OTSI Office of Transport Safety Investigations

BUS SAFETY INVESTIGATION REPORT

UNMANNED/UNCONTROLLED MOVEMENT RESULTING IN DRIVER FATALITY HURSTVILLE 3 FEBRUARY 2016

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THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of incidents and accidents in the rail, bus and ferry industries. OTSI investigations are independent of regulatory, operator or other external entities.

Established on 1 January 2004 by the Transport Administration Act 1988 (NSW), and confirmed by amending legislation as an independent statutory office on 1 July 2005, OTSI is responsible for determining the contributing factors of incidents and accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence. Importantly, OTSI does not confine itself to the consideration of just those matters that contributed to a particular accident; it also seeks to identify any transport safety matters which, if left unaddressed, might contribute to other accidents.

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It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI's investigation reports strive to reflect a balanced approach to the investigation, in a manner that properly explains what happened, and why, in a fair and unbiased manner.

Once OTSI has completed an investigation, its report is provided to the NSW Minister for Transport and Infrastructure for tabling in Parliament. The Minister is required to table the report in both Houses of the NSW Parliament within seven days of receiving it. Following tabling, the report is published on OTSI's website at www.otsi.nsw.gov.au.

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EXECUTIVE SUMMARY

On 3 February 2016, a Punchbowl Bus Company (PBC) bus driver parked a bus on a downward incline on Park Road Hurstville, approximately 13 metres behind another PBC bus. The driver alighted from the bus and walked to the driver's side window. The driver closed the bus entry door by operating the door close control button through the driver's side window contrary to PBC operating procedures. The driver then walked in front of the bus and towards the other PBC bus. The driver had not applied the bus park brake. Moments later, the bus rolled forward and the driver attempted to impede its movement by pushing against the front of the bus. The bus impacted the rear of the other parked bus and the driver received fatal injuries when captured between the colliding vehicles.

The investigation determined the accident was a result of the driver not applying the park brake and not following the PBC operating procedures.

Technical Specification 146 (TS146) was developed in 1997 by the NSW Road and Traffic Authority (RTA) to address the risk of passengers being trapped by a closing bus door on a departing bus. The controls introduce a new risk scenario that provided the drivers with an opportunity to manipulate the door interlocking button control through the driver's side window.

As a result of the investigation, OTSI recommended that:

1. Roads and Maritime Services (RMS) amend TS146 to incorporate items 1,2,3,4 and 6 within the Bus Industry Confederation Door Advisory (2012) document.
2. Transport for New South Wales (TfNSW) work in collaboration with RMS and assist in the amendment of TS146.
3. There should be an additional risk control in the form of a secondary technical system to prevent bus rollaway by providing the driver a warning regarding the off park brake position. This additional control should be included in the amended TS146.

Full details of the Findings and Recommendations of this bus safety investigation are contained in Part 4 Findings and Part 5 Recommendations respectively.

PART 1 FACTUAL INFORMATION

Introduction

1.1 At 1622 on 3 February 2016, a PBC bus driver parked a bus on a downward incline on Park Road Hurstville, approximately 13 metres behind another PBC bus. The driver alighted from the bus and walked to the driver's side window. The driver closed the bus entry door by operating the door close control button through the driver's side window contrary to PBC operating procedures. The driver then walked in front of the bus and towards the other PBC bus. The driver had not applied the bus park brake. Moments later, the bus rolled forward and the driver attempted to impede its movement by pushing against the front of the bus. The bus impacted the rear of the other parked bus and the driver received fatal injuries when captured between the colliding vehicles.

