Report 06-106, express freight Train 826, signalling irregularity, Cora Lynn, 31 July 2006

Report 06-106

express freight Train 826

signalling irregularity

Cora Lynn

31 July 2006

Abstract

On Monday 31 July 2006 at about 2054, eastbound express freight Train 826 stopped at Cora Lynn Arrival Signal 10244 on the Midland Line. The arrival signal was displaying a green aspect, while at the same time the facing points were set in the reverse position and the "L" light was not illuminated.

The locomotive engineer suspected a signalling irregularity because about 2 hours earlier he had set and locked the west-end points in the reverse position when he departed from the crossing loop on westbound Train 841. He had monitored the radio channel during the intervening time and was aware that no other trains had since passed through Cora Lynn.

Safety issues identified included:

- the suitability of the single-line automatic signalling system for the Midland Line
- the inspection and testing of the universal switch controller units
- the procedures for communicating the status of main-line points at crossing stations within single-line automatic signalling territory.

One safety recommendation has been made to the Chief Executive of the New Zealand Transport Agency to address these issues.

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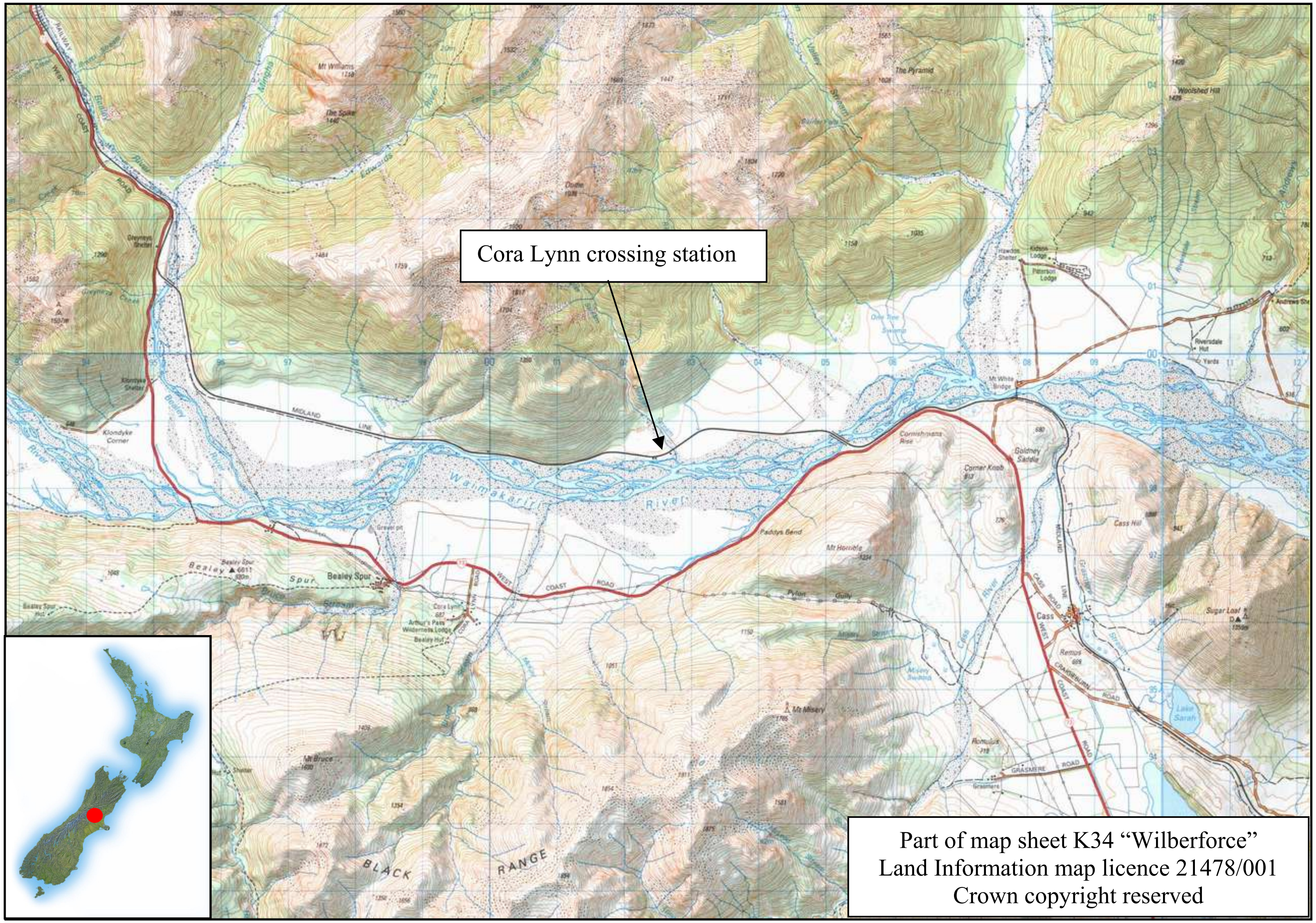
Abbreviations

km	kilometre(s)
km/h	kilometre(s) per hour
LHS	left-hand side
m	metre(s)
mm	millimetre(s)
RHS	right-hand side
SLAS	single-line automatic signalling
the Code	Ontrack's Signals Traction and Electrical Code Document S006, Issue 6
UTC	co-ordinate universal time

Data Summary

Train type and number:	express freight Train 826
Date and time:	31 July 2006, at about 2054[1]
Location:	Cora Lynn
Persons on board:	crew: 1
Damage:	nil
Operator:	Toll NZ Consolidated Limited
Investigator-in-charge:	P G Miskell

[1] Times in this report are New Zealand Standard Times (UTC + 12 hours) and expressed in the 24-hour mode.



Location of the incident

1 Factual Information

1.1 Narrative

1.1.1 On Monday 31 July 2006, Train 841 was a westbound express freight train conveying empty coal wagons from Lyttelton to Ngakawau. The locomotive engineer had started work at 1500. He was rostered to drive Train 841 from Christchurch and return with Train 826. Train 841 departed from Christchurch at about 1605, crossed 2 trains at Darfield and proceeded toward Cora Lynn.

1.1.2 At about 1845, the train stopped short of Down Arrival Signal 10171 at Cora Lynn (see Figure 1). The locomotive engineer set the points for the loop, berthed the train then waited about 5 minutes for the arrival of eastbound express freight Train 844.

