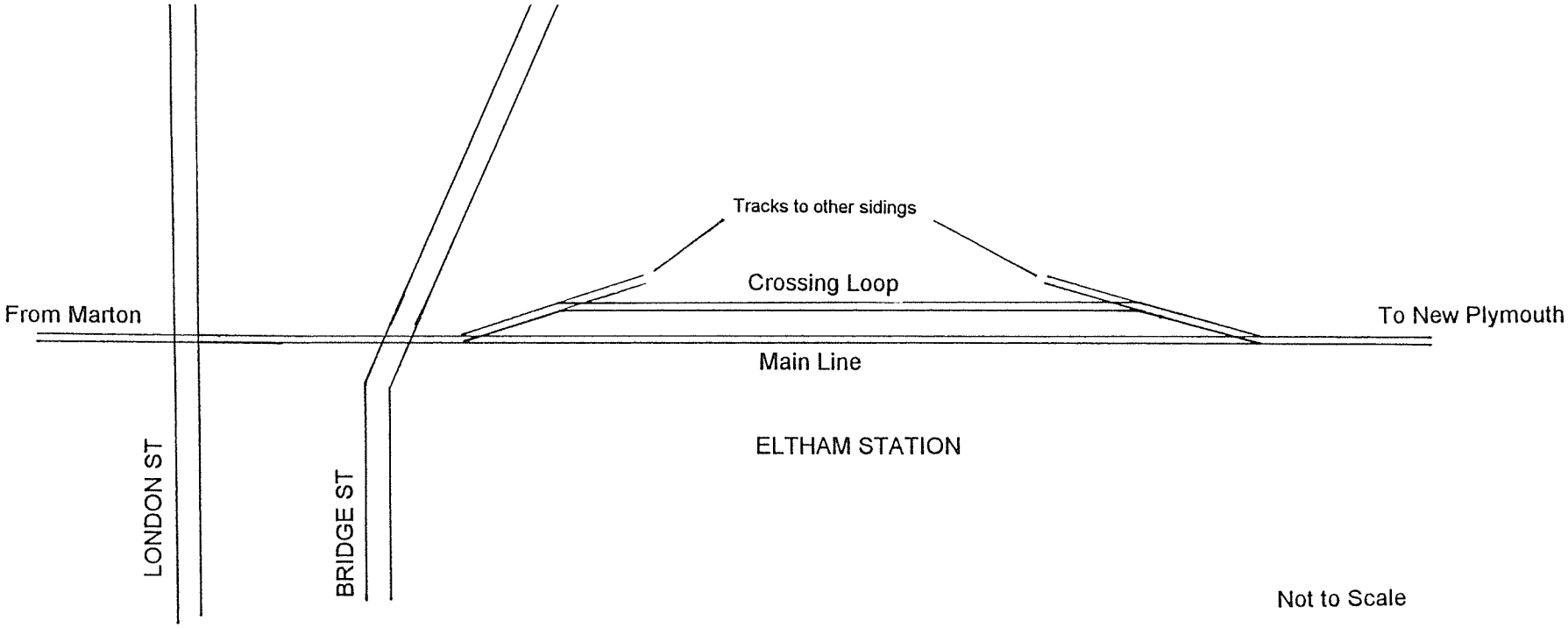

DIAGRAM SHOWING LAYOUT OF ELTHAM CROSSING LOOP AND ADJACENT LEVEL CROSSINGS

activated some time before a train reaches the crossing, but to cancel immediately after it passes over the crossing. In addition to the insulated joints placed some distance from the crossing, there are insulated joints on either side of the crossing. When a train crosses one of the distant joints, it activates the track circuit, and the control equipment takes account of which part of the circuit was first activated. In effect, the control mechanism is then "set" to work for the direction in which the train is travelling. The alarms will cancel when the train has passed over the joint on the side of the crossing opposite to the distant joint which was first crossed. When the train passes the other distant insulated joint on the far side of the crossing, so that there is no longer any train on the circuit, the control system returns to a waiting state.

1.15 The sequential berthing of trains 57 and 573 at Eltham caused an anomaly on the operation of the crossing alarms at both Bridge and London Streets. The first train on to the circuits for both crossings was 57, and as it passed the insulated joints after each street, the alarms cancelled correctly.