Location

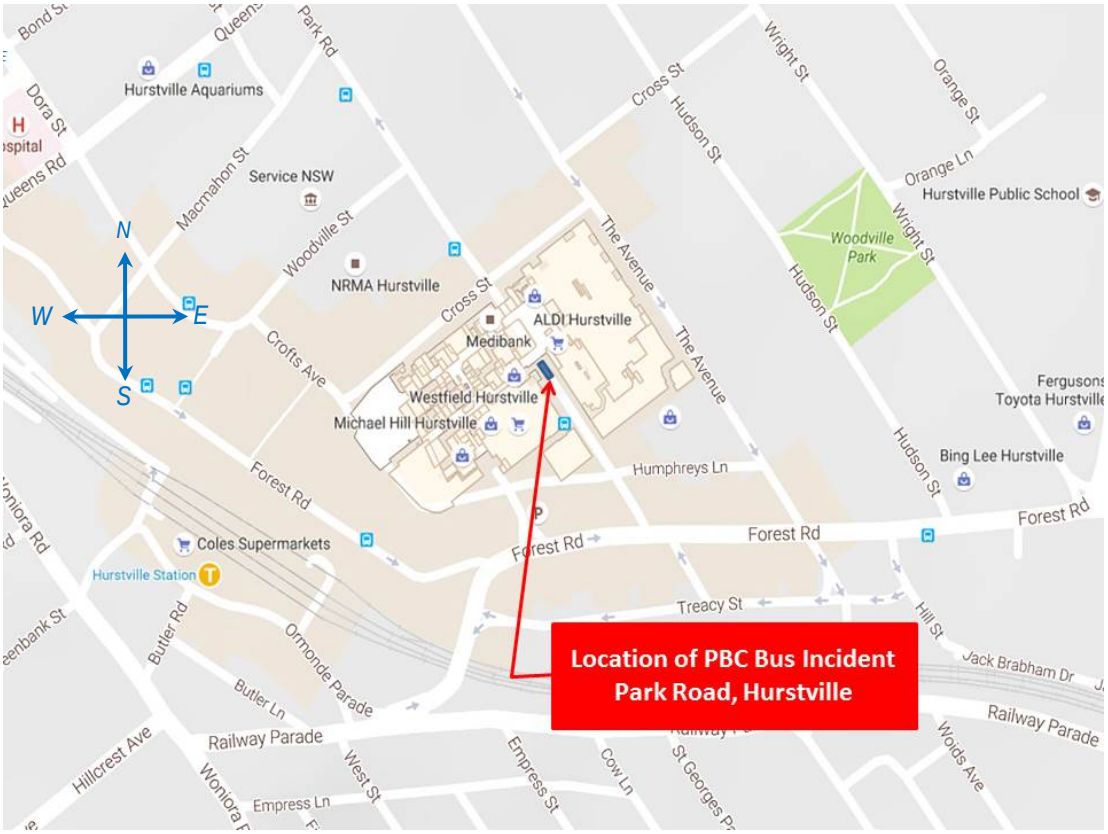


Figure 1: Location of the bus incident on Park Road, Hurstville

1.2 The incident occurred outside the Westfield shopping complex on Park Road, Hurstville (see Figure 1). The driver stopped outside the complex to have a scheduled recess break, while waiting for the next trip.

Environmental Information

1.3 The afternoon of 3 February 2016 was dry and sunny. A temperature of 28.5°C was recorded by the Bureau of Meteorology at 1500 at Canterbury, a suburb of Sydney approximately 12 km to the north-west of Hurstville. It was determined that the environmental conditions played no part in the incident.

Bus Information

1.4 The bus was a Scania 2003 L94 model. It had one door opening, located at the front near side[2] of the bus (see Photograph 1). The bus had a Tare weight of 11220 kg and a seating capacity of 47 passengers with a standing capacity of 34 passengers. The bus's total Gross Vehicle Mass (GVM) when loaded is 19100 kg. The bus was empty at the time of the accident.

Photograph 1: Scania 2003 L94 bus, one door on near side

[2] The left side when looking forward in the bus is the near side. The right side is the off side/driver's side.

1.5 The bus was a Scania chassis with a Custom Coaches (Sydney) built body. The bus was fitted with an SMC Pneumatics (Australia) Pty Ltd door interlock mechanism.

1.6 The door interlock design was compliant to TS146 (see Appendix 1).

1.7 The bus entered service with PBC in April 2003 and operated from the PBC Riverwood Depot.

1.8 The bus was used for general passenger and charter services.

1.9 The bus service history showed that it was regularly serviced and maintained. Its last 'general' service took place on 7 January 2016 with the 'annual door system service' conducted in 2015.

Punchbowl Bus Company

1.10 PBC is a family owned business and had been operating bus services in the southwest of Sydney since 1947.

1.11 The company currently has 75 buses within the Sydney metropolitan area. The age of the bus fleet extends from a 1990 Scania model to the latest, a 2015 Scania model. The average age of the fleet is approximately 13 years old.

Development Of The Accident

1.12 The bus driver's shift started at 1025 on 3 February 2016. At 1414 the driver arrived at Hurstville for a schedule recess break until 1513. The driver then departed Hurstville at 1514 and travelled to Lugarno. At 1555 the driver departed Lugarno and travelled back to Hurstville, arriving there at 1622 for a recess break before the driver was due to depart Hurstville at 1646.

1.13 The Park Road entrance into the Westfield shopping complex bus stop area had been reconfigured. New curb and gutter had been installed, however traffic signs related to the previous entrance configuration had not been removed, resulting in bus drivers continuing to abide by the obsolete signage. Typically a bus is parked within half a metre of other buses unless otherwise specified. Bus drivers, however, were concerned they would receive a

parking infringement if they did not comply with the still posted, but obsolete signage, even though the configuration had changed.

1.14 At 1622 the driver arrived at the bus stop and brought the bus to a halt adjacent to a ‘no stopping sign’. Due to the placement of the signs, the driver stopped the bus some 13 metres away from the rear of the other PBC bus. The driver had operated the foot brake to stop the bus and then opened the door relying on the door interlocking to keep the bus stationary. The bus was equipped with a door interlock mechanism that interlocked the rear axle brakes and the door operation. The interlocking prevents the bus from moving while the door is in an open position while passengers are embarking or disembarking from the bus.

The Accident

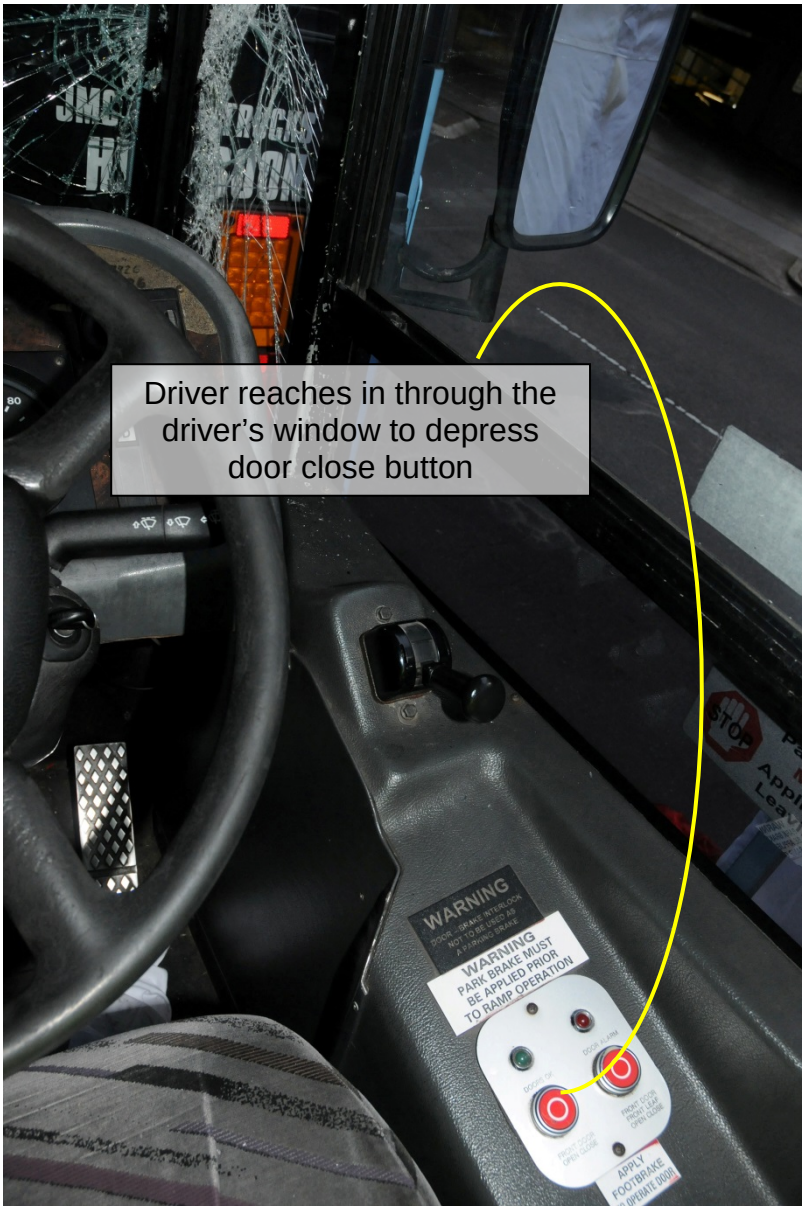
1.15 At approximately 1624 the driver disembarked the bus. The park brake had not been applied to the vehicle.

