Train Door Emergency Egress and Access and Emergency Evacuation Procedures
TRAIN DOOR EMERGENCY EGRESS AND ACCESS
and
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1.0 INTRODUCTION AND OBJECTIVES

The purpose of this paper is to consider if a standard should be created in NSW covering train emergency evacuation procedures, door egress and access and associated equipment. The purpose of this standard would be to improve the emergency response capability of rail operators within the state. This standard would apply to all passenger carrying trains operating within NSW. This paper considers whether the new standard should encompass the ability of passengers to self-evacuate (escape) if the situation should be serious enough to warrant it and includes a review of the door security policy currently adopted by RailCorp.

2.0 EXECUTIVE SUMMARY

This project has involved researching various reports covering the subject, reviewing some of the existing standards and legislation in place in some countries; reviewing accident reports and the accompanying recommendations involving some of the train accidents that have occurred within NSW and overseas in the last 10 years. Various reports covering a comparison between Australia and other developed countries have also been taken into account.

In Canada, the USA and the UK, recent accidents have led to more prescriptive legislation and/or standards being imposed regarding this issue. These mandatory standards are imposed by the government bodies responsible for rail safety in each of these countries. In Australia, no such standards have been imposed by State Government rail regulators.

These countries had no policy similar to that of RailCorp where doors were locked and passengers were unable to open them in an emergency. Rather, trains operating in these countries had internal door release mechanisms and in some cases emergency windows as well. However a continuous theme in the accident report recommendations included calls for improved means of passenger escape mechanisms. This included better signage and availability of information for the passengers. Easier access to emergency levers and handles, better lighting to illuminate escape routes, are other repeated themes. Many reports are critical of crew actions following emergencies that indicate a lack of training and preparedness in emergency procedures.

The current RailCorp door security policy is reliant upon the train crew to conduct and control the evacuation of passengers. The doors are locked before departure of the train from the platform and the passengers are unable to override this mechanism and open doors from the inside. In the event of the loss of power, the doors will “fail” in the locked position. The passengers are reliant upon the crew to facilitate their evacuation or for doors to be opened externally by the emergency services or rail personnel.

The Waterfall accident that occurred in 2003 was an example of an accident in which the crew became incapacitated. This was an accident which occurred in an area bordering a national park away from main roads and the highway. It was accessible only by dirt roads and behind a locked gate. It took some time for StateRail (approximately 40 minutes) to identify an accident had occurred and to locate the position of the train.

This accident highlights that there is the potential for an accident to occur where the crew are unavailable to conduct an evacuation, power is lost, the doors are locked, people are injured, mobile phones work only intermittently, the train is two kilometres from the nearest station in a relatively isolated area and the emergency services are having trouble finding the location.
The research conducted for this project highlights that:

a) Trains operating within the USA, the UK and Canada all have doors that permit passengers to open and self evacuate in the case of an extreme emergency. In some cases emergency window exits are also provided;

b) All these countries have legislation and/or standards covering the requirements for emergency exits and the availability of information to the public;

c) The incidence of vandals tampering with emergency door opening devices in these countries is reportedly not significant, even though these are countries that suffer other forms of vandalism to their trains;

d) Many of the accident reports studied have a recurring theme amongst the safety recommendations, including the need for better signage and the provision of information to passengers on how to operate emergency exits, for the maintenance of emergency exits and for better emergency lighting and public address systems;

e) Another reoccurring theme is the deficiency of emergency procedures training provided to train crew;

f) According to an independent report prepared by Det Norske Veritas Consultancy Services, the rate of frequency of fires occurring on the StateRail network is twice that of the rate that occurs on the rail network in the UK;

g) RailCorp procedures are dependent upon the train crew unlocking the doors and controlling the evacuation;

h) However the Waterfall accident was an example of an emergency where the crew were incapacitated and unable to perform that role.

From all the documentation and expertise available, it is the recommendation of this paper that the current door security policy adopted by RailCorp should be amended and that passengers should have the ability to open the train doors in an extreme emergency and self evacuate (escape).

The inherent dangers associated with this are recognised. It is important to stress that the preferred means of train evacuation following an emergency would be (as it is currently) for the driver to stop at the closest station, open doors onto the platform and for the train crew to control passenger egress from the train. Passengers opening doors themselves and self evacuating is a last resort that would only occur in the most extreme situation where to remain on the train could pose a greater danger than that posed by exiting the train.

It is also recognised that the provision of an internal emergency door release mechanism could result in doors being opened accidentally or as an act of vandalism. Steps should and can be taken to minimise such occurrences and suggestions are included in this paper as to how this could be accomplished. However this area does need further study to see how it is best achieved. It is worth noting that in the USA, Canada and the UK, countries that are also subject to acts of vandalism on their trains, there are few reports of doors being opened in such circumstances.

Lord Cullen conducted an inquiry into the Ladbroke Grove Junction accident in the UK. In his report he states that:

"Where it is necessary for passengers to leave a train after a crash or other emergency, they should do so, if circumstances permit, under the supervision of train staff in a controlled or organised manner... There may be cases where there is no organised evacuation and where the apparent hazards inherent in remaining on board are substantial....... This is one of the lessons of Ladbroke Grove. In these circumstances provision has to be
made to enable individual passengers to escape on their own initiative. The means of evacuation and escape must be readily identifiable, available and effective."

In the Ladbroke Grove inquiry the issue of vandalism was raised. It was agreed that measures should be included to minimise the damage done by vandalism; however it was stated in the report that “vandalism should not be an excuse for a lack of passenger emergency safety features”.

Professor Galea, from the University of Greenwich, who was called as an expert witness to the inquiry, stated that vandalism was really a separate issue from passenger safety, and he stated that:

“If the risk assessment case shows that the suggested recommendation is of benefit, of net benefit to passenger safety, then the issue of vandalism should be addressed as an issue of vandalism and not as an issue potentially of passenger safety”.

Generally Lord Cullen agreed with this remark; however he believed that it was unrealistic to ignore the risk of vandalism.

This is also the case with this report. The recommendation is that the doors should be provided with an internal door opening device that permits passengers to escape in a serious situation. However physical, mechanical and psychological (eg fines and penalties) defences should all be explored to deter misuse of any safety device.
3.0 DOOR ACCESS, CURRENT POLICY

Currently doors can be opened from the outside. Doors can be opened via the Emergency Door Release (EDR) button or lever. All these buttons or levers are located behind a panel that is notated EDR. There is a minimum of one of these devices located on the side of each car, with a second device diagonally opposed on the opposite side of the car. Some cars, for example the XPT, the Xplorer and the Endeavour cars have a device on every door.

The panel covering the EDR device has no identifying feature to indicate it is a piece of emergency equipment, there is no colour or striping. The only notation is the lettering “EDR”.

However this acronym is not familiar to all emergency services personnel. At the Waterfall accident, emergency services were unaware of this panel and proceeded to attempt to open doors and break windows using rocks and other such pieces of equipment. There are examples overseas of accidents where the emergency services were unable to locate door opening devices to gain quick access to the train and lives were lost as a result, for example the accident at Silver Spring in the USA.

At the Waterfall accident, one of the StateRail staff who attended the site attempted to open one of the doors but he found that the EDR button failed to open the door. This is an issue that needs further study to investigate if doors can be opened 1/ if the carriage is on its side and 2/ if there is a loss of power and air. Another issue to clarify is if the EDR device opens all pairs of doors on one side of the car or if the device opens one pair of doors only.

If the “EDR” sign is replaced with a placard that clearly identifies the release mechanism, there is the possibility that this will make it easier for unauthorised persons to open the doors and enter the cars when the train is stabled. This could lead to vandals, or persons posing a security threat, entering the train. To overcome this problem, there should be a locking mechanism that locks all the doors when the train is stabled. This would mean the train is secured and render the EDR mechanisms unusable whilst in this mode.
4.0 EMERGENCY DOOR OPENING, CURRENT POLICY

4.1 Current Policy adopted by RailCorp

RailCorp currently have a door security policy. This involves the side passenger doors of the train being locked as the train is about to move off from the station. Passengers are unable to override any locking device and unlock and open the doors themselves in an emergency. Evacuation procedures are dependent upon the train crew unlocking the doors and directing the evacuation.

The doors are set to “fail” to the locked position in the event of loss of power or air.

However there are exceptions to this. The Xplorer and the Endeavour cars have doors that are centrally locked, however there is the provision for passengers to open the doors in an emergency.

The other anomaly is that on some of the older trains, notably “K”, “C”, “S” and “R” sets, the passageway between cars is not contained and it is possible to fall, jump or climb off the train through this opening. Passengers have been killed and injured doing this.

4.2 Why this policy was adopted

The door security policy was adopted by StateRail in 1990. The purpose of it was to reduce injuries to passengers i) through falling from open doorways and ii) after unsupervised exit.

This policy involved disabling the internal emergency release mechanism that was fitted to the existing Tangara cars and having it deleted in the future cars. All other cars were similarly fitted. By 1994 all manual passenger-operated doors were to be eliminated on suburban CityRail trains.

The policy stated that passengers would not be able to exit unsupervised.

The policy also called for the door motors to fail in the “locked” position in the case of the loss of electrical or pneumatic power supply.

This policy was endorsed by the SRA Board in 1990. The installation of locking door engines commenced in 1990 and compliance of the suburban electric fleet was to be achieved in 1994.

