Report 06-110, passenger Train 4045, uncontrolled movement, between Britomart station and Quay Park junction, 9 October 2006

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passenger Train 4045

uncontrolled movement

between Britomart station and Quay Park junction

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Abstract

On Monday 9 October 2006 at 0806, passenger Train 4045 travelled 526 metres between Britomart station and Quay Park junction with the locomotive engineer not at the controls of the train. The locomotive engineer had left the train to operate a valve to restore air-brake pressure following an uninitiated emergency brake application. Once air-brake pressure had been restored, the train began to move before the locomotive engineer re-boarded the train.

There was no damage and none of the 3 crew and 12 passengers on board at the time was injured.

Safety issues identified included:

- adherence to standard operating procedures
- maintenance and testing of passenger emergency stop mechanisms
- diagnosing and correcting intermittent faults on old passenger rolling stock
- the provision of event recorders
- monitoring fault trends for safety-critical equipment
- audit performance

Four safety recommendations have been made to the Chief Executive of the New Zealand Transport Agency to address these issues.

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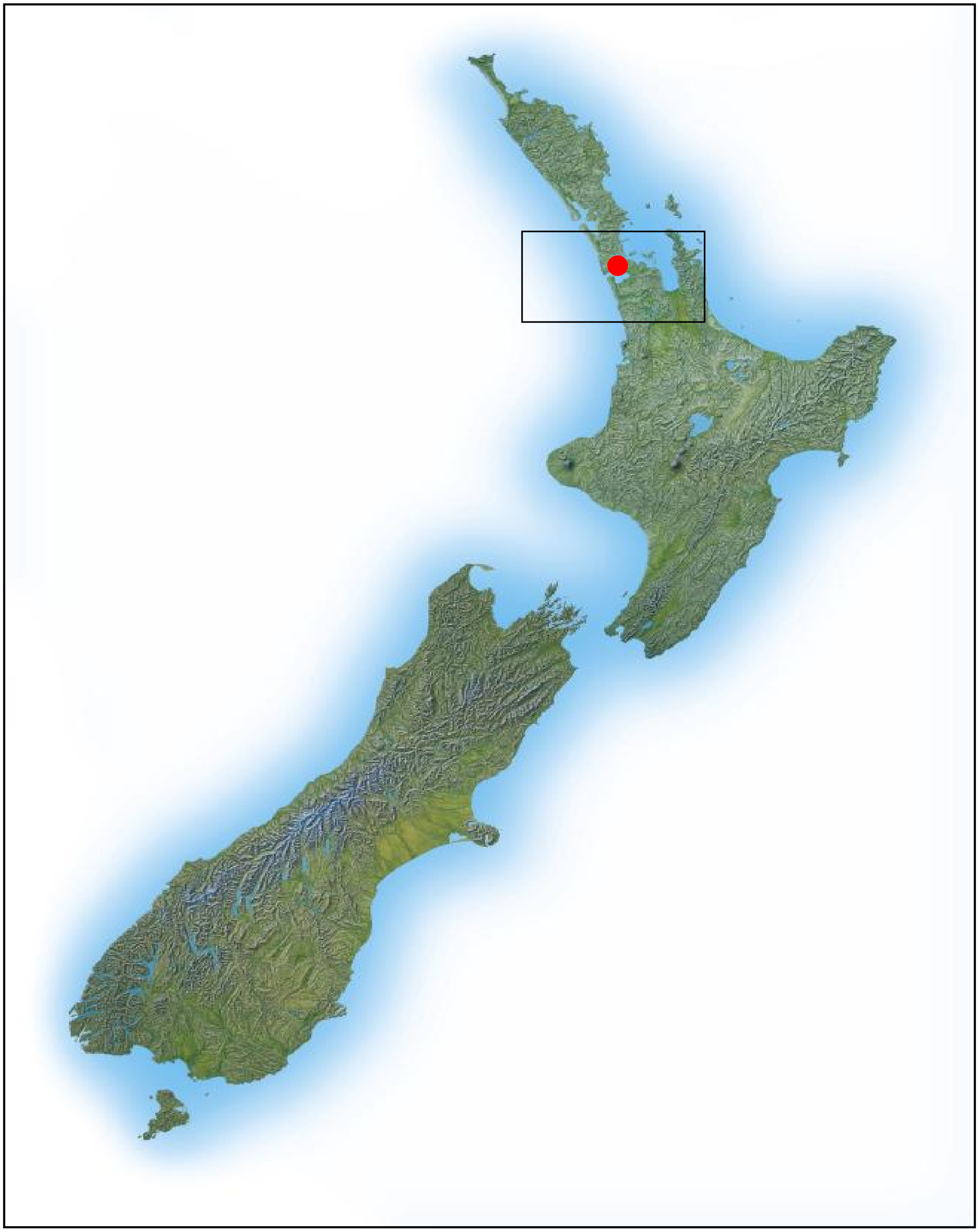
Abbreviations

ARTA	Auckland Regional Transport Authority
DMU	diesel multiple unit
EP	electro-pneumatic
FMP	fleet management protocol
km/h	kilometre(s) per hour
kPa	kilopascal(s)
m	metre(s)
NRSS	National Rail System Standards
NZTA	New Zealand Transport Agency
TAMM	Toll Auckland Metro Maintenance
Toll Rail	Toll NZ Consolidated Limited
UTC	co-ordinated universal time
Veolia	Veolia Transport Auckland Limited

Data Summary

Train number:	passenger Train 4045
Train type and consist:	diesel multiple unit (DMU) set consisting of ADL810 motor car coupled to ADC860 trailer car
Year of manufacture:	1985 by A. Goninan and Company Limited of Newcastle, New South Wales, Australia
Year of overhaul/refurbishment:	2002 by Alstom Transport New Zealand Limited at Hutt Workshops, Woburn under contract to Tranz Rail Limited
Date and time of occurrence:	Monday 9 October 2006, at 0806[1]
Location:	Britomart station-Quay Park junction, Auckland
Persons on board:	crew: 4 passengers: about 12
Injuries:	nil
Damage:	nil
Operator:	Veolia Transport Auckland Limited (Veolia)
Investigator-in-charge:	Vernon Hoey

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



Location of the Occurrence

Auckland rail passenger system: roles and responsibilities

Rail Services
Auckland Regional Transport Authority

- Specifier and purchaser of rail passenger services
- Specification and preliminary planning of infrastructure upgrades
- Rolling stock owner
- Management of stakeholder relations

Veolia Transport Auckland Limited

- Rail participant
- On-train staff
- Marketing/ Communications
- Fare collection

Ontrack

- Access provider
- Train control
- Track maintenance
- Track development

Auckland Regional Transport Network Limited

- Britomart access
- Station access
- Station facilities management
- Station development

Toll NZ Consolidated Limited

- Locomotive lease
- Maintenance facilities access
- Stabling
- Maintenance/Fuelling
- Locomotive engineer hire
- Locomotive engineer training
- Silver Fern charter
- Rolling stock refurbishment

1 Factual Information

1.1 Narrative

1.1.1 On Monday 9 October 2006, a Veolia locomotive engineer suburban[2] and train manager booked on for duty at Westfield at 0430. The train manager checked the door operation on the DMU set consisting of ADL810 motor car and ADC860 trailer car and noted that the doors operated correctly.

1.1.2 The train manager authorised the locomotive engineer to depart from Westfield and the set was driven as an empty service to Papakura. The set then took up the running of passenger Train 3314 from Papakura to Britomart station via Glen Innes.

1.1.3 The set returned as an empty service from Britomart station to Otahuhu, where it was routed to a siding because of other main line movements. While stationary in the siding, the locomotive engineer noticed that the emergency brake applied on the set for an undetermined reason. The locomotive engineer telephoned a supervisor, who recommended that he reset a circuit breaker that controlled the brake operation. He executed this action, but it did not correct the fault.

1.1.4 The locomotive engineer then isolated[3] the master controller, left his cab and walked to an emergency brake valve isolating cock (dump valve) located under the non-driving end of ADC860 (see Figure 1). He isolated and restored the valve, and the brake pipe air pressure restored to normal. He returned to his driving position and radioed details of the fault to staff in Britomart station, where it was recorded in Veolia's fleet management protocol (FMP) system. He also wrote up details of the fault in the Toll NZ Consolidated Limited (Toll Rail) 54D book.

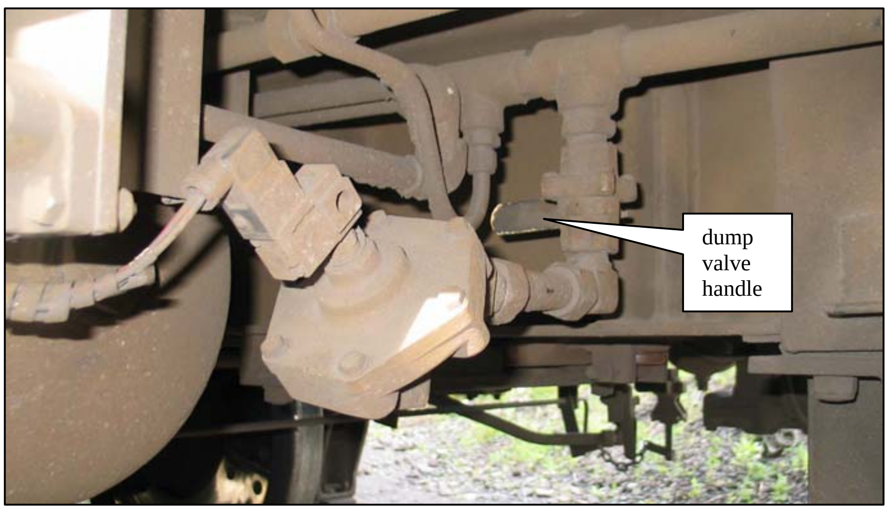


Figure 1
Dump valve

1.1.5 With the air-brake pressure restored, the locomotive engineer drove the set from Otahuhu to Britomart station as passenger Train 4332. The DMU then formed passenger Train 4045, the scheduled 0805 service travelling from Britomart station to Otahuhu via Newmarket. A route for the train was signalled from platform 5 to the Down Main line via No.39 and No.35 points to the Newmarket Down Main line (see Figure 2). Two Veolia passenger operators had joined the set by then and there were about 12 passengers on board.