1.16 The driver exited the vehicle and operated a door close push button (see photograph 2) through the driver’s side window. The driver then closed the window to secure the vehicle. The driver then began to walk towards the other PBC bus driver.

1.17 As the driver walked towards the other PBC bus, the vehicle began to roll forward. This action was a result of the door closure and the door interlocking mechanism releasing the brakes.

1.18 As the bus rolled forward the driver attempted to prevent the bus movement by pushing on the front driver’s side of the vehicle. The other PBC bus driver observing the incident yelled a warning to driver. The bus then collided with the rear of the other bus. The driver received fatal injuries after being pinned between the two colliding buses.

1.19 The emergency services were called and attended the accident site.



Photograph 2: Park Brake Buttons located in the L94 Scania

Development of Technical Specification 146

1.20 On 17 July 1997 as a result of two fatal bus accidents, the then Roads and Traffic Authority of NSW (now RMS), following consultation with the bus industry, published TS146 (see appendix 1). The intent of the document was to specify a door safety standard to prevent passengers from being trapped in a bus door and dragged by the moving bus. The specification provides details of the door interlock mechanism and its operations.

1.21 As a result of the introduction of the door safety system, another safety issue, unrecognised at the time, began to evolve. Bus companies were finding an

increase in the number of bus rollaways. It was discovered that bus drivers were stopping their vehicles with the foot brake and using the door interlock system to hold the vehicle stationary, including those on significant downward gradients. In the event of the driver leaving the driver's seat and inadvertently forgetting to apply the park brake, the vehicle's door interlock system would hold the vehicle stationary providing the door remained open. However, should the driver then close the door through the driver's window, the door closure would cause the door's interlock mechanism to disengage the holding feature upon the brakes. As a result of the park brake not being applied, the bus would begin to move.

1.22 Most buses built after 2005 are equipped with a programmable logic control system (PLC) or a Thoreb system[3]. In conjunction with the chassis, the door system and signals from either a brake signal and or accerlerator signal these systems can determine if a driver is in the proximity of the controls. Should the driver forget to apply the park brake and circumvent the procedures by accessing the door closing operations buttons through the driver's window, the system will not allow the door to close and the vehicle will be held stationary by the interlock system.

1.23 TS146 was to specify a door safety system to minimise the likelihood of a passenger being trapped in a bus door. The document did not specify that the vehicle brakes must hold a bus stationary while the door interlocking system was engaged.

1.24 OTSI identified there were organisations that adhered to the exact defined specifications of TS146 (which did not stipulate that the brakes must hold the vehicle) and so, did not have the bus set up to hold the brakes on while the door of the bus is opened.

[3] A PLC and Thoreb system is a specialised computer used to control processes throughout a vehicle. It therefore shares common terms with typical computer language such as a central processing unit, memory, software and communications. Unlike a personal computer though, the PLC and Thoreb systems are designed to survive in a rugged automotive atmosphere and to be very flexible in how it interfaces with inputs and outputs to the various components of a vehicle.

PART 2 ANALYSIS

Introduction

2.1 The investigation focussed principally on the factors that contributed to the unintentional movement of the bus. This included the driver's actions; the design and purpose of the door-brake interlock mechanism; and data from similar incidents and accidents in NSW, Victoria, and South Australia.

Previous Bus Incidents/Accidents

2.2 A review of available data found that in NSW since February 2010 there had been 56 reported bus rollaway events, none of which had resulted in fatalities. OTSI's incident database system had recorded 74 events since 2004.

2.3 In June of 2000, a STA bus collided with another bus on Young Street at Circular Quay. Witness statements confirmed that the driver, after parking the bus, had alighted and left the front doors open. The driver was then observed reaching through the driver's side window and the bus doors closed. The driver then walked in front of the bus as it began to roll forward on the downward gradient. The driver sustained fatal injuries as a result of being captured between two colliding buses.

2.4 The vehicle on this occasion was a 1997 Scania 113CRL bus. The bus was fitted with an operating door interlock system.

2.5 In Victoria there had been 42 rollaway type incidents reported since 2000.

2.6 In South Australia the state government had also recorded several rollaway incidents since 2000. In 2005, a bus driver was killed in a similar circumstance as to the 3 February 2016 fatality at Hurstville. One week after the South Australian fatality, another bus driver sustained serious injuries in similar circumstances. As a result of these accidents in South Australia, the Adelaide Metro introduced additional technical and operational risk controls to minimise bus rollaways.

2.7 Adelaide Metro installed additional devices to protect the bus from rolling away in the event a driver alights from the bus without applying the park brake.

