Office of the Chief Investigator
Transport Safety

Rail Safety Investigation
Report No 2009/14

Passenger Fatality

Connex Melbourne Ltd

Melbourne Central Station

(Melbourne Underground Rail Loop)

20 October 2009

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THE CHIEF INVESTIGATOR

The Chief Investigator, Transport Safety is a statutory position under Part 7 of the *Transport Integration Act 2010*. The objective of the position is to seek to improve transport safety by providing for an independent no-blame investigation of transport safety matters consistent with the vision statement and the transport system objective.

The primary focus of an investigation is to determine what factors caused the incident, rather than apportion blame for the incident, and to identify issues that may require review, monitoring or further consideration. In conducting investigations, the Chief Investigator will apply the principles of 'just culture' and use a methodology based on systemic investigation models.

The Chief Investigator is required to report the results of investigations to the Minister for Public Transport and/or the Minister for Roads and Ports. However, before submitting the results of an investigation to the Minister, the Chief Investigator must consult in accordance with section 85A of the *Transport (Compliance and Miscellaneous) Act 1983*.

The Chief Investigator is not subject to the direction or control of the Minister(s) in performing or exercising his or her functions or powers but the Minister may direct the Chief Investigator to investigate a transport safety matter.

EXECUTIVE SUMMARY

This incident occurred while Connex Melbourne Limited was the operator of the Melbourne metropolitan passenger rail franchise. Metro Trains Melbourne commenced operating the franchise 43 days later.

At about 2352[1] on Tuesday 20 October 2009, as a Frankston service was departing Melbourne Central Station on the MURL (Melbourne Underground Rail Loop), two passengers forced open a door of the train as it began to move and attempted to alight.

One of the passengers, a male aged 36, was trapped when his left leg slipped into the gap between the platform and the train. The man's companion fell out of the train onto the platform. The train departed, dragging the man to the end of the platform where he was fatally injured.

The investigation found that the victim had consumed quantities of alcohol and a prescription drug and that his companion reported consuming alcohol and prescription drugs before and during the train trip from Frankston. It was also found that an electrical circuit that should have conveyed an alert to the train driver that a door had been forced after the train had commenced to move was faulty.

The report recommends that the operator:

- Ensure that train drivers are equipped with a vehicle consist list for trains they are to operate.
- Review the PEI (Passenger Emergency Intercom) system on Comeng[2] trains and consider alterations to prevent such communication problems in the future.
- Institute a daily process to test for the correct operation of the door monitoring circuit of all trains prior to entry into service each day.
- Familiarise themselves with the regulatory requirements applying to the variation of maintenance and other processes and their frequency.

[1] All times are expressed as Australian Daylight Saving Time.
[2] Commonwealth Engineering Co. Ltd., the builders of this rolling stock.

1. CIRCUMSTANCES

The 36 year old man and his female companion are recorded on CCTV boarding the train at Frankston at about 2233, both holding carry bags containing what was later identified as cask wine and possibly other items and sat near the leading end of the last car in the train. At Richmond Station, at around 2336, three young males joined the last car of the train and a few minutes later one of them covered the lens of that car's № 3 CCTV camera, obscuring its view.

The train travelled via Flinders Street and Southern Cross stations, thence into the MURL and arrived at Melbourne Central Station at 2351; then departed at 2352.

Two seconds after the train commenced to move, the male passenger was observed to force open the leading right-hand (in direction of travel) passenger saloon doors of the last car and attempt to alight. His companion followed and fell over him and onto the platform, but the man's left leg dropped between the platform and the train and was trapped as the train gathered speed. The door closed and the man was left in a seated position on the platform edge (coping strip) with his body against the side of the car. He was dragged along the platform edge with his right leg extended in front, and holding a bottle in his right hand. He slid on his buttocks in this position for the remaining length of the platform until striking a safety-handrail post at the top of the access stairway at the platform extremity, then to the ground (the track structure) and beneath the train. The speed of the train at this point would have been in excess of 50 km/h.