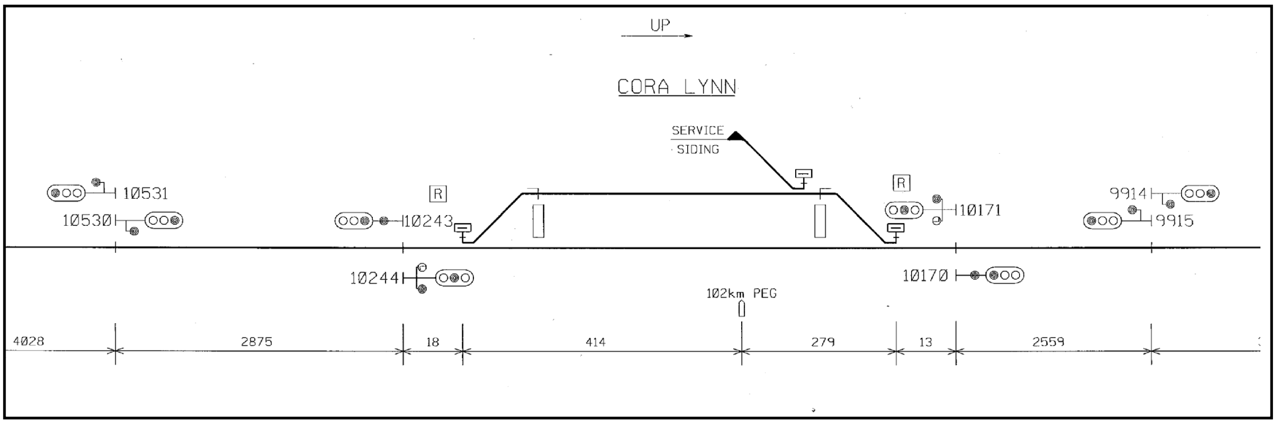


Figure 1
Signals and interlocking diagram for Cora Lynn

1.1.3 As soon as Train 844 had berthed on the mainline, the locomotive engineer from Train 841 climbed down from the locomotive cab, plunged[2] for a light, got a green aspect (proceed indication) on Departure Signal 10243 then set and locked the west-end points in the reverse position. At about 1852, as the train was departing from Cora Lynn, the locomotive engineer radioed the train controller to tell him that the west-end points at Cora Lynn were locked in the reverse position.

1.1.4 Soon after departing from Cora Lynn, the locomotive engineer looked back to confirm that his train was complete. He noticed that after the train had cleared Intermediate Signal 10530, the signal still displayed a green aspect, even though the west-end points were locked in the reverse position. He had expected to see a yellow aspect, so he strongly suspected that a signalling irregularity had occurred.

1.1.5 At about 1940, Train 841 berthed at Otira to cross Train 826, an eastbound Greymouth to Christchurch express freight train. After a crew change, the locomotive engineer from Train 841 took up the running of Train 826 back to Christchurch. Train 826 consisted of 2 DC class locomotives in multiple hauling 6 wagons with a gross weight of 234 tonnes and a total train length of 117 metres (m). The train departed from Otira at about 2000.

1.1.6 When the train controller later gave the locomotive engineer of Train 826 his operating instructions before the train departed Arthur's Pass, he also told him that the facing points at Cora Lynn were set fixed in the reverse position. The train controller said that although it was not mandatory to advise locomotive engineers of the orientation of facing points, he always did so. In this instance, he knew that the locomotive engineer on Train 826 had earlier locked the west-end points at Cora Lynn in the reverse position, but he told him anyway.

[2] Pressed a button to activate local signalling equipment.

1.1.7 The locomotive engineer on Train 826 observed a green aspect on both the first and second intermediate signals when travelling from Arthur's Pass to Cora Lynn. Approaching Cora Lynn he saw that the next signal, Intermediate Signal 10530, was still displaying a green aspect rather than the yellow aspect he expected. He reduced the train speed in anticipation that the west-end points were locked in the reverse position as he had left them when departing from Cora Lynn on Train 841.

1.1.8 The locomotive engineer stopped the train short of Arrival Signal 10244, which was displaying a green aspect and the associated "L" light was not illuminated. He alighted from the locomotive and confirmed that the west-end points were locked in the reverse position, then he contacted the train controller to advise him of the signalling irregularity.

1.1.9 After discussing the situation with the train controller at about 2054, the locomotive engineer reset and locked the west-end points in the normal position so that Train 826 could continue on the mainline towards Christchurch. When the points were moved to the normal position, the signal indication did not change and continued to display a green aspect, as it should with the points set for the main line.

1.1.10 The train controller arranged for Otira-based signals staff to be called out to investigate the reported signalling irregularity. The train controller discussed the alleged wrong-side failure with the attending signal maintainer. They agreed that because the next 2 trains scheduled to arrive at Cora Lynn were through trains, and as both sets of main-line points were in the normal position, there was no benefit to be gained by suspending signals. During the discussions, they also agreed that planned train crossings at Cora Lynn would cease until the signalling irregularity had been investigated and rectified. The train controller endorsed the train control diagram accordingly.

1.1.11 At about 2245, the incoming train controller was apprised of the situation at Cora Lynn during the handover.

1.1.12 The following morning, the signal maintainer examined the points but could not see any initial cause for the signalling irregularity. He tried, without success, to replicate the fault by repeatedly moving the points from the normal position to reverse and back again. With the points left in the reverse position, he examined the universal switch controller to find that the contacts for the "Normal" position opened only about one or 2 millimetres (mm) and that there was contaminated moisture on top of the contacts (see Figure 2).

1.1.13 With agreement from the train controller, he secured and locked the points in the normal position. He suggested to the train controller that there be no crossings at Cora Lynn until advised otherwise. He returned to his Otira Depot and wrote a note of his findings for the signal technician who would be starting work later that morning.

1.1.14 After reading the notes left by the attending signal maintainer, the signal technician contacted the train controller for an update on the operating procedures put in place for Cora Lynn. He then contacted the signal field engineer to advise him of the signalling irregularity. The signal field engineer, who was responsible for commissioning new works and auditing work practices and equipment throughout the South Island, was conducting a field audit near Invercargill. The signal field engineer suggested specific tests be carried out on the equipment at Cora Lynn and that the arrival and departure signals at Cora Lynn and the down departure signal at Arthur's Pass be fixed at Stop, so that train crossings could take place at Cora Lynn under controlled conditions.

1.1.15 On arrival at Cora Lynn, the signal technician examined the electrical cables to the universal switch controller and the cables to the intermediate signal at 105.30 kilometres (km). The universal switch controller had been left undisturbed since the signal irregularity had been reported.