Examination of Other NSW Incidents with Similar Circumstances

2.8 On 17 February 2016, RMS released *Information Alert 1/16* entitled *Runaway Buses Information Procedure* (see Appendix 2). On 1 March 2016, a bus on the South Coast travelled unmanned and uncontrolled for a distance of approximately 20 metres. The incident occurred after the bus driver was having difficulties with the door mechanism. The company sent a mechanic to the site to rectify the fault and, while working on the vehicle, the mechanic closed the bus door through the driver's window of the bus. The doors closed and, seconds later, the bus rolled away and came to rest against an embankment.

2.9 There were no passengers onboard at the time of the incident. This event demonstrated the risk associated with using the door interlocking feature to hold the vehicle at a stand without applying the park brake.

2.10 On 14 March 2016, OTSI was notified of a similar rollaway bus incident at Mittagong NSW. The driver had stopped a 2005 Mercedes 0500 series coach roadside and the passengers alighted from the bus. The driver also alighted and then closed the door by actuating the external emergency door release button adjacent to the front door. The driver walked away not realising the park brake had not been applied. The vehicle then rolled into the rear of another coach.

2.11 OTSI contacted Mercedes Australia and found that the 2005 Mercedes 0500 series coach had two specifications of door interlocking. One series of this model would not allow the door to close until the system received an input signal from the brake unit to signify that the driver was at the bus controls. Therefore, with the door in the open position, the brakes cannot be released.

2.12 The other series of the 2005 Mercedes 0500 model, in use at the Mittagong incident, did not require a brake input to the door interlocking system and the moment the driver closed the door the bus could rollaway and did so.

Compliance with Standards

2.13 TS146 specifies that the door safety system shall detect a 20 mm diameter rod (similar to the thickness of a child's wrist). Once such an intrusion is

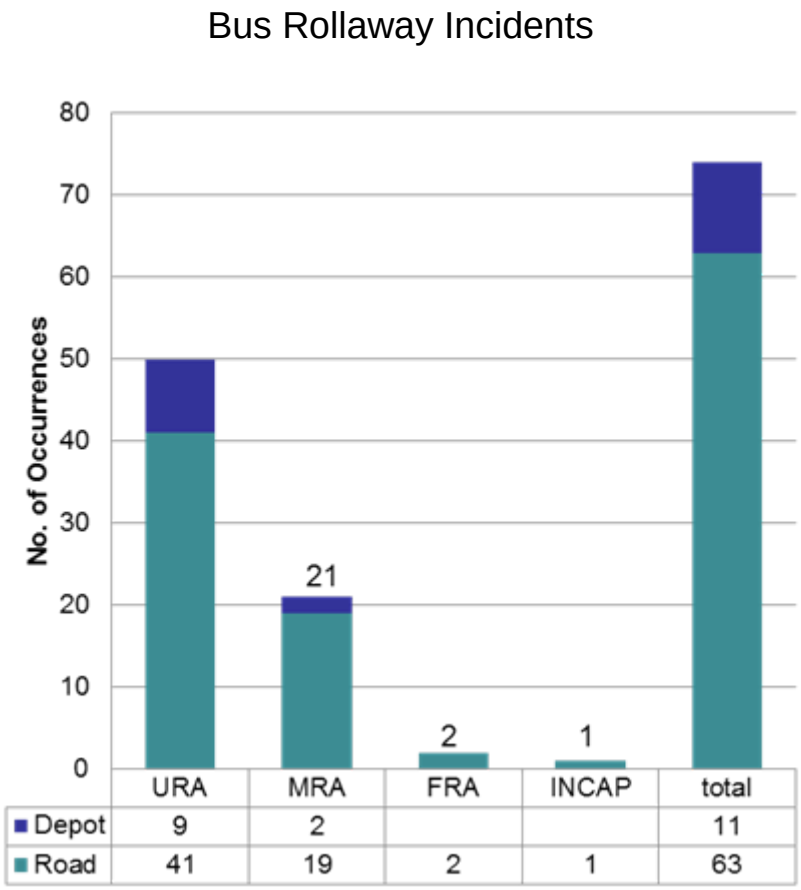
detected the vehicle should become immobilised, and an audible or visual alarm shall be given to alert the driver that an interlock function has operated.

2.14 TS146 did not stipulate that a secondary failsafe safety measure be included, such as a brake unit input. OTSI met with several bus industry experts about this matter and found the consensus was that all buses should be fitted with the secondary safety measure. When TS146 was introduced, the new risks were not foreseen. OTSI has a view there is scope to enhance TS146 further to include systems that will prevent bus rollaway and provide driver warning regarding the park brake position.

2.15 The majority of buses manufactured since 2005 are equipped with some form of secondary safety measures built into the bus management system.

2.16 On 22 April 2016, OTSI met with TfNSW, RMS and bus industry experts to develop strategies to mitigate current trends in bus rollaways. The consensus of the meeting was that there was room for further enhancement of the current systems in place. OTSI displayed a graph depicting the 74 known reported rollaways since 2004 captured in OTSI's incident database *(*see Figure 2). The graph depicts that out of 74 rollaway events, 63 of these events occurred out in the public domain.

2.17 OTSI further detailed the other known reported incidents in Victoria and South Australia, and that TS146 had created an environment for an increase in the likelihood of further rollaway events.



Key:
URA – Un-manned rollaway (no driver on-board)
MRA – Manned rollaway (driver on-board)
FRA – Fatality due to rollaway
INCAP – Driver incapacitation

Figure 2: OTSI graph depicting the 74 known reported rollaway incidents

Re-enactment of the Hurstville Incident

2.18 On 16 February 2016, NSW Police, accompanied by OTSI and PBC, re-enacted the Hurstville incident at the accident location to determine the collision parameters. A similar bus was utilised for the re-enactment.