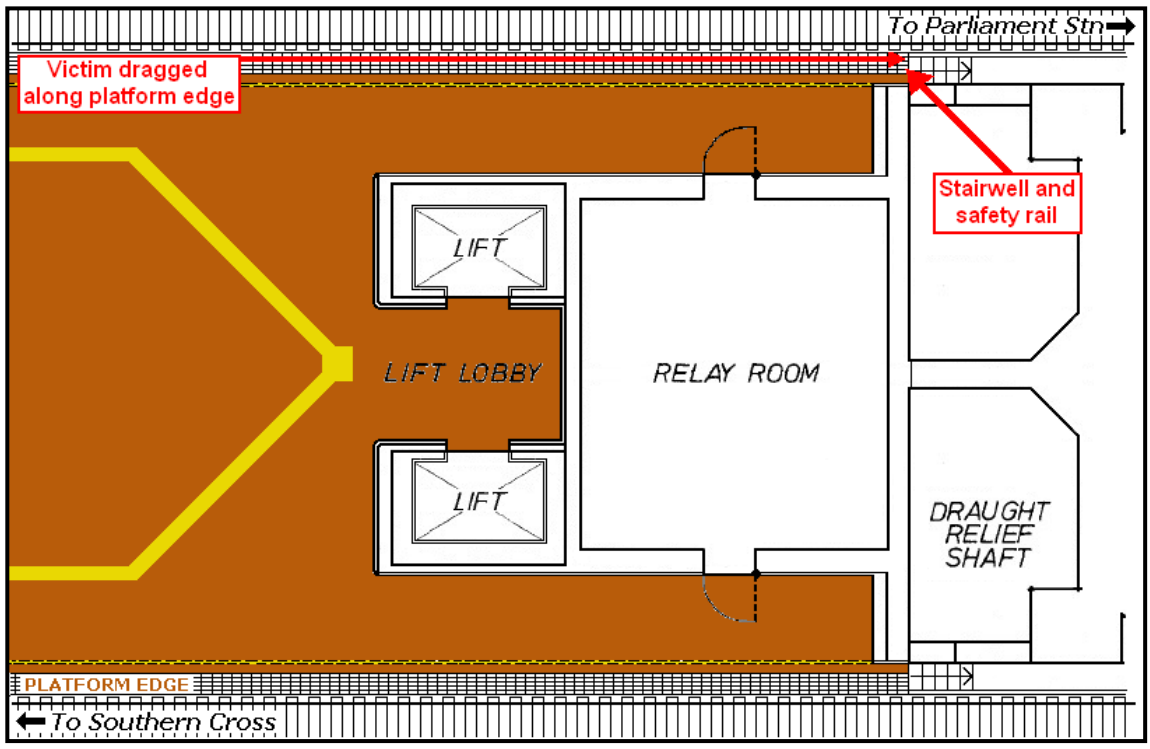

Figure 1 – Plan of Melbourne Central Station platform incident location.

2. FACTUAL INFORMATION

2.1 Personnel

2.1.1 Train driver

The driver has approximately 23 years experience in train operations. He was medically fit for duty at the time of the incident, had been appropriately rostered, and reported that he was alert and well-rested.

He reported that the stop at Melbourne Central Station was otherwise normal. At the time of departure he checked his right-hand rear-view mirror and waited for passengers to complete boarding and alighting. Being satisfied, he closed the doors, received a steady blue door *Close* light on his control panel (indicating all saloon doors were closed), sounded the train warning device, and departed the train. These actions satisfied the requirements regarding driver's responsibilities in departing trains from station platforms[3]. Within a few seconds the forward end of the train had entered the tunnel and the driver then focused his attention on the trackside signals and on driving through the tunnel toward Parliament Station. He stated that he did not receive a door warning alert.

The driver reported receiving a PEI (Passenger Emergency Intercom) call when the train was about half-way between the Melbourne Central and Parliament stations. When he responded by pressing the intercom *Reply* button, CCTV vision from car № 499M was displayed on the DDU (Driver's Display Unit). This was the rear-most car of the train, however the driver stated that he was unaware of the actual location of car 499M within the train make-up; only that it was one of the vehicles of the trailing three-car set. The vision displayed four or five people gathered around the intercom and repeatedly pressing the call button, and one agitated passenger waving their arms. At first, the driver thought that this agitated person was the reason the other passengers had activated the PEI.

The repeated pressing of the PEI call button by the passengers resulted in the constant sounding of the alarm tone in the driver's cabin. Although the driver responded repeatedly to the PEI call and requested details of the emergency, the passenger reply was unintelligible due to the incessant PEI call tone being generated in the driver's cabin. Eventually, the driver was able to elicit the information that somebody had jumped from the train at Melbourne Central Station while the train was moving off.

At this point the train was approaching Parliament Station, so the driver initiated an Emergency radio call to Metrol[4] and made a normal station stop. As the train came to a stand the driver's Emergency call was answered by Metrol. The driver provided particulars and Metrol undertook to contact Police and ambulance services. Following this, the driver secured the train, took a portable radio, and made his way back along the train to locate the car from which the distress call had been made. At this point the police arrived, and the driver made a PA announcement to passengers from the rear driver's cabin that there would be an indefinite delay.

[3] Connex: *Right Time Departure of Trains*, document No. cml-8.13-tsg-099 Rev. 02, 06/10/09, page 5 of 7.
[4] Metropolitan Train Control Centre.

2.1.2 Passenger and CCTV evidence

A statement to police from the victim's companion recorded that she and the deceased had come to the city at around midday. The victim had obtained the drug Xanax[5] on prescription and he and his companion had each taken a quantity of the tablets. The victim later sold a number of tablets to finance the purchase of a cask of wine from a supermarket. The victim was arrested by police outside the Melbourne Central Shopping Centre shortly after 1300 in an impaired state and transported to the Melbourne Custody Centre in the city. Later that evening, after the victim was released, he and his companion decided to go to Frankston and back for a 'train ride', drinking more wine on the way there and on the return. This is also recorded by on-board CCTV security vision.

On the return journey, at Richmond Station, train CCTV recorded that three young males joined the train, sat near the victim and his companion and spoke to them. Within a short while, one of the youths moved towards the № 3 CCTV camera (recording vision from the centre of the car towards the end in which these five individuals were seated) and placed some material over the lens, completely obscuring its view. From this point on, the only CCTV vision available to the investigation was from the № 2 camera located at the rear end of the car, thus providing a distant view of events occurring in the car leading up to arrival at Melbourne Central Station and the dwell-time spent at the platform. For this reason the investigation obtained no clear on-board view of the events surrounding the movements of the victim and his companion in moving to and opening the door and alighting from the moving train.

The statements of several passengers in the same car as well as those on the platform indicated that as the train started to move off from Melbourne Central Station, the victim and his companion got up from their seats and moved to the nearest door. The man forced the doors open and appeared to be intending to hold them while his companion alighted. Platform security vision shows, however, that the man's left foot slipped from the door tread and he appeared to lose his balance, falling out of the car into a sitting position on the platform with his left leg completely within the gap between the platform and the car. As this occurred, and before the doors could slide shut, his female companion jumped through the doorway and onto the platform, stumbling and falling.

[5] See section 2.3, page 14.