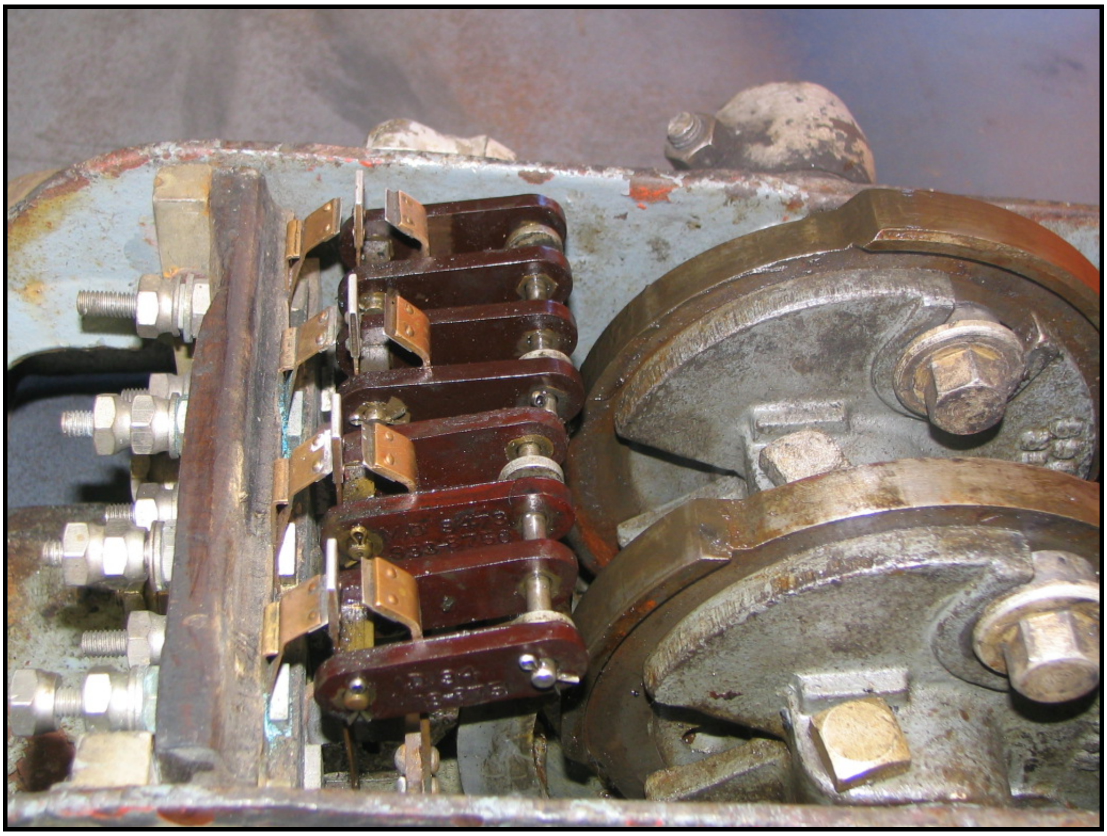


Figure 2
Universal switch controller contacts

1.1.16 On Wednesday 2 August 2006, the signal technician and the attending maintainer met the signal field engineer on site. Together, they managed to replicate the signalling irregularity. However, they determined that the fault could not easily be rectified on site, so the universal switch controller was replaced and the signalling system then operated as designed. At about 1500, the signalling system between Arthur's Pass and Cora Lynn was restored.

1.2 Route and site information

1.2.1 The coal route was used to transport coal from the west coast at Ngakawau (near Westport) and Greymouth, to the coal export facility at the Port of Lyttelton.

1.2.2 The coal route utilised the Midland Line from Rolleston to Stillwater, a distance of 197 km, and the Stillwater to Westport Line from Stillwater to a loading facility at Ngakawau, a distance of 164 km. The Midland Line traversed the Southern Alps, with eastbound trains climbing a ruling gradient of 1 in 33 over a 12 km section between Otira and Arthur's Pass (including the Otira Tunnel). The route was also used by the *Tranz Alpine* passenger express and general freight services.

1.2.3 There were 18 train movements scheduled between Rolleston and Stillwater during a 24-hour period, which included:

eastbound

- 6 loaded coal trains
- 3 general express freight trains
- one passenger express service

westbound

- 6 empty coal trains
- one general express freight train
- one passenger express service.

Cora Lynn

1.2.4 Cora Lynn was a crossing station between Cass and Arthur's Pass on the Midland Line (see Figure 3).

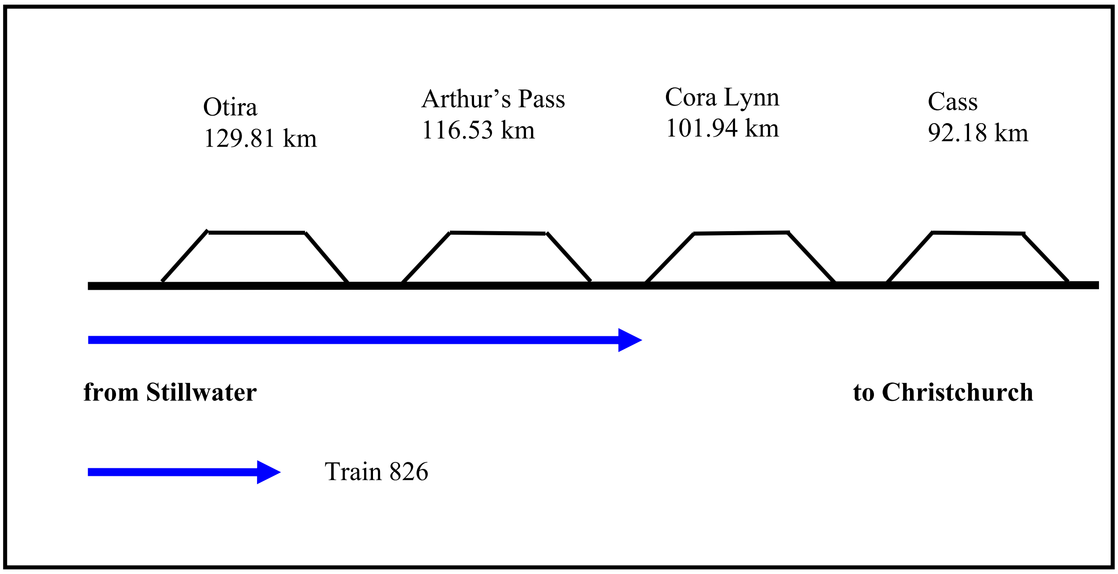


Figure 3
Route map (not to scale)

1.2.5 The maximum authorised line speed for express freight trains travelling between Arthur's Pass and Cora Lynn was 80 km per hour (km/h), while the *Tranz Alpine* passenger express was restricted to a maximum operating speed of 90 km/h.

1.2.6 Cora Lynn crossing station consisted of a 572 m long crossing loop, connected to the mainline at each end by hand-operated points.

1.3 Operating information

Single-line automatic signalling

1.3.1 Train movements between Rolleston and Arthur's Pass and Otira and Stillwater on the Midland Line were controlled from the national train control centre in Wellington, and operated under single-line automatic signalling (SLAS) rules and operating procedures. SLAS had been introduced on the Midland Line when the Otira Tunnel was opened in 1923.

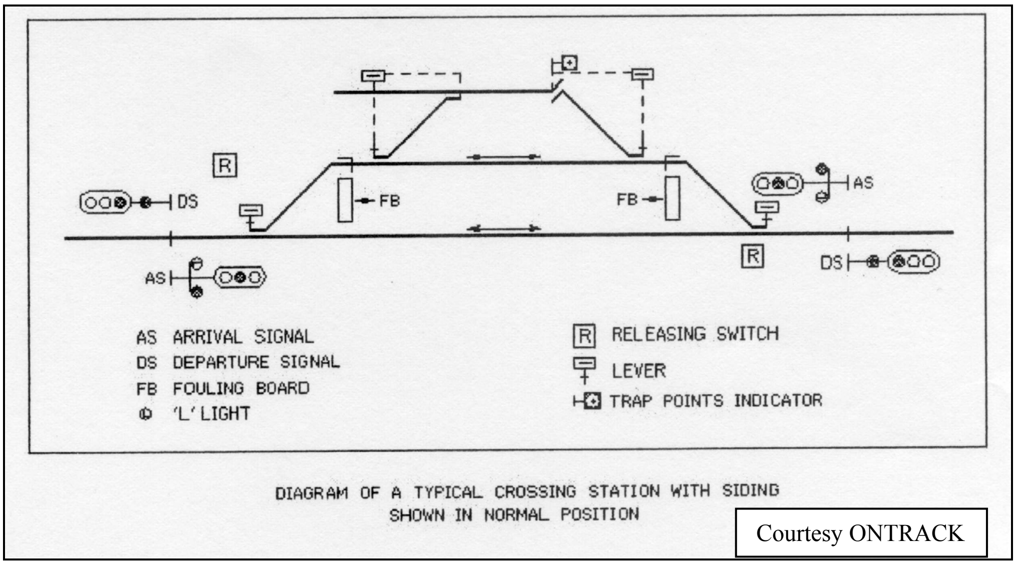
1.3.2 At the time SLAS was introduced, a freight train crew comprised 3 persons: a locomotive engineer, a locomotive assistant whose duties included opening the points for the train, and a guard who restored the points to normal after the train departed from a crossing loop.