2.19 The intent of the re-enactment was to understand the actions of the driver associated with the movement of the bus. Information from witness reports was also considered. OTSI was able to determine the actions of the driver and the circumstances prevailing at the time of the accident. The driver:

- stopped the vehicle on the grade with the foot brake just short of the no standing sign,

- opened front door of the vehicle,
- alighted the vehicle without applying the park brake,
- walked in front of the vehicle to the driver side window,
- reached in and operated the door close button,
- closed the driver's window, and
- walked in front of the vehicle.

NSW Police used a certified 'Kustom ProLaser III LIDAR' to accurately measure the speed of the bus at the impact point. The test determined the bus had travelled approximately 13 metres and had reached a final speed of 15 km/h at the impact point.

Bus Drivers Not To Engage with Rollaway Buses

2.20 In reviewing the circumstances leading up to the rollaway at Hurstville, OTSI determined it would be significantly safer for the drivers to stand clear and alert persons nearby the area of the impending danger of a rollaway bus. Had the driver of the Hurstville accident stood to the side and alerted anyone in area of the impending danger, the vehicle would have collided with the rear of the other PBC bus with no injuries to the driver. Throughout the investigation and in looking at many of the fatalities that arose from rollaway buses, it was determined that there are predominately three types of categories in relation to driver fatalities;

- Driver becoming caught between two vehicles (whether they inadvertently walked in front of the two vehicles and/or tried to impede the vehicle's forward motion). e.g. State Transit driver caught between vehicles at Circular Quay, Sydney, 2000: Metro driver caught between vehicles, Adelaide, 2005: PBC driver caught between vehicles, Hurstville, Sydney, 2016.
- Driver trying to open the front door to regain control of the vehicle e.g. Bus driver, Michigan, USA. 2013.
- Driver attempting to operate the controls of the vehicle through the driver's window e.g.: Miami USA, 2014.

Bus Brake Operation Signage and Compliance

2.21 OTSI looked at the signage displayed on the bus controls of the door. Additionally, procedures and training documentation were reviewed to understand what systems were in place to mitigate the risk of rollaway bus events.

2.22 Three warning signs (stickers) were displayed in close proximity to the door push-button controller (see photograph 3). The signs read the following:

- WARNING Door- Brake interlock not to be used as a parking brake.
- WARNING PARK BRAKE MUST BE APPLIED PRIOR TO RAMP OPERATION, and
- APPLY FOOTBRAKE TO OPERATE DOOR.

Photograph 3: Photograph of MO7926 door controls and warning signs

2.23 A warning sign was also displayed on the interior of the driver's side window and adjacent to the door push-button controller (see Photograph 4). The sign was to reiterate the message of ensuring the park brake is applied before leaving the driver's seat. The sign in large bold letters read as:

- PARKING BRAKE MUST BE APPLIED BEFORE LEAVING SEAT.

Photograph 4: Scania 2003 L94 warning sign inside of driver's cabin on driver's window

2.24 An additional park brake warning sign (sticker) was also displayed on the exterior of the lower driver's cab window (see photograph 5). This type of warning signage had been installed on most public buses in NSW as a result of similar incidents.

Photograph 5: Outside signage of driver's lower window, of the Scania 2003 L94 bus

Roadside Signage

2.25 Previously on Park Road, Hurstville, a side entrance was positioned from Park Road and into the Hurstville Westfield shopping complex. The purpose of the side entrance was for patrons and staff vehicles to enter the complex for parking. There was a no-parking zone directly opposite the entrance to prevent vehicles blocking access. Approximately six months before the incident, the side entrance was closed and the obsolete signage was not removed.

2.26 Due to the position of the obsolete signage, the driver of the PBC bus stopped approximately thirteen metres from the rear of the other PBC bus, as the driver was abiding to the posted signage. Typically a bus is parked within half a metre of other buses unless otherwise specified.

2.27 OTSI contacted the Hurstville City Council to establish why the obsolete signage had not been removed. The Council responded that the issue was a matter for the Hurstville Traffic Advisory Committee (TAC).

2.28 On 3 March 2016, the TAC recommended for Council to remove the 'No Parking' signs and re-categorise as a bus zone.

2.29 On 16 March 2016, the Council endorsed the TACs recommendations.

Bus and Coach Industry Door Safety Advisory Document

2.30 The Bus Industry Confederation (BIC) after consultation with a number of bus and coach industry members published a Door Safety Advisory in 2012 which outlined seven recommendations to minimise risk of bus rollaways. The seven items of interest were listed as follows:

1) *"To reduce the chances of vehicle runaway once activated the Bus Stop Brake shall only release after the activation of the throttle or foot brake. Alternatively, the door close button shall not operate unless the handbrake is applied or the foot brake is depressed.*
2) *For doors that can be closed via an external power close button, then these external buttons shall only operate if the handbrake is applied.*
3) *For doors that have an external air dump button which allow the doors to go limp, the Bus Stop Brake shall not release unless the handbrake is applied even if the doors are manually pushed shut.*

4) Vehicles should also be fitted with alarms that activate if the driver turns the vehicle off and does not apply the handbrake.

5) Some modern chassis will not allow the vehicle to be shut down unless the handbrake is applied. The use of these systems is encouraged.

6) Other warning systems such as alarms on the driver's cabin door or sensors that detect if the driver has left the cabin without applying the handbrake are also encouraged.

7) A handbrake warning system should still operate even if the driver activates any battery isolation switch accessible within the driver's cabin."

2.31 BIC further has advised OTSI that

"'*The items 1 to 7 above can, or should, be fitted to all newer buses and for older buses that do meet RTA 146, then at least items 6 and 7 should be used.*

The other issue is that RTA 146 allows the Bus Stop Brake to only be active if an obstruction is detected and although it is not common, some buses do use this configuration (noting that most RTA 146 compliant buses in NSW have the Bus Stop Brake Apply whenever the door is open).

In Victoria where the use of a Bus Stop Brake on the front door is not required in any form, they do have rollaways with the front door open, so another issue may be to make it mandatory that the Bus Stop Brake must apply when any door is open".