There is no information available that indicates that any risk assessment was conducted to ensure this policy was the correct one to adopt.

4.3 Injuries due to passengers opening doors

The SAD database from RIC/RailCorp was interrogated to search for injuries and fatalities that resulted from passengers opening doors and subsequently falling from both CityRail and CountryLink trains. Records are available from 1989. These figures appear in Figure 1.

Information in the “remarks” section of the database did not always adequately explain the reason for the injury; as a result there may be some inaccuracy in these figures. For example, in many instances the term “fall from train” is used but it is unclear if the passenger fell from a doorway or fell between carriages.
| Year | CityRail | | | CountryLink | | | | Total |
|------|----------|---|---|-----------|---|---|---|
|      | Injury   | Fatality | Injury | Fatality |          |          |
| 1989 | 37       | 6          |        |           | 43         |
| 1990 | 55       | 9          | 6      | 1         | 71         |
| 1991 | 41       | 8          | 5      |           | 54         |
| 1992 | 52       | 6          | 4      |           | 62         |
| 1993 | 20       | 2          | 1      |           | 23         |
| 1994 | 23       | 2          | 3      |           | 28         |
| 1995 | 30       | 3          |        | 1         | 34         |
| 1996 | 18       |            | 2      |           | 20         |
| 1997 | 13       | 1          | 2      | 2         | 18         |
| 1998 | 29       | 3          | 3      | 2         | 37         |
| 1999 | 25       | 1          | 2      |           | 28         |
| 2000 | 16       | 3          | 1      |           | 20         |
| 2001 | 6        |            | 1      |           | 7          |
| 2002 | 10       |            | 2      |           | 12         |
| 2003 | 8        |            |        |           | 8          |
| 2004 * | 3        |            |        |           | 3          |

Figure 1: Table showing number of injuries and fatalities due to passengers opening doors and falling from the train.

Note*: the figures for 2004 are incomplete and only cover the first six months of the year.

Figure 2: The total number of injuries and fatalities on both CityRail and CountryLink expressed as a graph.
Injuries and Fatalities on CityRail.

The figures in Figure 1 show a significantly high number of injuries and fatalities until the mid to late 1990s when the figures start to decrease.

The StateRail door security policy was signed in 1990 and by 1994 all doors were to be locked on CityRail trains. However it was still possible in many of the cars to force open some of the doors. Two of the fatalities in 1998, involved young men forcing the doors open and then jumping from the train. As a result of the continuing injuries through people forcing doors open, StateRail then ordered a “door motor locking system” to be installed on all trains. This commenced in approximately 1997, however the modification took a few years to retrofit to all cars. This door motor locking system was to prevent persons being able to force the doors open. This explains why injuries continued even once the door security policy was introduced.

The reasons for the injuries vary and although often categorized under the term “vandalism” this is not always the case. Certainly there are cases of school age children leaning out of open doorways or forcing doors open and jumping from the train. However there are several cases of adults forcing the doors open to either alight from the train at an unscheduled stop, leaping off prior to the train stopping at a station or jumping off as the train starts to move. There are cases of elderly persons forcing the doors open as they realised at the last minute they were about to miss their stop, for example an 89 year old priest pulled the doors open as the train was leaving a station and other cases of ladies in their seventies or eighties pulling doors open to get off the train. In these cases the term “vandalism” is not really appropriate; it gives an unrealistic impression of what is happening and the problem involved. Vandalism as defined in the dictionary, involves malicious or willful damage to property. Door opening does not always fall into this definition. The reasons for it happening are often different from that associated with graffiti or damage to seats. If this problem is to be managed it must be properly understood.

Injuries and Fatalities on CountryLink

The door security policy differed for CountryLink. The injuries and fatalities involving falls from CountryLink involved predominately the XPT. When it was introduced into service, the doors on the XPT could be opened from the inside by the passengers, even when the train was moving.

Several of the injuries involved people both young and old, opening doors and jumping onto the platform before the train had stopped. Other examples involved teenagers opening doors and hanging outside or jumping from the train. In some cases intoxicated passengers jumped from the train between stops. There was one fatality involving a nine year old boy who opened the door accidentally believing it was the door to the next car.

As a result of these accidents, CountryLink fitted a flap over the handle to prevent accidental deployment. However when problems continued, the doors were then centrally locked. This occurred in the late 1990s.

The Xplorer was introduced into service into 1993. The doors on the Xplorer have always been centrally locked and controlled by the crew. However the doors can be opened by use of a key in an emergency. The key is kept behind a glass case which passengers have to break to access. Following the accident at Baan Baa, two passengers opened the doors themselves using this escape mechanism,
Reduction of injuries by keeping the doors locked

Figure 1 and Figure 2, confirm that for the safety of passengers, the train doors must be locked when the train is in motion and the doors should not be unlocked until such time as the train is stopped at a station. The doors should then be relocked as the train is about to commence moving.

4.4 Review of current evacuation procedures

The train crew are responsible for directing an evacuation and unlocking the doors. The first preference in the event of an emergency is for the driver to proceed to the closest station and disembark passengers directly onto the station platform. If the driver cannot get to a station, the second preference is for the crew to direct passengers in a controlled evacuation, opening the doors on the side of the train away from any adjacent lines and directing passengers away from sources of danger.

The procedures call for the crew to receive confirmation from the signaler or from train control that oncoming trains in the area have been stopped.

Procedures contained in the “Operator Specific Procedures” dated September 2003 instruct the driver to “do everything possible to stop all trains on adjacent lines”. The driver and guard then have to agree on a passenger evacuation plan taking into account the risks present at the time.

From reading these procedures it becomes clear that the driver and the guard have a lot of decisions to make prior to ordering an evacuation. They need to establish the urgency of the situation. They need to establish if it is safer to keep passengers on the train rather than evacuating. The numbers of passengers on board, the dangers present in the external environment, the protection arrangements required, the safe area to which passengers should be directed and which doors to open; are all factors to be considered.

The urgency of the situation will dictate to a large extent the protection that the crew can put in place. Fitting track–circuit shorting clips can be done quickly but it would take longer to place detonators and these actions would require the crew to leave the train, so these tasks would only be possible if time was not critical.

For crew to be empowered to make such decisions, adequate training would be essential. Crew would need to be presented with a variety of scenarios to practise and test these decision making skills.

Crew would need to practise the conduct of the evacuation in a variety of scenarios and the making of suitable announcements via the PA. The wording used in emergency announcements is important, firstly to obtain the attention of the passengers and then to provide information and direction. The appropriate tone, speed and clarity of voice are essential to ensure the message is understood. Unless this has been practiced, crew may have trouble finding the right words to use in the confusion and turmoil that can occur at such a time. Commands should be short, concise and positive.

The train crew procedures provided by RailCorp have different dates on different documents and it is unclear what procedures are current. Crew procedures seem to be scattered through a variety of documents. This can lead to confusion amongst the crew and it makes the procedures difficult to update as several documents would have to be amended.
4.5 Emergency Signage

On CityRail trains the emergency information provided to passengers has been a notice positioned throughout all the carriages that contains the wording:

“In the event of an emergency or a delay, please remain in this carriage and wait for instructions from staff”

Words such as please are inappropriate in an emergency instruction as they tend to denote a request rather than a command.

A memo, dated February 2001, from StateRail Passenger Fleet Maintenance included a description of the new sign (notice number 3) that was to be fitted to the electric fleet. This new sign states:

“If the train is delayed, please remain in this carriage and wait for instructions from staff”

Note that this new sign provides no information about emergency procedures. On some trains both these signs are present, however recent inspections of the new Millennium train has revealed this second sign to be the only one present. This lack of information is of concern when considering the criticism that has been laid at train operators in the US, the UK and Canada following accidents regarding insufficient information being provided to passengers.

These signs all have a white background and are similar in appearance to all the other “prohibited” notices displayed inside the carriages. There is nothing to denote it is a safety or emergency sign. It does not comply with the Australian Standard for “Safety signs in the occupational environment”, which could provide a guide for this type of signage.

There are instructions on the CountryLink trains; however a recent survey of passengers who were involved in the Baan Baa accident revealed that of the 16 passengers who responded, four passengers remembered seeing some emergency signage.

There is a lot of information on this topic contained in some of the overseas standards reviewed as part of this project and in some of the associated research.
5.0 COMPARISON WITH OTHER TRANSPORT MODES

There are regulations governing the requirements for emergency evacuation in the other three public modes of transport operating within NSW, notably aviation, bus and marine. In these three modes of transport the mechanism for self evacuation (escape) exists.

On aircraft passenger emergency exits are clearly marked, and signage indicating escape routes and emergency door opening procedures are illustrated. This information is supplemented by a verbal briefing prior to each take-off, and in regular public transport operations there is a safety card in front of each passenger.

Before a new type of passenger aircraft is certified to operate in Australian airspace, it must be demonstrated that a full load of passengers can be evacuated in less than 90 seconds using only half the available exits.

The requirement for buses to be fitted with emergency exits is covered by the Australian Design Rule number 58. This stipulates the requirements for emergency windows, doors and in some cases emergency hatches in the bus. These emergency exits must be capable of being opened from the inside and from the outside and must be clearly labelled with the words “EMERGENCY EXIT”.