[2] Throughout the report, the term "locomotive engineer" has been used.
[3] An action that describes the neutralisation of the master controller and removal of a reverser key.

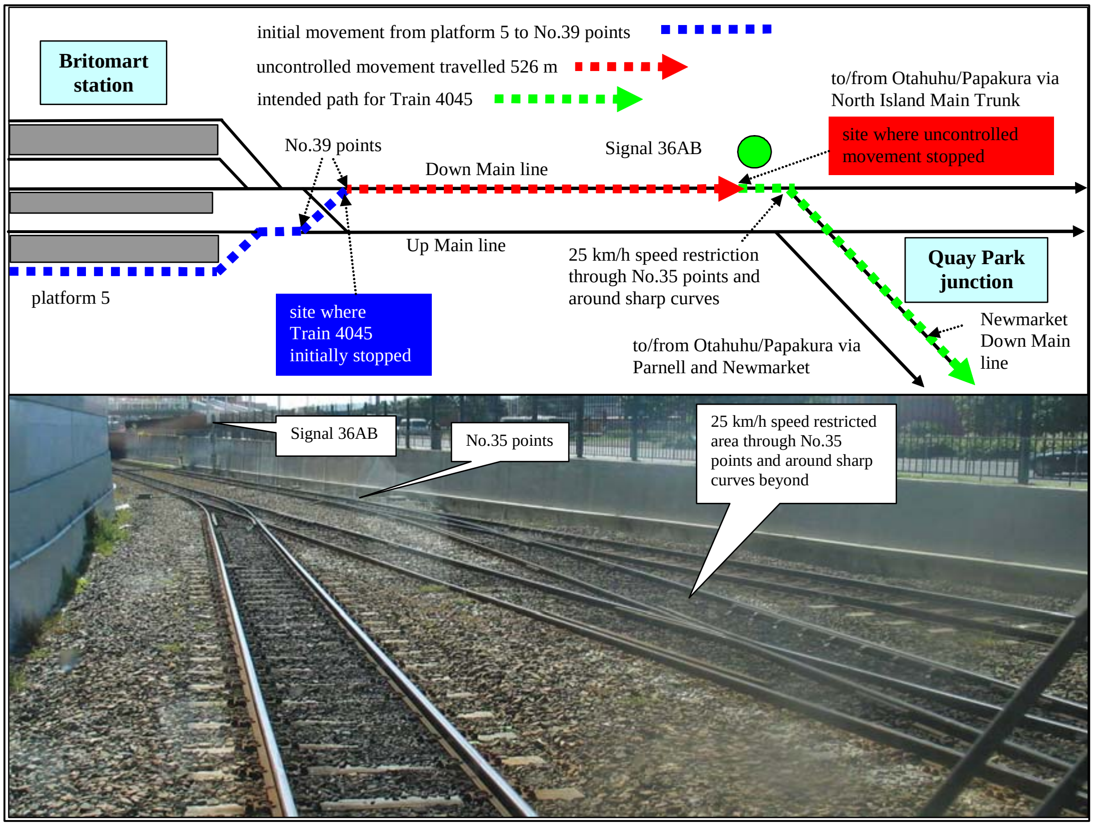


Figure 2
Schematic plot of Train 4045 movements (not to scale); and below, Quay Park junction

1.1.6 Train 4045, with ADL810 leading, departed platform 5 at Britomart station on time at 0805. After the train had travelled about 300 metres (m), the emergency brake applied without being initiated by anyone on the train. The train stopped over No.39 points.

1.1.7 The locomotive engineer reset the same circuit breaker as before, but again this had no effect, so after seeking permission from the signal box controller at Britomart station, he left the train to operate the dump valve. The train manager saw the locomotive engineer alighting from the cab side door. The locomotive engineer told him that he had the same problem.

1.1.8 When the emergency brake had applied, the master controller handle was in the throttle 2 position (see Figure 3). On this occasion, the locomotive engineer had forgotten to return the handle to the application[4] position and remove the reverser key to isolate the train before he alighted. After the dump valve had been isolated (closed) and restored (opened) and the air-brake pressure had sufficiently restored, the brakes released and the set began moving before the locomotive engineer re-boarded the set.

1.1.9 Meanwhile the train manager thought the locomotive engineer had returned to the cab when he felt the set move. Because the locomotive engineer did not know how to contact the train manager, he contacted a Veolia supervisor from his mobile telephone and asked him to contact the train manager to apply the emergency brake.

[4] The neutral position on the master controller that also applied the brakes on the DMU.

Figure 3
The master controller handle in the throttle 2 setting left;
and right, in the application position with the reverser key removed

1.1.10 After about one minute, the air brakes automatically applied, bringing the train to a stop. The set had travelled 526 m in that time, stopping 68 m in front of Signal 36AB and about 100 m before the entry to the curved road of No.35 points.

1.1.11 When the train manager realised the set had stopped again, he went to the front cab and saw that the locomotive engineer was not present at the controls. The train manager could not see him when he looked out both sides of the cab, so he walked through the passenger saloons to the rear cab, checking the area between the 2 cars, but still did not see him.

1.1.12 The train manager returned to the front cab then back to the rear cab again, looking for the locomotive engineer. He posted a passenger operator to each cab position. The train manager then received a telephone call requesting him to telephone the locomotive engineer, which he did. The locomotive engineer instructed the train manager to apply the emergency brake in the cab he was in, which he did (see Figure 4).

Figure 4
Emergency brake handle on back wall of both cabs

1.1.13 The Veolia supervisor, who had been informed of the problem, walked from Britomart station and found the locomotive engineer at No.39 points where Train 4045 had first stopped. The supervisor marked the location where it had stopped and they walked to where the train was now standing at Quay Park junction. On the way, the locomotive engineer explained to the supervisor that he had forgotten to remove his reverser key when he left the cab.

1.1.14 On arrival at the train, the supervisor marked the ground where the set was standing and boarded the front cab. The supervisor saw the master controller handle was in the throttle 2 position and also noted the electro-pneumatic (EP) brake was fully applied, the brake cylinder pressure registering 300 kilopascals (kPa) on ADL810 and 240 kPa on ADC860, and the emergency brake was fully applied.

1.1.15 The supervisor drove the set back to Britomart station, where it was taken out of service.

1.2 Site information

1.2.1 The track arrangement between Britomart station and Quay Park junction was double line with the 2 tracks being designated as Up and Down Main lines. The signalling system allowed trains to be signalled into and out of Britomart station on either track.

1.2.2 The track gradient from the underground station at Britomart station to Quay Park junction was rising at 1 in 50. Illuminated formed walkways were provided along the tunnel walls in the area of No.39 points at Britomart station.

1.2.3 The maximum speed for all trains running between Britomart station and Quay Park junction was 40 kilometres per hour (km/h), but there was a reduction of speed to 25 km/h for trains travelling to and from the Newmarket Line via No.35 points. The 25 km/h restriction extended from Signal 36AB for a distance of about 620 m because the track alignment negotiated several sharp-radii curves towards Parnell. In contrast, the North Island Main Trunk followed a straighter alignment and was not subject to a restricted speed (see Figure 2).

1.3 Diesel multiple units

Historical information

1.3.1 The ADL/ADC class of DMU sets (10 in total) were built by A. Goninan and Company Limited of Newcastle, New South Wales, Australia in 1981 (5 sets) and 1985 (5 sets) and were initially owned and operated by Western Australian Government Railways in Perth, Western Australia. The sets were purchased by New Zealand Rail Limited[5] in 1993 after the vehicles had become surplus following the electrification of the Perth suburban system. The Auckland Regional Transport Authority (ARTA) subsequently purchased the sets from Toll Rail in August 2004.

Figure 5
ADC860/ADL810

[5] Brand name of the integrated rail business at the time.

1.3.2 The ADL/ADC cars were permanently coupled together to form a 2-car set with driving cabs at the outer ends. The 2-car sets were designed to be coupled together to form a 4-, 6- or 8-car set. Veolia mostly operated them as 2- or 4-car sets in passenger service.

1.3.3 Tranz Rail[6] overhauled the ADL/ADC sets during 2002 and 2003. The overhaul did not include any alterations to the braking and vigilance systems. A Toll Rail management plan for the Auckland passenger rail fleet said the ADL/ADC fleet would be retained in service until 2014.

Control systems

1.3.4 Each cab of the ADC/ADL set had a driver's console. The console was fitted with a master controller with a single handle controlling both brake and throttle applications, and a mechanically interlocked reverser switch. The handle controlled the braking, engine-throttling and some transmission functions, whilst the reverser switch controlled direction. The master controller was provided with a key, which could only be inserted or removed when the control handle was in the brake application position and the reverser switch in the isolation position (see Figure 3).

1.3.5 The isolation position was used when stabling, when changing driving ends at terminal stations such as Britomart station, or when the cab was to be unoccupied. With the key removed, the master controller was locked, neutralising the control system so the set could not move.

1.3.6 Two dump valves were provided on an ADL/ADC set. The valves were located at the inner end of each car, diagonally opposite each other. The locomotive engineer was required to operate the valve on the car that he was driving.