2.2 The train

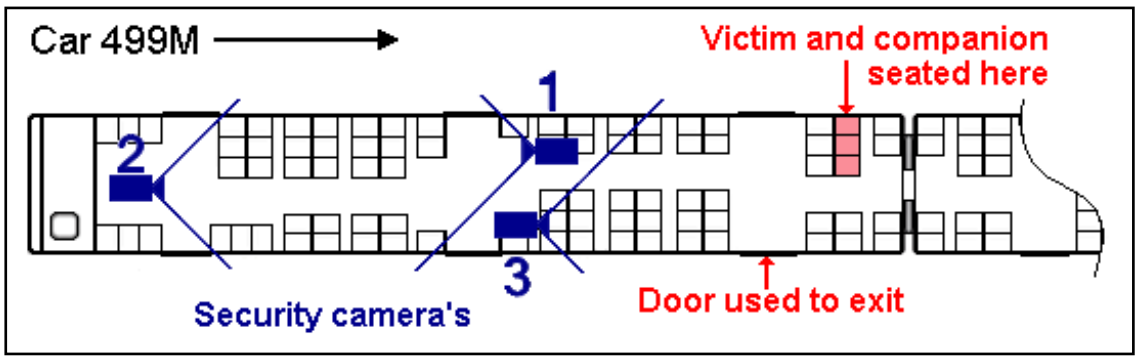

Figure 2 – Car floor plan

The six-car Comeng EMU[6] comprised cars 383M[7], 1042T[8], 365M, attached to 534M, 1100T, and 499M. Car № 499M was equipped with three CCTV cameras as illustrated above. A six-car train occupies almost the full length of MURL platforms.

A bogie-mounted brake cylinder and piston assembly is located immediately below the door tread of this passenger saloon access door and below platform surface-level. This apparatus is part of the train's braking system. The brake cylinder casting includes — at its free end — alternative attachment points for the air-line connection. One of these is utilised with a flexible hose attachment and the other is plugged (refer to photo at Figure 4). Images of the brake cylinder display fresh scuff marks.

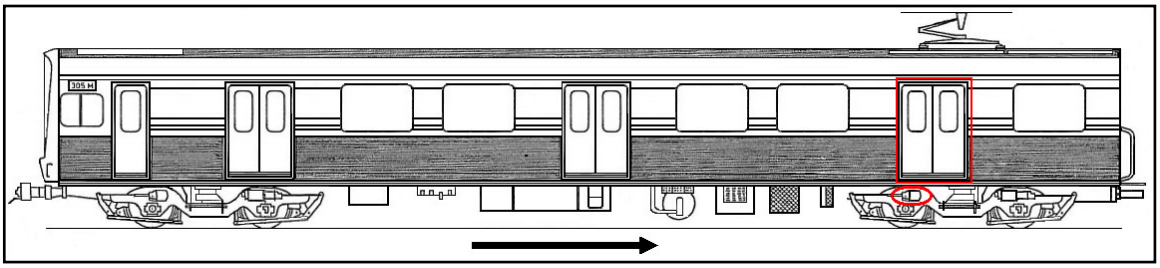

Figure 3 – Comeng motor car, showing door used by victim and proximate car brake cylinder (see photo below).

[6] Electric Multiple Unit.
[7] Motor Car - equipped with traction motors and therefore providing motive power for the train.
[8] Trailer Car – non-powered.