2.32 OTSI viewed these recommendations as robust. In a review of the NSW bus data relating to bus rollaways, many of the 74 incidents may have been averted if the recommendations had been in place.

South Australia Adelaide Metro

2.33 Adelaide Metro operates similar buses to the PBC bus involved in the Hurstville incident. Adelaide Metro are currently retro-fitting their Scania fleet with a three-way valve and a logic control system to prevent rollaway buses.

2.34 To prevent rollaway buses, all buses were fitted with an air Broms[4] valve to cater for the air build up from a low air situation. The control logic in the bus was changed so that unless there was a signal from either the foot or park

[4] Is a safety feature that applies the brake, that when the air pressure is too low the Broms brake, blocks, and holds the brakes on. The brakes can only then be released once the predetermined air pressure setting has been obtained.in the brake system.

brake the doors will not close. This prevents a person from reaching through the window to close the doors.

2.35 Further, to prevent rollaway buses when they are powered down and no power is present to operate the control logic, a three-way valve was installed on the brake line to the maxi brake. When there is no power the valve shuts off and prevents air supply to the maxi brake, thus applying the spring brake.

2.36 An additional issue was identified following a level crossing incident involving a MAN bus where the doors of the bus were forced opened by some of the passengers which engaged the interlock brake on the bus. As a result the bus was immobilised and was struck by a train, as the driver was not able to shut the doors. As a result of this accident, the interlock design was modified to include a momentary push button override to tenable the vehicle to be moved at limited speed in emergency situations.

2.37 OTSI inspected two buses. The first was an older style L94 bus similar to the bus involved in the Hurstville accident which had been retro-fitted with a three-way valve. The second vehicle was a new Scania bus, in which Scania, in conjunction with the operator's pre-purchase agreements, had developed and installed a dedicated three-way valve. Both buses when tested had operated in the exact same manner.

2.38 Both buses were trialled to simulate a rollaway condition. The test applied various known rollaway situations and neither of the vehicles rolled away with the park brake off.

2.39 Additionally, the test included a vehicle during a cold start up, with building air pressure (low or no air pressure) and the park brake off. The test proved that even during a cold start up, with no air in the air reservoir system, the vehicle would not rollaway. This was because Broms valve prevented the supply of air to the brake system until the air pressure had reached operating pressure and the valve was reset by the driver. The vehicle logic control system required that it had to have attained a predetermined pressure setting within the air brakes system, as well as a brake input signal from the foot brake to indicate that a driver was at the controls of the vehicle.

2.40 As a result of the retro-fit, SA Adelaide Metro had the bus design independently assessed which verified the interlocking provided a high level of confidence in the effectiveness of system. All Scania buses within the current fleet were undergoing retrofitting with either three-way valves, and/or reprogramming the logic system on relevant buses.

PART 3 REMEDIAL ACTIONS SINCE THE ACCIDENT

Punchbowl Bus Company

3.1 The accident in February 2016 highlighted areas for potential improvement within TS146 which would mitigate the risk of rollaway. Throughout this investigation and in conjunction with OTSI and bus industry experts, PBC investigated which buses were susceptible to a rollaway condition. PBC found that buses manufactured between 1997 and 2006 did not have a secondary safety mechanism to mitigate the risk of rollaway if drivers access the door controls through the driver's side window.

3.2 TS146 was introduced in 1997 and hence, buses manufactured before this date do not have a door interlocking system incorporated into their design. These buses are not affected by the same scenario at Hurstville; however, they are subject to bus rollaway if not secured by the park brake.

3.3 In 2006 Scania modified the design so that the PLC required a driver to activate the door close button and depress the foot brake to close the doors. This input indicates to the system that a driver is in close proximity to the bus controls. As a result of this design modification, a driver can no longer reach through the driver's side window to activate the door controls, resulting in a bus rollaway. The logic in the system prevents the door closing without the secondary input and will hold the vehicle at a stand.

3.4 PBC identified 23 buses in their fleet built prior to 1997 and 34 buses built after 2006. A further 18 buses built between 1997 and 2006 were being modified to include a secondary input to the door system.

3.5 The retro fit involved fitting an extra relay to the bus. This feature means that a driver cannot place their arm through the driver's side window from outside

the bus and operate the door control switches to close the door, causing the bus to rollaway.

3.6 The retro fit comes in two variations, either:

- air over electric, an electrically controlled solenoid valve that cuts the air supply from an air operated door switch, unless the foot brake is applied when doors are closing (door close switch is isolated unless the foot brake is applied), and or
- electric over electric

3.7 Future PBC bus orders will include a driver's side window configuration that prevents a driver accessing any controls from outside the bus through the driver's window. This additional feature will complement the secondary safety devices connected to the interlocked door system.

3.8 Since the accident PBC has updated and replaced 3 vehicles moving the average age of the bus fleet to approximately 11.5 years. The latest vehicles are three 2016 Scania's. All three vehicles are fitted with an advance logic system that will not allow the vehicles to rollaway unmanned.

Technical Specification 146 Roundtable Forum

3.9 Since July 2016 a panel consisting of representatives from TfNSW, RMS, BIC, State Transit and an OTSI observer met on several occasions in regards to amending TS146. A number of changes have been accepted and will be amended in a new TS146 in March 2017.

Hurstville City Council

3.10 As a result of OTSI's investigation, on 3 March 2016 the TAC recommended for Council to remove the 'No Parking' signs and re-categorise as a bus zone.

3.11 Hurstville City Council endorsed this matter on 16 March 2016, and the signage has since been replaced.

PART 4 FINDINGS

Contributory Factors

4.1 The driver of the PBC bus did not apply the park brake.

4.2 The driver of the PBC bus did not follow PBC operating procedures when operating the door close button through the driver's window. This action enabled the bus to rollaway.