Braking systems

1.3.7 The ADL/ADC sets were equipped with 2 separate braking systems: an EP brake system and an emergency brake system. The only connection between the 2 systems was through a double check valve, enabling the system carrying the greater air pressure to charge the brake cylinders and thereby apply the brakes.

1.3.8 The EP braking system worked as follows:

- the EP brake system was controlled from the end at which the reverser key was inserted, which enabled the operation of the control handle. The system enabled all the cars coupled in a consist to receive braking commands simultaneously
- air pressure was supplied by a compressor fitted to the ADC car. Besides supplying air pressure for the brakes, the air was used to operate the horn and doors and raise the airbags that provided suspension between the bogies and the car body
- there were 2 main air reservoirs installed on an ADC car. The compressor charged these reservoirs and the one installed on the ADL car. A main reservoir pipe ran throughout the cars. A choke and regulating valve charged and maintained air pressure in the brake pipe at a maximum of 550 kPa.

[6] New Zealand Rail Limited was rebranded to Tranz Rail on 18 October 1995.

1.3.9 The emergency braking system worked as follows:

- air pressure in the emergency brake system was retained in an auxiliary reservoir as long as the brake pipe pressure was held at the maximum of 550 kPa. Any fall in air pressure in the brake pipe caused a triple valve to shut off the brake pipe supply and pass air from the auxiliary reservoir into the brake cylinders, which then applied the brakes. The triple valve would return to charging the auxiliary reservoir and vent the brake cylinders when brake-pipe pressure was restored
- the emergency brake system was normally dormant. There was a series of normally closed electrical contacts throughout the system that kept the dump valve closed. A break in this electrical circuit at any point de-energised and opened an emergency brake application valve, venting the brake-pipe pressure to atmosphere and applying the brakes
- emergency stop buttons were located at each of the 4 bi-parting doors in the ADL car and the ADC car. The operation of any one of the 8 push-buttons, which were self-locking when pressed, would apply full braking effort by dumping air from the brake pipe. Once the push-button was locked in, it could only be released by using the train manager's key (see Figure 6)
- an emergency application of brakes could also occur on application of the emergency brake on the control handle, in response to the vigilance system, or on applying the brake handle on the back wall of the cabs.

Figure 6
Passenger emergency stop button

Vigilance system

1.3.10 The driving positions were equipped with a solid state electrical vigilance system, which was designed to bring the ADL/ADC sets to a stop in the event of the locomotive engineer becoming incapacitated, or in this case if no one was present at the controls. The system became operational whenever the reverser key was moved from the isolation position. The vigilance system monitored the following functions:

- brake cylinder pressures. If the brake cylinder pressure exceeded 100 kPa, all timing sequences were inhibited. Suppression of the vigilance system beyond 100 kPa was designed to prevent the vigilance system activating when the sets were stopped
- movement of the control handle between throttle steps restored the timing sequence to zero, including the penalty application
- driver operation of the vigilance system reset push-button restored the timing sequence to zero, and restored the penalty application.

1.3.11 The timing sequence was:

- 57 seconds after actuating, a vigilance system lamp flashed. After a further 7 seconds, an audible alarm sounded, followed 7 seconds later by a full brake application. The audible alarm would de-energise, but the vigilance system lamp would continue to flash and the brakes would remain applied
- the timing sequence could be reset at any time, including after a brake application
- if the vigilance system initiated a brake application, the diesel engines were reduced to idle speed.

Event recording system

1.3.12 ADL810/ADC860 was not equipped with an event recording system at the time of the incident. Ontrack's National Rail System Standards (NRSS) required the Auckland DMU fleet, encompassing the ADL/ADC sets, to be so equipped by 30 June 2007. The date was subsequently deferred until 1 July 2009 in an Ontrack semi-permanent bulletin.

1.3.13 Without an event recording system, it was not possible to use the diagnostic function, if available, to assist in locating the origin of the emergency brake applications or confirm that the vigilance system had intervened in stopping Train 4045 at Quay Park junction.

1.3.14 Event recorders were subsequently installed in all the cabs of the ADC cars by June 2007 and in the ADL cars by November 2007. Priority was given to installing the recorders in the ADC cabs to ensure there was at least one recorder on each ADL/ADC set. Event recorders were installed in ADC860 on 24 May 2007 and in ADL810 on 31 October 2007.

1.3.15 The event recorders fitted to the ADL/ADC sets were a modern "Tranzlog" type (see Figure 7).

Figure 7
A Tranzlog-type of event recorder

1.3.16 The Tranzlog event recorder was capable of recording the following data:

- train speed
- direction of travel
- master controller position
- brake pipe air pressure
- main reservoir air pressure
- air pressure from brake cylinders on both bogies
- dump valve operation from the master controller
- dump valve operation from the passenger emergency stop buttons
- headlight, ditch light and train whistle operation

- locomotive engineer response to the vigilance system
- 6 critical functions in the door opening and closing operation
- 3 aspects of the engine performance.

1.3.17 Depending on the amount of time the ADL/ADC sets were operated, about 25 to 35 days of data could be retained in a Tranzlog-type event recorder. After that time, the recorded data was overwritten as new events occurred on a first -on/last -off basis.

Inspection and maintenance policies/procedures

1.3.18 Toll Rail's mechanical code M2000 determined that ADL/ADC sets would be inspected at regular intervals:

• daily check routine	every night
• A-check routine	every 6 weeks with an upper limit of 8 weeks
• B-check routine	every 3 months with an upper limit of 5 months
• C-check routine	every 6 months with an upper limit of 8 months
• D-check routine	every 12 months with an upper limit of 14 months.

The check routine process included the requirement to complete all lower-order check routines.

1.3.19 The daily check routine included a brake efficiency test as specified in Toll Rail's mechanical code supplement M9337-01. The code included a test of the emergency brake using the control handle and a test of the vigilance system.

1.3.20 The B-check routine included the testing of the brake systems as specified in Toll Rail's mechanical code supplement M9337-02, as well as an efficiency test of all 4 passenger emergency buttons installed in each ADL/ADC car. A component of this test required an examination of the contact effectiveness of the brake blocks on the wheels.

1.3.21 ADL810/ADC860 passed a B-check routine on 13 June 2006, four months prior to the incident.

1.3.22 Following the incident, Toll Rail advised that there was some "looseness" in what was required in the daily check routine in that the inspection certificate was not being completed in an accurate fashion on a consistent basis.

1.3.23 Brake continuity was required to be checked, but the routine should be expanded to specify exactly what was required on each type of vehicle. At the completion of the daily check routine, an inspection certificate that expired at the next daily check routine was attached to the cab, indicating that the pre-departure checks had been done. A procedure was subsequently implemented whereby the servicing supervisor was required to do compliance monitoring before the trains entered service each workday.

Post-incident examination of ADL810/ADC860

1.3.24 Following the incident, Toll Rail engineers conducted a series of tests to determine the cause of the repetitive emergency brake applications.

1.3.25 An emergency brake application test was carried out as detailed using the control handle. The emergency brake applied when the control handle was moved to the emergency position.

1.3.26 A vigilance system test was carried out. The vigilance system cycled through with the light illuminating, the audible warning sounding and the EP brake applying after the appropriate time had elapsed. The system was found to be operating correctly.

1.3.27 The passenger emergency stop buttons were then individually tested. The emergency brake applied when each button was pressed. The push-button components in ADL810 were checked. A suspect contact block on the emergency stop button on door No.1 was changed. The push-button components were adjusted to ensure that, when reset, the push-button fully released.

Re-enactment of uncontrolled movement

1.3.28 On 2 November 2006, with the Commission's investigator in attendance, a re-enactment of the uncontrolled movement with ADL810/ADC860 took place between Britomart station and Quay Park junction. The tests were conducted in an attempt to replicate the movement of Train 4045 from No.39 points to Quay Park junction as occurred on the day of the incident.

1.3.29 The following criteria were set for the re-enactment:

- how long did it take between isolating the dump valve and the movement of the train?
- what speed did the train reach?
- was it possible by replicating the incident to confirm that the vigilance system stopped the train, and not another uninitiated application of the emergency brake system as had occurred twice on the day of the incident?

Test run number	1	2	3	4	5
Emergency brake option	application of passenger emergency stop button	application of passenger emergency stop button	application of passenger emergency stop button	application of passenger emergency stop button	emergency brake application from driver's console
Throttle application	throttle 2	throttle 2	throttle 2	throttle 2	throttle 2
Air-brake release option	isolating dump valve	restoration of passenger emergency stop button	isolating dump valve	restoration of passenger emergency stop button	release of emergency brake at driver's console
Elapsed time before train moved	28 seconds	not recorded	not recorded	not recorded	not recorded
Speed attained	40 km/h	40 km/h	40 km/h	40 km/h	40 km/h
Vigilance system cycling	yes	flashed as train approached No.35 points	did not flash as train approached No.35 points	flashed as train approached No.35 points	yes
Method of stopping train	automatic brake application close to where Train 4045 stopped	locomotive engineer applied brakes beyond the stopping place of Train 4045	locomotive engineer applied brakes beyond the stopping place of Train 4045	locomotive engineer applied brakes beyond the stopping place of Train 4045	automatic brake application beyond the stopping place of Train 4045

1.3.30 Test run conclusions:

- test run 1 closely replicated the actual starting and stopping points of the incident, and showed that the vigilance system could bring the train to a stop. The locomotive engineer noted that the brake cylinder pressure seemed lower than normal at about 250 kPa as against the 350-400 kPa expected. The cylinder air pressure dropped away quickly and smoothly
- test run 2 did not replicate the actual incident. The slower release of air from the brake cylinders may have caused a late activation of the vigilance cycle. It was noted that brake cylinder pressure was approximately 375 kPa and it gradually reduced, but the reduction seemed slower than in test run 1
- test run 3 did not replicate the actual incident. The point of the vigilance system cycle applying could not be determined

- test run 4 appeared to be a failure of the vigilance system. All present agreed that no one had made any move that could have caused the vigilance system to reset without the brake application. The vigilance system flashed 7 times, followed by 10-11 beeps from the audible alarm. The audible alarm and the flashing light ceased but the brakes did not apply. By this time the train had travelled beyond No.35 points
- test run 5. The initial zero brake cylinder pressure almost certainly contributed to the fact that the distance travelled before the brakes stopped the train was greater than in the original incident. With no initial brake pressure, the train accelerated quickly. The vigilance system cycled correctly, but the train easily reached No.35 points before the brakes were applied.

