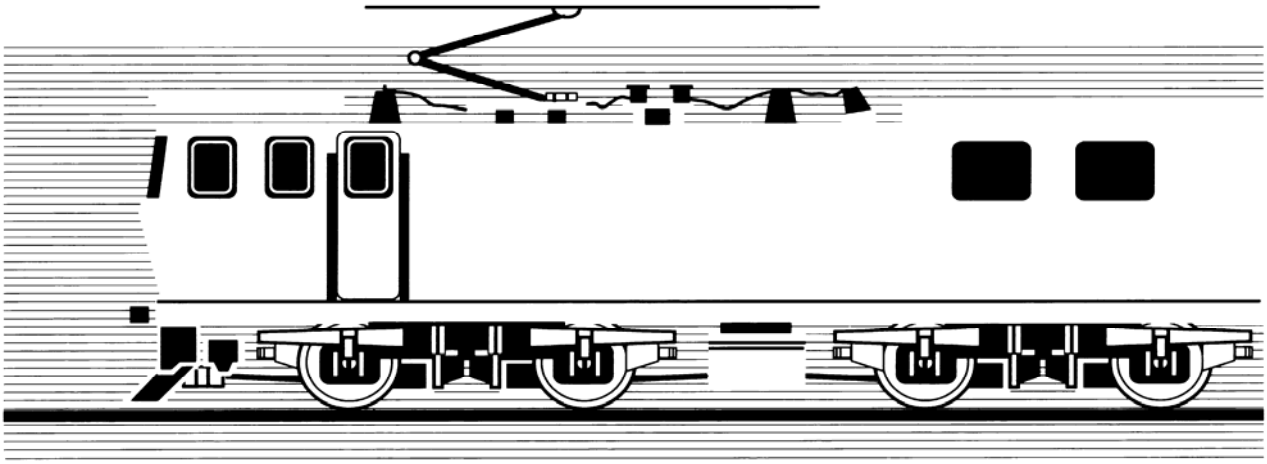
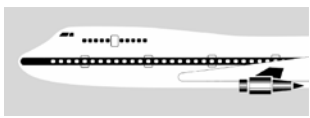
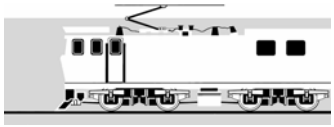


RAILWAY OCCURRENCE REPORT

05-128 diesel multiple unit Train 3056, passenger injury, Papatoetoe 31 October 2005


TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Report 05-128

diesel multiple unit Train 3056

passenger injury

Papatoetoe

31 October 2005

Abstract

On Monday 31 October 2005, at about 0827, a set of bi-parting doors on Train 3056, a Connex Auckland Limited Papakura to Britomart diesel multiple unit passenger service, closed on a passenger boarding at Papatoetoe. The passenger became trapped, but was freed when the doors were prised open by a locomotive maintainer who was travelling on the train.

The passenger suffered minor leg injuries.

Safety issues identified included:

- the door control and operating mechanisms
- the use of a defective safety-critical component
- the fault-recording processes.

Safety recommendations have been made to the General Manager of Veolia Transport Auckland Limited[1] and the Chief Executive of Toll NZ Consolidated Limited to address these issues.

[1] On 1 March 2006, Connex Auckland Limited rebranded its Auckland suburban rail operation to Veolia Transport Auckland Limited.

Contents

Abbreviations ii

Data Summary iii

1 Factual Information 1

1.1 Narrative 1
1.2 Site information 2
1.3 Personnel 2
Train manager 2
Locomotive maintainer 3
Locomotive engineer multiple unit 3
Injured passenger 4
1.4 Diesel multiple unit 4
Historical information 4
Reconfiguration 5
ADK/ADB refurbishment programme 5
Multiple unit operation of the composite consist 5
Door-operating mechanisms 6
Door-operating procedures 7
1.5 Fault-recording and repair procedures 7
Connex's FMP system 7
Toll Rail's 54D book system 8
1.6 DMU inspection and maintenance 9
Post-incident examination of the composite consist 10
1.7 DMU event recorder 11
1.8 Previous reference to FMP/54D book fault recording systems 12
Occurrence report 05-108, diesel multiple unit passenger Train 3334, fire, Auckland, 23 February 2005 12
1.9 Previous similar rail occurrence investigated by the Commission 12
Occurrence report 03-103, diesel multiple unit Train 3247, passenger injury, Glen Innes, 15 May 2003 12

2 Analysis 13

3 Findings 16

4 Safety Actions 16

5 Safety Recommendations 17

Figures

Figure 1 The composite 4-car consist with standard set at top and refurbished set at bottom 1