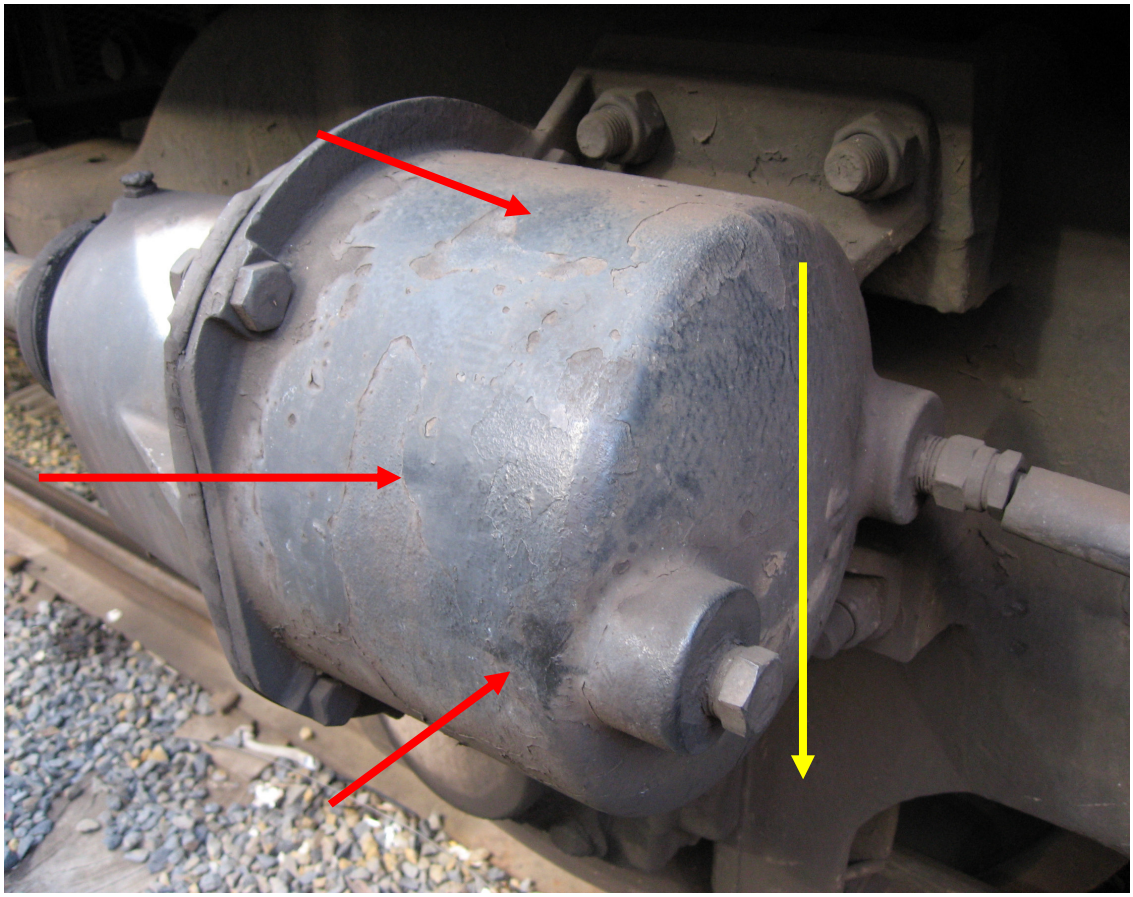

Figure 4 – Bogie-mounted brake cylinder photographed post-incident. Red arrows show fresh scuff marks on the cylinder casing. Yellow arrow between air hose attachment points shows relative position believed assumed by victim's leg.

2.2.1 The door system

Comeng trains have power-operated sliding saloon doors fitted with robust metal door-knobs. Upon arrival at a station the doors are 'released' by the driver and are manually opened by passengers as required. Prior to departure, the driver initiates door closure by depressing the door CLOSE push-button, and the doors are closed automatically.

The controls for the driver's passenger saloon door consist of three illuminated push-buttons mounted on the driver's control console; two being used to RELEASE either the left- or right-hand doors, and the centre button to CLOSE the doors. These buttons illuminate when pressed; yellow for the RELEASE buttons and blue for the CLOSE button. When the CLOSE push-button is depressed, a warning tone is sounded throughout the train then the doors will close after a one-second delay. The button will display a blue FDCL (Flashing Door Close Light) until all doors in the train are closed. Any obstruction in a doorway will cause the doors on that car on that side of the train to 'system-release' (re-open) briefly — accompanied by an FDCL — then re-close.

The sliding saloon doors are operated by a pneumatic door engine that holds the doors closed with an operating pressure of 400-420 kPa. This system is designed to require the exertion of a *minimum* 20.5 kg (or 201 N) of force by a person in order to open the

door once it is closed[9], however, engineering comment from MTM is that the force required to open a door is more likely to be in the order of 300 N.

Trainlined door monitoring

A warning system monitors the 'door-closed' state by means of an energised wire that extends the length of the train and that is supplied from a single point at the rear of the train. This wire is carried through the door control system on each car, and its operation is such that any interruption to the voltage upon it (such as will be caused by a sliding saloon door being opened after the train driver has pressed the door CLOSE pushbutton) will be detected as a voltage drop and will cause the driver's door CLOSE push-button to flash and an intermittent warning tone to sound. The doors are not released by the system under these conditions[10]. The electrical supply to this wire is via a relay controlled by an Auto Coupler Contact switch (ACC) contained within the coupler assembly at each end of the EMU car-set. When one cab is configured as an *operating cab*, the door monitoring wire at that end of the train is isolated from this electrical supply, leaving — as the only point of supply — that controlled by the closed ACC on the rear-most coupler.

When two 3-car EMU sets are coupled together, this monitoring wire is extended (trainlined[11]) — via a connection automatically established when the two multi-function couplers are connected — to include the attached car set. A component called the Coupler Plunger Striker Arm (part of the ACC contained within each coupler) opens each ACC, also isolating the door monitoring wire from the electrical supply at these two intermediate locations. Once again, this leaves the supply controlled by the rear-most ACC as the only supply to the door monitoring wire.

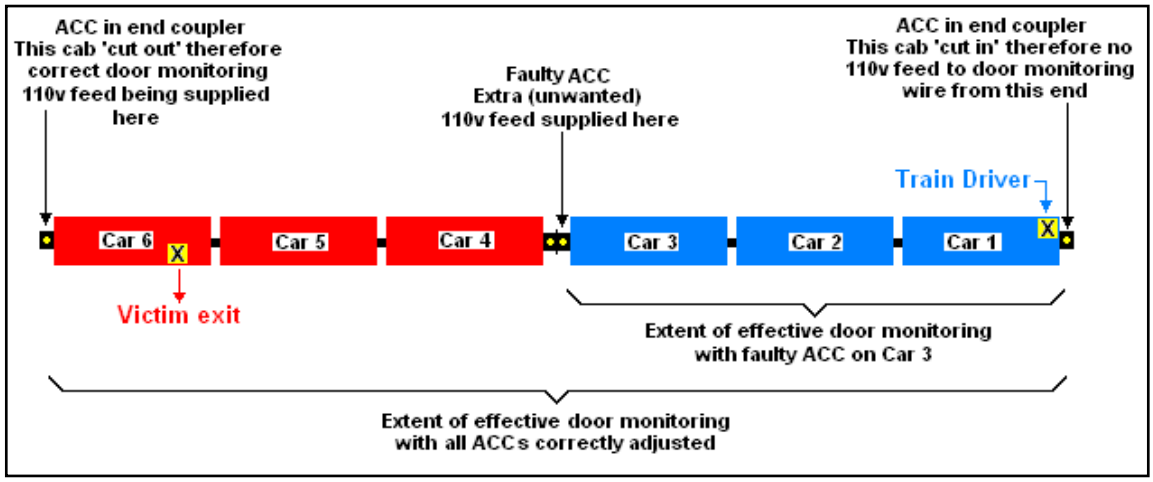

Figure 5 – Depiction of trainlined door monitoring circuit.

In this incident, the Coupler Plunger Striker Arm in the ACC in the end-coupler of the third car (refer to Figure 5) had been incorrectly adjusted such that although the coupler was in its *coupled* state, the ACC remained closed providing an intermediate feed onto the door monitoring wire. Since the location of this intermediate feed was *ahead* of the point on the door monitoring wire at which the interruption had been caused by the open door (at car 6), its presence acted to maintain the voltage on the wire. The result was that the system — monitored at the active driver's cab — did not detect a voltage drop and therefore did not provide a warning indication to the driver.