1.3.31 Two supplementary tests after test run 4 were made in an attempt to understand the operation of the vigilance system better. The tests were conducted while stationary. The brake cylinder pressure was reduced to 100 kPa. It was evident that the vigilance system did not cycle. The brake pressure was reduced to zero (held the train on the park brake). The vigilance system was allowed to cycle, and it did so correctly through the 57, 7 and 7 seconds followed by emergency brake application.

1.3.32 During the first test, the walk from the dump valve to the cab was timed at 15 seconds.

1.4 Fault recording policy/procedure

1.4.1 Within Toll Rail's and Veolia's safety systems there were parallel fault-recording procedures applying to the operation of the DMU fleet. The procedures were:

- FMP, an automated system operated by Veolia that transferred fault/repair information between Veolia and Toll Auckland Metro Maintenance (TAMM)
- the 54D book operated by Toll Rail, which was where Toll Rail and Veolia operating staff manually recorded faults/repair information.

1.4.2 Veolia was responsible under its safety system for recording each fault in an accurate, relevant and timely manner so that TAMM, the fleet maintenance facility, could repair the fault and fulfil its responsibilities under Toll Rail's safety system. Veolia also had contractual responsibilities to ARTA to manage the maintenance contract with TAMM. Toll Rail was then obliged under its safety system and contract with ARTA to maintain Auckland's commuter fleet and present the vehicles to Veolia in a "fit for purpose" condition each operating day.

1.4.3 Veolia's operating staff recorded fault details in both the FMP system and the 54D book. Because FMP was a computer-based system, it did not provide a record of faults and maintenance to which locomotive engineers could refer while on the train, so the 54D book had been retained to provide that record. TAMM staff then recorded their corrective actions to both FMP and the 54D book. Being an automated system that captured fleet-wide fault and repair data, FMP then provided Veolia with management functionality to overview more easily the nature, frequency and trends in reported faults and subsequent repairs recorded in the system. FMP was available to TAMM engineering staff to overview the nature, frequency and trends in reported faults and subsequent repairs that were recorded in the system.

1.4.4 Veolia management held weekly meetings with TAMM engineering staff to discuss fleet-wide maintenance issues. Breakdowns during the preceding week were reviewed, with particular attention being paid to recurring faults and to those where an initial fault report was closed out with the comment "no fault found". Although there was no memorandum of understanding between Veolia and TAMM that formalised the objectives, responsibilities and outcomes from the meetings, minutes were retained that showed issues were assigned to relevant people until each issue was closed out.

1.4.5 The 54D book procedure operated as follows:

- initial entry was made by the person who experienced the fault. In most cases this was a locomotive engineer
- the defect was attended to by servicing depot staff when the locomotive or DMU underwent its daily check routine
- the servicing depot staff recorded brief descriptions of work carried out in the 54D book. The locomotive or DMU returned to service when the defect was repaired
- the top page was removed and passed to the depot manager for perusal
- information on the fault details was entered into a database and the top page was filed
- the completed 54D book was stored and when filled, the book was replaced.

Recent faults reported on ADL810/ADC860

1.4.6 In the 3 months leading up to the incident, the following faults relating to the braking problems on ADL810 and ADC860 were recorded in FMP and the 54D book:

Date 2006	Nature of fault	FMP	54D book	Nature and comment on repair
7 Jul	Bad brakes – no grab above 200 kPa	no	yes	Changed No.2 end pads, cleaned No.1 bogie. Discs covered in oil, tried around yard OK. Gauges reading OK both ends.
8 Jul	Brakes on one end fairly weak	no	yes	Brake cylinder pressure checked-adjusted, now OK.
23 Jul	Brakes one end very poor	no	yes	Water blasted oil off No.1 and 2 bogie discs.
30 Jul	Brakes extremely soft	no	yes	Gauges checked. Pads, rigging checked. Travel of adjusters checked OK.
31 Jul	Brakes very spongy both ends. Pressure gauge rises and falls very slowly	no	yes	[Indecipherable]
1 Aug	Brakes extremely "spongy"	no	yes	Full brake efficiency test carried out. 4 brake cylinder slack adjusters reconfigured. All blocks checked, one changed due to contamination. Bogies degreased and pressure washed.
3 Aug	Brakes very "spongy"	no	yes	Checked all brake pads – OK. Still some oil on discs.
9 Aug	As booked in 54D book. The braking on this set is very poor with brakes fading badly	yes	yes	Checked all brake cylinders and found 4 not working. Four new brake cylinders fitted and tested.
18 Aug	Emergency brake firing off when going into application	yes	yes	Both controllers checked from application to throttle 3. No emergency application happened.
22 Aug	Placing brakes into application, emergency would apply, unable to brake normally	yes	no	Tested several times, unable to recreate fault.
23 Aug	Lost all brake pipe pressure and came to a stop	yes	no	Braking, emergency brake applying. No fault found.
24 Aug	TB handle in lap, release, application of 1/3 notch, the emergency brake applied	yes	no	Emergency brake contact removed, cleaned and reinstalled – tested OK. Door buttons checked for correct operation.
9 Sep	Unit kept making emergency brake application even when going from throttle to lap application	yes	yes	Brake cylinder pressure high – adjusted. Test run all OK. Three phase jumper neutral pin burnt – resurfaced and tested OK.
11 Sep	Brakes poor	no	yes	Emergency brake feed valve cleaned and overhauled. Brakes carried out – tested OK.
12 Sep	Brakes, other equipment slow to apply	yes	no	Emergency brake feed valves cleaned and overhauled. Brake test carried out – all within code.
13/14 Sep	Slow response on TB handle and soft braking	no	yes	Brake cylinder gauge replaced and master controller cam plate replaced and adjusted.
7 Oct*	Trying emergency brake from TB handle – there was no emergency brake	yes	yes	Braking, auto brake. No fault found, tested OK.

* Fault recorded by locomotive engineer at Henderson.

1.4.7 There was no specific mention of the ADL810/ADC860 set in the weekly maintenance meeting minutes leading up to the incident on 9 October 2007.

1.5 Regulation of rail activities

Licensing

1.5.1 In its rail safety licensing and safety assessment guidelines, the Chief Executive of the New Zealand Transport Agency (NZTA) required that all rail participants, such as Toll Rail and Veolia, submit an overarching safety case. NZTA approved the safety case as a prerequisite to issuing a rail safety licence. The safety case referred to all activities that each rail participant intended to operate and also referred to how the participant would make reference to NRSS standards, such as inter-operability arrangements with other rail participants.

1.5.2 The purpose of the safety case was to provide assurance to NZTA that the rail participant was able to operate safely, that all key risks had been identified and assessed and that control measures were in place to ensure the safety of people and property with a view to continuous improvements in safety performance. Underpinning each safety case was the participant's safety management system. The safety management system was the detail that showed how a rail participant was going to operate in accordance with its safety case, and as such, was approved along with the safety case.

Rail participants were not required to forward for approval any safety management system documentation to NZTA provided the safety case was comprehensive in its coverage of the requirements of the Railways Act 2005.

Toll Rail's safety case

1.5.3 Toll Rail's safety case stated in part that:

> **1.4 Rail activities**
>
> Toll NZ is the primary Operator using the National Rail system. It has three principal operating divisions:
>
> - Toll Rail, primarily responsible for rail freight activity, Toll Auckland Metro Maintenance (TAMM) and Rail Engineering Workshops.
>
> Other Operators may interface with Toll Rail including (without limit):
>
> - Veolia Transport Auckland, the Operator of the Auckland metro passenger services between Pukekohe and Helensville.
>
> **2.3.1 Objective**
>
> The objective of National Rail System Standards is to provide a generic framework for the management of the critical elements within Toll NZ's Rail Safety System and the systems of other Rail Participants (Access Provider and Operators). National Rail System Standards are designed to meet the requirements set out in the relevant legislation and Land Transport Safety Authority document "Rail Safety Licensing and Safety Inspection Guidelines".
>
> National Rail System Standards should be read in conjunction with this Rail Safety System Case and other applicable or relevant Standards.
>
> **3.1 Organisation Scope**
>
> Toll NZ's Rail Safety Case supports the following rail activities (by business group):
>
> - Provision of mechanical maintenance services for Veolia Transport Auckland, Ontrack and third parties e.g. inspection services for heritage groups.

Appendix A - Key rail safety responsibilities (Toll NZ)

Management Level	Rail Safety Responsibilities – (Toll NZ)
General Manager Operations, Toll Rail	Monitoring the implementation and management of commercial contracts and their interface with the licensed rail system and interoperability requirements

6.2 Design, Construction, Inspection and Maintenance

Standards and procedures for the design, construction, inspection and maintenance are detailed in the following Toll Rail documents:

- Mechanical Code (M2000)
- Mechanical Engineering Design Manual (M3000)
- Wheelset manual (M6000)
- Supplements and supporting documentation (M9000 series)
- Manufacturers' manuals and other associated documentation
- Field Modification Instructions (FMI's) and SIN's

Relevant interoperability requirements are specified in document National Rail System Standard / 6 -Engineering Interoperability.