1.16 There were two options for the complete clearing of the track circuits for the crossing alarms. The first was an insulated joint placed on the main line, while the second was a joint in the loop. If 573 were not present, the passage of 57 over either of these joints would have cleared the circuit completely and the control equipment would have returned to the waiting state.

1.17 However, the distant insulated joint on the main line at the other (northern) end of the circuit was occupied by the southbound 573 before 57 had cleared the joint in the loop. The circuitry was not designed to discriminate between these joints, and the control circuitry did not resume the waiting state. Consequently when 573 moved southwards from Eltham, the crossing alarm control mechanism did not recognise the southward movement and the alarms did not activate correctly.

1.18 The passage of the train over the first insulated joint close to the crossings did cause the alarms to activate, but this gave no timely warning to motorists.

1.19 At stations where there were fixed signals operated by Train Control or a local signalman, the crossing alarm circuits would have been connected to the signals so that when a signal was held at stop", the crossing alarm would not have been activated for a train approaching from the same direction. However, with the introduction of Track Warrant Control, the fixed signals at Eltham were removed.

1.20 There are three stations on NZRL where there are no fixed signals and where there is a level crossing in close proximity to a loop. They are Eltham, Waipukurau, and Henley.

1.21 The possibility that this incident could occur had been recognised by the Signals Engineers of NZRL. To cater for what was seen as a low probability risk, the following instruction was included in the Working Timetable (section L4):

> **3.8.4 London and Bridge Streets, Eltham**
>
> The alarms operate automatically for all train movements on the main line. For all other movements the alarms must be controlled manually by the pushbuttons at the crossings. The alarms must be operating before any movement over or fouling the crossing. The alarms cancel automatically once the movement has cleared the crossing. The alarms must be cancelled for all Down trains standing on the main line. A time delay may operate before the alarms cancel.

1.22 The Locomotive Engineer of train 573 was not aware of the unusual nature of the interaction between the operation of the crossing alarms and the sequential berthing of trains on the loop and main lines. The Working Timetable instruction did not alert him to it, because 573 was on the main line, and the first sentence of the instruction made it clear to him that the alarms would operate automatically.

1.23 Immediately following this incident, New Zealand Rail Limited modified the instruction by including the word "non-stopping" in the first sentence so that the instruction read:

> "**3.8.4 London and Bridge Streets, Eltham**
>
> The alarms operate automatically for all non-stopping train movements on the main line. For all other movements the alarms must be controlled manually by the pushbuttons at the crossings. The alarms must be operating before any movement over or fouling the crossing. The alarms cancel automatically once the movement has cleared the crossing. The alarms must be cancelled for all Down trains standing on the main line. A time delay may operate before the alarms cancel."

1.24 While the amendment alerts the Locomotive Engineers of trains which are required to stop on the main line at Eltham that the alarms must be controlled manually, the second last sentence of the instruction does not appear to deal clearly with the situation which arose in this incident. The sentence reads:

> "The alarms must be cancelled for all Down trains standing on the main line."

This instruction is intended to tell a Locomotive Engineer that if he stops on the main line at Eltham and is not immediately proceeding over the crossings, he must take action to stop the operation of the crossing alarms which will have automatically started as his train approached.

1.25 In this incident, the alarms ceased operating (i.e. cancelled) automatically when 57 shunting service passed over the crossing. There was no reason for the Locomotive Engineer of 573 to cancel them. The action he needed to take was to "reset" the alarm control equipment so that the alarms would activate for his train.

1.26 The Train Operator of 57 was aware that the alarms needed to be "reset" manually. He did not do it while he was setting the points for the berthing of 57 because he did not know how long 573 would be at Eltham. He knew that if he reset the alarms, they would immediately activate for 573's southwards movement, and that traffic would be stopped, so he left the manual operation for the Locomotive Engineer of 573 to undertake when he was ready.

1.27 The Locomotive Engineer of 573 had joined New Zealand Railways in Wanganui in 1981, and had undertaken route familiarisation training for the Marton-Stratford section of the Marton-New Plymouth Line. He had had many years' experience on this section.

1.28 However, following the introduction of Track Warrant Control and consequential alterations to the signals throughout the section, the Locomotive Engineer had not become aware of the possible consequences of the train movements which occurred at Eltham in this incident. The changes to the signals and the introduction of Track Warrant Control effectively outdated an important part of his route knowledge.