[9] Metro Trains Melbourne Fleet Maintenance Instruction UFMI 020205.
[10] Referring to an automatic release otherwise provided by a programmed *door obstruction cycle*.
[11] See description at section 3.4, page 20.

The *Comeng SPOT*[12] *Cars, Vol. 2, Operating, Maintenance, & Overhaul Manual* – (Issue 5.0, May 1997) lists three events that will generate a 'flashing blue light' warning indication in the drivers' door CLOSE pushbutton.' These are:

1. Any door open (after having been closed).
2. Any equipment failure (defined by MTM as, '...failure of a part [or] component within the door monitoring circuitry, or associated with activation of that circuitry.').
3. A loss of trainline continuity (defined by MTM as meaning, '...that all cars within the train, be it 3 or 6 cars in our normal operation, have a continuous line the length of the train.').

The investigation has been informed that at the time of the occurrence no daily process existed to check the integrity of the door monitoring circuit prior to a train entering service.

The operator has advised the investigation that full consist lists of coupled EMU sets are not provided to drivers taking them into service, although decals affixed to the interior of each drivers cab list the numbers of the three cars comprising that particular EMU set. From this, drivers are aware of the car numbers and positioning of the individual vehicles in their leading EMU set but may not know the numbers and positioning of vehicles in a trailing set.

CML investigation report

In November 2008, CML (Connex Melbourne Limited - the metro rail operator at the time) undertook an investigation into the problem of Comeng trains moving away from stations with doors still open. Between 3 July and 23 September 2008, there were 17 confirmed incidents relating to Comeng trains moving with at least one passenger saloon door open.

Technical inspections revealed that in some cases ACC misalignment or incorrect wiring on an end-of-train[13] coupler nullified the system's functionality — when two 3-car sets were coupled together — of the door monitoring circuit providing warning coverage of an opened door on the trailing car-set[14]. The operator was aware of the potential of this defect to exist as a 'hidden fault', and that a driver would be unaware of it and would be provided with a door status indication confirming 'all doors closed' when, in fact, this might not be the case.

The Connex investigation report recommended:

1. *That a Failure Modes Effects and Criticality Analysis (FMECA) on the Comeng train ACC, previously completed by United Melbourne Transport Ltd., (UMTL*[15]*) be reviewed. This analysis had identified issues such as ACC misalignment and incorrect wiring that caused incorrect door operation, and proposed a maintenance process to check for these faults. The report recommended that this proposed process be implemented and that if additional failure modes be identified in the future, that the FMECA be again reviewed.*

[12] Single Person Operation of Trains.
[13] The end couplers by which two 3-car EMU sets are coupled together.
[14] See also Section 3.5, page 22.
[15] Rolling stock maintenance provider to CML.

MTM report that this recommendation was integrated by Connex into Recommendation 2 (below) for implementation. It is recorded as CLOSED (no date provided).

2. *That visual inspections and functional checks be implemented to confirm that the correct wiring configuration has been applied to Comeng train ACC switches. UMTL is understood to be developing a fleet maintenance instruction for testing and inspecting the ACC on Comeng couplers.*

MTM advise that a once-off visual inspection of all ACC switches commenced late in 2008 and concluded in June 2009. A maintenance task specifically designed to check the functionality of the ACC switch has now been developed and included as part of the rollingstock D exam (40,000 km) and E exam (500,000 or 550,000 km).

3. *That an alert be issued to train drivers informing them of the importance of depressing the door Close pushbutton on Comeng trains for at least two seconds and not departing from a station unless a steady door Close light is received. In addition, that continuation training as well as biennial driver safety audits be applied.*

MTM advise that a Safety Alert was issued on 19 December 2008. No details were provided of planned continuation training or changes to driver safety audits.

4. *That a review of the operation of the Comeng door system be undertaken to determine its suitability in the current (2008) operating conditions. This review to consider the adequacy of the 15-second traction delay as provided.*

MTM advise that this review has been completed. The 15-second traction delay has been increased to 60 seconds, and by June 2010 approximately 70 per cent of the fleet has received the modification.

5. *That a review be undertaken of the quantum of information that is requested when a public complaint is received via Metlink.*

MTM advise that this matter was closed on 5 December 2008, although no detail was provided.

6. *That a review be completed of incident response protocols to clarify issues and responsibilities around who needs to be informed of a 'train moving with door open' incident.*

MTM have advised that this matter is on-going.

The investigation obtained other information from Connex that — in response to the recommendations listed above — the rolling stock maintenance contractor, UMTL, had developed a special tool to improve the reliability of maintenance of the ACC switch. In May 2009 an Engineering Change Request in consideration of the proposed new maintenance practice being a change to a rolling stock maintenance procedure was submitted by UMTL to Connex Technical Services for endorsement. This request was forwarded by Connex to the Rail Safety Regulator (PTSV) on 7 October 2009 for approval although the Rail Safety Regulations 2006 specify that a variation of this nature[16] requires no more than *notification* to PTSV. The Rail Safety Regulations mandate a minimum 28-day period for consideration by PTSV before the change can be implemented, however this requirement is moderated by a PTSV rail safety

[16] A change made by an accredited rail operator that is within the scope of that operator's accreditation.

guideline[17] that, *"Where a proposed decision needs to be implemented urgently in the interests of safety, PTSV will not strictly enforce notification timeframes."* Subsequent to this incident the Connex Manager Rolling Stock — on 21 October 2009 — authorised the change for immediate implementation.