Veolia's safety case

1.5.4 Veolia's safety case stated in part that:

2.3 Auckland Rail Passenger Services in 2006

In accordance with the Auckland Rail Project plan, Veolia Transport Australia (then Connex Group Australia) was awarded a contract (the PSA) by the Auckland Regional Council for a term of between 4 and 7 years for the provision of rail passenger services on the Auckland network, with an obligation to assume responsibility for the services from Toll Rail at the operations commencement date (which proved to be 22 August 2004).

In 2004, the government changed the organisation of regional transport planning and delivery in Auckland. An important change was the establishment of the Auckland Regional Transport Authority (ARTA), which assumed responsibility for managing the PSA. The relevant legislation is the Local Government (Auckland) Amendment Act 2004.

2.4 The Fleet

Safety Responsibilities for the Fleet

Toll Rail maintains the fleet under contract to ARTA in accordance with the standards set out in its approved safety system/safety case.

The operation of these vehicles is governed by Veolia's safety system.

5.3 Interface Risks

Nearly all of the coordination among rail participants is achieved by compliance with a set of industry-developed standards known as the National Rail System Standards. All rail participants are bound by contracts to conform with these standards, which in turn make reference to detailed codes and manuals that are also shared.

8.2 Railway Activities of Veolia Transport Auckland

1. The operation of suburban passenger trains (supplied and maintained by others) over the infrastructure (maintained and operated by others except as described below) within the Auckland region under contract to the ARTA. The stations are also provided and maintained by others.

13.2 Interface Management and Inter-operator Agreements

In the context of Veolia operations, interface management refers to the management of the relationships between Veolia Transport and other rail participants. Whilst there exists formal inter-operator agreements between Veolia and these participants covering how the businesses co-exist on the legal and financial level, there are practical aspects concerning the boundaries between these entities that require management processes to be defined.

In lieu of having a vertically integrated rail network, the management of the interfaces with other rail participants is fundamental to the robustness of this safety case.

The identified interfaces cover:

- Operational control aspects (especially with the access provider, Ontrack; and the fleet maintainer, Toll Rail);

The formal inter-operator agreements cover legal and contractual obligations relating to:

- Fleet maintenance;

14.2 Rail Vehicles

Most of the rolling stock currently in use by Veolia was operated by Toll Rail in the period preceding Veolia operations' commencement date. Accordingly, the rolling stock maintenance safety system standards and processes used by Toll Rail and applied to Veolia are based on those adopted by Toll Rail at that time.

As with Veolia's rail operations standards and processes, the rail vehicle standards and processes are governed by the agreements entered into between Toll Rail and the Crown.

DMUs

The DMU fleet is maintained at the Toll Auckland Metro Maintenance (TAMM) facility at Westfield. Toll Rail's documented safety system covers the maintenance of the DMUs by Toll Rail and the standards of maintenance and inspection are based on those formerly used by Toll Rail when they operated urban services in Auckland. In addition, the contract for DMU maintenance is based on the former contract between Alstom and Toll Rail, although amendments have been made to cover increased maintenance requirements and a more rigorous inspection and audit regime. The performance of the maintenance contractor is managed through:

- Key information technology based tools (FMP, TOPS, Resolve, and the Safety database); and
- Weekly and monthly meetings between Veolia and the contractor.

14.5 Vehicle Standards

NRSS/6 Engineering Interoperability Standards

The NRSS/6 Engineering Interoperability Standards set out the rules, processes, and standards for the operation of Veolia's vehicles on the Auckland network, the Otahuhu and Westfield Depots. More specifically, the document sets out how leased vehicles interface with the network infrastructure and other vehicles on the network.

Included in the NRSS/6 Engineering Interoperability Standards are sections covering:

- Audit inspections;
- Exceptions to the standards;
- Qualification of vehicles for the network;
- Acceleration and braking;

Operating and maintenance agreements

1.5.5 A passenger services agreement existed between ARTA (the rolling stock owner) and Veolia (the operator). This agreement formed part of Veolia's safety system.

1.5.6 An agreement existed between Toll Rail and Veolia for Toll Rail to provide maintenance of the rolling stock owned by ARTA and operated by Veolia. This agreement was established on 22 August 2004. The suite of documents associated with this agreement formed part of both Veolia's and Toll Rail's safety systems. The agreement was essentially to (in part):

- establish a long-term arrangement for the professional maintenance of the rolling stock to enable an improvement in the performance of the rolling stock, recognising that this improvement may require additional funding for maintenance to enable the operator to deliver high-quality train services in accordance with the passenger services agreement.

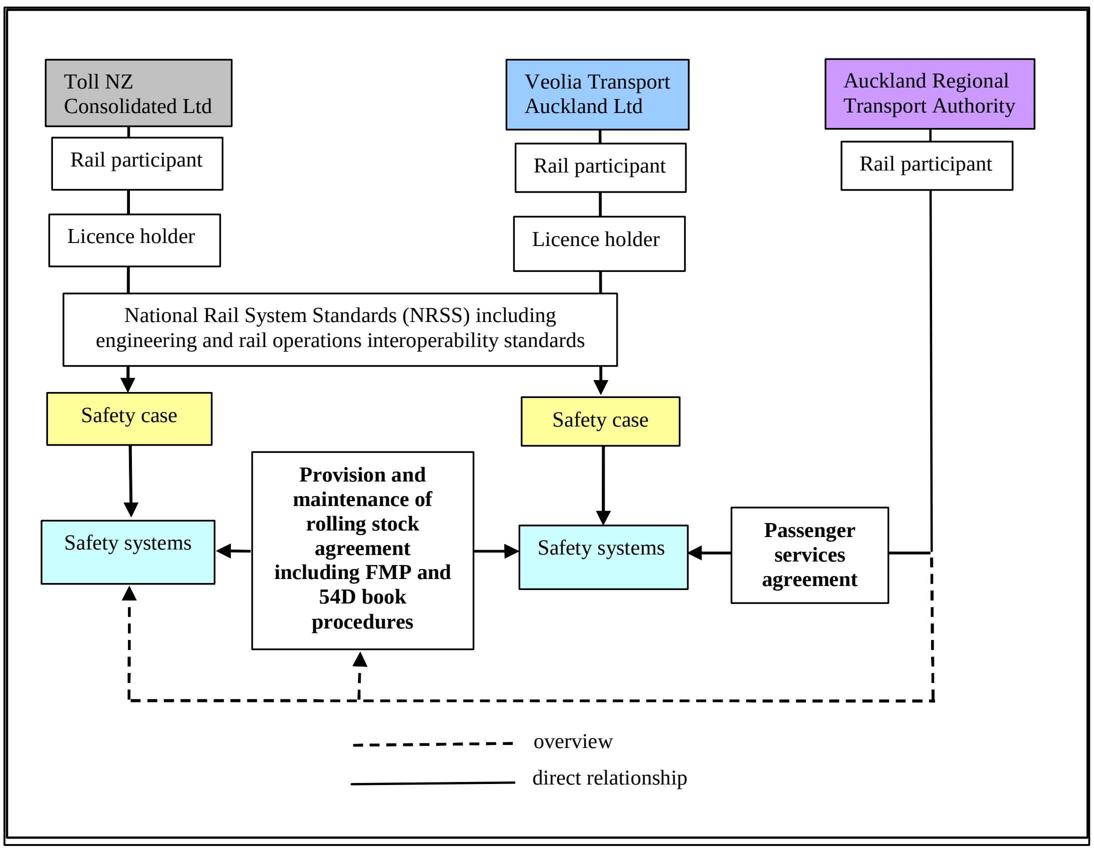


Figure 8
Relationship details in the Auckland metro operation

1.6 Personnel

Locomotive engineer

1.6.1 The locomotive engineer joined Tranz Rail in August 2003 as a passenger operator and in October 2003 attained a train manager's position. In February 2005 [and now working for Veolia], he transferred to locomotive driver training and was certified as a locomotive engineer in November 2005.

1.6.2 The assessor who certified the locomotive engineer to driving duties made the following comments in the work book:

> He [the locomotive engineer] has a very good knowledge of faults and takes great care in doing things right, checking and re-checking. His care in removing his selector before leaving the cab has become very noticeable. He places his reverser into Start or 'N' when at a Red Starting/Departure Signal. (He didn't leave it even when rushed and not having it attached).

1.6.3 The locomotive engineer said that on 30 September 2006, nine days prior to the incident, a person committed suicide in front of a train he was driving. He had been given 3 days off work after the incident, but had not been contacted by Veolia management during that time about his wellbeing and fitness for work. He resumed driving duties on 4 October 2006, five days before the incident under investigation.

1.6.4 On 7 October 2006, two days prior to the incident, the locomotive engineer experienced a braking problem while he was conducting an air brake and continuity test on the same DMU set (ADL810 and ADC860) during a short layover at Britomart. On that occasion he saw that the brake pipe pressure was reading 510 kPa, but when he applied the emergency brake it did not activate. He informed a supervisor, who checked the operation of the emergency brake from both cabs. The locomotive engineer and a supervisor confirmed that the emergency brake had not applied in the ADL cab. Because the DMU was to be driven from the ADC cab, it was agreed that the locomotive engineer would drive the train to Henderson where time was available to check the dump valve.

1.6.5 At Henderson, the locomotive engineer found the dump valve in the isolated position, so he restored the valve. He referred to the 54D book but saw no record of any similar problem. He telephoned the supervisor at Britomart and told him what he had done and arranged for details of the problem to be recorded in the FMP system. He also recorded details of the problem in the 54D book (refer to the last line of the table in paragraph 1.4.6).

1.6.6 On the day of the incident, the locomotive engineer performed an air brake and continuity test after he had operated the dump valve at Otahuhu, and because the brake system had worked correctly he cancelled a previous arrangement to change consists at Britomart. He added that the emergency brake problem was unusual.