Figure 2 Track layout between Papakura and Britomart (not to scale) 2

Figure 3 ADK/ADB consist configurations 5

Figure 4 Selection switch in cab of ADK 687 6

Figure 5 Conduit and jumper plug socket on ADK 687 11

Abbreviations

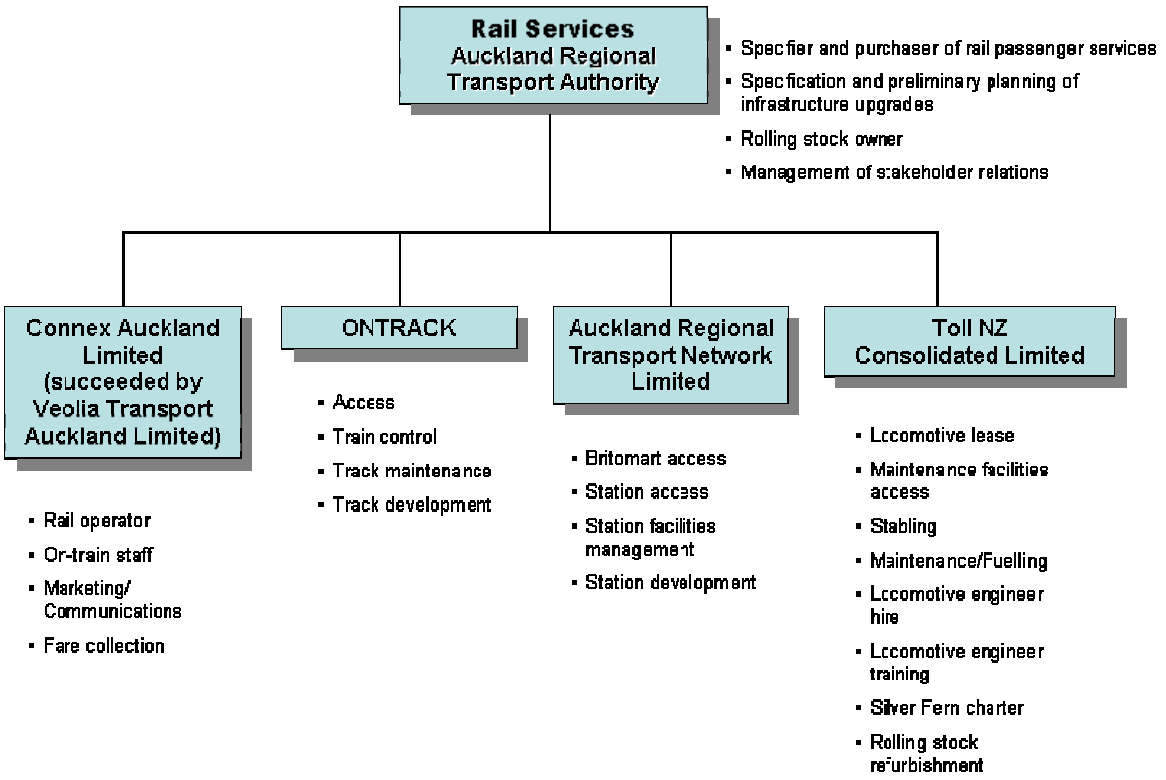
Connex	Connex Auckland Limited
DMU	diesel multiple unit
FMP	fleet maintenance protocol
LEMU	locomotive engineer multiple unit
mm	millimetre(s)
Toll Rail	Toll NZ Consolidated Limited
United	United Rail Group Limited
UTC	co-ordinated universal time
Veolia	Veolia Transport Auckland Limited

Data Summary

Train type and number:	diesel multiple unit Train 3056	
Classification:	ADB 777	
Year of manufacture:	1969	
Date and time:	31 October 2005 at about 0827[2]	
Location:	Papatoetoe	
Persons on board:	Connex Auckland Limited (Connex):	3
	United Rail Group Limited (United):	one
	passengers:	about 110
Injuries:	crew:	nil
	passengers:	one minor
Damage:	nil	
Operator:	Connex	
Investigator-in-charge:	Vernon Hoey	

[2] Times in this report are New Zealand Daylight Time (UTC + 13 hours) and are expressed in the 24-hour mode.

Auckland rail passenger system: roles and relationships



1 Factual Information

1.1 Narrative

1.1.1 On Monday 31 October 2005, Train 3056 was the scheduled 0802 Connex diesel multiple unit (DMU) passenger service stopping at all stations from Papakura to Britomart via Newmarket. The service was crewed by a locomotive engineer multiple unit (LEMU), a train manager and a passenger operator all employed by Connex, and conveyed about 110 passengers.

1.1.2 Train 3056 consisted of a standard[3] ADK 687 and ADB 777 set coupled to a refurbished ADB 772 and ADK 682 set (see Figure 1). Special connections for door control and other systems had been made because of the differing electrical equipment and circuitry on the composite consist[4].

Figure 1
The composite 4-car consist with standard set at top and refurbished set at bottom

1.1.3 A United[5] locomotive maintainer was travelling on the train trying to locate the cause of a door problems reported on earlier services.

1.1.4 At about 0827, Train 3056 stopped at Papatoetoe and the LEMU pressed the door-release button on his driving console, and the train manager opened the doors from her local[6] door on ADK 687.

[3] A term describing the original condition of the ADK/ADB set prior to refurbishment.
[4] A term describing the coupled 4-car consist.
[5] United was contracted to supply the inspection and maintenance of rolling stock to standards set by Toll Rail.
[6] The door at which the train manager selected to operate the door-control buttons.

1.1.5 While a passenger was entering the second car, ADB 777, the doors closed on him suddenly, trapping his lower leg. Other passengers inside the car attempted to free him. Shortly afterwards, the locomotive maintainer arrived at the outside of the doors and manually prised them open.

1.1.6 The train continued its journey to Britomart where the composite set was taken out of service.

1.2 Site information

1.2.1 Papatoetoe station was an island platform with Up and Down main lines on either side of the platform. Britomart-bound services berthed on the Up main line and services from Britomart berthed on the Down main line.

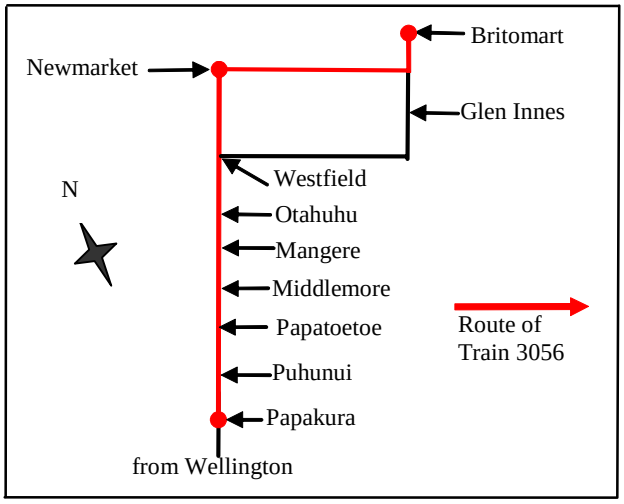


Figure 2
Track layout between Papakura and Britomart (not to scale)

1.3 Personnel

Train manager

1.3.1 The train manager was employed by Connex in June 2004, after working for 18 years on long-distance passenger trains operated by Tranz Scenic and its predecessors. Amongst other duties, the role required her to close the doors after the passenger operator had provided the appropriate hand signal at the completion of passenger work at stations.