1.3.3 With the guard's position made redundant and the introduction of single-person locomotive crewing by 1992, the resetting of points to the normal position after a train departed from a crossing loop was no longer practical because the locomotive engineer would have been required to walk back the entire length of the train to complete that task, then return to the driving cab. To overcome this situation, operating procedures were amended to allow main-line points to be left in the reverse position after a train departed from a crossing loop. When points were left in the reverse position, the locomotive engineer had to advise train control and the train control diagram was endorsed accordingly.

1.3.4 It was not mandatory for train controllers to advise locomotive engineers of the location of main-line points that were left in the reverse position. Ontrack gave 3 main reasons for this:

- the points were protected by the signalling system, and any pre-advice could cause a locomotive engineer to pre-empt a signal aspect or requirement to stop
- the resetting of reversed points to the normal position by authorised personnel, other than train crews, was a common practice, and as a result the train controller could never guarantee that their latest information regarding the setting of the points was still current
- the operating system had a high level of radio traffic during the day, which generated a high task load on train control, and the addition of non-critical tasks could impact on a train controller's ability to undertake critical tasks relating to the safe running of the trains.

1.3.5 The arrival signals and the departure signals in SLAS territory were positioned adjacent to each other at crossing stations, either on opposite sides of the main line (see Figure 4) or back to back.



Courtesy ONTRACK

Figure 4
Typical layout of a crossing station in SLAS territory (not to scale)

1.3.6 In SLAS territory, an arrival signal was a stop and proceed signal positioned at the entrance to a crossing station. When an arrival signal displayed a red aspect (stop indication), the locomotive engineer was required to stop the train short of the signal, ensure that the route was properly set and safe for the passage of the train, then wait 10 seconds before proceeding to the next signal in advance.

1.3.7 An arrival signal (see Figure5) would display a red aspect when:

- an opposing train was approaching the station from the opposite end at the same time
- the trailing points at the opposite end of the station were in the reverse position
- the facing points immediately past the arrival signal were reversed (in which case an "L" light would also be illuminated).

When both sets of points were in the normal position, the arrival signal would normally display a yellow aspect (caution proceed) if there was a train in the track section in advance, or a green aspect (clear proceed) if the track section in advance was clear.

1.3.8 Arrival signals were fitted with a short-range light, which showed an illuminated white letter "L" when the facing points were set for the loop (see Figure 5) and the points for any diverging lines off the loop were in the normal position. With the points set for the loop, the arrival signal controlling the entrance of a train into the station was at "stop". The illuminated "L" light confirmed that the route was set for the loop, but not that the loop was unobstructed. A locomotive engineer on a train entering a loop was not required to stop at the arrival signal when the "L" light was illuminated, but was required to be satisfied that the route was clear before proceeding at a maximum speed of 25 km/h.

1.3.9 The points were electrically connected to the signals so that when the points at either end of a crossing station were reversed, both arrival signals went to a red aspect (stop) and the "L" light was illuminated at the end at which the facing points were reversed.

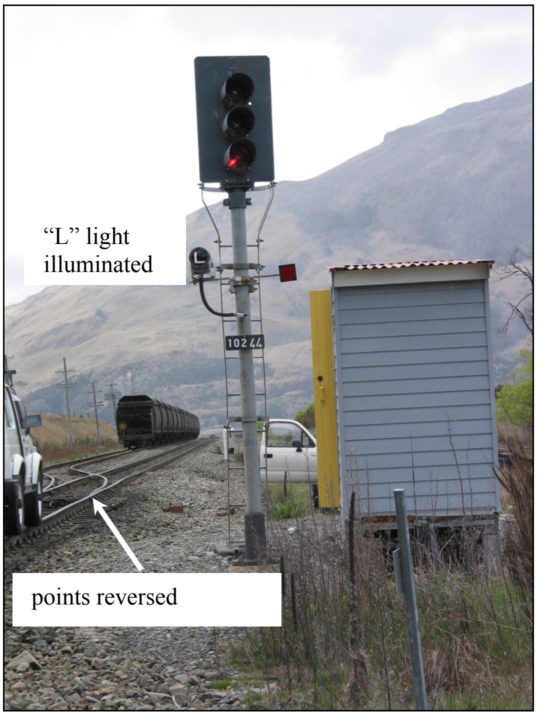


Figure 5
Arrival Signal 10244 at Cora Lynn with the "L" light illuminated

1.3.10 The departure signal controlled the exit from a station and the entrance to the next single-line block section. In SLAS territory, there was only one departure signal at each end of the crossing station and this controlled the departure of trains from either the loop or the main line (see Figure 4).

1.3.11 Intermediate signals were provided where necessary within SLAS territory to divide the line between stations into shorter sections and to control the entry of trains into such sections. Intermediate signals also advised the locomotive engineer of the signal indication expected at the next signal in advance.

1.3.12 Intermediate Signal 10530 was 2875 m in advance of the west-end Arrival Signal 10244 at Cora Lynn.

Working a crossing station in SLAS territory

1.3.13 Train controllers managed the running order of trains by issuing Mis.50/Mis.51 operating instructions to locomotive engineers at the entry into SLAS territory and at other locations as necessary. With a few exceptions, a single operating instruction was issued to the locomotive engineer of each train and remained with the train through one of the 2 portions of the SLAS territory, those being between Rolleston and Arthur's Pass, and between Otira and Stillwater.

1.3.14 Locomotive engineers were required to comply with those operating instructions. When a train arrived at a station selected by the train controller for a crossing, the locomotive engineer was required to operate various items of signalling equipment, including hand-operated points, in order to execute the planned crossing. There were some circumstances wherein the first train that arrived at the designated crossing station could find the arrival/departure signals displaying green aspects (proceed indication). These green aspects had to be disregarded then changed by the locomotive engineer to red aspects. This would allow the opposing train, which could be waiting at red aspects at the next station in advance, to travel under proceed indications from that station to the designated crossing station.

1.4 Universal switch controller

1.4.1 Ontrack could not confirm when the universal switch controller for the west-end points at Cora Lynn had been installed. However, the single-arm, split-cam indicator was typical of the type operating on the Midland Line since SLAS had been commissioned in 1923.

1.4.2 The universal switch controller was housed in a cast-iron protective casing designed so that it could be mounted on an extended sleeper and suitable for continuous use under extreme weather conditions.

1.4.3 The universal switch controller consisted of a camshaft mechanically connected to the set of rail points. When the points were moved, the camshaft rotated. The double-cam followers were attached to the camshaft and arranged so that they positively activated both the opening and the closing of the electrical contacts (see Figure 6). The camshaft rotated approximately 90 degrees by the movement of the point's mechanism as it changed from either the normal (mainline) to the reverse (diverging line) or reverse to normal positions. The 3 contacts on each switch, Common, Normally Open and Normally Closed, were wired out through a terminal block to dedicated terminals (12 terminals in total) to connect with the local signal indication circuit.