The Waterways Authority of NSW audits the requirements for commercial craft to have emergency exits, life saving apparatus and appropriate signage.

There are differences between rail operations and those of the other transport modes. The ratio of crew to passengers is different; there can be a large number of passengers on board one train (as many as 1500), with a minimum of two operating crew members, whereas a 747 aircraft for example operates with approximately 18–20 crew and less than 400 passengers.

As there are a limited number of crew on a train, and as they are located away from the passengers this would have to be taken into account with respect to their emergency training and procedures. The train crew would be very reliant upon the use of the PA when directing an emergency unlike other forms of transport where the crew communicate directly to the passengers. Therefore crew would need to practise making emergency PA announcements as part of their training. This also highlights the importance of the train having a functioning PA and the ability of the PA to operate when power has been lost. A faulty PA should be a no-go item.
6.0 LESSONS LEARNT FROM PAST ACCIDENTS

Several accidents and accident reports have been reviewed as part of this project and some of these accidents are summarised here. Some of these accidents are important in that the resulting accident reports and recommendations had a direct bearing on resulting standards and rules covering emergency evacuations. Other accidents have produced lessons that are of value to this project and to the topic of emergency evacuations and emergency response planning.

6.1 International examples

6.1.1 NORWAY

January 2000: Asta, Norway. Two passenger trains collided and the diesel tanks on both trains burst in the violent collision.

Nineteen people were killed in the collision and the subsequent fire and 67 persons survived the accident. Immediately after the accident there was confusion as to how many passengers were actually on the train, the operator was unable to provide an accurate figure.

According to rescue workers some passengers survived the crash but perished in the fire that raged for six hours following the accident.

By the time the fire-fighters arrived, the fire had strengthened to such an extent that it was not possible to extinguish or prevent it from continuing to spread in the front carriage.

All the efforts of the fire service personnel were focused on saving surviving passengers in the front carriage of one of the trains where several passengers were trapped. Prior to the fire-fighters arriving, the passengers had attempted to fight the fire using hand held extinguishers.

It was not possible to extinguish the fire because of the large amount of diesel fuel present and the carriage furnishings that were burning. The diesel fire outside the front carriage was inaccessible to the fire-fighters because of the position of the carriage and the damage it received in the collision.

6.1.2 AUSTRIA

November 2000: Kaprun, Austria. Kaprun funicular railway.

There was a fire on the Kaprun funicular railway, in a tunnel, carrying skiers up a mountain. The fire released poisonous fumes which quickly overcame the trapped skiers.

A total of 158 passengers died, 12 passengers survived.

According to the BBC News website, there was confusion regarding the communication between the train operator and train control. The driver was told to open all doors, however there seemed to be a delay in this happening.

There are also conflicting reports about whether the train’s doors remained closed, sealing passengers in the burning train.

The head of technical operations for the company running the railway, said the driver was
told to open all doors after an alarm sounded. After another five or ten minutes radio contact was lost. But a German survivor said the doors had jammed, trapping passengers inside. “They screamed as they tried to prise open the doors and smash the windows,” he said.

“All I wanted was to get out and I only managed to escape by the skin of my teeth because a window was kicked open, letting me battle my way out.”

For the passengers who did get out of the train there was no fireproof emergency refuge or evacuation tunnel through which they could escape. There were no clearly-marked emergency exits. Some passengers who got out of the front of the train are believed to have been choked by the fumes as they clambered upwards through the dark, smoke-filled tunnel. The few who fled downwards from the rear of the train were the only ones to survive.

6.1.3 KOREA

**February 2003: Dae-gu Subway, Korea.**

A fire was lit deliberately in a train whilst it was positioned at the Dae-gu subway station, by a person using 4 litres of gasoline. The fire developed beyond control within four minutes, it then engulfed the entire compartment. It is estimated to have taken approximately 8 minutes to burn down the affected car.

The fire then spread to other compartments. A second train approached, and the subsequent rush of air caused the fire to spread to the second train. It took 2 minutes and 15 seconds for the fire to spread from one train to the other.

The Dae-gu subway fire resulted in the death of 192 persons and injured 147 persons.

There was a failure of communication between the train driver and the operations controller. The operations controller did not fully appreciate the seriousness of the situation. This delayed the evacuation process allowing the fire to spread to the second train approaching from the opposite direction.

The extremely flammable and toxic nature of the interior materials of the rolling stock caused passengers to suffocate. Emergency facilities were inadequate.

According to survivors, the doors of the first train were open, but the doors of the second train were shut. Passengers complained of locked doors on the train trapping many passengers who choked to death.

A fire shutter positioned between the subway entrance and the shopping centre at underground level automatically functioned. Many of the passengers who had escaped the trains died as the fire shutter blocked their path.

The Dae-Gu emergency system relies on the driver’s action, needing him or her to attempt to suppress the fire first, before evacuating passengers.

(This contrasts with the Japanese system, where passenger evacuation comes first).

Following this accident the Subway Safety Task Force suggested several corrective measures be put in place, some of these included:

- “Public education of safety procedures and safety issues (e.g. how to escape from railway vehicles manually); and
- Universalised manual emergency door system”.
6.1.4 United Kingdom

**September 1997: Southall, UK.**

The crash took place at Southall East Junction when a high speed train operated by Great Western Train Company collided with an empty freight train operated by English Welsh and Scottish which was crossing to Southall Yard.

Seven people died in the crash and 139 were injured.

An inquiry was chaired by Professor John Uff, and his report included 93 recommendations aimed at improving rail safety. Several of these recommendations included a review of emergency evacuation equipment including:

- That a review should be carried out by the Association of Train Operating Companies (ATOC), on the ways in which internal safety features may be modified and standardised to provide the best practicable means of emergency exit under accident conditions, including vehicles lying on their side;
- The provision of emergency lighting and standardised public announcements should be reviewed;
- A single body should be empowered to specify common standards for safety features in the interior of passenger vehicles and to identify and approve types of vehicles and/or operators to which particular standards are to apply;
- Safety briefings or other appropriate means of communicating safety information to passengers should be adopted, including pointing out safety notices to passengers; that ATOC should monitor these methods and that recommendations for different types of journey should be made;
- That train crews should be given improved training and briefing on emergency actions, including participation in a practical evacuation.

**October 1999: Ladbroke Grove Junction, UK.**

About two minutes out of Paddington station, a Turbo of Thames Trains collided almost head on with a high speed train operated by First Great Western. Both train drivers were killed. The impact was followed by a number of fires caused by the dispersal and ignition of diesel fuel.

There was no organised evacuation. Passengers had difficulty in knowing how to open the external doors and how to break windows. Some of the cars had tilted over at a substantial angle and passengers had difficulty in opening internal doors which had fallen shut due to gravity.

Many passengers were injured, and 31 passengers died.

An inquiry was conducted by Lord Cullen and the recommendations included improved safety information to be provided to passengers regarding evacuation, additional research into emergency exit windows and a greater emphasis on the humanitarian response.

An issue arising at this, and the Southall inquiry, concerned the opening of internal doors. Passengers experienced difficulties in both these accidents when attempting to open the internal doors in some of the coaches which had derailed and landed on their sides. They found that once opened, the doors had fallen shut under the force of gravity. Two of the experts called to give evidence suggested 1/ the provision of suitable handles to make it less difficult to move the doors and 2/ the installation of an automatic catch mechanism for holding such doors in an open position.
In the report, Lord Cullen recommended that there should be a study regarding the possibility of installing a telephone by which passengers can communicate with the signaler in the event of the driver being killed or incapacitated, so as to enable them to obtain advice and information in an emergency. He made this recommendation with respect to driver-only trains, however this suggestion is also relevant to other passenger carrying trains.

Lord Cullen made recommendations regarding the fuel tanks. He recommended that there should be a review of Group Standards in respect of improved crash resistance of fuel tanks. This included utilizing smaller fuel tanks and repositioning the tanks away from exposed and vulnerable locations. However this issue is outside the scope of this report.

6.1.5 USA

September 1993: Mobile, Alabama, USA.

An Amtrak train derailed whilst crossing a bridge that had been displaced after being hit by a barge. The train derailed and three locomotive units, the baggage and dormitory car, and two of the six passenger cars fell into the water. The fuel tanks ruptured and there was a fire.

Of the 220 passengers and crew on board, 42 passengers and 5 crew were killed, 103 passengers were injured.

This accident raised the issue of emergency response and evacuation procedures and the need to provide passengers with information regarding emergency equipment.

February 1996: Silver Spring, Maryland, USA.

A collision between an Amtrak passenger train and a Maryland Rail Commuter MARC passenger train caused the fuel tank of the MARC train to be ruptured and there was a resulting fire.

On the MARC train all 3 crew members were killed. Of the 20 passengers, 8 were killed in the derailment and subsequent fire, and 11 passengers were injured.

On the Amtrak train, 15 of the 182 passengers and crew were injured.

The investigation pointed to a lack of appropriate regulations to ensure adequate emergency egress features on the passenger cars.

The eight fatalities occurred in one car. In this car the passengers were unsuccessful in opening the left and right rear exterior doors after the accident.

The surviving passengers stated they had known nothing about the operation of the emergency doors or windows. After unsuccessfully attempting to open the rear doors, the survivors escaped through a hole in the train.

The investigation found that damage to the doors in the accident had prevented them from opening.