Post-incident testing

When the subject train set was tested post-incident by the maintenance contractor for door system functionality[18], it was found that all aspects of the door operation of car № 499M (as well as the Passenger Emergency Intercom) operated correctly and were within specification, except that a warning indication of the 'obstructed' door could not be conveyed to the driver. This latter fault was found to be the result of an incorrectly-adjusted component within the ACC on one car coupler (see section 2.2.1). Once this device was re-adjusted, the circuit — and the warning display to the driver — functioned correctly

2.2.2 Passenger Emergency Intercom, and passenger actions

The on-board surveillance recording function operates automatically and continuously without the need for driver intervention. The vision from each camera is recorded on the Digital Video Recorder module at the rate of one frame per second independently of the vision on the DDU, which displays vision in real-time. CCTV vision is available to the train driver, via the DDU, when the train is stationary or moving at up to eight km/hr. Above this speed the vision automatically cuts out unless a passenger emergency call is made.

Passenger emergency contact with the train driver is available via three PEI units situated in each car; each unit consisting of a microphone, speaker, and indicator. When a PEI call button is pressed the associated camera switches to recording at the rate of eight frames per second for a two-minute period.

From departing the Melbourne Central Station platform until stopping at the Parliament Station platform the train travelled approximately 1,117 meters. From the CCTV vision and time recorded thereon, the journey from Melbourne Central to Parliament is observed to take approximately one minute and 47 seconds.

The first passenger use of the PEI to alert the train driver was 31 seconds after departure, by which time the last car of the train would have been almost 160 metres into the tunnel. It took some time for the driver to comprehend the nature of the emergency (see section 2.1.1) and within a further 76 seconds, the train was arriving at Parliament Station.

2.3 Coroner's report

The investigation received expert advice interpreting the Coroner's post-mortem toxicology report on the victim. This advice stated that the test results provided a strong indication that the deceased had consumed alcohol in the hours prior to his death, and furthermore, that the alcohol ingestion had been quite recent at the time of death.

[17] *Accreditation – An overview of accreditation for rail operators in Victoria*, Sept 2009: Section 3.5.3, p30.
[18] *United Group Rail, Door Incident Report for 499M Incident* date 21/10/2009, location Melbourne Central.

The chemicals, diazepam (trade name Valium), nordiazepam, alprazolam and temazepam — all members of the benzodiazepine family of medications — were detected in blood samples in the deceased. Valium is metabolised to temazepam and nordiazepam. Temazepam is prescribed as a sleeping tablet in its own right, but is also a metabolic by-product of diazepam.

Alprazolam is also known by its trade name of Xanax, and is prescribed usually as an anti-anxiety medication. It is sometimes also used with other recreational drugs to offset the panic reactions of a dysphoric response to psychedelic agents such as LSD, to increase the relaxing effect of marijuana, and also to facilitate sleep when stimulant drugs are used recreationally.

The levels of diazepam, nordiazepam and temazepam are consistent with ingestion of diazepam and its progressive metabolic breakdown into the two metabolites (temazepam and nordiazepam).

3. ANALYSIS

3.1 The incident

The victim and his partner had consumed a quantity of a prescription sedative as well as alcohol throughout the day before deciding to travel by train to Frankston and return to the city. Throughout this journey the couple continued to consume alcohol. As their train was about to depart Melbourne Central Station, they decided at the last minute to alight.

As the train began to move, the victim forced the sliding saloon door open and he and his companion sought to exit. It is probable that (1) the difficulty of holding the doors apart, (2) the couple's expected state of heightened anxiety as the train started to move, (3) and the lack of coordination of both persons due to their impaired physical condition contributed to the victim stumbling at the doorway, with one leg slipping between the platform and the train, and to his companion falling over him and out onto the platform. Although apparently not physically trapped, the victim was not observed to make any meaningful attempt to extricate himself, nor did his companion — after recovering from her fall onto the platform — appear to make any attempt to raise the alarm as the train departed.

When the victim's leg slipped into the gap between the platform edge and the train, it would likely have been against the free end of the brake cylinder located below the doorway and laterally between this cylinder's air supply hose and the matching plugged attachment point. Scuff marks expected to have been made by footwear and/or clothing have 'polished' the brake cylinder surface in places consistent with the likely movements of the victim's foot and leg relative to the position of the brake cylinder.

As the train started to move, with the brake cylinder bearing against the back of his leg and/or thigh, the victim — in his seated position — was propelled along the platform. Due to the faulty monitoring circuit that would normally warn of the doors having been re-opened at some point during the departure, the train driver was unaware that anything was amiss and continued into the tunnel.

The train proceeded toward Parliament Station and was completely within the tunnel before other passengers in the car raised the alarm via the Passenger Emergency Intercom. The train driver contacted the train control centre prior to arriving at Parliament Station, and after stopping, proceeded back to meet the passengers and ascertain the reason for their emergency call. At this point, police arrived, the train was inspected, and the nature of the incident became apparent.

3.2 Use of prescription drugs

The coroner's toxicology report confirms the presence of alcohol and benzodiazepine drugs in the victim's body. The victim's companion reported that the victim had obtained the drug Xanax via prescription that day. The drug is known for its muscle relaxant properties and ability to produce euphoria, disinhibition, and short-term memory loss. It is also known to promote mental confusion, retard inhibition and impair motor functions. Use of the drug in combination with alcohol can result in severe sedation, behavioural change, and intoxication.

The victim and his companion had each consumed a quantity of this sedative drug in combination with alcohol. The observed behaviour of both the victim and his

companion throughout this occurrence displays a degraded decision-making ability and is consistent with the above medical side effects[19].

3.3 Passenger Emergency Intercom

The driver reported that he received a PEI call when the train was about half-way between the Melbourne Central and Parliament stations. The first passenger use of the PEI to alert the train driver was 31 seconds after departure, by which time the last car of the train would have been almost 160 metres into the tunnel. It took some time for the driver to be able to comprehend the nature of the emergency due to the repeated pressing by passengers of the PEI call button and the consequent incessant sounding of the alarm tone in the driver's cab.