1.4.4 The cams were adjusted to operate one pair of changeover switch contacts when the track points were in the normal position and the other pair when the track points were in the reverse position. Ontrack's setting instructions required the Common and Normally Open contacts on the cam-operated switch to close when the track points were within 6 mm of the respective state. The switch had to be closed within 2 mm of the respective state and open when more than 6 mm from the respective state.

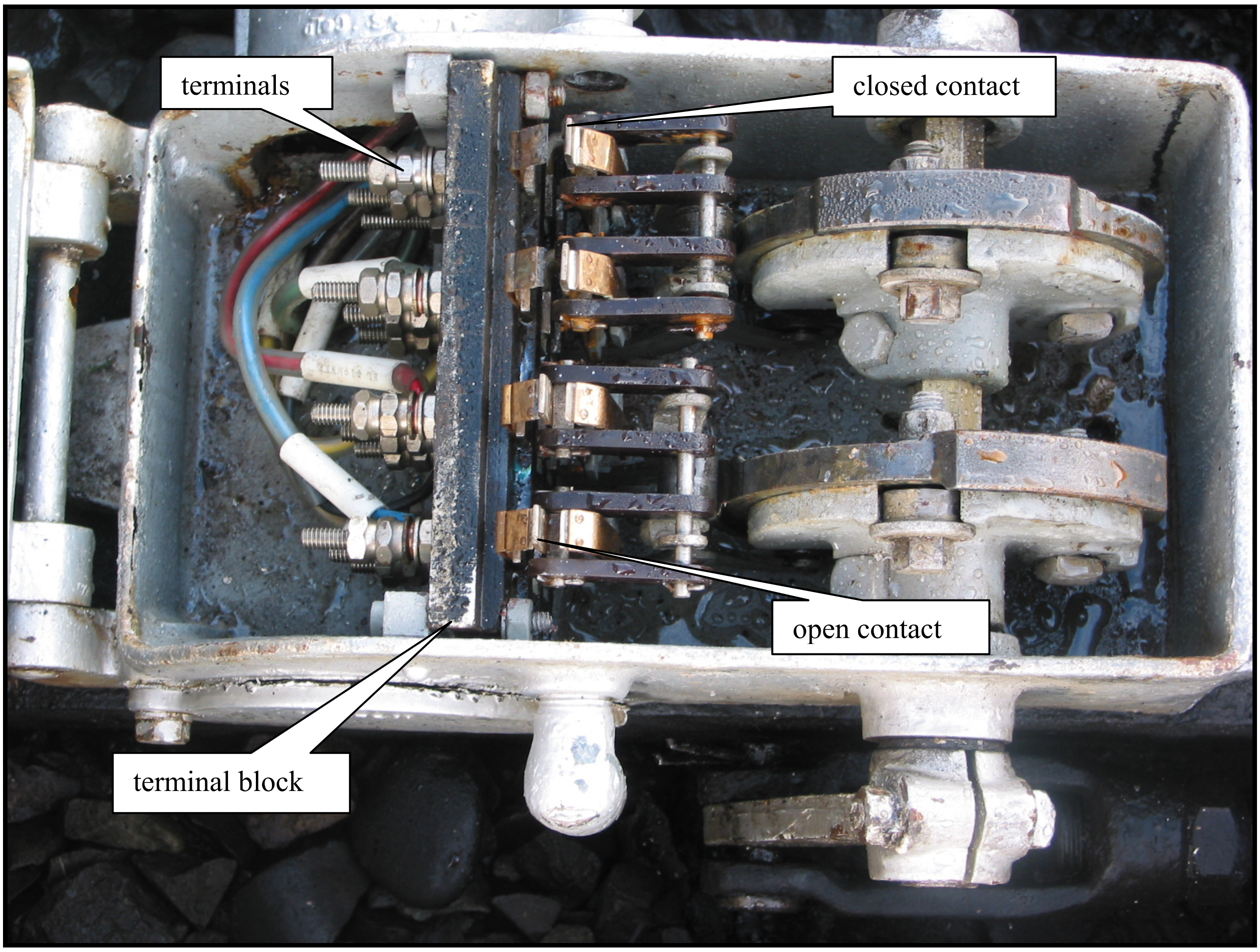


Figure 6
Universal switch controller

1.5 Inspection of interlocked, hand-operated points

1.5.1 Ontrack's Signals Traction and Electrical Code Document S006, Issue 6 (the Code) required hand-operated points to be inspected and tested on a 3-month cycle. All operable points had to be code compliant with the switch obstruction test whereby:

For Normal and Reverse Positions:

- Test points pressure
- Insert a 6mm-obstruction gauge between the switch and stock rail approximately 150mm back from the point of switch to ensure the points do not lock and detection circuit contacts remain open.
- Insert a 2mm-obstruction gauge between the switch and stock rail approximately 150mm back from the point of switch to ensure the points lock and both circuit contacts close.

After any adjustments, points had to comply with the switch obstruction test before they were returned to service.

1.5.2 The following inspections were also carried out at 3-monthly intervals to ensure:

- The stock rail lip or switch lip is less than 0.5mm
- There is no excessive wear or damage to the points layout
- There is no build up of rust
- All moving parts are lubricated.

1.5.3 The most recent 3-monthly code checks on the west-end points at Cora Lynn had been carried out on 17 May and 22 February 2006 and 22 November and 23 August 2005. There were no areas of concern identified on any of the reports following these maintenance inspections.

1.5.4 At yearly intervals points pressure tests, lock tests and detection tests were repeated and a more detailed inspection of all components had to be conducted and adjustments made as necessary.

1.5.5 The annual inspection and maintenance code checks had been carried out on 22 February 2006, 7 February 2005 and 15 January 2004. No non-compliances were identified during these checks.

1.6 Personnel

1.6.1 The locomotive engineer had worked out of the Christchurch locomotive depot since 1979. He gained Grade 1 locomotive engineer certification in November 1988 and at the time of the incident was qualified to drive trains between Christchurch and Seddon on the Main North Line, between Christchurch and Oamaru on the Main South Line and between Christchurch and Greymouth on the Midland Line.

1.6.2 The train controller had gained certification for the Midland Line in 1988. He held current certification to operate all South Island train control desks.

1.6.3 The attending signal maintainer had nearly 20 years' experience with railway signalling maintenance and installation. He had worked out of the Otira Signals Depot for the previous 4 years.

1.6.4 The signal technician, responsible for the inspection and maintenance of the signalling system at Cora Lynn, had worked out of the Otira Signal Depot for 34 of his 36 years' work experience with Ontrack and its predecessors.

1.7 Examination of the failed universal switch controller

1.7.1 The initial inspection of the failed universal switch controller confirmed the terminal block was not fastened securely to the cast-iron casing. The upper-left terminal mounting bolt was missing and the upper-right connection was loose. Similarly, the 2 lower securing brackets were also loose (see Figure 7). Although there was some minor pitting of the contacts, it was not sufficient to cause electrical continuity problems.

1.7.2 Because the available dimensional drawings did not show clearances, critical clearances on the failed unit were measured and compared with those of an overhauled unit. The cam follower clearances were measured initially as left-hand side (LHS) 4.6 mm, right-hand side (RHS) 3.7 mm. Once the securing bolts were tightened the clearances were re-measured as LHS 4.7 mm and RHS 3.8 mm.