The investigators from the National Transportation Safety Board (NTSB) concluded that the absence of comprehensive Federal passenger car safety standards resulted in the inadequate emergency egress conditions. As a result, the NTSB issued four urgent safety recommendations, one of which was:

“Install an easily accessible interior emergency quick-release mechanism adjacent to all exterior doors.”

Another major issue at this accident involved the access to the train by the emergency
responders. The firefighters stated that they could not observe any instructions detailing how to open the emergency windows or the location of the emergency door release handles on the car exteriors. In some cases they reported that door opening devices were found to be missing.

Post accident inspection of the cars found that the exterior emergency door release handles were missing from one car. The handles on another car were inaccessible as they were buried in ballast when the car derailed. The handles had originally been designed to be positioned adjacent to the door, above the bottom of the car body. However, the handles were actually installed below the floor line of the car and approximately 3 inches inboard, this meant they were inaccessible when the car derailed. The investigators found there was no existing requirement for the maintenance or the accessibility of these devices.

As a result of this, it was the recommendation of the NTSB that:

"all exterior emergency door release mechanisms on passenger cars be functional before a passenger car is placed in revenue service, that the emergency door release mechanism be placed in a readily accessible position and marked for easy identification in emergencies and derailments, and that these requirements be incorporated into minimum passenger car safety standards."

March 1999: Bourbonnais, Illinois, USA.

An Amtrak train, with 207 passengers and 21 Amtrak railroad employees, struck and destroyed the loaded trailer of a semitrailer that was traversing the railway crossing.

Both locomotives and 11 of the 14 cars in the Amtrak consist derailed. The derailed Amtrak cars struck 2 of 10 freight cars that were standing on an adjacent siding. A fire resulted. The accident resulted in 11 deaths and 122 people being transported to local hospitals.

When the first Bourbonnais Fire Protection District personnel arrived at the accident scene, they saw that employees of Birmingham Steel had responded to the scene and had begun the rescue effort. The steel plant employees had brought a number of hand-held fire extinguishers and ladders from the plant to combat the flames. While some of the steel plant employees applied the fire extinguishers to the flames, others entered some of the damaged passenger cars to extricate entrapped passengers. These efforts were continued for about 45 minutes when the steel plant employees were relieved by the arriving Fire Protection District personnel.

There was confusion about passenger numbers. Amtrak advised that there were over 400 people on board, however this number was wrong. The fire-fighters spent additional time searching for an additional number of passengers. It took Amtrak a couple of days to revisit the passenger manifest and establish the correct numbers of people on board.

6.1.6 CANADA

November 1994: Riviere-Beaudette, Quebec, Canada.

A VIA Rail Canada Inc. train collided with a tractor-trailer at a public crossing. The leading locomotive derailed and the fuel tank ruptured, fire erupted at the rear of locomotive and the train continued for approximately 4000 ft before stopping. Railway employees fought the fire with on board fire extinguishers.

Of the 197 passengers, 2 passengers and 2 staff sustained minor injuries.

The conductor was unable to contact the crew in the locomotive as the train radio had been damaged in the accident. Conflicting advice was given to the passengers as they detrained
as to where they were to proceed. Once outside the train they were apparently directed to walk to a nearby crossing, but this was a different order from what the conductor was trying to give. It highlighted the lack of coordination amongst the crew members.

There were eight crew on board the train and they provided assistance to the passengers. However no one employee was taking control and no pre-determined plan seemed to be in effect.

The emergency lighting did not activate. There was no exterior emergency lighting to provide illumination for passengers detraining into darkness. There were no portable flashlights, only small pen flashlights given to crew which proved inadequate. The lack of lighting increased anxiety amongst passengers. This issue is repeated in other accident reports.

The PA system did not function on emergency power and the train crew were unable to communicate basic evacuation instructions to the passengers. The crew had no other back-up method such as a megaphone available to them.

These factors explained why passengers received conflicting instructions from different crew members. In the darkness with the lack of identifying clothing the train crew could not be readily identified by the passengers.


A VIA Rail Canada Inc. train struck a piece of rail intentionally placed on the track. A fire erupted and the trailing portion of the locomotive and the first two passenger cars became engulfed in flames. The piece of rail punctured the locomotive fuel tank and severed electrical power cables.

Of the 385 passengers on board, 46 were injured.

The accident report stated the emergency exit features of the passenger cars did not provide an acceptable level of safety.

Passengers attempted to move to the rear of the train; however they were unable to open the door leading to the following car. Panic ensued and many passengers felt they may not survive. A crew member eventually made her way to the door and managed to open it.

Passengers and staff began breaking windows with their feet. Passengers then started to escape through broken windows, and this was whilst the train was still moving. Two rail employees managed to open doors and operate the associated steps that allowed people to exit the train.

Passengers were injured exiting windows as they received cuts and abrasions from broken glass. Others were injured jumping from the windows.

The investigation found inadequate information pertaining to the operation of the doors. Manual operation of the vestibule door was accomplished by pulling down on a “T” handle; however the investigation found that not all passengers would be able to reach this handle. It was considered that the force to operate this handle, coupled with lack of instruction on its operation rendered manual deployment of the door as extremely difficult if not impossible for some passengers.

There was inadequate signage outside the train indicating how to operate the door opening device.

A questionnaire was sent to the passengers and the most common observations included:

• The emergency exit windows could not be opened;

• The train crew located in the first two cars where the fire entered became confused and were unable to give basic instructions;
• The rail employees could not be identified in the dark;
• The lack of external lighting;
• Passengers felt they were not provided with adequate information during the emergency.

The investigation found that although train crew were provided with information during their training regarding the preferred methods of evacuation, they did not get a chance to practise the task. They received no instruction on communication skills and providing direction to passengers in an emergency.

Major issues in the accident report covered emergency evacuation and egress. The Canadian Transportation Safety Board recommended that the Department of Transport take steps to ensure a suitable standard is introduced.

**March 1996: North Bay, Ontario, Canada.**

An Ontario Northland Railway train derailed. Eight (8) of the 54 passengers were injured and 2 of the 6 crew on board were injured.

After the derailment, passengers in the second car believed that steam coming from the first car was smoke. The emergency windows would not open and passengers exited via the rear side door which had been opened by the crew from the outside.

There were no written instructions on how to open the side doors.

The end door providing access to the first coach was not in line making it treacherous to pass from one coach to the other through the end doors. This was attributed to minor deformation of the car frame.

Major findings included a lack of emergency evacuation information amongst other safety deficiencies.

**September 1997: Biggar, Saskatchewan, Canada.**

This accident involved the derailment of a VIA Rail Canada Inc. train following the fracture of the lead axle of the trailing locomotive.

Thirteen of the nineteen cars and the two locomotives derailed.

Of the 198 passengers and crew on board, 79 were injured, 1 fatally and 13 seriously.

Major problems identified included the lack of adequate emergency training for crew and lack of emergency information provided to passengers.

Several passengers and crew were injured departing the train into darkness, reportedly jumping from as high as 4 metres to the ground.

There was no posted written information to advise how to operate the side entrance doors, which are the primary exits in an emergency evacuation. There were no instructions posted to advise of the proper operating method of the retractable stairs.

Transport Safety Board (TSB) investigations into previous accidents involving passenger trains at Brighton and elsewhere, resulted in the identification of hazards regarding passenger safety. This accident once again raised issues of passengers’ safety and evacuations and safety briefings. The TSB identified the following short term measures to be implemented. These measures included the following:

• Safety briefings for passengers
• Passenger’s safety cards
• Emergency window exit hammers with signage and instructions for use
• Flashlights
• Emergency signage for all emergency exit routes
• Exterior emergency signage to assist first responders
• Effective emergency PA systems & emergency lighting
• Stowage and restrictions on carry on baggage
• Emergency procedures training for all crew on trains.

The Ministry of Transport stipulated that VIA Rail completed its implementation of these measures within 30 days.

6.2 NSW Accidents

July 2000: Linden-Woodford.
A CityRail, 4 car InterCity train came to a stand after suffering wheel slip problems. There were 80 passengers on board.

In the leading car a fire started in the roof and smoke entered the first and second cars through the air conditioning system.

The crew directed passengers to the two rear cars of the train. The driver and the guard then left the train to place train protection. Whilst they were away, the police and emergency services arrived and believed that the passengers were in fact trapped in the rear cars.

The emergency services started to try to gain entry to the train to allow passengers out. Two security officers (SRA staff) who were operating on the train, saw this and started to panic and began smashing windows and trying to unlock doors. This resulted in fear amongst the passengers. There was a failure of the interface between train crew and emergency services. Six passengers were taken to hospital with smoke inhalation.

It was identified that there was a lack of training in emergency procedures for train crew and for security guards.

This accident highlighted that the emergency services were unaware of the significance of the EDR button and failed to identify it.

October 2000: Kingsgrove.
This accident involved an eight car CityRail, Tangara. The last three carriages derailed and rolled onto their sides.

Ten passengers suffered minor injuries, the train was lightly loaded and the majority of passengers were in the non derailed cars.

Overhead electrical wires were brought down and this caused concern regarding isolation of electrical power. There was no clear communication received that indicated that the site was “electrically safe”. This caused delay and confusion for the responding emergency services and delayed the evacuation of the passengers.