When the driver responded by pressing the intercom REPLY button, CCTV vision from car № 499M — the car from which the PEI call had originated — was displayed on the DDU. This was the rear-most car of the train, however the driver stated that he was unaware of the actual location of car 499M within the train make-up. The identifying numbers of the three vehicles that comprise a train-set are provided in the driver's cabin at each end of that set, however a driver might be unaware of which vehicles comprise the second set to which he is attached.

The driver's lack of awareness of the actual location of car 499M within the train did not materially affect the outcome, since the train was well into the tunnel by the time he understood the nature of the emergency. However, in the process of departing Melbourne Central the victim had been dragged almost the entire length of the platform and the time to travel this distance would have afforded the driver the opportunity to stop the train before that car entered the tunnel had he received timely warning of the incident (via a door alarm) and known immediately that it involved the last car. Connex document MO 56 PASSENGER INFORMATION DISPLAY SYSTEM (PIDS) and CCTV/PASSENGER DURESS SYSTEM (Document No. 13 WI MO 56, Rev. 01, 6 August 2003) states, under clause 3.11.2 [regarding Emergency Calls received by a train driver], *"...due consideration must at all times be given to the train's location, prior to responding to* [an emergency] *call. ...It will be at the discretion of the train driver as to whether it may be necessary to stop the train immediately."* From this, it is clear that drivers who become aware of such a situation are expected to assess it (if practicable) and are at liberty to stop the train immediately at their discretion.

3.4 Trainlined door monitoring

Subsequent testing of the train indicated that all aspects of the door operation of car № 499M (as well as the Passenger Emergency Intercom) operated correctly except that the *"...*[coupler] *plunger striker arm on 365M* [the 3rd car] *was found to be adjusted incorrectly and that this prevented an obstructed door on car 499M* [the 6th car] *from being indicated* [to the driver]*."*

An MTM investigation report of this occurrence (MTM Ref. № 776) refers to the faulty ACC component causing the door monitoring circuit to be 'incomplete', thus preventing the train driver receiving a warning that a carriage door had been forced open. The report also states that this faulty switch, *"...failed to indicate to the train driver the loss of trainline continuity through the six carriages."*

[19] http://www.drugs.com/alprazolam.html.

The MTM definition of the meaning of the term 'trainline' — provided to the investigation — is that it refers to all cars within a train having a *"...continuous line* [for] *the length of the train..."* (refer to page 15). This is an imprecise declaration, as the meaning of 'continuous line' is vague. One credible industry source[20] defines a [non-pneumatic] trainline as *"...an electrical cable system that allows electrical signals to be sent over the entire length of the train. Types include power, control, communication and data, often with more than one function contained within the same cable. The trainline may connect to equipment in each vehicle, or may simply pass through, providing a signal path between vehicles on opposite ends of that vehicle."*

Most within the industry will accept that 'trainlining' a circuit (be it electrical or pneumatic) is the physical process of carrying it across from one detachable vehicle to another and this is usually achieved as part of the process of coupling the separate vehicles together. To be effective (that is to say, 'useable'), such a circuit must be continuous from the front to the rear of a train. These precepts are adequately articulated in the APTA definition above.

Electric Multiple Unit sets used on the Melbourne metro rail network comprise of three semi-permanently coupled cars and in this configuration can be considered as a single entity on which end-to-end circuits are carried between the constituent vehicles by semi-permanent connections that are seldom disturbed. When two EMU's are coupled together the electrical and pneumatic circuits necessary to operate the trailing EMU and to provide control feedback (in other words, the circuits requiring being 'trainlined') are automatically established via connections made within the Multi-Function Coupler. These unions are made and broken with relative frequency as EMU sets are separated and re-connected in the normal course of operations, and are thus subject to wear-and-tear and potential degradation at any time. In the context of this incident, this system defect is not one that is likely to occur randomly during over-the-road train operations.

Referring to the door monitoring circuit, Connex documentation provided to the investigation states that*, "…a loss of trainline continuity is indicated to the driver by flashing the blue light in the Driver's Door Close pushbutton…"* The test report referred to above stated that the incorrect adjustment of the Coupler Plunger Striker Arm (as part of the Auto Coupler Contact mechanism) prevented the door that was obstructed on car 499M being indicated on the driver's console. This is so, although the means by which this fault occurs is not made clear. There is comment (quoted above) regarding a 'loss of trainline continuity' but this is also misleading. In fact there was no issue with the *trainline* continuity of the door monitoring wire, which was established at the connection between the two 3-car sets (the coupler) and there has been no suggestion that this connection was compromised.

The door monitoring system functions such that a signal wire, energised at 110 VDC from a point at the extreme end of the train, runs the length of the train. This system indicates the presence of a problem *by exception*; so long as the 110 volt signal is present, the system considers the door condition as *'status ok'*. If the voltage drops (or is absent), the system displays a warning indication to the driver. If a saloon door is forced open after being closed, an electronic control device on that car will disrupt the wire such that the voltage signal is no longer detected and the driver's warning indication is generated. This is indeed an interruption to the continuity of the door monitoring circuit (that is the design intention of this warning system) but not to its *trainlined* continuity.

[20] American Public Transportation Association document APTA RP-E-017-99 *Recommended Practice for 27-Point Control and Communication Trainlines for Locomotives and Locomotive-Hauled Equipment* (APTA Commuter Rail Executive Committee, reaffirmed June 15, 2006).

In this incident, the faulty ACC permitted a second (undesirable) 110 VDC feed to the door monitoring wire. Since this feed was between the disruption to the wire caused by the opened door and the point of detection at the front of the train, it acted to maintain the voltage on the wire — in effect masking the fact that a door had been opened.