1.29 Route knowledge is an essential aspect of safe train operation. A motorist with a driver's licence, providing that he or she obeys the road signs and traffic signals, can travel over an unfamiliar road safely. By contrast, a Locomotive Engineer must have a good knowledge of the physical features of the track section, the location of the signals, and the meaning of the signal aspects in order to operate a train safely.

1.30 To become familiar with a track section over which he or she is to drive trains, a Locomotive Engineer accompanies experienced Locomotive Engineers in trains for a period which is not stipulated by NZRL, but which may be as short as three trips. During these trips the Locomotive Engineer is expected to become familiar with the section, and the signals and local instructions for the area. When the Locomotive Engineer considers that he or she feels ready, the Train Supervisor for the area will

conduct an oral examination on the general and local instructions pertaining to the section, and will usually accompany the trainee on a trip over the section.

1.31 The requirements for section familiarisation are set out in the NZRL Rail Operating Code. The instructions are contained in sections 3.2.8 and 3.3.1. The relevant parts of these sections read:

> "**3.2.8 Certification of Road Knowledge**
>
> Until Locomotive Engineers have signified on the Road Knowledge certificate that they are sufficiently familiar with the section concerned and have a thorough knowledge of instructions and signals controlling the movement of trains in the area, they are not to be rostered to run trains over that section of line.
>
> Train Operators are not to be booked on any train until they have signified on the prescribed form that they have a thorough knowledge of the signals controlling the movement of trains in these areas.
>
> [One paragraph omitted]
>
> **3.3.1 Procedure when Transferred to a New Area**
>
> When Locomotive Engineers or Train Operators are transferred to a new depot they must be given reasonable opportunities for learning the road before being booked to take up normal duties.
>
> In order to learn the road a Locomotive Engineer or Train Operator should travel as an additional person on a locomotive, but is not to travel in the driving compartment of railcars or other single manned passenger stock without special authority. Locomotive Engineers may be booked to run freight trains during daylight hours accompanied by the Train Supervisor or another Locomotive Engineer, until passed by the Train Supervisor.
>
> When a Locomotive Engineer or Train Operator is transferred or appointed to a new depot, instructions from the Signalling and Interlocking (S and I) book must be given by the Train Supervisor or by a competent Locomotive Engineer.
>
> At centres where large shunting yards or terminal areas are situated, new members must be conducted around the yards to facilitate knowledge of signalling arrangements, layouts and methods of working and issued with a personal copy of the appropriate S & I circular.
>
> Before a Locomotive Engineer is called upon to sign the Knowledge Certificate, he must receive an oral examination on general and local instructions which will be recorded on the Loco 337 card."

1.32 When Track Warrant Control (TWC) was introduced in 1991, the Locomotive Engineers who worked on the Marton-New Plymouth Line were given a two day course on the operation of TWC and the signalling changes that were also made at that time. However, there was no detailed examination of Locomotive Engineers to ensure that they were fully aware of the impacts of the changes on their road knowledge.

1.33 The staff who conducted the training course were not Train Supervisors. They were staff members of the Personnel Division of NZRL, assisted by Signalling staff.

1.34 Route knowledge was tested by Train Supervisors, who were part of the Operating Division.

1.35 The Train Supervisors attended the same course as the Locomotive Engineers, and were not required to recertify the Locomotive Engineers' route familiarisation.

1.36 Since this incident at Eltham, NZRL has commenced a reorganisation of the training and supervision of Locomotive Engineers so that both aspects are controlled by the Operations Division, and undertaken by the same staff.

1.37 NZRL does not require Train Supervisors to have a written syllabus for section familiarisation in any area.

1.38 While the result of the oral examination is recorded, the questions are not recorded.

1.39 The Rail Operating Code, the Signalling Rules, the S & I circulars, and the Working Timetable set out the formal instructions to be followed by staff concerned with train operations.

1.40 Details of a section which a Locomotive Engineer needs to know in order to drive a train with optimum safety and economy, but which do not constitute operating rules, are handed on essentially by word of mouth, and NZRL has not attempted to record them consistently or provide a method of disseminating them.

2. FINDINGS

2.1 The Locomotive Engineer on Train 573 was certified correctly to drive the train.

2.2 Train 573, travelling south, stopped on the main line at Eltham at the same time as train 57 shunting service, travelling north, entered the loop.