July 2002: Hexham.
An empty coal train derailed and as the driver attempted (unsuccessfully) to call the signal box at Maitland, a second crew member started to place protection on the adjacent lines. Approximately 8 minutes after this occurred, a two car passenger train collided with one
of the derailed wagons which were positioned foul of the Down main line. At the time of the collision the second crew member had not yet placed protection on the Down line. All carriages remained upright.

The accident report indicated an inadequate communication process in arranging protection for the derailed train.

The driver and guard of the passenger train and ten of the passengers were injured.

**August 2002: Bargo-Yerrinbool.**

There was a collision between a ballast train and a four car passenger train. There were no injuries.

Following the collision communications became confused between the driver of the passenger train, the signaler and the guard due to equipment being used incorrectly or being out of range.

The accident investigation report states that the driver had lost situational awareness and he was unable to 1/ confirm positively to the train controller that a collision had occurred and 2/ advise if all passengers were uninjured. The guard had a radio with a flat battery. Using his mobile phone, the guard contacted the signaler at Moss Vale as he did not have the number for the signaler at “Tennessee”. Rail terminology was used that was not understood by the emergency responders. The train controller did not have an appropriate map that enabled him to provide the emergency services with directions to the site.

This accident highlighted a lack of an effective emergency response from the crew and a lack of effective communication procedures. There are many examples in this accident that highlight the lack of an emergency plan. These same issues arise later at the Waterfall accident.

Initially police and ambulance officers were attempting to transfer passengers from the train to the top of the embankment by using ropes to haul each passenger up the side of a cutting. However a safer route was then found by walking passengers along the base of the cutting for a short distance to a gentler track. There was a need for better consultation between the emergency services and rail personnel at the site.

**January 2003: Waterfall.**

A four-car Tangara train operating from Sydney to Port Kembla overturned at high speed and collided with a stanchion and a rock cutting approximately 2km south of Waterfall. When the train hit the staunchion the first and second carriages righted themselves.

Of the 49 persons on board, the driver was deceased (however that was most probably due to medical reasons rather than as a result of the accident), 6 passengers were killed and 47 passengers and the guard were injured.

As a result the crew were not available to conduct the evacuation and passengers were unable to quickly escape the wreckage except where the structure had been opened by the crash.

Upon arrival at the site the emergency services did not know how to open the train doors from the outside, they were unfamiliar with the panels marked EDR that indicated the position of the “emergency door release” button. In some cases police resorted to using rocks to attempt to break some windows.

It was discovered that some doors were unable to be opened by use of the external EDR buttons. According to the accident report this may be due to the weight of the plug type doors or due to no or insufficient stored air being available. This needs further investigation.
It was also found that while the multi-layer polycarbonate windows had hampered passengers’ efforts to escape from the carriages, the strength of the windows had helped contain passengers during the roll-over.

May 2004: Baan Baa.

This accident involved a collision at a railway crossing, between an automobile and a CountryLink Xplorer. The train derailed and the front carriage ended up on its side, with the fuel tank ruptured. There were some injuries and two passengers required hospitalization.

As the front car tipped over, the coupling between the carriages broke, leaving the second car upright. This exposed a doorway at the rear of the first carriage through which the passengers were able to exit. However as the train was on its side, it was very difficult to climb through the carriage, over seats, baggage and the spilt hot water from the buffet.

The two photographs that follow show the inside of the first carriage and illustrate the difficulties that would be experienced by passengers when the car is in this state.

Figure 3: Photograph of the first carriage of the Xplorer involved in the accident at Baan Baa. The photograph is taken looking forward towards the door that provides entry into the driver’s cab.
The Office of Transport Safety Investigation sent out a survey to the passengers involved in this accident to seek information from them regarding emergency evacuation.

Generally the survey indicated a lack of emergency information being provided to the passengers. Of the 17 passengers who responded to the survey, three remembered seeing some written instructions regarding emergency procedures.

Passengers reported having difficulties getting out of the train, due to being injured, being in pain, having other passengers on top of them, having to crawl over seats, over glass windows, over hot water spilt from the buffet, suffering from shock, smelling and seeing fuel lying everywhere. Some passengers recalled that people were shouting and screaming to “get out urgently”, feeling panic as they thought the train would explode or a fire would start due to the spilt fuel.

These types of passenger surveys can be most useful in obtaining details of the passengers’ experience in the aftermath of the emergency and should be considered in the future following similar occurrences.

Two passengers in the first car described how they helped the driver from his cab and assisted him out of the rear of the carriage. As can be seen by the photographs on the previous page, the design of internal doors is important when the cars end up in an unusual attitude. Gravity can make the doors very hard to open and to keep open. That is why there should be some device to keep the door open. These findings are reflected in some of the overseas standards. For example, in the UK, the ATOC Vehicle Standard requires that internal doors should be hinged from opposite sides or should slide in opposing directions.

This accident also indicated a lack of any suitable response planning by CountryLink to follow up on the passengers, many of whom are angry at having heard nothing from the organisation.
6.3 Findings from Rail Emergency Exercises

Train Disaster Field Exercise “Blue Rattler”

This exercise was conducted in May 1997, in the Sydney underground railway tunnel system between Wynyard and Town Hall stations. It was a full field exercise with the State Rail Authority participating along with all the relevant emergency services. The scenario involved the detonation of an incendiary device aboard a passenger train.

The exercise involved 40 “passengers” on the train at the time of the emergency. In this exercise it took two hours to evacuate the passengers from the train to safety outside the station. This was with only 40 passengers involved whereas there can be trains traveling at peak hours within the city carrying around 1500 passengers.

It was the unanimous view of all the combat agencies who attended the exercise that had this situation been a real event it is most probable that all the passengers would have died from fire or smoke either on the train or in the tunnel.

The major issues identified at this exercise included:

- The deficiency of communications, both via the telephone system within the tunnel and communications from the train;
- The lack of a smoke extraction system and a ventilation system within the tunnel;
- The lack of any smoke, fire detection or fire suppression system in the tunnel;
- The fact that passengers were unable to open doors themselves and self evacuate;
- The responding emergency services did not know how to open the train doors from the outside;
- The ladders used for passengers’ egress from the train down to the track are difficult to use. Elderly passengers or those with mobility problems would find the ladders very awkward;
- The exercise highlighted the difficulties in removing injured passengers from a train in this situation;
- Once they had arrived at the station it took a long time for the emergency services to reach the train.

In the opinion of the responding emergency services they all expressed concern regarding the difficulties encountered regarding train access; the total reliance by the passengers on the train crew to open the doors and the need for additional emergency response training for rail personnel and train crew.

Operation “Join Forces”

This exercise was held on the 10th July 2004, in the Sydney underground railway tunnel system at St. James station. The exercise involved RailCorp personnel and a few observers from the Independent Transport Safety and Reliability Regulator. The exercise involved four scenarios, including a controlled evacuation from a train stopped within the tunnel due to a technical problem, and a fire on a train and a subsequent evacuation.

The train used in the exercise was positioned about 100 metres south of St. James station. As a result the “passengers” were evacuated to the track via the use of stairs placed at the front of the train. Several issues were noted during this exercise:
• Inappropriate announcements made over the PA by the train crew. The guard made several announcements in which he sounded very stressed and scared. In a real event this would have had the effect of alarming passengers;

• There was a conflict between the announcements made by the guard and that made by the driver. Whilst the driver was asking people to remain calm, the guard was directing people to make a “speedy evacuation”;

• Some of the transit officers were involved in the exercise, and this showed the importance of having these officers trained so they can assist with an emergency situation. In one of the exercises, the author of this paper observed that the officers remained calm and provided a calming effect to the “passengers”, the fact they are in uniform gives them a degree of authority;

• The ladder positioned at the front of the train is awkward to use. Elderly passengers or those with mobility problems would have difficulty;

• There is the potential for passengers to be injured as they descend the ladder onto the ballast which is very hard to walk upon. If passengers descended the ladder in a hurry or if they tried to jump they could fall on the ballast below;

• Had this been a real event rather than just an exercise, it is most likely that some passengers would have jumped off the train between cars to avoid waiting in the queue to get off at the front of the train.

Although problems were identified, RailCorp are to be commended for holding this exercise. It is through the conduct of exercises that problems can be identified and emergency plans and procedures can be improved.

6.4 Review findings from past rail accidents.

In the preceding reports there are examples of fires on trains, accidents within tunnels and accidents occurring as a result of collisions between road vehicles and between other trains. There are accidents in remote areas, in metropolitan areas and off bridges into water. Train operations within NSW operate in all these types of environments.

Running through many of these reports are some common themes. The need for improved signage and instructions provided to passengers to ensure they are better prepared to respond appropriately in an emergency is repeated in several accident reports as is the need to ensure the escape devices are maintained and easy to use.

Some of these accidents are significant in that they brought about tighter rules and regulations. The USA, Canada and the UK imposed stricter regulations as a result of recommendations from investigations involving some of these recent accidents; to be specific this included the major accidents at Silver Spring and at Mobile; at Brighton and Biggar; and at Ladbroke Grove respectively.

Even though the ability for passengers to self evacuate existed in these specific accidents, the reports found that the provision of inadequate emergency information doubled with inadequate lighting contributed to injuries and in some cases fatalities.