1.3.2 On the day of the incident, the train manager started her shift at Papakura at 0610 where she joined the composite consist for the first of a series of services between Papakura and Britomart. During the stoppage at Glen Innes, she encountered the first indication of the door problem. She said that when the doors were opened from the standard set, the door-close alarm sounded before she had pressed the door-close button and all the doors, other than her local door, closed. After departing Glen Innes, she briefed the LEMU and telephoned details of the problem to a staff member at Britomart.

1.3.3 On arrival at Britomart, the train manager was told that the consist would return to Papakura, where a stabled replacement set was available. Before departure, the doors on the standard set, now at the rear, were isolated[7]. During the return journey, the problem had reappeared and the train manager was informed that a locomotive maintainer would join the train at Westfield. She later added that even the doors on the isolated rear set opened at one station. A mechanical maintenance staff member who was travelling to work on this train told the train manager that he had heard about the problem the previous week.

1.3.4 The train manager said that during the layover at Papakura, the locomotive maintainer requested that the composite consist return to Britomart as Train 3056 so he could have more time to locate the cause of the problem. The refurbished set, now at the rear of the train, was isolated. After the train had departed and stopped at some stations, she said the door problem reappeared. At Puhunui, passengers were alighted through the driver's cab sliding door when none of the doors would open.

1.3.5 The train manager said that she was unaware of the passenger injury and only became aware of the incident when the passenger operator informed her after the train had departed Papatoetoe. At Otahuhu, the train manager instituted a work-around[8] process with herself and the locomotive maintainer locally operating 2 out of the 3 doors on the standard set for the remainder of the journey to Britomart.

Locomotive maintainer

1.3.6 The locomotive maintainer had been employed by United in Westfield since 2004.

1.3.7 On the day of the incident, he started duty at 0700 and shortly afterwards was instructed to look at a problem that was occurring on the train. At about 0730, he joined the train at Westfield station and the train manager briefed him on the problem, adding that the local door closed normally when the close button was pressed.

1.3.8 During the layover at Papakura, the locomotive maintainer arranged to restore the door operation that had been isolated on the standard set and saw the problem for himself.

1.3.9 The locomotive maintainer said that he travelled in the standard set on Train 3056 and saw the problem occurring at the stations before reaching Papatoetoe, noting that the LEMU and train manager seemed to be doing everything normally. He noted that the doors would open, the door-closing alarm would sound and the doors would immediately close. During that time he also saw some passengers being struck by the closing doors.

1.3.10 At Papatoetoe, the locomotive maintainer stepped onto the platform and saw the doors close on the passenger, trapping him at his shoulders and ankle. He said that he rushed over and managed to prise open the doors to allow the passenger to enter the car. The locomotive maintainer said that he offered his services and after Otahuhu assisted the train manager by locally operating one of the doors.

Locomotive engineer multiple unit

1.3.11 The LEMU had been driving DMUs for Connex since gaining his certification in November 2004. His licence to operate was current at the time of the incident. He was familiar with the special operating arrangements for the composite consist.

[7] The cutting-out of the doors of selected vehicles within a DMU consist, preventing passengers boarding those vehicles.
[8] A term used to describe an alternative process, arranged on site by local staff which differed from an approved documented process.

1.3.12 On the day of the incident, the LEMU booked on at Westfield at 0450 from where he drove the empty consist to Papakura. He said that he first became aware of the door problem at Glen Innes and after discussing the matter with the train manager, he notified the signal box controller at Britomart by radio that his service was experiencing door problems.

1.3.13 On arrival at Britomart, the LEMU said that he explained the situation to several staff members. The LEMU was told that the composite consist would return to Papakura where an exchange of sets would occur.

1.3.14 The LEMU said that when the locomotive maintainer joined the train, they arranged to dip the headlight at several stations, but this had no effect. The LEMU said that he deferred to the locomotive maintainer's request and cancelled the replacement arrangements and instead drove the composite consist back to Britomart as Train 3056.

1.3.15 The LEMU later said he was not aware that a passenger had been trapped at Papatoetoe.

Injured passenger

1.3.16 The injured passenger travelled regularly by train between Papatoetoe and Newmarket. He was in his early 60s and considered himself to be fit for his age.

1.3.17 On the day of the incident, the passenger stood in his normal position on the platform, along with a small group of other passengers. He said that when the train stopped, the door of the second vehicle was adjacent to him.

1.3.18 When the bi-parting door opened, the passenger, leading the other passengers, stepped up and entered the door. He said that when he was almost through, the door suddenly closed on him. A satchel he was carrying under his right arm took most of the impact on that side of his body, but his left side wasn't protected and the door closed on his ankle, preventing him moving.

1.3.19 The passenger said that he felt helpless and was concerned for his safety had the train moved off while he remained trapped. He said that he remained trapped until a man wearing orange overalls opened the doors from the outside of the car. He said that once he had sat down, he tended to his injured ankle and notified the passenger operator of the incident. He was told that he was not the first person who had been struck by the closing doors. The passenger said that the train manager arrived shortly afterwards and recorded his contact details.

1.4 Diesel multiple unit

Historical information

1.4.1 The ADK and ADB cars were originally owned and operated by Western Australian Government Railways in Perth, Western Australia. The ADK motor cars were built by Commonwealth Engineering of New South Wales in 1968 and the ADB trailer cars were built by Westrail in 1968 and 1969.

1.4.2 The ADK and ADB cars were permanently coupled together to form 2-car sets with driving cabs at each end. The ADK had 2 bi-parting doors each side of the car, and the ADB had one bi-parting door each side of the car.

1.4.3 On arrival in New Zealand in 1993, the 19 cars, which operated in nine 2-car sets with one spare ADB car, were modified for use on the Auckland rail network system. The 2-car sets could be coupled together to form 4-, 6- or 8-car consists in a nose-to-tail configuration because they all faced the same direction.

Reconfiguration

1.4.4 In early 2005, the Auckland Regional Transport Authority and Toll NZ Consolidated Limited (Toll Rail) decided to operate the ADK/ADB fleet permanently as 4-car sets instead of the arrangement of mostly operating them as 2-car sets. To bring the ADB cars together, 4 of the 9 sets were turned to face the opposite direction and the ADB cars were then permanently coupled together (see Figure 3).