1.6.7 To start Train 4045 from the platform at Britomart, the locomotive engineer motioned the control handle from the application position to the throttle 1 position. As the DMU neared No.39 points, the locomotive engineer returned the control handle to the release position to slow the DMU and advancing the control handle to the throttle 1 position once through the points, but could not recall complying with the 25 km/h speed restriction through the points. The locomotive engineer recalled advancing it to the throttle 2 position (where it was later found) for the climb to Quay Park junction.

1.6.8 The locomotive engineer said that because it was peak time, he "inadvertently left my key in the cab" in his haste to clear the train from the tunnel at Britomart.

Train manager

1.6.9 The train manager started his career with Veolia in February 2006 as a passenger operator. He started training to become a train manager in August 2006 and gained certification for the role on Friday 6 October 2006. The day of the incident was his first day operating as a train manager.

1.6.10 The train manager said that he had not noticed the position of the control handle and reverser key when the service stopped at Quay Park junction.

1.6.11 The train manager had been trained in the operation of the emergency brake tap because he was required to pilot DMUs during regular reversing movements at Newmarket.

1.7 Operating rules and procedures

1.7.1 Ontrack's rail operating rules and procedures, operating rules general, stated that:

> **Rule 114. Accident or Delay**
> In all cases of accident or delay to a train conveying passengers the train crew must at once ensure their safety and comfort as far as possible. When it is necessary to leave the train for any other reason the train is to be securely braked and if possible the brakes are to be left in the charge of some suitable person. Passengers are to be advised the cause of the delay and of the action being taken.
>
> **Rule 128. Leaving Motive Power Units Unattended**
> Motive power units and rail shunting tractors must not be left unattended except:
>
> (a) at Depots and other authorised localities
> (b) when authorised by special instructions
> (c) when required by Rules and Regulations for the work of trains
> (d) when manned by a Locomotive Engineer only and Train Control has been advised.
>
> A motive power unit may only be left unattended after all precautions as required in the related rules and instructions have been taken by the Locomotive Engineer.

1.7.2 Toll Rail's rail operating code supplement 4.10, operating instructions for ADL and ADC classes of DMUs stated in part that:

> **8.4.1 Air Brake and Continuity Test**
> The air brake and continuity test proves the operation of the air brake and the continuity of the air hoses and jumper cables between vehicles. The air brake and continuity test is to be carried out prior to moving as follows:
>
> When the DMU is first started up each day.
>
> When the DMU is coupled or uncoupled to another DMU or a locomotive.
>
> When the continuity of the air hoses or jumper connections between the ADL/ADC is altered.
>
> When the Locomotive Engineer considers the air brake or jumper circuits are not functioning satisfactorily.
>
> The above instructions must be read in conjunction with the Operating Rules.
>
> **10.6 Changing Driving Ends**
>
> **Locomotive Engineer**
>
> Bring the cars to a standstill and, with the control handle in "brake application" and engines idling, check that main reservoir pressure is above 600 kPa. Turn reverser key to the opposite direction (reverse), apply park brake on early models and check on late models (park brake automatically applied when changing direction with reverser key), wait for "engage" lamp to flash and when extinguished, move reverser key to "isolate" and lock the master controller by removing the reverser key.
>
> **12.3 Motor car ADL**
>
> (b) The traction engines will return to idle under the following conditions:
>
> - Emergency brake application by Guard or passenger
> - Vigilance device penalty.
>
> A return to idle caused by any one of these removes the throttle control, and empties the transmission. When cooled, throttle control and transmission operation will return to normal control. Restoration of air pressure will enable normal control to be restored in the braking system.

12.6 Brakes

Fault	Cause	Remedy
Passenger emergency stop button used, unable to recharge brake pipe		Isolate emergency dump valve with cock provided, located left side, end of defective car. With this valve isolated no emergency brake position on the TB handle or **passenger** emergency stop buttons operates on that car. Advise Train Control in Loco 54D book. Passengers MUST not be carried in car that has no emergency brake. Written report to Locomotive Engineer's Manager.

1.8 Regulatory assessment of Veolia

1.8.1 At the time of the incident, an ordinary safety assessment of Veolia was being conducted by Land Transport New Zealand (predecessor to NZTA) in accordance with its safety assessment guidelines. An ordinary safety assessment required a review and sampling of compliance with Veolia's safety case and safety system, resulting in the provision of a report on assessment findings, remedial actions required and corrective actions if necessary.

1.8.2 The assessment period was between 9 and 13 October 2006 and the assessment report was published on 7 November 2006. Under the heading of consultation, planning and specific issues, the assessment reported, in part, the following:

> **<u>Maintenance Performance</u>**
>
> Maintenance and reliability performance is monitored by both Toll Rail and Veolia.
>
> Veolia utilises the FMP data. As more trips and rolling stock are added to the commuter services there continues to be a strain on servicing and stabling of rolling stock. Veolia and Toll are aware of the situation and are continuing to implement new initiatives to manage the process e.g. additional servicing staff, servicing planned for new locations.
>
> At the time of the assessment and excluding the conditions noted in this report, maintenance protocols were implemented in accordance with the approved safety system.
>
> **<u>Loco 54D Log Books</u>**
>
> It was reported that the Loco 54D forms from time to time were not being acknowledged and the reported fault not being addressed and/or inappropriate responses were being noted by the maintenance or servicing staff.
>
> A random selection of Loco 54D books was reviewed by the assessment team. Although compared to the number of completed Loco 54D forms the sample size was relatively small, there were no cases observed where these forms were either inappropriately completed or the mechanical repair not completed.
>
> In conclusion the Loco 54D books are being satisfactorily and appropriately utilised.

1.9 Previous references to FMP/54D book fault recording systems

Occurrence report 05-108, passenger Train 3334, fire, Auckland, 23 February 2005

1.9.1 On 23 February 2005, Train 3334, a Papakura to Britomart DMU passenger train, suffered a traction motor fire while it was stopped at a signal in Britomart. As a result of that investigation, discrepancies were found in the records entered into FMP and the 54D book.

1.9.2 FMP had 4 entries between 1 February and the day of the fire, all of which related to a flashing light on the locomotive engineer's console indicating low cooling water in one or both coolant tank compartments. The 54D book had 6 entries between 4 December 2004 and the day of the fire, relating to a flashing light on the locomotive engineer's console indicating a low level of coolant water. Only one of the 54D book entries matched the FMP database.

1.9.3 Although the 54D book recorded corrective actions such as pressure testing coolant systems, the recurring low water problem remained. Had this trend been investigated, it would probably have led to an earlier detection of the location and nature of the fault that eventually contributed to the fire.

Occurrence report 05-128, passenger Train 3056, passenger injury, Papatoetoe, 31 October 2005

1.9.4 On 31 October 2005, a passenger boarding Train 3056, a Papakura to Britomart DMU passenger train, suffered minor leg injuries when he became trapped in a set of bi-parting doors that closed prematurely. A long-standing and undetected fault affecting the door operation had manifested itself as a worsening problem on the day of the incident.

1.9.5 Train crews had been recording details of the fault to both the FMP and the 54D book systems, but inconsistently to both, during a 2-month period prior to the incident. The origin of the fault lay undetected and it was not until the set was withdrawn from service following the incident that the fault was ultimately detected. Connex, predecessor to Veolia, advised that none of the recorded door faults was raised during the scheduled weekly maintenance meetings during the 2-month period.

1.9.6 On 12 September 2006 and as a result of these 2 investigations, the Commission issued separate safety recommendations to the Chief Executive of Toll Rail and the General Manager of Veolia to implement an integrated fault recording and management process for the Auckland suburban rail passenger vehicles that incorporated, but was not limited to, the features of the existing FMP and 54D book recording systems.

1.10 Previous reference to Auckland rail fleet maintenance systems

Occurrence report 06-101, passenger Train 3163, fire, Manurewa, 15 March 2006

1.10.1 On 15 March 2006, the auxiliary motor installed under DMU trailer car ADC857 in the consist of Train 3163 caught fire when lubricating oil sprayed from a loose connection onto the hot surface of the turbocharger. The train was stopped at Manurewa where the passengers were evacuated and the fire was extinguished by the New Zealand Fire Service.

1.10.2 The safety issues identified during this investigation were:

- the process for fitting the oil inlet hose to the turbocharger
- the accessibility of the auxiliary engine
- the cleanliness of the auxiliary engine surround
- the monitoring and recording of maintenance and spare parts
- the lack of a fire detection and suppression system.

1.10.3 On 19 June 2007 and as a result of this investigation, the Commission issued a safety recommendation to the Director of Land Transport New Zealand that, because of anticipated growth in rail passenger traffic in the Auckland region in the foreseeable future and the ageing current rail fleet, he require all rail participants to operate a maintenance system where:

- engineering standards consistent with world standard practice are identified and adhered to
- manufacturers' inspection, repair and maintenance instructions are documented and followed
- safety-critical components are identified and documented
- work instructions are issued for maintaining safety-critical equipment and work on safety-critical components is signed off by someone other than the maintainer
- all maintenance is recorded. (015/07)

1.10.4 On 26 September 2007 (after publication of the report), Land Transport New Zealand responded to the safety recommendation as follows:

> Land Transport NZ will continue to seek assurance, through its annual safety assessment process, that licence holders have robust and appropriate maintenance systems as outlined in approved safety cases and safety systems. Furthermore, Land Transport NZ will continue to instruct its safety auditors during their annual safety assessment of operators to pay special attention to specific safety issues identified by TAIC investigations.