6.4.1 Emergency Procedures

Another recurring issue throughout these accident reports is the inadequacy of the crew response and the inadequacy of the emergency response by the operator. This is evidenced by recent accidents within NSW, where crew did not effectively manage the evacuation of passengers and where the operator’s emergency plan did not adequately provide protection for the accident site. The lack of effective procedures to enable quick and informed
notification to the emergency services and effective interaction with the emergency services whilst on site are other reoccurring themes. These same issues arose in the exercise “Blue Rattler”.

The issue of crew training arises again in the two exercises described in section 6.3. This issue needs further investigation. If train crew are to be responsible for conducting an effective controlled evacuation they need to be equipped with the necessary tools to accomplish this. This means adequate training, practise in the use of the PA and serviceable and reliable communications equipment.

6.4.2 Emergency Access

In some accidents both overseas and within NSW, emergency services personnel have been delayed in gaining access to the train by being unable to locate or operate external door opening devices. This issue arose at the Waterfall accident and the earlier exercise “Blue Rattler”. Emergency responders did not understand the term “EDR”. The panel covering the EDR device is not identified as being a piece of emergency equipment.

Some of the recommendations from accident reports included in this section are that clear signage and instructions are to be placed outside the train for the information of responding personnel.

To train all emergency services personnel in the term EDR would be very difficult due to the numbers of staff involved throughout NSW and the high turn-over of staff, especially in the voluntary organisations.

6.4.3 Diesel and Electric trains

Three of the accidents described previously in section 6.1 resulted in major fires as a consequence of collisions involving diesel powered trains, notably Ladbroke Grove in the UK, Silver Spring in the US and Brighton in Canada.

Both the trains involved in the accident at Ladbroke Grove, the Turbo and the High Speed Train, were diesel powered. Upon impact there was an almost immediate development of fireballs and subsequent fires on and around the trains. It was agreed that the source of fuel for the fireball was finely dispersed diesel fuel.

Much of it came from the contents of the fuel tank of the front car of the Turbo which contained 688 litres at the time of the crash. The presence of diesel fuel inside one of the coaches (coach H) played a significant role in the development of the fire from its early stages. Mr Christie of Geoffrey Hunt & Partners, who was called to the subsequent inquiry as a specialist in the investigation of fires and explosions, explained that in the early stages the predominant factor was the combustion of diesel fuel. He stated it was inevitable that, when an accelerant was burning on a material, even one which was normally fire-retarded, there would be an eventual stage where the material could no longer resist the fire. He believed that diesel fuel could have entered the coach by way of broken windows, openings at each end of the coach and/or areas where the body of the coach had been damaged.

It was agreed between the experts that this fire spread through the coach over the course of seven or eight minutes until it fully engulfed it. Of those passengers who remained in coach H after the impact of the crash, all but one managed to escape from the coach before fire engulfed it. The majority of the combustible materials within the coach were then consumed over a period of about 30 minutes.

There were many potential sources of ignition. The most likely were the overhead line equipment, the onboard electrical systems and sparking, all three of which were almost certainly present.
Another example of a catastrophic fire involving diesel operated trains was at Silver Spring, involving the collision between an Amtrak train and a MARC train. The subsequent investigation found that the fuel tank of the Amtrak lead locomotive unit had catastrophically ruptured open during impact. The fuel had then ignited and sprayed over and engulfed the MARC cab control car.

At Brighton the piece of rail punctured the fuel tank and the severed electrical power cables provide the source of ignition.

Even though diesel is a relatively stable product, these accidents prove that given the right conditions such as fuel escaping under pressure and the presence of an ignition source, a fire can result.

While electric trains would not have the same potential for ignition as that of diesel trains, both electric and diesel trains operate within NSW and they use the same tracks and infrastructure, so the potential for collision between the two types is possible. The majority of trains operating within NSW are now built with fire retardant material; however there are some examples of older passenger trains still in use that would not be of the same standard. Some of the older diesel trains, notably the 620 and 720 cars, have interiors lined with wood panelling that would pose a greater risk in the event of fire. So it needs to be recognised that there are some differences between trains operating currently within NSW, and this should be taken into account with respect to emergency procedures and crew training.
7.0 FINDINGS FROM THE WATERFALL COMMISSION OF INQUIRY

The Waterfall accident was an example of the train crew being disabled and unable to direct the evacuation. Emergency services had problems gaining access to the train and passengers had difficulties getting out.

The issue of RailCorp's door security policy was raised several times during the Waterfall Inquiry.

7.1 Evidence from Mr Heumiller

On day 84 of the inquiry (15\textsuperscript{th} March 2004) evidence was given by Mr Donald Les Heumiller. Mr Heumiller is an engineer who worked on the construction of the Tangara train. He was questioned extensively regarding the door security policy of StateRail and the inability of passengers to be able to open doors in an emergency.

He was not in agreement with the StateRail policy. He believed that the trains should have doors capable of being opened by passengers following an emergency. When questioned as to how this could be achieved whilst at the same time trying to prevent people accidentally (or deliberately) opening the door when they should not, he offered a few suggestions.

He suggested that the mechanism to operate the door in an emergency could be 1/ placed under a break-glass cover and 2/ could be related to the speed of the train. He explained that there are speed sensors on board the train which allow for the activation of various operations electrically. It is possible that the doors could be locked until such time as the train was below a predetermined speed, for example 3 km/hour. This would mean that if a passenger did inadvertently open the door the effect would be benign.

He stated that the train could be so designed that unless it was stationary or close to stationary the emergency door release mechanism would not operate. Or if the train was stationary and delayed, then the passengers would have to break the glass to get at the emergency door opening device.

There could also be a time delay fitted to the emergency door release, so that if it were not an emergency and someone were improperly using the emergency door release, when they break the glass and pull the handle for example, then an alarm bell would ring in the guard's compartment. If there was no obvious reason why the doors should be opened, then the guard could simply override that by pressing some other button or taking some other course of action.

Mr Heumiller indicated that the above features were not technically difficult tasks.

During his evidence, the use of CCTV to monitor any vandal activity at the emergency doors was mentioned as being possible.

The inclusion of a ramp or ladder for passengers to get from door down to the track was also mentioned, as escaping from a train can be awkward if the train is not stopped at a station platform. Jumping from the door down to the track could result in injury.

7.2 Evidence from Mr Frankovic

Several passengers gave evidence and reported on difficulties experienced in trying to get out of the train. For example, on day 11 (8\textsuperscript{th} April 2003), there was evidence from Mr Frankovic.
He was very scared and believed that there may have been a fire following the accident. He assisted another passenger in trying to break a window to escape. He described the situation as being in a box, “a potential death trap”. He could see no other way to get out of the train.

### 7.3 Evidence from Mr Johnson

On day 24 of the commission (8th May 2003), David Edwin Johnson, a train driver employed by StateRail, gave evidence. Upon hearing of the accident the morning it happened, Mr Johnson had proceeded directly to the site to see if he could offer assistance. He lived nearby and was able to reach the site within an hour, arriving at the same time as some of the police and the Rural Fire Service.

He saw that the police were having trouble entering the train cars. He went to the third car, which was on its side, and operated the emergency push button (the EDR) however he stated that “due to the fact that the car was on its side there was insufficient air pressure to push the doors up before they open……they didn’t get far enough up to start opening, so I couldn’t get into that car”.

Mr Johnson stated that the emergency reservoirs were probably intact, this led him to believe that there is insufficient pressure to enable the doors to be opened when the car on its side.

He reported that the attending police wanted to get in the car as a matter of some urgency and they used a large rock to break the glass in the door in an attempt to gain access.

Mr Johnson then met up with the train guard from the stopped northbound train, (the train on the Up had been stopped just north of Helensburgh) who had walked up to the accident site. The guard had obtained the door emergency release bar from underneath the guard’s seat of the affected Tangara.

Mr Johnson and the guard then went to the second car to attempt to open the doors. They were unable to open the doors on the southern end of the carriage as the carriage was buckled. They were able to open the doors at the northern end of the car.

Mr Johnson then went back to the inside of the third car to use the door release bar to try and open those doors in that car, however the bar had become bent and the thread could not be inserted into the other doors, it had become useless after attempting to open the doors on the second carriage.

On returning to the third car, Mr Johnson found that with the glass removed from that door there was enough air pressure to push the doors up with a bit of assistance. The emergency services were then able to open the doors and put ladders into the third car. This enabled them to get people in and out using the ladders.

Mr Johnson was then ordered off site by the crew area manager, his supervisor.

Whilst giving evidence at the commission, Mr Johnson was asked if he had any suggestions that could assist getting the train doors open when the cars are on their side. He offered the following solutions:

1. the doors could be made of a lighter material. The two panes of glass currently used in the door are very heavy;
2. the use of a removable runner so the windows could fall out easily; and
3. that the emergency air reservoir pressure could be increased to an extent where it would be able to lift the doors when the car is positioned on its side.
Mr Johnson stated that nobody at the scene knew how to open the train doors, nobody knew about the EDR button. He stated that he “walked up probably an hour after the incident and just pressed the button and the door opened straight away on the second car and no-one had actually thought to do that because no-one knew about it”.

He recommended that a sign or sticker should be placed next to the emergency buttons so they could be recognised by the emergency services. He did not believe it was possible to train all the emergency services personnel on train entry equipment.