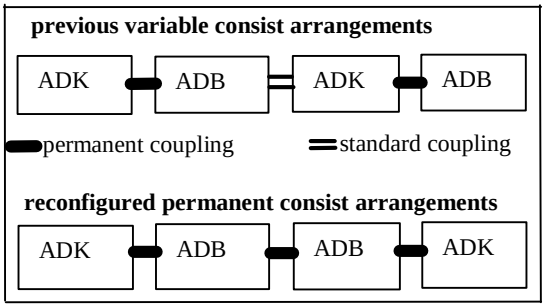


Figure 3
ADK/ADB consist configurations

1.4.5 The 4-car sets were dedicated to services between Britomart and Papakura.

ADK/ADB refurbishment programme

1.4.6 In early 2005, a refurbishment programme was approved to extend the working life of the ADK sets for another 7 years and bring them up to the same standard as the already completed ADL/ADC fleet upgrade. The refurbishment programme was scheduled for completion in February 2007.

1.4.7 A design feature of the refurbishment programme was the relocation of the auxiliary motor from its under-car position on ADK 682 to the driving cab of ADB 772. This was done in concert with the decision to reconfigure the ADK/ADB fleet into four 4-car sets. Thus the composite consist and the reconfigured unrefurbished consists were all driven from the ADK cars.

Multiple unit operation of the composite consist

1.4.8 ADK 682 and ADB 772 was the first set to be refurbished, and on its return to service in August 2005, special one-off arrangements were made to enable this set to operate when coupled to a standard set until completion of the refurbishment programme.

1.4.9 Door-control and other electrical systems on the standard set comprising ADK 687 and ADB 777 were specially modified to allow this set to operate:

- on its own
- coupled to another standard set
- coupled to the refurbished set ADK 682 and ADB 772 and any subsequent refurbished set.

A selection switch was mounted in the cab of ADK 687 to enable it to operate in any of the modes (see Figure 4). The switch enabled maintenance staff to choose between refurbishment and standard mode and thus synchronise door control and other electrical systems with whatever set the set was coupled to.

Figure 4
Selection switch in cab of ADK 687

1.4.10 The refurbished set ADK 682 and ADB 772 and standard set ADK 687 and ADB 777 were permanently coupled together. The composite consist was commissioned for service on 1 September 2005.

1.4.11 Operational practicalities subsequently determined that ADK 687 and ADB 777 would be the only standard set to be specially modified. It was unlikely the composite consist would be separated during the course of the fleet refurbishment programme unless a lengthy delay affecting one of the vehicles occurred.

1.4.12 Toll Rail developed and issued the following mechanical code supplements to operate the composite consist:

- M 9364 dated 8 August 2005 incorporating general operating instructions
- M 9331 RU dated 6 October 2005 incorporating door status test procedures.

The composite set was subject to the normal inspection and maintenance routines.

Door-operating mechanisms

1.4.13 The door-operating mechanism on the standard ADK/ADB cars was a scroll mechanism. The bi-parting doors were opened and closed by a large screw drive mechanism located above the door, and ram pressure was provided by compressed air at 450 kilopascals. The mechanism locked the doors around an obstacle and the doors were difficult to force apart physically.

1.4.14 The overall width of the exterior doorway opening between the handrails on ADB 777 was 965 millimetres (mm), and the 2 bi-parting doors opened to a width of 900 mm.

1.4.15 As part of the refurbishment programme, the entire door-operating mechanism was replaced with a hanger-type system that restricted the door's lateral movement. A pulley and belt mechanism, incorporating an obstacle-detection system, closed the doors at a slower rate. In the event of a door striking an obstacle, the doors retracted automatically before attempting to close again 2 seconds later. This cycle repeated itself until the obstacle was removed and the doors could close completely.

1.4.16 The pulley and belt system was in use on the ADL/ADD and SA/SD fleets in Auckland and on the electrified multiple unit fleet in Wellington.

Door-operating procedures

1.4.17 Tranz Rail's (predecessor to Toll Rail) operating code supplement CSR 3.1 dated 6 August 2001, Instruction 3.0 specified the duties of train managers and passenger operators on trains in the Auckland suburban area.

> When a train is ready to depart, the passenger operator(s) must signal the train manager that all is clear by extending one arm out at right angles to the shoulder.
>
> When more than one passenger operator is on the train the all clear must be passed along from the rear of the train with the next passenger operator not giving the all clear until the one in the rear of him/her has done so.
>
> Before giving the all clear, passenger operators must ensure that all passengers have boarded or alighted and that no one is in danger of being caught by the closing doors in their section of the train.
>
> **It must be kept in mind that the safety of the passengers is paramount at all times.**
>
> After receiving the all clear from the passenger operators, the train manager, after ensuring all passengers are clear, closes the doors from one of the door control panels. Before closing the door the train manager is standing by, a visual check must again be made to ensure all passengers are clear of the train, before signalling the LEMU to proceed. As the train moves off the train manager must again look along the train for any emergency signals or unusual situations.

1.4.18 Tranz Rail's operating code supplement CSR 4.16 dated 19 November 2001, Instruction 6.0 specified instructions for the operation of doors and bell codes.

> An audible warning sounds for 2 seconds before the door begins to close.

1.5 Fault-recording and repair procedures

1.5.1 There were 2 fault-recording procedures in operation on the DMU fleet:

- fleet maintenance protocol (FMP), an automated system operated by Connex
- a 54D book operated by Toll Rail.

Connex's FMP system

1.5.2 FMP was a system for recording faults and transferring information from Connex to United's passenger vehicle depot for repairs to the vehicles. Maintenance personnel recorded in FMP what corrective action had been taken, and the vehicle was then transferred to Connex.

1.5.3 Connex was responsible for recording faults on vehicles and relaying the information to maintenance personnel. FMP provided Connex management with an overview of the nature and frequency of reported faults.

1.5.4 Connex held weekly meetings with Toll Rail engineering services staff to discuss fleet maintenance issues recorded in FMP. 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".