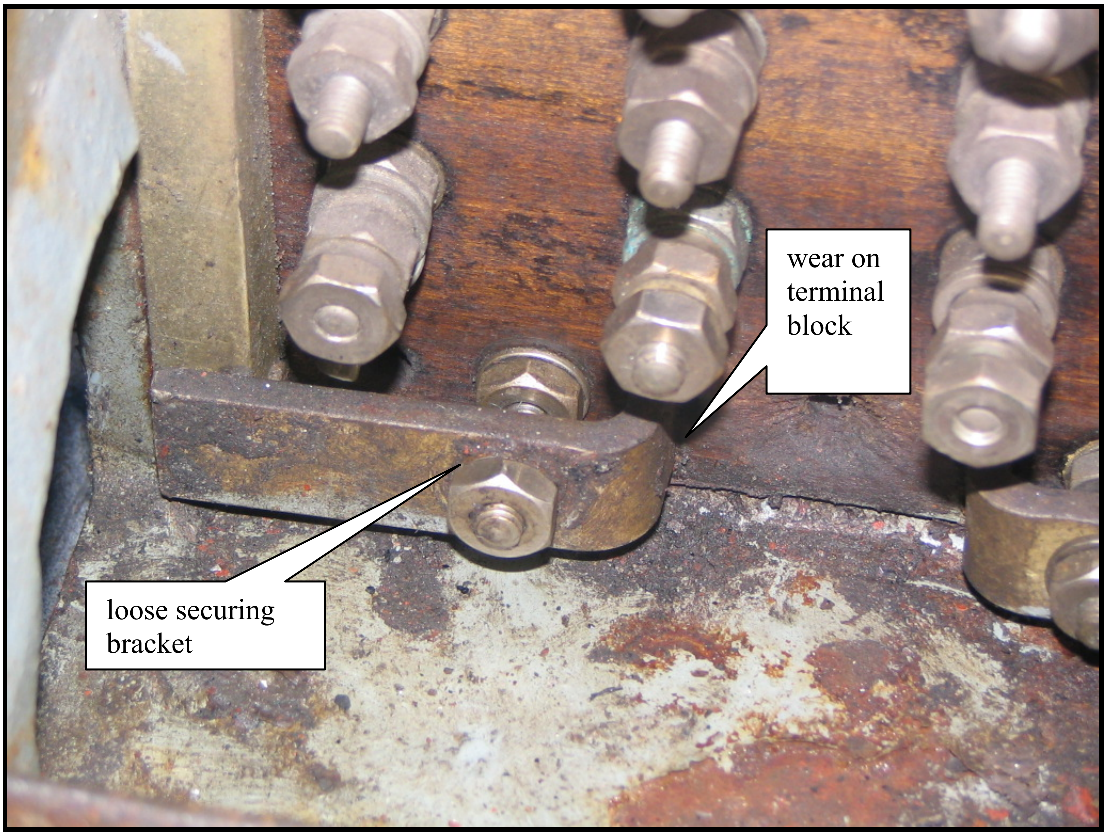


Figure 7
Failed universal switch controller

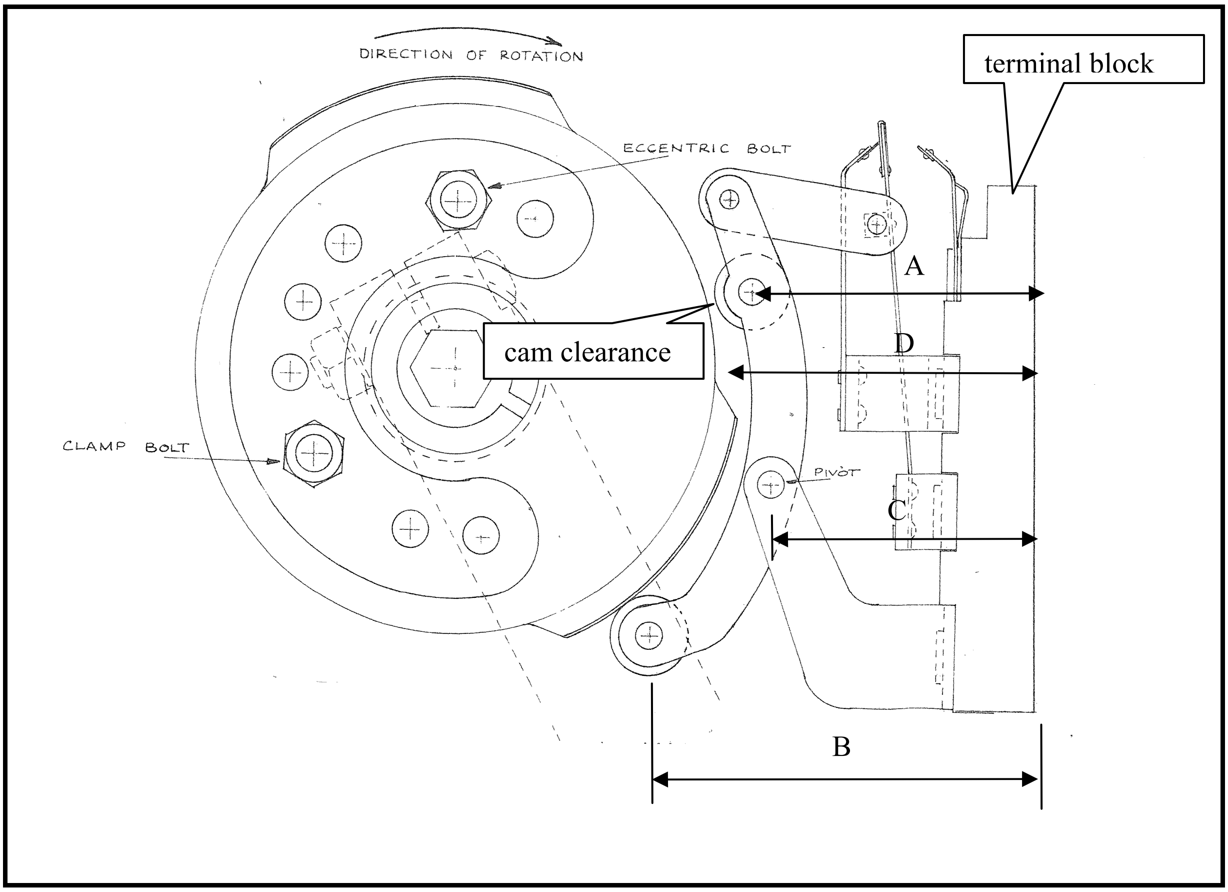


Figure 8
Location of critical dimensions

1.7.3 Critical dimensions, as indicated in Figure 8, were measured on the failed unit. In order to demonstrate that the increase in clearance between the cam followers and the cams was, in most part, due to the wear in the terminal block and not the result of other causes, the worn area in the terminal block was restored with epoxy filler then the unit was reassembled and re-measured. These new dimensions were then compared with those of a fully overhauled and correctly adjusted unit. All dimensions in the table below are in mm.

	Cam Clearance		A		B		C		D	
	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS
Failed unit	4.71	3.81	70.4	69.59	101.37	100.46	67.46	67.19	87.03	87.03
Failed unit after repair	2.45	1.16	76.54	77.35	108.58	110.97	73.56	75.32	87.03	87.03
Overhauled unit	0.5	0.21	72.48	72.5	104.76	105.05	69.67	70.1	86.51	86.55

1.7.4 Following the repair, the reassembled unit functioned smoothly, with the contacts opening and closing as the arm was moved throughout its operating range.