7.4 Evidence from Mr Lauby

Mr Lauby, formerly from the National Transportation Safety Board (NTSB) in the US, assisted the Commission. He gave evidence on day 62 (29th July 2003) to the Commission regarding train operations within the US. Trains are required to have emergency doors and windows that can be opened by passengers in each passenger car. The emergency exits are marked on the outside of each car by prominent luminous and reflective signs. Mr Lauby stated that although there are times when it is best to keep passengers inside a train in an emergency, there are other occasions when the passengers need to be able to escape.

Mr Lauby used two examples of rail accidents where escape was necessary, the accident at Mobile, Alabama; and the collision at Silver Spring in Maryland. He stated that these accidents provided a great learning experience in the US and brought about new regulations relating to the working of emergency exits and the location of door release mechanisms.
8.0 OTHER REPORTS AND ASSOCIATED RESEARCH

As part of this project some other associated reports and research were found that were relevant. Some of these are briefly described in the following section.

8.1 Comparison with other operators

A report commissioned earlier this year included the results of an international survey regarding emergency access and egress. The resulting report is dated 6th April 2004.

The authors of the report surveyed eight non-identified railway operators; two from Australia, two from the US, two from Asia, one from the UK and one from Northern Europe.

Results of this survey indicate that the two Asian operators evacuated passengers by having them move along the train which has open gangways between cars, and then proceed into the crew compartment which is accessible by passengers in an emergency. The passengers then detrain out of the end detrainment doors. No emergency escape device is fitted to allow passengers to open side doors. However both these operators run systems in a metropolitan environment and the majority of the route is in a tunnel or on an elevated structure.

Of the other operators surveyed, all advised that on their trains the side doors are always operable by passengers in an emergency. Some also provide emergency escape through emergency exit windows.

One Australian operator replied that the side doors can be forced open in an emergency but new trains are being provided with emergency release devices on the doors (windows do not form part of their emergency egress strategy).

8.2 Research conducted by Professor Galea

Professor Galea, Director of the Fire Safety Engineering Group at the University of Greenwich in the UK, has conducted research on passenger evacuation from different transportation modes, including marine, aviation and rail. He carried out a project on “Evacuating an overturned smoke filled rail carriage”.

He argues that there is a requirement to ensure that “rail vehicle design and crew procedures are adequate to allow the safe egress of passengers under a variety of conditions”. He has carried out tests on evacuations from overturned and partially overturned carriages. Due to his expertise in the area of evacuation he was called as an expert witness at the inquiry into the accident at Ladbroke Grove.

He is of the opinion that there should be more consideration given to “improving safety related signage onboard trains and the oral communication of safety information to passengers”. On intercity services he suggests additional oral and written information should be provided to passengers in a somewhat similar fashion as is used on passenger aircraft.

He suggests that accident investigators should consider carriage design and passenger survivability factors whenever there is an evacuation from a train, no matter how minor the incident was, as valuable lessons can be learnt as they have from aviation incidents and accidents.

He hopes that the rail industry and rail regulators will “explore these issues as they have a
demonstrated impact on passenger survivability and hold the potential to make an already safe form of transport safer by design”.

8.3 Research into Emergency Door Release conducted by Interfleet Technology Ltd.

Interfleet Technology Ltd., based in Derby in the UK, was commissioned by Railway Safety (UK) to undertake research into emergency door release mechanisms with emphasis on signage and illumination. This project was carried out in response to recommendations made by the Ladbroke Grove inquiry.

Generally this project concluded that information provided to passengers should be clear and concise. Ideally wording on signage should be reinforced with pictograms where possible. However signage should not rely on the use of pictograms solely. Emergency door opening instructions should be located adjacent to the door to which it refers. The signage must not block any panels or covers that protect the door opening or unlocking device. To avoid confusion, other unrelated signs should not be in the same vicinity.
9.0 REVIEW OF LEGISLATION AND STANDARDS IN SOME DEVELOPED COUNTRIES

A review of any existing standards and legislation covering emergency access and egress on trains was conducted to see what was in place in some other countries. There are currently no standards in place within NSW that cover this issue. This study focussed on what was in place in the UK, the USA and in Canada.

9.1 United Kingdom

There are several standards in place in the UK covering the issue of emergency evacuation. Some of these are covered below. Following the Southall and Ladbroke Grove accidents, these standards were amended and criteria covering passenger escape equipment became more prescriptive.

9.1.1 British Standard BS 6853:1999


Section 10 of this standard covers passenger and crew escape requirements.

It states that "all trains should have doors which can be used for emergency exit." The standard covers distances of seats from the nearest emergency exit, "no passenger seat should be more than 15 m from an emergency exit door on the train,…"

In the case of trains that are designed for running on routes where emergency evacuation from the sides of the train is not possible, this section states that "the emergency doors should be at the ends of the train, and it should be possible to gain access to both of these doors from any part of the train." This is the case with trains operating in the London Underground, where the risks of permitting passenger evacuation from the sides of the train are considered too great. The London Underground procedures call for the evacuation of passengers to be managed by the crew who are trained in this role and who have a good knowledge of the operating environment.

Section 10.2 covers the “Properties of emergency exit doors”. This section states that "Emergency doors, which are normally, or which may be, locked should be capable of being opened in an emergency by passengers without the use of keys or tools."

Section 10.3 covers “Powered external doors”. This section states that "Power operated external doors should be capable of being opened in an emergency by passengers, without the use of keys or tools, from inside the vehicle even if the power or powered operating mechanism has failed."

Sections 10.4 and 10.5 cover the requirements for internal doors. Power operated internal doors should be capable of being opened without the use of any keys or tools, even if the power has failed. Swing doors in corridors should swing in both directions, but if only a single direction is possible then this should be towards the nearest external door.

Section 10.6 covers the requirement for emergency lighting to be available for 90 minutes after losing main power.
9.1.2 Power Operated External Doors on Passenger Carrying Rail Vehicles GM/RT 2473

This Railway Group Standard is dated February 2003. Railway Group Standards are mandatory. This is a document that is most relevant to this project. This standard came into effect on January 1st of this year. It mandates that only power operated external doors are to be fitted for passenger use on trains. It stipulates that to ensure safety of the occupants doors are to be prevented from opening whilst the train is in motion, or, when the train is stopped away from a platform and/or it is not safe for the doors to be opened.

However, this standard stipulates that each external door is to be fitted with an external emergency access device to enable the doors to be opened from the outside when the train is at a standstill and that this mechanism must be operable irrespective of the vehicle power supply at the time. The operating instructions for this mechanism are to be clearly labeled.

It is also stated that each door is to be provided with an internal emergency egress device so doors can be opened from the inside by passengers irrespective of the power supply. However, the door will only be able to open when the train speed is less than 5km/hour. Again the device is to be clearly labeled and there should be instructions for its use.

9.1.3 Emergency and Safety Equipment and Signs on Rail Vehicles. GM/RT 2177

This Railway Group Standard, dated January 1995, covers the requirement for safety and emergency signs to take priority over other signs. It provides guidance on the information that should be covered in emergency signs in that the text and layout of the sign must reflect the importance of the information. For example:

1st piece of information would name the equipment;
2nd piece of information would describe its operation;
3rd piece of information would advise restrictions in its use;
and lastly information to deter inappropriate use, for example the penalty imposed for improper use.


ATOC standards are not mandatory but are advisory. Issue One of this document was published in December 2002. This standard was produced on behalf of the Association of Train Operating Companies (ATOC) by Railway Safety. It is intended for use by the railway industry and it is expected that all companies contributing to the supply of new railway vehicles to operate in the UK will comply with its requirements.

The purpose of this document is to ensure the interior design of rail vehicles provides passengers and crew with adequate opportunity to evacuate and escape from a train in the event of an emergency.

The standard, in a similar fashion to the requirements for aviation, stipulates a minimum time that passengers should be evacuated. Section 6.1 a) states that:

For side evacuation, …..with maximum passenger loading conditions…..all passengers shall be evacuated to platform level in a period not exceeding 90 seconds."

Section 6.1.1 stipulates that no passenger seat may be located greater than 12 metres from a bodyside door or a bodyside emergency escape exit on both sides of the vehicle.
This same section states that:

"Power operated bodyside doors and manually operated slam doors fitted with a secondary locking system shall have emergency door release facilities adjacent to each door."

This standard stipulates that if there is some type of removable cover over the device that operates the escape exit, the removal of it or operation of the emergency device must not entail the use of tools or keys. However the cover should adequately deter unauthorised use under normal conditions.

This standard also covers the operation of internal doors. Section 6.1 of this standard covers the requirement that passengers should be able to open internal doors regardless of the state of power. To overcome the problems associated with operating internal doors when the car has derailed and is wholly or partially overturned, this standard states that:

"...internal doors shall slide open in opposing directions or be hinged from opposite sides at each end of the passenger saloon…"

9.2 CANADA

Following the accidents at Brighton and at Biggar, the Canadian rules and standards were amended as a result of the recommendations made by the Canadian Transportation Safety Board in response to these accidents. As in the US, Canada requires that each passenger car has no less than four emergency windows per passenger carriage.

In recent discussions with the Railway Association of Canada (RAC), they do not record many instances of vandals tampering with emergency door release mechanisms. If a door opening device is operated inappropriately, then an indicator light would illuminate in the driver's cab and the train would stop.

The RAC also indicated that the information provided in the form of a safety brochure to passengers, advises passengers to keep away from other train tracks in the event they do need to escape the train.