1.5.5 In the 2 months leading up to the incident, the following faults relating to the doors on the composite set were recorded within FMP:

Fault date	Nature of fault and vehicle identification	Date repaired	Nature and comment on repair
1 September 2005	Door faults, not releasing when coupled to ADK 687	2 September 2005	PCR relay with intermittent fault replaced
4 October 2005	Flat batteries	4 October 2005	Flat batteries on ADK 687 causing door light to be lit on ADK 682
11 October 2005	Doors not opening when coupled to ADK 687	11 October 2005	Doors repaired after they failed and were inoperative
11 October 2005	Doors not opening when coupled to ADK 687	11 October 2005	Water drained from jumper plug*
27 October 2005	Doors faulty, door alarm kept going off	31 October 2005	Misaligned door piston repaired
28 October 2005	Door alarms kept going off. Isolated door fault switch to cease alarms	31 October 2005	Misaligned door piston repaired

***** Dirt and water were removed from the same area after this incident.

1.5.6 Connex advised that none of the recorded door faults that occurred on the composite set was raised during the scheduled weekly maintenance meetings during the 2-month period.

Toll Rail's 54D book system

1.5.7 The 54D book was a manual system operated by Toll Rail. Locomotive engineers were required to record in the 54D book details of faults or problems encountered on locomotives that they were driving. The book was also stored in the driving cabs of the DMU fleet operated by Connex. The 54D book procedure operated as follows:

- initial entry made by person who experienced the fault. In most cases this was a Toll Rail locomotive engineer or a LEMU in the case of a Connex-operated train
- defect attended to by servicing depot staff when locomotive or DMU was scheduled for maintenance
- servicing depot staff recorded in 54D book brief description of work carried out. Locomotive or DMU returned to service when defect repaired
- top page removed and passed to depot manager for perusal
- information of defect details entered into a database and page filed
- completed 54D book stored and book replaced.

1.5.8 In the 2 months leading up to the incident, the following faults relating to the doors on the composite consist were recorded in the 54D book held in each driving cab:

ADK	Fault date	Nature of fault	Date repaired	Nature and comment on repair
687	30 August 2005	Door No.2 ADK end doesn't work properly. It will shut at same time as other doors	31 August 2005	Door 2 control box components repacked into box after remounting components
682	2 September 2005	No.2 door not closing at times	Not recorded	Illegible
682	3 September 2005	Unable to open doors on the diesel alternator set	6 September 2005	Lock barrel changed
687	11 October 2005	When all door lights come on, press, but all doors don't open, only when we operate 687 by itself	11 October 2005	All doors operated – both DMUs at either end leading – checked OK. Moisture removed from inter car jumper boxes 687/772 and 19 pin jumper 687/772*
682	27 October 2005	Door problems, red light won't go out on door No.5	27 October 2005	Door sensor adjusted. Operated several times. Unable to fault
Not recorded	27 October 2005	Door alarm keeps sounding. Checked all doors but found no fault.	27 October 2005	Door sensor adjusted

***** Dirt and water were removed from the same area after this incident.

1.6 DMU inspection and maintenance

1.6.1 Toll Rail's mechanical code M 2000 determined that ADK/ADB sets would be inspected at regular intervals:

- daily check every night
- A-check every 6 weeks
- B-check every 3 months
- C-check every 6 months
- D-check every 9 months

1.6.2 The refurbished set underwent a door check on 5 July 2005 in Hutt workshops in compliance with special mechanical code M 9333 RR. This code was developed for the passing out of the sets after their refurbishment and simulated the set being coupled to a standard set for test completeness. Another special mechanical code, M 9333 RU, was also developed for the passing out of a composite consist comprising a standard and refurbished set.

1.6.3 After the refurbished set arrived in Westfield and was permanently coupled to the standard set, the composite consist was given a B-check on 16 August 2005 prior to being commissioned in accordance with code M 9331 RU. Because this was the first occasion a check on the composite consist was carried out, maintenance staff took the opportunity to evaluate and fine-tune the check process contained in mechanical code M 9331 RU. The code was formally accepted as a company document on 6 October 2005 following this check.

1.6.4 The daily checks were carried out by qualified maintenance staff at United's servicing depot during overnight downtime.

1.6.5 A pre-departure check schedule required that the door operation be checked on the coupled sets. If a set had been separated for any reason, the door operation check was held over until they had been recoupled. This check involved the doors being opened and closed on each side and the doors-closed lights illuminating when all doors were closed.

1.6.6 Toll Rail did not have a record of United's pre-departure check on the composite consist for the morning of the incident.

Post-incident examination of the composite consist

1.6.7 After Train 3056 arrived at Britomart, the composite consist travelled empty to United's passenger vehicle depot in Westfield where Toll Rail staff examined the door-control systems.

1.6.8 The following observations and conclusions were made by Toll Rail engineering services staff during the initial examination:

1) Basic fault was an erroneous "door close" cycle which was initiated when the door release push button was pressed by the driver and the "Door Release" circuit activated.

2) The door closing sequence went through its normal cycle, which means that the "Doors Closing" alarm sounded for 2 seconds before the door closed. This occurred just after doors had been opened by the Train Manager.

3) The doors therefore closed just as passengers were about to get on or off.

Fault found:

An erroneous partial connection between trainline[9] wire 24 (door release) and trainline 27 (door close command) resulted in the door close timer relays on both ADK cars being turned on and left on which resulted in the door closing alarms sounding continuously and, after the first 2 seconds, the doors closing. This was revealed by measuring the voltage on wire 27, without a door close push button being pressed, of 17 volts with the door release circuit (wire 24) livened, as would have been the normal situation after stopping at a station.

The fault was detected when the cars were first checked after the incident. The fault then disappeared, and did not reappear during 2 subsequent days of testing and test runs.

All door control boxes were checked for loose wiring by operating the controls at each box in turn with the "door release" light up while shaking the box as much as possible.

All jumper boxes, sockets and plugs checked for moisture and loose connections.

During this second action, copious quantities of dirt and water were removed from the 19-pin jumper plug and socket between ADK 687 and ADB 777 (see Figure 5).

The socket and plug were dried and cleaned before reassembly.

[9] The name of the wire system that extends throughout a coupled vehicle consist.