2 Analysis

The uncontrolled movement

2.1 The re-enactment journeys up the gradient from No.39 points to Quay Park junction showed that ADL810/ADC860, the same consist that had formed Train 4045, consistently reached a speed of 40 km/h. On the day of the incident, it was most likely that the vigilance system had completed its cycle and automatically applied the brakes, stopping the train where it did. Had this not occurred, it would have only taken a further 9 seconds for Train 4045, travelling at the same speed, to cover the remaining 100 m to No.35 points.

2.2 The rules pertaining to the leaving of motive power units unattended were clear in that the locomotive engineer must advise the signal box and/or the train controller. Before leaving the cab, he was required to ensure that the braking system was left under the supervision of another train-operating staff member. Both of these options were available to the locomotive engineer in this instance, and although he executed the first option, he did not exercise the second.

2.3 After the train manager saw the locomotive engineer leave the cab, he returned to his fare-collecting duties. Unlike the piloting role in which the train manager had been trained when undertaking the now-redundant reversing movements at Newmarket, he was not aware that he should have remained in the lead cab, and therefore he was unaware that the locomotive engineer was not at the controls when the set moved off. By the time that telephone contact was made, the train had stopped and the train manager had already become aware that the locomotive engineer was not in his cab.

2.4 If the brakes had not applied and even if the train manager could have been contacted earlier, there would have been little time available for him to react and apply the emergency brake tap in one of the cabs. It was calculated that Train 4045 would have then entered the curved road of No.35 points at about 60% faster than the authorised speed. The potential for a serious incident, such as a derailment or overturning, was significant. Damage to the train and infrastructure and injury to passengers and onboard crew were a possibility.

2.5 The locomotive engineer knew, and had recently demonstrated, the correct process that required him to move the control handle to the application position and remove the reverser key before leaving the cab. While he was familiar with the process requiring him to remove the reverser key, what was not so clear was his understanding of the reasons for doing so. Veolia has acknowledged that its locomotive engineer training syllabuses were not explicit in explaining why this process was necessary and has since written up its own specific DMU training material, emphasising the critical importance of this task. In view of this, no safety recommendation has been made on this point.

2.6 Veolia has highlighted a number of scenarios where it might be difficult or impracticable, to place another onboard train staff member at the cab controls, such as in a 4-car set or a locomotive-hauled push/pull train consist, where it is physically difficult for a train manager to get to the driving position from within the train. What could be done is to require the locomotive engineer to inform the train manager when they are about to vacate the cab, and subsequently inform them when they have returned.

2.7 Any movement of the train in the interim, as in this instance, could be stopped by the train manager operating any one of the emergency brake controls. For this to work, some form of communication system between the locomotive engineer and the train manager would be necessary and a safety recommendation has been made to the Chief Executive of NZTA to deal with this issue.

Understanding the locomotive engineer's actions

2.8 Locomotive engineers did not have, nor were they required to have, any expertise in diagnosing the cause of emergency brake applications. However, they were trained in procedures to "troubleshoot" such problems, then record details of what they had encountered in FMP and in the 54D book. The 2 dump valves were located midway on the outside of the ADL/ADC sets, which meant that locomotive engineers had to alight from their cabs and walk the short distance to operate the relevant valve, irrespective of which end the sets were being driven.

2.9 On the day of the incident and because the locomotive engineer had already dealt with the same problem at Otahuhu, he instinctively knew what course of action to follow at Britomart. While at Otahuhu, there was no time or operational pressure on the locomotive engineer because the set was required to be stopped anyway. He was able to follow the advice of his supervisor while the set was stationary and secured in the relative safety of the siding.

2.10 However, the operational circumstances at Britomart were quite different. The presence of the stationary Train 4045 over No.39 points had blocked both tracks, thereby stopping the movement of all other services between Britomart and Quay Park junction. This section of track was probably the busiest in the Auckland system, particularly during the morning peak hour, with rapidly occurring arriving and departing movements on both tracks. This resulted in some pressure on the locomotive engineer to minimise the delay to his service and other services, a portion of that pressure being an inherent factor of a commuter operation and possibly some self-imposed pressure by the desire to resolve the problem and maintain his schedule.

2.11 After the locomotive engineer had isolated and restored the dump valve, it was clear that he lingered for a few seconds to see if any further action was needed. The locomotive engineer would not necessarily have known how long it would take for the air pressure to restore enough for the set to begin moving. For this reason and because of his experience at Otahuhu earlier that morning, the locomotive engineer wouldn't have understood the need to return to the cab immediately after operating the dump valve. However, the difference being that at Otahuhu, the set had not been left "in gear".

2.12 Regardless, at Britomart the set was left "in gear" and time measurements recorded during the re-enactments showed that it was possible to have walked smartly back to the cab, before it moved off about 28 seconds after the dump valve had been operated. No.39 points were located at the foot of the underground tunnel and there was sufficient lighting to illuminate the underfoot conditions.

2.13 Forgetting, or overlooking, the compliance with established procedures that required the isolation of the master controller before leaving the cab in this instance, was considered in human factors' terms to be a lapse rather than a knowledge-based error. Lapses could occur for a number of reasons and haste is one cause that has been discussed in this report. There were no other obvious reasons for the lapse other than possible preoccupation with other matters at the time. The locomotive engineer reported that he was well and not feeling fatigued.

2.14 The locomotive engineer did not think that there was any connection between the incident under investigation and the recent suicide occurrence. The level of support made available to the locomotive engineer following the suicide occurrence is of concern; however, in view of the safety actions since taken by Veolia that include at least one interview with a counsellor, no safety recommendation covering this issue has been made.

NRSS and interrelationships between safety cases

2.15 Although both Veolia and Toll Rail were required to include reference to interoperability arrangements when submitting their safety cases to NZTA, it wasn't until the safety system level of documentation was reached that there was a formal maintenance agreement between the 2 entities in regard to continuous supply of safe rolling stock on the Auckland suburban rail system. This agreement officially brought the 2 entities together and was a critical relationship component in each of their safety systems. Veolia and Toll Rail had to merge their respective specialised business skills and engineering expertise to ensure the safe carriage of the travelling public, because Veolia was the specialist commuter passenger operator and Toll Rail was the specialist long haul heavy freight operator with mechanical engineering skills.

Fault trend and maintenance management systems

2.16 Isolating and restoring the air-brake dump valve was only applying a temporary resolution to the intermittent fault that had brought the set to a stop twice on the day of the incident, and several times during the preceding 2-month period. The most likely cause of the fault was vibration, causing the damaged contact within the suspect passenger emergency stop button mechanism to momentarily make contact then self-correct, but when it did fail, it failed to safe mode in that it brought the train to a stop.

2.17 Within the EP circuitry, this type of fault was indistinguishable from a genuine emergency brake application that could be initiated by a locomotive engineer at the control handle or by anyone at any one of the passenger emergency stop buttons. The emergency brake system then reacted as designed and released the air pressure, applying the brakes.

2.18 After such an occurrence, isolating and restoring the dump valve essentially "rebooted" the system and initiated restoration of the air pressure to release the brakes. Rebooting the system was not fixing the fault, as was apparent from examination of the FMP system/54D book records during the previous 2 months. It was only after a fuller examination of the set following the incident that the fault was found and repaired.

2.19 The FMP system/54D book fault reporting process (as shown in paragraph 1.4.6) was supposed to be a parallel closed-loop procedure, yet examination of the 2 sets of records showed numerous examples where faults were recorded in one system but not the other. The trend appeared to be that locomotive engineers generally filled in the 54D book more often than arranging for the information to be recorded in the FMP system until such time as the fault became more problematic, or resulted in an incident.

2.20 The table in paragraph 1.4.6 shows that an examination of either the FMP system or the 54D book may not have picked up the general braking problem occurring on ADL810/ADC860. Examination of the same information showed that during a previous 4-week period, there was a series of fault reports commenting on the poor braking performance on the same consist. It was apparent that the repairs that finally addressed these related braking problems were not done until 4 new brake cylinders were fitted on 9 August 2006. However, in regard to the subsequent series of reports relating to an intermittent emergency braking problem, in a number of cases a "no fault found" comment was recorded after tests had been conducted from the master controller. It was not until this incident had occurred that a full engineering investigation found where the fault lay.

2.21 The last recorded entry in the FMP/54D book systems on 7 October 2007 referred to the emergency brake system not functioning. The locomotive engineer found the cause to be an isolated dump valve. It was not established why, or for how long, it had been isolated, but if it had been isolated in the days beforehand, it should have been identified during the daily check routines conducted before the set entered service that day, or in the days beforehand. The fact that it was not indicated that the daily check routine may not have been fully completed in that period.

2.22 Although the DMU fleet was considered aged, this did not diminish the responsibility to ensure that it was being maintained in accordance with current standards and policies. Because of its age and projected lifespan, it was important that maintenance practices continued to be applied to ensure the vehicles could operate safely into the future.

2.23 This incident, and other incidents referred to in this report, would suggest that Veolia and Toll Rail missed vital clues in the areas of fault recording, trend analysis and follow up. In this instance, it was apparent that throughout the 3-month lead-up period to this incident, Veolia and Toll Rail personnel had not detected either of the 2 distinctive fault patterns, nor was it apparent that consideration had been given to removing the set from service in order to devote time and resources to find the cause. It was critical that the FMP and 54D entries be scrutinised so that trends could be detected, this being one principal outcome of the weekly meetings between the parties. A safety recommendation, made to the Chief Executive of NZTA in respect of the maintenance of rolling stock in relation to other events, should address these issues.

Audit

2.24 The Chief Executive of NZTA has a responsibility to conduct audits of, in this case, both Veolia and Toll Rail to ensure each operator is complying with its safety case and with policies and procedures in its underpinning safety systems. While acknowledging that a single audit cannot cover the entire scope of a safety case, in this instance a concurrent audit was underway on the maintenance system, and in particular the 54D book system, in response to a report that the system was not being used appropriately.