2.3 The crossing alarms on Bridge and London Streets worked correctly for train 57 shunting service, but because train 573 entered the track circuit for the alarms before train 57 had cleared it, the control equipment did not reset and recognise the presence of train 573.

2.4 The Locomotive Engineer of train 573 did not know that this situation could arise, and that the alarms were required to be reset manually by operating two buttons in a box beside the track.

2.5 The Locomotive Engineer was surprised to find that the Bridge Street level crossing alarms were not working, and started them by driving the train over the insulated joint close to the crossing at slow speed.

2.6 The practice of starting crossing alarms without using the push buttons provided (described to the Investigator of this incident as "crashing" them) by travelling over the insulated joint close to the crossing is not approved by NZRL.

2.7 NZRL supervisory and management staff were not aware of the occurrences of "crashing" the alarms at Eltham.

2.8 "Crashing" the alarms was easier for Locomotive Engineers than stopping the train, leaving the locomotive, walking over ballast to the control box, unlocking the box, operating the push buttons, locking the box, and returning to the locomotive.

2.9 The Locomotive Engineer of 573 did not know that "crashing" the alarms at Bridge Street did not reset the circuit for London Street, and consequently, the alarms at London Street did not operate as 573 approached.

2.10 There was almost a collision with a vehicle on London Street level crossing.

2.11 It is probable that there were earlier occurrences of crossing alarms not working as expected that were not correctly reported or followed up.

2.12 The instruction in the working timetable was wrong in that it stated that the crossing alarms worked automatically for all train movements on the main line.

2.13 The instruction as amended immediately following the incident still did not explain the need to reset the alarms if sequential berthing of trains in order to cross occurred at Eltham.

2.14 In the course of the training following the alterations to signals in the section, the Locomotive Engineer did not become aware of the potential for this incident to occur at Eltham.

2.15 The changes to the signals effectively rendered the Locomotive Engineer's familiarisation certification for the Eltham section out-of-date.

2.16 The training was carried out by staff who did not have responsibility for section familiarisation certification.

2.17 Since this incident, NZRL has reorganised the training and supervision of Locomotive Engineers to bring together the two functions.

2.18 The Locomotive Engineer reported the incident promptly as required by NZRL.

2.19 Section familiarisation training is not documented within NZRL, other than that it has been undertaken.

3. SAFETY RECOMMENDATIONS

3.1 It was recommended to NZRL that:

3.1.1 They review the wording of clauses 3.8.4 and 3.8.5 of section L4 of the Working Timetable with a view to explaining clearly the situation which arose in this incident i.e. the need to reset the alarms if sequential berthing on the main line and loop occur at Eltham, and the crossing alarms cancel after the passage of the northbound train (040/94)

3.1.2 They review the methods of section familiarisation training, with a view to establishing syllabi and examinations that are documented and able to be audited (041/94).

3.1.3 They investigate the practicability of providing Locomotive Engineers with a remote control device for resetting the alarms at Eltham, to obviate the need for the Locomotive Engineers to leave the cab to reset them. (065/94).

3.1.4 They investigate the practicability of introducing an operating procedure that, when trains are to cross at Eltham, requires one train to stop outside the limits of the track circuits for the Bridge Street and London Street level crossing alarms until the other train has berthed and advised that the train is in the siding clear of the fouling boards. (066/94)

3.1.5 They reiterate to Locomotive Engineers that "crashing" alarms to operate them is not an acceptable practice, and that it may lead to unreliable or unexpected results. (067/94)

3.1.6 They take positive steps to encourage a safety culture among Locomotive Engineers and other operating staff in which events which are not understood, and apparent faults or errors are promptly reported, openly discussed and solutions disseminated (068/94).

3.2 New Zealand Rail Ltd responded:

Recommendation 040/94: The wording in clause 3.8.4 and of section L4 of the Working Timetables has been amended to explain more clearly the situation which arose in this incident (amendment No. 14 dated 24.7.94 refers).

Recommendations 041/94, 065/94 and 066/94: NZRL plans to investigate and review its current practices and procedures in relation to rail operations.

Recommendations 067/94 and 068/94: These recommendations are accepted—NZRL continues to actively encourage improved operating compliance and reporting of non compliances.

12 October 1994

M F Dunphy
Chief Commissioner