Figure 5
Conduit and jumper plug socket on ADK 687

In the driving cab of ADB 777, the controller was removed and 3 trainlines for engine run indications were disconnected. These 3 wires were converted to a new role while the composite consist remains intact. This has resulted in the driving cab in ADB 777 being completely removed from the system and cannot be erroneously left "live" with the controller in the undetected neutral position which could create issues.

Blocking diodes were added to trainline wire 27 at the door timer relays to protect against lost negatives creating a series return of back feed circuit. This same wire was temporarily disconnected from the tranzlog event recorder in case of something untoward occurring inside the tranzlog.

Test runs were conducted after this work was completed on the day of the incident and there was zero voltage readings on wire 27 with wire 24 operating correctly. The mechanical engineer accompanied the consist on its return to service on the following day and no faults occurred.

1.7 DMU event recorder

1.7.1 The event recorder from ADK 682 was supplied for analysis. Data downloaded during the time that Train 3056 was stopped at Papatoetoe showed the following:

- at 08:28:12, the door release was operated by the LEMU when the train had stopped
- between 08:28:12 and 08:28:24, the door control trainlines repeatedly switched between open and close
- between 08:28:24 and 08:29:08, the doors closed by the trainline remained energised continuously
- at 08:29:08, the train manager signalled the LEMU to depart the train.

1.8 Previous reference to FMP/54D book fault recording systems

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

1.8.1 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, the following discrepancies were found in the records entered into FMP and the 54D book.

1.8.2 FMP had 4 entries between 1 February and 5 February 2005 (the day of the fire), all of which related to a flashing light on the LEMU's console indicating low cooling water in one or both coolant tank compartments.

1.8.3 The 54D book had 6 entries between 4 December 2004 and the day of the fire, relating to a flashing light on the LEMU's console indicating a low level of coolant water. Only one of the 54D book entries matched the FMP database. Although the 54D book recorded corrective actions such as pressure testing coolant systems, the recurring low water problem remained.

1.9 Previous similar rail occurrence investigated by the Commission

Occurrence report 03-103, diesel multiple unit Train 3247, passenger injury, Glen Innes, 15 May 2003

1.9.1 On Thursday 15 May 2003, a passenger attempting to alight from ADK 684 while the doors were closing became trapped as the train departed. The passenger freed himself and fell to the platform, suffering minor injuries.

1.9.2 As a result of this incident, it was found that while the B-check did not require the top hanger door connection to be specifically checked, a post-accident inspection had identified significantly loose connections on the bi-parting doors that trapped the passenger. These connections had sufficient slack to make it possible to wedge a 40 mm block between the bi-parting doors at floor level and have the top of the doors close as normal, thereby activating the "door closed" micro switch as designed. This in turn activated the train manager's green "door closed" light on the local control box, giving an incorrect door status. On 30 April 2004, Tranz Rail amended mechanical code M 9331 to include an additional test:

> At each door in turn:
> Close the doors with a 30 mm block placed between the door side faces at the bottom.

1.9.3 On 19 July 2004, as a result of this incident, the Commission recommended to the Chief Executive of Toll NZ Consolidated Limited that he:

> ensure that the rubber door seals used on the bi-parting doors of passenger cars are of a material type and profile that allows trapped limbs to be freed with minimal discomfort to the person caught between the doors. (032/04)

1.9.4 On 13 July 2004, Toll NZ Consolidated Limited advised that the planned refurbishment of the ADK and ADB fleet would incorporate:

> soft door nosings that are currently fitted to the EM and ET fleet,
>
> obstacle detection facility whereby if the door encounters an obstruction it stops the door from closing and re-opens it.

1.9.5 On 28 July 2004, Toll NZ Consolidated Limited advised that the refurbishment of the ADK fleet had begun, and was scheduled to be completed by the end of 2005.

2 Analysis

2.1 The passenger became trapped when the bi-parting doors closed prematurely and forcibly gripped his lower left leg as he boarded the train at Papatoetoe. Before the doors closed, there would have been a 2-second warning alarm, which was able to be heard from outside the car. However, the 2-second warning was designed to alert those passengers on board the train, who due to congestion were standing next to the doors, to stand clear as they were about to close. Boarding passengers would not have expected the doors to close, or the alarm to sound, so soon after the doors had opened.

2.2 However, on this occasion the passenger was probably stepping up from the platform to the open door and, although it was not known whether he had heard the alarm, he would have needed to react quickly to avoid becoming trapped. It was probable that his body position and the lack of room to pivot meant he had committed himself to boarding the train and there was no opportunity to check his forward movement and abandon his entry. Regardless, the warning would very likely not have prevented the passenger becoming trapped because of the speed of closure of the doors. It was not known if any passengers alighted from Train 3056 beforehand.

2.3 Each door had to travel about 150 mm only before it came into contact with the passenger. It was fortunate for the passenger that his satchel absorbed some of the impact and that his fitness enabled him to withstand the shock and pressure of the doors against his body. It was likely that a more frail person would have suffered more traumatic injuries.

2.4 The locomotive maintainer's intervention meant that the passenger's leg was freed as quickly as possible. The train manager's view of the incident was probably obstructed by the other passengers who may have gathered at the door waiting for it to reopen or may have been moving to another open door. Regardless, the ensuing train departure process contained sufficient procedural checks for on-board train staff to have become aware of the incident and it was highly unlikely that the train would have departed while the passenger's leg remained trapped. Additionally, the safety actions taken after the previous incident at Glen Innes required a regular check of the security of the door hangers and the testing of the door closure mechanisms during planned maintenance periods. These additional examinations and testing meant that it was highly unlikely the train manager would have obtained a door closure light and been able to give the train departure signal to the LEMU while the passenger's leg remained trapped.

2.5 The explanations of the door problems provided by the on-board train crew were consistent with the event recorder data that showed the door-control trainlines repeatedly switching between open and closed. This fault was consistent with the accumulation of dirt and water in the jumper plug and socket. Their comments that the doors were closing without the door-close button being pressed were also consistent with a short circuit, because in normal operation the trainline would only be energised momentarily, instead of being energised continuously as seen in the data.

2.6 The ADK/ADB fleet refurbishment programme was probably the first occasion in the 37-year lifespan of the vehicles in Australia and New Zealand that such an extensive upgrade of the mechanical workings, including the door-operating mechanisms, had been undertaken. The scroll door operating mechanisms were probably original fittings, except for some component replacement because of normal wear and tear.