1.7.5 When the reassembled failed unit was compared with the overhauled unit, it was noted that the failed unit had single nuts on the bolted assembly while the overhauled unit had a double-nut assembly. The plans provided by Ontrack did not show a lock-nut assembly.

2 Analysis

2.1 In SLAS territory, the train controller did not have the benefit of a mimic screen that displayed the status of the various points and signals at each crossing station, so he relied on reports from the field for the status of points at crossing stations. The system relied heavily, almost entirely, on the integrity of the signalling system to inform the people in the field of the status of the points.

2.2 When single-person crewing was introduced throughout most of the railway network, a decision was made that train controllers were not required to inform locomotive engineers when points were left in the reverse position. Three reasons were given for this decision.

2.3 The first reason given was that a locomotive engineer might pre-empt a signal aspect and thus not be prepared to stop their train. This could of course apply to any location in any signalling system, and there have been accidents that have resulted from just that. Whether this reasoning was rational is a debatable point. While it is feasible that a locomotive engineer might predict the aspect of the next signal based on being told that the points ahead were not set in the reverse, there are intermediate signals positioned between crossing stations that warn locomotive engineers of the aspect of the next signal. This is a defence put in place to mitigate that very risk. Also, telling a locomotive engineer that the points ahead are in the reverse position is a useful defence against a wrong-side signal failure such as occurred at Cora Lynn. The locomotive engineer would naturally be approaching the loop with caution, preparing their train to stop or to enter the loop as planned, whichever was the case. Another point here is that the emphasis should be on promoting strict adherence to the operating rules instead of tacitly approving what might have become a routine violation of passing signals at stop. The Transport Accident Investigation Commission (the Commission) raised this safety issue in another occurrence report, Report 05-124, when Train 834 collided with Train 841 at Cora Lynn.

2.4 The second reason given was that the changing of points from reverse to normal by staff other than train crews was not uncommon practice. The reasoning of this argument too is debatable. Firstly, it could simply be made a rule that staff are not authorised to change the points unless they are in contact with train control and have permission to do so. Secondly, if staff other than locomotive engineers did restore the points to the normal position, this would be a fail-to-safe action. That is, a train approaching the crossing station at normal operating speed would remain on the mainline with no risk of derailment or rollover. A train entering the loop from the other direction would in any event be travelling slowly and the locomotive engineer would be aware from the signals displayed that the points at the exit from the loop were not set for their train.

2.5 The third reason given was that the system experienced a high level of radio traffic during the day, which generated a high task load for the duty train controller, and the addition of "non-critical" tasks could impact on a train controller's ability to undertake critical tasks related to the safe running of trains. The first point here is the reference to "non-critical tasks"; any task that relies solely on the signals to prevent high-speed rollovers or derailments, or potential head-on collisions, at crossing stations must be considered safety critical. The second point is that in the opinion of some experienced train controllers, this would simply not be an issue. This is supported by the fact that most train controllers on the Midland Line do already report back to locomotive engineers the status of points when they have been left in the reverse position.

2.6 For the reasons given above, the Commission is of the opinion that the operating rules and procedures for communicating the status of points at crossing stations within SLAS territory should be reviewed and changed to lessen the likelihood of an accident owing to a single-point failure in the signalling system. A recommendation has been made to the Chief Executive of the New Zealand Transport Agency to address this safety issue.

2.7 The safe operation of a railway is dependent on both the integrity of the signalling hardware and compliance with the operating rules and procedures. Much of the SLAS equipment currently in use on the Midland Line is original and more than 80 years old. The reliability of such aged equipment can be enhanced by inspecting at more frequent intervals and replacing critical components at defined intervals.

2.8 The locomotive engineer had correctly set the route and locked the points in the reverse position before west-bound Train 841 departed from the loop at Cora Lynn. The train controller was aware of the reverse setting of these points because the locomotive engineer had, as required, confirmed the status of these points after the train departed.

2.9 Although the locomotive engineer became aware of the possibility of a wrong-side failure on Signal 10244 after Train 841 passed Intermediate Signal 10530, more than 2 hours elapsed before he contacted the train controller to confirm that Signal 10244 was displaying a green aspect while at the same time the west-end points were locked in the reverse position. Had he not changed over with the locomotive engineer on Train 826 and been driving the next eastbound train to approach Cora Lynn, there would probably have been a different outcome. Any other locomotive engineer approaching Cora Lynn and sighting a green aspect on both Intermediate Signal 10530 and Arrival Signal 10244 would have expected the facing points to be set in the normal position and approached the arrival signal at close to the maximum authorised line speed of 80 km/h for a freight train and 90 km/h for a passenger train. By the time a locomotive engineer saw that the facing points were actually in the reverse position, there would not have been any time to get the train speed under control to enter the crossing loop at less than the authorised speed of 25 km/h. A rollover would highly likely have occurred.

2.10 Had the train controller been alerted by the locomotive engineer to the possibility of a signalling irregularity as soon as outbound Train 841 cleared Intermediate Signal 10530, a special inspection of the signalling equipment at Cora Lynn could have been arranged earlier and alternative safe running procedures initiated before the arrival of the next eastbound train.

2.11 By not doing so, the locomotive engineer left unreported a high risk unnecessarily, and while he could have monitored radio traffic and alerted train control to the irregularity had the routing of trains through Cora Lynn changed, this was not a surety.

2.12 Although at the time of the signalling irregularity there were no inspections of signalling equipment outstanding, neither the 3-monthly switch obstruction test nor the 3-monthly lock examination and testing would necessarily have alerted an inspector to the possibility of an intermittent signalling irregularity at Cora Lynn. When the attending signal maintainer confirmed the signalling irregularity, it took him a number of cycles of moving the points lever from the normal to the reverse position and back again to replicate the fault.

2.13 Points detectors were designed and set up so that as the cams were moved from either normal to reverse or reverse to normal, the moving contacts were driven from the made position fixed contacts across to the opposite position fixed contacts and held firmly against the opposite contacts during the entire stroke. At no time during the stroke should the moving contact have been able to make the previously made fixed contact.

2.14 The wrong-side failure at Signal 10244 resulted from excessive clearance between the cam and the cam followers, leading to the incomplete operation of the double throw switches. The excessive clearance allowed the moving contact on the normal cam to move and touch the fixed normal contact, even though the points had been changed from the normal position and were locked in the reverse position.

2.15 The excessive clearance that developed between the cam and cam followers was caused by the bolts securing the pivot brackets becoming loose in service and allowing the pivot brackets to fret against the terminal block. The extent of the wear on the terminal block suggested that the bracket had been loose for a considerable period of time. Because the 3-monthly testing regime did not require clearance measurements to be taken and recorded, the wear continued undetected. To reduce the risk of similar occurrences, Ontrack issued a Significant Information Notice on 1 July 2007 that required extra checks on all single-arm and split-cam detectors every 3 months (see "Safety Actions").

2.16 Immediately following this incident, Ontrack issued an instruction to inspect all similar Westinghouse universal switch controllers. All terminal mounting bolts were checked for tightness and that the bottom bolts were double-nutted for security, so no safety recommendation was necessary.