4.3 The bus involved in the Hurstville incident was not fitted with a secondary failsafe safety system that would prevent the vehicle from moving off without a park brake being applied (this was a bus design issue).

4.4 The vehicle was not fitted with a warning system to warn the driver that the park brake was not applied (this was a bus design issue).

Other Safety Factors

4.5 TS146 stipulates the parameters of a bus door safety system. It does not specify that the brakes must hold the vehicle while the doors are open.

4.6 TS146 does not stipulate that a secondary failsafe system must be installed to prevent a bus moving off without the driver at the controls of the vehicle.

4.7 The bus parked 13 metres from the other PBC bus to correspond with the location of obsolete road signage.

PART 5 RECOMMENDATIONS

Noting that a number of remedial safety actions have been implemented, it is recommended that the following additional safety actions be undertaken by the specified responsible entities.

Punchbowl Bus Company

5.1 Shall reinforce the requirement for bus drivers to apply the park brake before exiting the vehicle.

5.2 Shall reinforce the requirement for bus drivers not to operate the door closed button through the driver's window.

5.3 Shall reinforce that bus drivers are not to engage with a rollaway bus and to stand clear and alert persons in that area of the impending danger.

Roads and Maritime Services

5.4 Shall alert all bus operators in NSW to the issues identified in this report relating to rollaway buses.

5.5 Shall amend TS146 to ensure items 1,2,3,4 and 6 within the Bus Industry Door Advisory document are incorporated into TS146.

5.6 Shall amend TS146 so the specification clearly defines that all buses must ensure that the door interlocking mechanism holds the vehicle brakes 'on' while the door is open.

5.7 Shall amend TS146 to ensure that a secondary device is installed on all public commercial buses and coaches so bus door(s) cannot operate unless the system receives a signal from the park brake/foot brake/accelerator.

5.8 Shall reinforce by publication and as part of the accreditation of bus organinisations and operators with RMS, that bus drivers are not to engage with a rollaway bus and to stand clear and alert persons in the area of the impending danger.

TfNSW

5.9 Shall work in conjunction with RMS and assist in the development of the amended TS146.

5.10 Shall draft a document and release it to the bus industry of the advances that the South Australia Adelaide Metro bus fleet and Punchbowl Bus Company have implemented in reference to rollaway bus protection.

5.11 Shall reinforce by publication and as part of the procurement of bus organisations with TfNSW, that bus drivers are not to engage with a rollaway bus and to stand clear and alert persons in the area of the impending danger.

PART 6 APPENDICES

Appendix 1: Technical Specification 146

Roads and Traffic Authority of New South Wales

TECHNICAL SPECIFICATION 146

Bus Door Safety Systems

1 Scope

1.1 This Specification sets the criteria for the design of a bus door safety system which is intended to prevent passengers from being trapped by a door system in a moving bus.

1.2 A door safety system meeting the criteria in this Specification will prevent the bus from moving or stop it, if already moving, which in turn will minimise any chance of injury to a passenger. The door safety system will also limit the door closing force in some positions of the door.

1.3 This Specification applies only to buses fitted with a driver controlled door.

2 General Requirements

2.1 Each passenger access door shall be fitted with a door safety system as described in this Specification.

2.2 The door safety system shall operate:

(i) without any driver intervention,

(ii) whenever the engine ignition key is in the "on" position,

(iii) in the case of a stored energy system, whenever there is sufficient energy to operate the door (see Clause 2.8).

2.3 The door system may or may not automatically reopen when the door safety system is activated.

2.4 The door safety system shall be capable of detecting a 20 mm diameter rod. Note: the rod is intended to simulate the thickness of the wrist of a child.

2.5 The door safety system shall detect the rod at all vertical positions of the rod when placed on the door step up to 1500 mm from the door step.

ISSUED: 16 July 1997

2.6 When the rod is detected, the door safety system shall prevent movement of the bus or stop it, if already moving, by:

(i) mechanically or electronically securing the engine in idle mode and,

(ii) applying the brakes on at least one axle or by locking the driveline.

2.7 The control of the braking or driveline system shall be designed so that it will not cause the brakes or driveline mechanism to apply while the bus is in motion if there is no controlled operation of the door system. Note: This can be achieved by disarming the brake or driveline control once a preset speed (nominally 10 km/h) has been reached.

2.8 The operation of the door safety system shall not affect the compliance of the bus with any Australian Design Rule in particular, any braking rule. If the braking system uses stored energy, the brake system shall be preferentially supplied.

2.9 When the door is being closed, the steady force applied to an object which is located at any position up to 1500 mm above the door step shall not exceed 150N when measured from 20 mm to 300 mm from the fully closed position (see Appendix A).

2.10 An audible warning and/or visual warning shall be given to alert the driver that the door safety system has activated. If a visual warning device only is installed, it shall be located in the area of the driver's normal driving controls and be marked with or display the word "DOOR FAULT". An audible warning device which reproduces a recorded message shall say in English "DOOR FAULT".

2.11 When activated, the door safety system shall only be capable of being deactivated by a reapplication of the door control.

2.12 Any emergency door release control or other device fitted to a door system shall not be rendered ineffective by the installation of a door safety system.

2.13 The correct operation of the door safety system shall be capable of being readily checked without the use of special tools or dismantling any component. In the case of components which have "normally open" circuits, there shall be a method of automatically checking the integrity of the circuit.

2.14 The door safety system shall be capable of operating reliably under the full range of environments likely to be encountered during bus operation. This includes extremes of temperature and cleaning with pressurised water. Note: rubber or plastic components might perform differently over a range of temperatures such as, the flexibility of a door seal.

2.15 All components shall be located or designed to minimise the risk of passengers tampering with their operation.

3 Checking the door safety system performance.

3.1 Place a 20 mm diameter rod between adjacent door panels in a two piece door system or, in the case of a door closing to one side, between the edge of a door panel and the door frame.