2.7 The refurbishment programme of the ADK/ADB fleet of DMUs, underway at the time of the incident, followed the already completed refurbishment of the ADL/ADD fleet of DMUs and the introduction of the SA/SD fleet of push/pull carriage trains. The doors on these later vehicles, together with ADK 682 and ADB 772, were equipped with the pulley and belt control mechanism that was slower and gentler. The design ensured that a passenger would not be trapped as occurred at Papatoetoe because the mechanism ceased to apply force when an obstruction was detected, then quickly followed with an automatic retraction. Additionally, the same mechanism allowed the doors to be moved back easily by hand if need be.

2.8 Although there had been several reports of door problems on the composite consist in the 2 months leading up to the incident, it was clear that these faults were random and variant. Nevertheless, on one occasion, it was recorded in the 54D book that water had been drained from a jumper plug, probably between ADK 687 and ADB 777, and not between ADK 687 and ADB 772 because these 2 vehicles were not coupled together. The source of the water was not established at the time as, less than 3 weeks later, dirt and water had again accumulated in the same jumper plug, with a more serious outcome.

2.9 Although the review processes associated with FMP and the 54D book were designed to detect and action repeated problems, there was no clear trend on this occasion indicating a recurring fault or problem with similar symptoms. There had been only one previous record on 11 October that was symptomatic of the incident at Papatoetoe and it would have been difficult to associate this problem with the other random door-related faults that were being reported during that time. Nevertheless, the water and dirt contamination in the jumper plug was an indication of an underlying problem with the potential to cause a serious incident.

2.10 The 2 independent reporting systems were designed to manage the same incidents but, because reports to FMP were transmitted verbally and entered into a computer at Britomart, the system did not have the capability to retain a written copy of any problem in the driver's cab. Therefore the 54D book system had been retained because it compensated for that disadvantage. This enabled LEMUs booking on for later shifts to be aware of historical problems, including those that had already been attended to.

2.11 However, the existence of the 2 separate reporting systems would probably not have been conducive to achieving compliant reporting as would more likely be achieved by a single integrated system that incorporated the best features of both systems. LEMUs and maintenance staff were required to record faults and problems, and corrections taken, to the 2 systems and it was difficult to understand how this would promote a culture of full reporting. The variance between the reporting levels was clear in the previous and current investigations, which showed faults and problems being reported to one or other system, but inconsistently to both. In view of this, a safety recommendation has been made to the Chief Executive of Toll Rail and to the General Manager of Veolia Transport Auckland Limited (Veolia) to merge the 54D book and FMP into one process.

2.12 On the day of the incident, critical decisions were made to continue the composite consist in service with defective doors without managerial input. The decision made at Britomart was understandable, not only because it was known that a spare set was available at Papakura, but also because at that time in the morning, passenger numbers travelling away from Auckland would have been light, allowing the train crew to concentrate their passenger work through 3 doors of the refurbished set equipped with the superior door-control mechanism. The decision also allowed the locomotive maintainer to witness the reoccurring problem first hand.

2.13 The isolation of the rear sets in such circumstances was the preferred practice that allowed the train manager to travel, and communicate face to face with the LEMU during the journey. Conversely, isolating the front set in such circumstances posed communication difficulties as train managers were not equipped with radios and there was no thoroughfare between the coupled ADB cars.

2.14 The subsequent decision-making process followed at Papakura that resulted in the running of Train 3056 was difficult to understand. By that time, it was apparent there was a recurring and worsening problem on the consist that had prompted the calling out of the locomotive maintainer. Again there was no managerial input or reference to higher expertise, and without any coordination, the decision, which culminated in the defective consist continuing in service, had probably not considered the potential for a serious incident to occur.

2.15 Before Train 3056 departed, the on-board train crew again isolated the rear set, a decision probably prompted by the acknowledgement of their experience of door problems so far. The desirable action would have been to operate Train 3056 with the replacement set because the composite set could not be separated or turned for the refurbished set to lead. Also the train could have been run with the front set isolated and the passengers conveyed in the refurbished set, but it was understandable why this less favoured option was not taken.

2.16 The locomotive maintainer's request was probably considered by the LEMU and train manager to be reasonable at the time. Analysing the cause of a problem that was manifesting itself variously was probably a difficult assignment for the locomotive maintainer. It was not clear who made the decision for the locomotive maintainer to join the train and it was not apparent that he had been given a clear understanding of what he was to achieve. The locomotive maintainer was in a difficult situation, and although there were merits in his request to run Train 3056 with the composite consist, it was probably driven more by his eagerness to locate the problem than for any other reason.

2.17 The alighting and boarding of passengers through the locomotive cab door at Puhunui when none of the doors would open was a reasonable decision. There was no comment if any difficulty was experienced with the opening of the doors at Papatoetoe. Between Papatoetoe and Otahuhu, Train 3056 was scheduled to stop at 2 further stations, but there was no comment on what occurred at those locations. However, by the time the train reached Otahuhu, the on-board train crew had probably become frustrated in not understanding, but having to contend with, the changing dynamics of the problem. After the incident, the presence of the locomotive maintainer allowed for a competent person to operate a second door manually with his own set of keys for the remainder of the journey to Britomart. However, the defective doors were compromising passenger safety, and the on-board train crew, including the locomotive maintainer, should not have been placed in such a demanding situation.

2.18 The departure of the defective consist from Papakura reduced the number of options available to the on board train crew. By departing, they indicated their commitment to running the train to Britomart. Nevertheless, and particularly after some passengers were seen to have been struck by the doors at stations prior to Papatoetoe, it would have been prudent for the crew to implement the work-around process earlier than they did.

2.19 Following the incident Veolia created a front-line managerial position that included the responsibility for receiving calls from on-board train staff reporting faults and problems then managing an effective response, so no safety recommendation covering this issue has been made. However, a safety recommendation relating to the provision of clearer guidelines for on-board train staff for the reporting of, and response to, defects on safety-critical components, has been made to the General Manager of Veolia.