3 Findings

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

3.1 Inspection of the signalling equipment at Cora Lynn had been carried out in accordance with code requirements, but was not commensurate with the design and age of the equipment and was unlikely to have detected the wrong-side signalling failure before it occurred.

3.2 The wrong-side failure at Arrival Signal 10244 was caused by excessive clearance between the cam and the cam followers on the universal switch controller. The universal switch controller had probably been in operation since the SLAS system was commissioned on the Midland Line more than 80 years previously.

3.3 The procedures for communicating the status of the points at crossing stations in SLAS territory meant that the failure of a signal for any reason resulted in a single point of failure with potentially severe consequences.

3.4 The locomotive engineer not immediately reporting to train control his suspicion of a wrong-side signal failure left a high-risk situation and was not consistent with the concept of good crew resource management.

4 Safety Actions

4.1 On 5 September 2007, ONTRACK advised that Significant Information Notice S 112, relating to the examination of universal switch controllers, was effective from 1 July 2007.

ONTRACK
New Zealand Railways Corporation Rere Totika

SIGNIFICANT INFORMATION NOTICE

Signals Telecommunications Electrical

Date Effective 1/7/07 Sin **S 112**

Universal Switch Controllers (Single Arm & Split Cam Detectors)

BACKGROUND

Single Arm & Split Cam Detectors

A recent wrong side failure was found to have been caused by a circuit being made through the normal contacts of a single arm detector when the points were locked in reverse. The effect of this was that a normal speed signal was displayed when the points were in the reverse position.

On close examination the detector that failed was found to have a moving contact on the normal cam that was able to move and almost make the fixed normal contact when the points had moved from normal and were locked in reverse.

The operation of the detector is set up so that as the cams are moved from either normal to reverse or reverse to normal, the moving contacts are driven from the made position fixed contacts across to the opposite position fixed contacts and held firmly against the opposite contacts during the entire stroke. At no time during the stroke should the moving contacts be able to make the previously made fixed contact i.e. if moving from normal to reverse then the previously made fixed normal contact should not be able to be made.

POLICY

Single Arm & Split Cam Detectors

At the next C12a check all single arm and split cam detectors must be checked and tested to the following criteria:

N.B.

The following tests are to be performed by finger pressure only without bending the moving contact.

Tests are to be carried out on both contacts (i.e. both legs of double broken circuit).

Starting with the points in the normal position check that the gap between the moving contacts and the fixed reverse contacts is more than 4mmMove the points out of the normal position so that the point of switch is open more than 6mm but not more than 12mm and check;

There is a the gap between the moving contacts and the fixed normal contacts and this gap is unable to be closed

There is a gap between the moving contacts and the fixed reverse contacts of more than 4mm and this gap is unable to be closed

Move the points to within 15mm but more than 12mm from the normal position and check;

There is a gap between the moving contacts and the normal and reverse fixed contacts of more than 4mm and this gap is unable to be closed

Move the points to within 15mm but more than 12mm from the reverse position and check:

There is a gap between the moving contacts and the normal and reverse fixed contacts of more than 4mm and this gap is unable to be closed

Move the points to within 12mm but more than 6mm from the reverse position and check;

There is a gap between the moving contacts and the fixed normal contacts of more than 4mm and this gap is unable to be closed

There is a gap between the moving contacts and the fixed reverse contacts and this gap is unable to be closed

Move the points into the reverse position check that the gap between the moving contacts and the fixed normal contacts is more than 4mm

If the detector fails the above tests, the points are to be removed from service immediately and a replacement detector sourced, fitted and the appropriate tests carried out before entering service. Any faulty detectors are to be forwarded to Hutt Prefab with appropriate DO NOT USE labels attached. They will be examined and possibly destroyed.

If the detector passes the above tests then the rest of the C12a code tests and inspections can be performed and the points returned to normal service.

At no time are single arm or split cam detectors to be dismantled (apart from changing arm positions) and rebuilt in the field. Any detectors that need rebuilding or contact configuration changing are to be referred to the local SFE who will seek Engineering guidance on the appropriate steps to be taken.

Reporting Results

When sectionmen have carried out the above tests and inspections they are to report the results to the local SFE who will in turn report by email to Signal Engineering. A suitable test sheet for carrying out and recording these tests is available from the local SFE and also on the ONTRACK OSP as document OMF-OP-0144 –Single Arm and Split Cam Detector Test Sheet.

SFE's, Signal & Technology Inspector and staff carrying out engineering inspections are to carry out the above tests on a random basis to ensure compliance with this Sin.

5 Safety Recommendations

5.1 On 21 May 2009 it was recommended to the Chief Executive of the New Zealand Transport Agency that he address the safety issue whereby:

024/09 The current requirements for communicating the status of main-line points at crossing stations within single-line automatic signalling territory results in a potential single point of failure where the consequences could be a high-speed rollover, derailment or collision.

5.2 On 8 June 2009 NZ Transport Agency's National Manager Commercial Operations Road and Rail stated in part:

024/09 We intend to work closely with ONTRACK with an aim to implementing and closing this recommendation as soon as possible. Discussion on this will commence on Wednesday 10 June 2009 and will be ongoing.

Approved on 21 May 2009 for publication

Hon W P Jeffries
Chief Commissioner

Recent railway occurrence reports published by
the Transport Accident Investigation Commission
(most recent at top of list)

07-108	express freight Train 720, track warrant overrun at Seddon, Main North Line, 12 May 2007
07-113	express freight Train 239, wagons left in section at 514.9km, between Te Awamutu and Te Kawa, 22 September 2007
07-110	collision, express freight Train MP2 and Work Train 22, Ohinewai, 19 June 2007
06-110	passenger train 4045, uncontrolled movement, between Britomart and Quay Park Junction, 9 October 2006
06-108	EMU Passenger Train 9268, struck slip and derailed, between Wellington and Wadestown, 26 August 2006
07-101	express freight Train 736, derailment, 309.643 km, near Vernon, 5 January 2007
05-123	empty passenger Train 4356, overran conditional stop board without authority following an automatic air brake irregularity, Meadowbank, 6 October 2005
05-116	collapse of Bridge 256 over Nuhaka River, Palmerston North-Gisborne Line, 6 May 2005
05-124	express freight Trains 834 and 841, collision, Cora Lynn, 20 October 2005
06-112	loss of airbrakes and collision, Tram 244, Christchurch, 21 November 2006
06-102	SA/SD passenger Train 4306, braking irregularity, between Westfield and Otahuhu, 31 March 2006
06-101	diesel multiple unit passenger Train 3163, fire in diesel auxiliary engine, Manurewa, 15 March 2006
05-127	Mainline shunting service M52, track occupation irregularity, Te Rapa, 27 October 2005
05-120	Express freight Train 142, runaway wagons, Mercer, 1 September 2005
05-128	Diesel multiple unit Train 3056, passenger injury, Papatoetoe, 31 October 2005
05-125	Taieri Gorge Railway passenger Train 1910, train parting, Dunedin, 28 October 2005
05-118	Express freight Train 245, derailment, Ohingaiti, 27 July 2005
05-115	Empty passenger Train 2100, train parting and improper door opening, Ranui, 1 April 2005
05-108	Diesel multiple unit passenger Train 3334, fire, Auckland, 23 February 2005
05-126	Express freight Train 246, derailment, South Junction, 30 October 2005

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