3.2 The rod shall be perpendicular to the vertical edge of the door and the end of the rod shall protrude no more than 30 mm beyond the inside surface of the door (see Appendix B).

3.3 Close the door using the normal door closing control.

3.4 Hold the rod loosely so that when the door makes contact the rod will self-align with the door closing geometry.

3.5 Once the rod is detected:

(i) the door may or may not automatically reopen,

(ii) the engine shall remain at or go to idle speed and be incapable of increasing engine revolutions,

(iii) the vehicle shall be immobilised by locking the brakes on at least one axle or by locking the driveline,

(iv) an audible and/or visual warning shall be given to alert the driver that the interlock function has operated.

3.6 Open the door using the normal door control or in the case of an automatic opening door safety system, operate the door control to release the brakes or driveline lock and throttle control.

3.7 Operate the engine throttle and attempt to move the bus to ensure the brakes or driveline lock and throttle control have released.

3.8 Close and open the door again to ensure normal vehicle operation.

3.9 Check the rod sensing operation at all vertical positions from the rod sitting on the door step up to 1500 mm from the door step.

3.10 Using a suitable gauge, check the door closing force between 20 mm and 300 mm to ensure that it does not exceed 150 N at all vertical positions up to 1500 mm from the door step.

Note: In order to assess the correct performance of the door safety system it might be necessary to disarm or override some of the automatic functions.

4 Certification

4.1 A plate or label made of durable material shall be fitted adjacent to the vehicle manufacturer's Compliance Plate. The plate or label shall display the following information:

The name of the door safety system manufacturer; the person who installed the door safety system and the statement,

The door safety system fitted to this bus has been manufactured and installed to comply with RTA Technical Specification No. 146 "Bus Door Safety Systems"

4.2 Where the door safety system uses the braking system to immobilise the bus, a certification is required by an RTA approved recognised engineering signatory (see Vehicle Standards Information sheet 15, "Recognised Engineering Signatories").

Appendix 2: Roads and Maritime Services Information Alert

17 February 2016

Runaway Buses Information Procedure

ISSUE:

Roads & Maritime Services is concerned at the number of incidents involving runaway buses, whereby bus drivers have incorrectly relied on the front door brake interlock system to act as a bus parking brake to secure a bus. This alert serves as a reminder for operators to ensure that drivers are conversant with the runaway bus information procedure to assist in reducing or eliminating the possibility of these incidents occurring in the future.

NOTICE:

This information alert outlines the correct procedure for securing a bus and should be distributed by bus operators to all drivers as a reminder that they should not under any circumstances:

(i) leave the seat of the bus without correctly securing the bus parking brake; and

(ii) access the bus control mechanism/s through the driver's window.

A runaway bus, whether in the bus depot or on a public road, has the potential to cause serious or fatal injury, and significant damage to property and assets.

To prevent these serious incidents from occurring, it is essential that bus drivers correctly secure their bus by applying the park brake before leaving the driver's seat.

Note:

It is not acceptable to rely upon an open front, centre and/or rear door (therefore utilising a door brake interlock system) or the bus stop brake to secure the bus.

There are engineering systems in place, which are designed to prevent incidents of runaway buses. These are, however, not substitutes for driver vigilance in ensuring that the park brake is always applied before leaving the driver's seat.

Bus drivers, as professional drivers, are responsible for their own and others safety. Correctly securing the bus before exiting is part of this responsibility

INSTRUCTION:

- Before leaving the driver's seat, you must apply the park brake and check that it is correctly engaged.
- Where a bus is fitted with an external door close control, you must use this to close the bus.

- You must not close the bus doors by reaching keys, handles, switches, levers or other controls from outside the bus through the driver's side window.

- Under no circumstances should you access the bus controls via the driver's window

The safety message in the form of an adhesive double-sided sticker is to be affixed in a visible position on the lower half of the driver's side window on all buses. The requirement to affix the safety sticker to all buses and to distribute the bus safety alert to all drivers forms part of the bus operator accreditation and audit program.

The safety message on the inside of the bus must be:

"Parking brake must be applied before leaving seat"

The safety message on the outside of the bus must be:

"Do not access bus through window"

REQUIRED ACTION:

Operators are required to ensure all staff are aware and trained in the runaway bus information procedure.

Furthermore operators are reminded that all required incidents are reported to Roads and Maritime via the Bus Incident Management Database and the Office of Transport Safety Investigations (OTSI). (Police should be notified only if required). The Bus Incident Management Database manual is available on Roads and Maritime website to provide guidance on all reporting requirements.

Appendix 3: Sources, Submissions and Acknowledgements

Sources of Information

- Punchbowl Bus Company
- Transport for NSW
- Roads and Maritime Services
- NSW Police
- NSW State Coroners Court Glebe
- Hurstville City Council
- Bus Industry Confederation
- South Australia Adelaide Metro
- Sapphire Coaches
- Pegasus Coaches
- Mercedes Australia
- Scania Australia
- Michael Neal
- NPW Services
- State Transit
- Transport Safety Victoria

References

- Punchbowl Bus Company
- Technical Specification 146
- South Australia Adelaide Metro documentation on rollaway proof buses
- Bus and Coach Industry Door Safety Advisory Document
- NSW State Coroners report into bus fatality, Circular Quay, Sydney, 2000

Submissions

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to

the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Punchbowl Bus Company
- Roads and Maritime Services
- Transport for NSW
- State Transit
- NSW Police
- Hurstville City Council
- Bus Industry Confederation
- South Australia Adelaide Metro

Submissions were received from:

- Punchbowl Bus Company
- Roads and Maritime Services
- Transport for NSW
- State Transit
- NSW Police
- Hurstville City Council
- Bus Industry Confederation
- South Australia Adelaide Metro

The Chief Investigator considered all representations made by DIPs and responded to the author of each of the submissions advising which of their recommended amendments would be incorporated in the Final Report, and those that would not. Where any recommended amendment was excluded, the reasons for doing so were explained.