2.20 The electrical and mechanical arrangements applied to the composite consist were appropriate. However, the effect that water leaking into the conduit and accumulating in the jumper plug would have had on the door operation had probably not been identified during the design phase and subsequent testing of the composite consist.

2.21 In view of the safety actions taken by Toll Rail and the finite lifespan of the composite set and other unrefurbished ADK/ADB sets equipped with the scroll-type door-operating mechanisms, no safety recommendation relating to the door-control mechanism on the unrefurbished sets has been made.

3 Findings

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

3.1 The incident occurred when the bi-parting doors of ADB 777 closed prematurely, trapping the first of several passengers to board the car at Papatoetoe.

3.2 The bi-parting doors closed unprompted due to short circuits in the door-control trainlines. The short circuits were caused by water and dirt that had leaked into a conduit then accumulated in a jumper plug.

3.3 The 2-second warning before the doors closed was a generic system across Veolia's fleet in Auckland, but on this occasion it did not provide the passenger with an effective warning.

3.4 The door problem had been reported 3 weeks earlier in both the FMP and 54D book systems but the underlying cause had not been corrected.

3.5 The door problem had reappeared on 2 previous services on the day of the incident, culminating in the passenger being trapped on Train 3056, its third service.

3.6 The composite set should have been removed from service at Papakura.

3.7 The continued operation of the defective consist created an unsafe environment for passengers and a progressively demanding work environment for the on-board train crew.

3.8 Given the apparently worsening door-operation problem and its potential to affect passengers' safety adversely, it would have been prudent for the on-board train crew to initiate the work-around process earlier than they did.

3.9 The actions of the on-board train crew after the incident ensured the defective consist was operated as safely as possible for the remainder of the journey to Britomart.

3.10 The recovery actions taken after the incident resulted in the detection and correction of the underlying fault that had been reported, but not identified and corrected, 3 weeks previously.

4 Safety Actions

4.1 On 1 December 2005, Toll Rail advised that the following actions were taken after the incident:

Some time after the consist was returned to service, the following actions were taken:

- the damaged conduit connecting to the 19-pin socket on ADK 687 was replaced.
- wire 27 to the tranzlog was reconnected.
- the tranzlog was downloaded after 3 days of normal operation and no faults in the door operations and other systems were noted.
- overall, the tranzlog was found to be working correctly.
- a negative earth fault introduced during repairs to the battery switch on ADK 687 was detected and repaired. This fault would have established the first part of a fault path which could then be completed by a positive earth fault elsewhere to create an unwanted circuit connection.

4.2 On 9 June 2006, the General Manager of Veolia advised that the following actions were taken after the incident:

- Veolia has revised the procedure for evaluating safety-critical faults that occur during operations, at least so far as on-board passenger staff are concerned. Locomotive Engineers, of course, are still expected to make judgements about brakes, transmissions, etc so far as safety to run is concerned. Since the incident last October, Veolia has appointed two Service Delivery Managers, one of whom is on duty at Britomart at all times. Responsibility for dealing with safety issues in the passenger areas, including the doors, has been passed to them.
- FMP reports are now all logged in the Service Delivery Manager's office. Train crews ring and advise the Service Delivery Manager or one of the Service Coordinators on duty. There are a number of extensions in the office including a "HUNT" number, which will send the call to the phone that is not busy, for example if two of the Service Coordinators are busy on the phone the call will be directed to the office phone that is available. This ensures that the duty Service Delivery Manager can always be contacted either directly or through his office.
- We have also added the lessons of this incident into our Train Manager training.
- I am glad to report that we have not had a similar incident arise.

5 Safety Recommendations

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

5.1 On 12 September 2006, the Commission recommended to the General Manager of Veolia that he:

5.1.1 provide clearer guidelines to operating staff defining the actions to be taken when safety critical components of a train consist become defective while in operation. The guidelines should include when advice is to be sought, the position of the person from whom it is to be sought, and the action to be taken if that person cannot be contacted. (038/06)

5.1.2 in conjunction with the Chief Executive of Toll NZ Consolidated Limited, implement an integrated fault recording and management process for the Auckland suburban rail passenger vehicles that incorporates, but not limited to, the features of the existing Fleet Management Protocols and 54D book recording systems. (039/06)

5.2 On 6 October 2006, the General Manager of Veolia replied in part:

> Veolia Transport Ltd accepts both recommendations.
>
> In respect of 038/06, the circumstances of the incident were advised to Train Managers soon after, and the importance of advising supervisory staff in Britomart Station when a serious problem arose was emphasised. Subsequently, a new position of Service Delivery Manager was created to strengthen the company's support for on board staff. A Service Delivery Manager is on duty at all times that passenger trains are running during week days, and a Train Services Officer is on duty during the weekend. These managers are empowered to make decisions about taking trains out of service if faults occur.
> Our instructions for on board staff, together with the training material, are being revised now and will be re-issued shortly. This will incorporate the lessons learned from this incident into our permanent documentation. I expect this work will be completed by the end of January 2007.
>
> In respect of 039/06, following receipt of your preliminary safety recommendation Veolia has opened discussions with Toll NZ Ltd (as fleet maintainers) over the best way to achieve an integrated fault recording and management process. You will appreciate that the Loco 54D book must be

> retained in some form because it is essential that any Locomotive Engineer who climbs on to a train must be able to see what faults (if any) have been logged by the previous drivers. The principal issue, therefore is to devise an efficient way to duplicate the Loco54D entries into a computer-based system.
> It is expected that decisions should be made and implemented by 30 June 2007.

5.3 On 12 September 2006, the Commission recommended to the Chief Executive of Toll Rail that he:

5.3.1 in conjunction with the General Manager of Veolia Transport Auckland Limited, implement an integrated fault recording and management process for the Auckland suburban rail passenger vehicles that incorporates, but not limited to, the features of the existing Fleet Management Protocols and 54D book recording systems. (040/06)

5.4 On 9 October 2006, the Chief Executive of Toll Rail replied in part:

> Toll Rail has consulted with Veolia Transport Auckland Limited and jointly determined a target date of 30 June 2007 for implementation of this recommendation.

Approved on 21 September 2006 for publication

Hon. W P Jeffries
Chief Commissioner

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