2.25 Additionally the Commission in Rail Occurrence Report 06-101, referred to in section 1.10 of this report, noted that the maintenance of safety-critical components was substandard and recommended the that then Director take action to resolve the issue. This report, and other reports referred to, indicate that there may be a problem with the maintenance of safety-critical components, but how widespread that problem is would need to be determined by NZTA. A safety recommendation has been made to the Chief Executive of NZTA that in view of this incident he revisit safety recommendation 015/07 made in Rail Occurrence Report 06-101.

2.26 Despite 2 separate indicators being received showed that there might be a problem, the audit did not raise any concerns about the 54D book fault-recording/resolution process. Although the audits acknowledged the existence of the parallel FMP/54D book systems, it did not identify that the systems were interrelated and effectively formed one system. The anomalies identified in this report suggest that the audit function of NZTA might need reviewing. Ironically, this incident occurred while an audit of the 54D book was in progress. A safety recommendation covering the scope and depth of safety audits has been made to the Chief Executive of NZTA in this report.

2.27 Because ADL810/ADC860 were not equipped with an event recorder at the time of the incident, there was no opportunity to prove if the vigilance system had stopped Train 4045 during the investigation, making it necessary to conduct a re-enactment in an attempt to test and prove the theory. If downloaded data had been available, particularly from a modern system that could have delivered an extensive range of information, it may also have been possible to use the data to assist in diagnosing and locating the origin of the recurring fault. In that case, an early location of the fault could have occurred and this could have then led to an early fix.

2.28 The Auckland DMU fleet, operated by Veolia, has since been equipped with a modern type of event recorder, but it is of concern that deadlines to comply with a previously set standard within the NRSS had been extended by the keepers of the NRSS without consultation with NZTA. This highlights previously voiced concerns by the Commission about the need for greater regulatory involvement within the rail industry. A safety recommendation covering the approval of changes to the NRSS has been made to the Chief Executive of NZTA in this report.

3 Findings

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

3.1 Train 4045 moved and accelerated up to a speed of about 40 km/h over a distance of 526 m without the locomotive engineer at the controls of the train. The locomotive engineer had left the cab to reset an uninitiated brake application. The uncontrolled movement occurred because the locomotive engineer had not isolated the master controller before leaving the cab.

3.2 The train’s vigilance system was the most likely mechanism that automatically brought the set to a stop about 100 m before it was to enter a series of 25 km/h speed-restricted curves at about 40 km/h. It could not be ruled out that the set was stopped by another uninitiated emergency brake application similar to that which had preceded the uncontrolled movement.

3.3 The intermittent fault that caused the uninitiated emergency brake applications was most likely an electrical fault on one of the passenger emergency stop button mechanisms located in ADL810.

3.4 Using the services of the train manager to monitor the controls, together with an efficient communication system between the locomotive engineer and the train manager, could have prevented the uncontrolled movement, or at least brought the train to an earlier stop.

3.5 The 3-way relationship between ARTA, Veolia and Toll Rail for the operation and maintenance of rolling stock required a robust closed-loop system for reporting and tracking the non-routine maintenance of safety-critical systems and components. The FMP/54D book maintenance systems that were supposed to achieve that function had failed to achieve a timely fix for 2 separate non-routine faults that had been reported by locomotive engineers over some 3 months.

3.6 Considering the maintenance issues raised in this report, including reference to previous Commission reports where maintenance of rolling stock was raised as a safety issue, indications are that the standard of maintenance of rolling stock in general on the New Zealand rail network is below a reasonable level.

3.7 The NZTA audit process was unable to identify shortcomings in the FMP/54D book maintenance system in spite of having been alerted to such issues in that system and focusing on that aspect in an audit that was in progress at the time this incident occurred. The scope and depth of audit of the rail participants would benefit from a review.

3.8 Apart from the benefits for accident and incident investigation, the fitting of modern event recorders on rail passenger vehicles has the potential to assist in fault finding and analysis, which may have assisted in detecting the brake system faults that were present on the set for some 3 months.

4 Safety Actions

4.1 On 27 August 2007, Veolia advised that the following safety actions had been taken following the incident:

> Following this incident and another (that TAIC is not investigating), we have changed our procedure. Staff members used to be given the opportunity for a counsellor to be present, and some declined. Veolia now contacts SEED [an employee assistance organisation] directly, and if possible, a counsellor attends debriefs. We have also told staff that if they wish to avail themselves of the stand down period that may follow a stressful event (such as a suicide, trespasser fatality, etc) they must have at least one interview with a counsellor. They may of course have as many interviews as are necessary. This change has been made with the local RMTU agreement, and it means that no person who has been subjected to a traumatic event returns to work without having had an interview with a counsellor.
>
> Referring to the Toll Rail Operating Code, Supplement 4.10 sections 3.0 and 12.3(b). While these instructions hint at the importance of removing the selector key before leaving the cab, they do not specifically stress the importance of doing so. Note in particular that section 12.3(b) does, ambiguously, hint that once the air is restored, normal operating functions are resumed. Veolia has used the experience of this incident to advise all drivers - existing as well as trainees of the importance of removing the key. However, please note that our ADL /ADC fleet of 10 was built in two bunches of five each. One of the groups of five is wired slightly differently, so that if a driver has to 'start' an engine from the external control panel, it is essential that the selector is in the lock in the cab. In other words, there is one circumstance in which a driver MUST leave the key in when leaving the cab.

4.2 On 28 August 2007 the locomotive engineer advised that when driving the ADC/ADL class of DMUs, he attaches the reverser key to a flexible plastic cord connected to his trouser belt. When he has to leave his driving position, he must remove the reverser key to enable him to leave the cab.

4.3 On 16 January 2008, Veolia advised that the following safety actions had been taken following the incident:

> Veolia did discuss the possibility that we would make it mandatory for a locomotive engineer to advise the train manager that he was leaving the cab.
>
> It was deliberated that such a rule could not be made mandatory because under a range of circumstances it was not possible to follow it. An example was when we had a double DMU train and the train manager was in the rear unit. Similarly, a train being pulled by a locomotive would present difficulty for the locomotive engineer in communicating with the train manager. Accordingly, Veolia concluded that the emphasis must be on the correct positioning of the control handle and the removal of the reverser key by the locomotive engineer.

4.4 On 18 January 2008, Veolia supplied a revised copy of its ADL mechanical training document used in its training of locomotive engineers. Training progress is also recorded in the document. The document, in part, included the following instruction:

> **2.0 TRAIN HANDLING TUITION**
>
> **2.2 MECHANICAL FAULT FINDING PRACTICAL TRAINING**
>
> Students to be shown fault and failure scenarios and examined on ADL/ADC mechanical knowledge
>
> *The use of safe and logical procedures in fault identification and remediation is an essential element of the training and assessment. Five key issues are:*
>
> - **THE TRAIN MUST BE PROPERLY SECURED AGAINST POWERED MOVEMENT ON ANY OCCASION THAT THE LOCOMOTIVE ENGINEER LEAVES THE CAB, BY RETURNING THE T/B LEVER [CONTROL HANDLE] TO APPLICATION AND REMOVING THE KEY.**

This instruction is reiterated in an abbreviated format throughout the document whenever reference is made to locomotive engineers leaving the cab.

4.5 On 27 March 2008, Toll Rail advised that following the incident, the DMU underwent the following monitoring:

> The alleged vigilance device failure was reported to Land Transport NZ, who monitored subsequent testing undertaken by Toll Rail and Veolia. The testing included mechanical inspections by Toll Rail engineers and, when returned to service, additional tests by Veolia locomotive engineers in addition to those carried out during the pre-daily service.
>
> There were 44 additional vigilance tests recorded in the 54D books between 9 and 27 November 2006.
>
> In all cases, the engineering inspections, pre-service test, additional in-service tests found nothing and the vigilance system functioned correctly.

5 Safety Recommendations

Safety recommendations are listed in order of development and not in order of priority.

5.1 On 21 August 2008 the Commission recommended to the Chief Executive of New Zealand Transport Agency that he address the following safety issues:

5.1.1 There is recurring evidence indicating that the standards of maintenance of rolling stock on the national rail network as demanded in Veolia's and Toll Rail's safety cases is lower than is preferable and reasonable in that for example:

- manufacturers' inspection, repair and maintenance instructions are not always documented and followed
- safety-critical components are not always identified and documented
- work instructions for maintaining safety-critical equipment are not always issued, and work on safety-critical components is not always signed off by someone other than the maintainer
- some maintenance is not recorded (015/08)

5.1.2 There is no requirement for operators of passenger trains to have effective communication between the locomotive engineer and the onboard person in charge of passenger operations that will facilitate good crew resource management and be effective in emergency situations. (016/08)

5.1.3 The date by which all passenger trains were required by the National Rail System Standards to be fitted with event recorders was extended by the rail participants without consulting with and getting approval from Land Transport New Zealand. (017/08)

5.1.4 The scope and depth of the NZTA programme for rail participants was not appropriate for the licence holders being assessed, audited or otherwise, and auditors do not make full use of the information available that signals potential areas of system weaknesses; information from accident and incident reports and recommendations being examples of some of the information available. (018/08)

5.2 On 26 August 2008 the Chief Executive of the New Zealand Transport Agency responded in part as follows:

5.2.1 NZTA acknowledges the list of safety issues [safety recommendations].

Because NZTA is not itself a railway operator it cannot directly implement actions in the field but will undertake further work to discuss those safety issues with the rail licence holders concerned with a view to ensuring that they are considered, and, where appropriate actioned, for safety improvement. Until that work is carried out, NZTA is not in a position to advise whether, or when, the recommendation[s] can be closed out. We will keep TAIC informed of progress.

Approved on 21 August 2008 for publication

Hon W P Jeffries
Chief Commissioner

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