The investigation sought information as to whether a daily process existed to check for door monitoring circuit integrity prior to a train entering service, or at some point during a daily cycle of service. No response was provided to this query and the investigation is left to assume that no such daily process existed. Neither is there evidence that the operator has instituted such a process since the incident. The check that has now been included in 40,000 and 500,000 km rolling stock exams hardly suffices to confirm the daily integrity of this warning circuit. There is no means by which a train driver can be aware of whether or not any ACC (there are four on a 6-car train) is in any way faulty. Such a condition is therefore, a 'hidden' fault, albeit a *known* hidden fault.

3.5 Notification of change to maintenance procedure

In November 2008, CML completed an investigation into the problem of Comeng trains moving away from stations with doors still open. This investigation revealed that, *"...some incidences have identified ACC switch misalignment or incorrect wiring on one of the couplers on the centre* [Motor] *cars of a six-car consist. The effect of this is that the door close circuit only* [monitors] *the first three cars..."* (this is explained above). The investigation report recommended certain improvements to maintenance processes.

The Rail Safety Regulations 2006 specify that a process variation of this nature requires that notification of change be submitted to the Rail Safety Regulator (PTSV). Such proposed change — where it remains within the scope and nature of the operator's accreditation — does not require the approval of the Regulator and the requirement for notification is not designed to complicate the process. *"Notification of these changes is not intended to be a holding point in a project nor a point where the operator must await approval or permission from the Regulator to continue the implementation of the change."*[21] On the day of this occurrence, the notification had been with the Regulator for 13 days out of that 28-day period. Although the notification had been presented by Connex as an Engineering Change Request (EC № F873) for Regulatory approval, this proposal required no such 'approval'. The proposed variation to the maintenance procedure was not subject to an implementation schedule and could have been executed without delay. The operator (MTM) immediately implemented the change following the occurrence.

[21] *Notification of Change Guideline for the Australian Rail Industry* – Rail Safety Regulators' Panel National Guidance, ISBN: 978-0-9806753-6-8.

4. CONCLUSIONS

4.1 Findings

1. The victim slipped while attempted to alight from the train after it had started to move. His leg was caught between the train and the platform and he was unable to extricate himself.

2. The victim consumed alcohol and a sedative drug both prior to and during travel on public transport.

3. Due to a faulty component preventing the correct operation of a safety circuit, the train driver was unaware of a door having been forced open.

4. Although the existence of this fault condition on any train would not be evident to any casual observation, the train operator was aware that these trains were susceptible to developing this defect. There was no daily pre-service procedure to check for such a fault condition.

5. Other passengers attempted to raise the alarm using an emergency communication system; however the driver was initially unable to communicate effectively with these passengers due to their continual pressing of the alarm button.

4.2 Contributing factors

1. The victim was physically affected and impaired by drug and alcohol consumption.

2. The victim forced open a powered door and attempted to alight from the moving train.

3. The door monitoring system on the train was faulty. As a result, the driver did not receive a warning that a door had been opened.

4. Proposals resulting from a previous internal investigation and intended to rectify systemic maintenance deficiencies and ensure the integrity of Comeng train door monitoring systems had not been implemented.

5. SAFETY ACTIONS

5.1 Safety Actions taken since the event

UMTL[22] has developed an approved maintenance process and a specialised adjustment tool that will facilitate correct adjustment of the Automatic Coupler Contact switch on the Comeng fleet. The contractor has included the new process in their programmed maintenance plan and has implemented the process.

5.2 Recommended Safety Actions

Issue 1

The driver was unable to determine the position within the train of the car from which the Passenger Emergency Intercom call had originated. This information could potentially prove valuable in assisting with decision-making during a future safety incident.

RSA 2009019

That MTM provide train drivers with a consist list for trains they are to operate, or that drivers be required to otherwise obtain the details of their own consist prior to taking a train into traffic, or prior to departure.

Issue 2

Repeated pressing of the PEI button by passengers resulted in incessant sounding of the alarm in the driver's cab. This hindered the driver in communicating with the distressed passenger(s) and in understanding the nature of the emergency. Such confusion could delay a critical safety response, and this might prove crucial in a future incident.

RSA 2009020

That MTM review the PEI system on Comeng trains and consider modifications to prevent repeated and successive calls being made such as to prevent timely communication with the driver.

Issue 3

The door monitoring system on a Comeng EMU is supposed to provide a warning to the driver if a saloon door is opened after the door CLOSE button has been pressed but in this instance it did not because it had been compromised by a component failure. A fault in the train's coupler caused an incorrect electrical feed to the door warning system, and this provided the driver with a door status indication confirming that all doors were closed when, in fact, one door had been forced open on the rear three-car set. The system was prevented from functioning when it might have prevented a

[22] United Melbourne Transport Ltd. - now a part of Metro Trains Melbourne and continuing to provide the rolling stock maintenance function.

fatality. This is a critical safety protection system that ought to have been confirmed prior to the train taking up its daily service, however the operator has no procedure to regularly check the integrity and operation of this safety warning circuit.

RSA 2009021

That MTM design and implement a process to test for the correct operation of the door monitoring circuit of all trains prior to each entry into service.

Issue 4

The operator had previously proposed a minor modification to a maintenance process with the potential to improve the functional reliability of the door monitoring circuit on Comeng trains. The change was required to be notified to the Rail Safety Regulator and could have been implemented without delay, however the operator applied for 'approval' to implement the change, expecting that they would have to wait for the expiration of a 28-day period while the application was considered. The incident occurred during that 28-day period.

RSA 2009022

That MTM familiarise themselves with the regulatory requirements associated with any intention to vary maintenance (and other) process or frequency.