9.2.1 Railway Passenger Car Inspection and Safety Rules

The Railway Association of Canada (RAC) produced these passenger car safety rules. The most recent issue is dated 8 November 2001. These rules prescribe minimum safety standards for passenger cars.

These rules stipulate that any powered doors and steps must have provision for manual operation in the event of a system failure. The preferred means of evacuation is for it to be controlled by the crew. However, these rules ensure that passengers will be able to open doors themselves as a last resort (reference section 19.3).

These rules also cover emergency exit windows. Section 20.2 states that "each passenger car shall have at least two accessible emergency exit windows free of obstructions installed on each side of the car, located near each end of the car, for a total of four emergency exit windows."

In addition these rules stipulate that there should be clear, visible instructions for passengers, that emergency equipment should be visible and accessible in each car, and that the interior finishes of the car should be free from any sharp objects or projections.

9.2.2. Railway Passenger Handling Safety Rules

These rules produced by the RAC cover the requirement for railway operators to have documented passenger handling safety plans that cover different types of emergencies from derailments to terrorist threats and that crew should be trained in these procedures.
9.3 USA

Since 1970 it has been a requirement in the USA that all passenger carriages should have a minimum of four emergency windows. The accidents at Mobile and at Silver Spring resulted in changes to the US legislation and standards as a result of the findings and recommendations made by the National Transportation Safety Board (NTSB). These accidents highlighted that it was necessary to maintain emergency exits, both doors and windows, and to provide adequate information and signage to passengers regarding their use.

During the NTSB's investigation into the Silver Spring accident, concern was expressed that unsafe conditions that had been identified on the MARC train may exist on other commuter lines. In 1996 the NTSB recommended that the Federal Railroad Administration (FRA) should inspect all commuter rail equipment to ensure that there were easily accessible emergency release mechanisms located adjacent to exterior doors and that there should be removable windows and prominently displayed emergency signage. The NTSB were concerned that the emergency release mechanisms for the exterior side doors on the MARC train were located in a secured cabinet some distance from the doors that they controlled. The cabinet required a screwdriver and a coin to open it. This was done to prevent inappropriate opening of the door whilst the train was in motion.

The new ruling implemented as a result of this finding was that emergency release mechanisms for exterior doors should be well marked and relocated so they are positioned adjacent to the door that they control. The new ruling permitted rail operators to protect the emergency release mechanism from casual use by placing a cover or screen over the device. However, this screen must be able to be removed without the use of any tool or special implement.

The FRA issued Emergency Order No. 20 that required emergency exits to be clearly marked and in operable condition on all passenger lines. This order required the position of emergency exit locations to be clearly marked both inside the car for the benefit of passengers and external to the car to assist emergency responders.

In recent discussions with the Federal Railroad Administration (FRA) in Washington D.C., they advise they are currently in the process of considering revisions to enhance these standards. They also advised they had few instances of vandals operating doors and windows inappropriately. They did recall a few instances some years ago, where there was a power failure and due to the lack of air conditioning and extremely hot conditions in the carriage, passengers popped the emergency windows to get air.

Some of the relevant standards include the following:


These regulations, 49 CFR, are federal law and are therefore mandatory. They include the need for emergency windows and doors that can be opened from both inside and outside the car by use of a manual override feature.

Each passenger car is to have a minimum of four emergency window exits, designed to permit rapid and easy removal from the inside of the car in an emergency situation, that do not require the use of any tool or special implement.

Each passenger car is to be equipped with a manual override feature for each powered exterior side door. Each of these manual override mechanisms must be capable of releasing the door to permit it to be opened, without power, from both the inside and outside of the car. Each of these devices must be located adjacent to the door which it controls.
The rail operator may protect these emergency door opening devices by placing a cover or screen over the devices. These covers must be capable of being removed without the use of any tool or implement.

All door and window emergency exits are to be marked and instructions provided for their use.

All door exits intended for emergency access by emergency services personnel are to be marked with retro-reflective material with clear and understandable instructions.

Emergency lighting is to be provided in each passenger car supported by a back-up power supply that is capable of operating in all equipment orientations and for a time period of not less than 90 minutes.

Passenger compartment end doors (i.e. doors that provide access to the next car) are to be equipped with a kick out panel, pop-out window or other similar means of egress in the event the door will not open, or alternatively, they are to be designed so as to pose a negligible probability of becoming inoperable in the event of car body distortion following impact in an emergency.

Also covered is the need for operators to have in place an emergency plan to ensure an appropriate response. It covers the subject of staff training. After initial training, train crew are to receive periodic training at least once every two years thereafter. The same applies to control centre personnel. This regulation also specifies the number of full-scale emergency exercises that each rail operator should conduct.

Under the heading of “special circumstances” the operation of trains within tunnels is identified as needing special consideration. The train operator’s emergency plan must reflect procedures designed to protect passenger safety in an emergency situation occurring in tunnels of 1,000 feet or more in length. For example the plan must include the provision of emergency lighting, access to emergency evacuation exits, ladders for detraining and effective radio or other communications.

The issue of escape hatches in the roof of the train is covered in the section titled “Emergency roof entrance locations”, which states that each passenger car is to have a minimum of one emergency roof hatch. This issue has been debated, with the major operators expressing concern about the inherent dangers of such a hatch. As an alternative, this regulation continues on to state that instead of a hatch, there must be at least one clearly marked structural weak point in the roof to provide quick access for properly equipped emergency response personnel.

This item may need further discussion in NSW. Due to the presence of overhead electrical wiring, escape hatches would not be viable. As an alternative, it may be possible to distinguish areas in the roof of the carriages that identify the best place for the emergency rescue personnel to cut to gain quick access to the car. This could be most useful when the cars are on their side. This would be similar to what is currently used on many types of aircraft. The best area for the rescue personnel to cut through is identified and marked. This is an area that would avoid items such as hydraulic lines, bundles of wiring or other such obstacles. This would entail no structural work, rather the identification and marking of areas. There would be no indication inside the carriage.

Some parts of these regulations do not apply to tourist, scenic, historic or excursion operations.

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1 retroreflective material: material that reflects the light emitted by a light source back to that source.
These regulations are currently being reviewed. One of the issues being reviewed is that of emergency communications from the train to the train control centre. The FRA considers it vital that effective communications can be achieved to assist with the protection of the site and the halting of any oncoming trains. They believe each passenger train should be equipped with both a primary and a secondary means to communicate. They stress that these two means of communication must be required to operate correctly before a passenger train is dispatched.

9.3.2 Standard for Emergency Signage for Egress/Access of Passenger Rail Equipment.

This standard, APTA SS-PS-002-98 Rev 1, published by the American Public Transit Association (APTA), provides detail regarding emergency signage, including the minimum letter height that should be used on signs that indicate the location of emergency windows and door exits and the requirement for all interior emergency signs to be clearly decipherable from a minimum of five feet under emergency light illumination.

9.3.3 Standard for Emergency Evacuation Units for Passenger Rail Cars.

Instead of prescribing how many exits each car should have, irrespective of its configuration and carrying capacity, this standard, APTA SS-PS-003-98 Rev 1, provides a formula to provide an acceptable level of escape windows and doors based on the car design. This will ensure a sufficient number of exits to allow passengers to exit within a prescribed time. The term used in this standard is Emergency Evacuation Units (EEU). A car manufacturer must determine the correct combination of emergency windows and exits required to facilitate an acceptable emergency egress system and this is measured in Emergency Evacuation Units (EEU).

2 These standards were developed for the 19 commuter railroads and Amtrak that come under the jurisdiction of the Federal Railroad Administration (FRA). The standards are mandatory, in that all operators agreed up front to abide by them. However, APTA has no enforcement power.
10.0 REPORT ON FIRE RISK ASSESSMENT

A report was prepared for the State Rail Authority (SRA) in 1999 by Det Norske Veritas Consultancy Services. This was in response to a request by the NSW Department of Transport. Following the VIA Rail Canada accident at Brighton, Ontario, where forty-six passengers were injured after a fire erupted, the NSW Department of Transport asked SRA to assess the implications of the accident with respect to their operations within NSW.

This study carried out by Det Norske Veritas involved, amongst other things, a review of the existing emergency evacuation arrangements in place at SRA and quantified the frequency of fire occurring on SRA trains and compared this to UK fire frequency data. The report studied the Maidenhead rail accident in the UK and the Brighton accident in Canada to provide background information.

The intention of the study was to carry out an assessment of the risks of fire occurring on an SRA passenger train.

The findings of this report included that the risk of fire was higher on the SRA network than on the UK network. The report made a calculation of fire frequency rates using the SRA data and compared this to UK data. Dividing the number of fires occurring per annum by the total average train kilometres per annum, it was found that the SRA fire frequency figure was twice as high as the UK figure.

The report then made several recommendations based upon good practice established in the UK and in Canada. One of these recommendations included:

“The provision of a facility to open the doors from the inside in an emergency is recommended. If secondary door locking is installed then information should be provided to passengers as to how to override it in an emergency.”
11.0 SUMMARY

According to the accident and incident RIC/RailCorp database there were a number of injuries and fatalities in the early to mid 1990s due to people opening doors and jumping or alighting from moving trains. The State Rail Authority had to take action to prevent that level of injury continuing so they introduced a door security policy. This entailed the introduction of central locking to keep the doors locked whilst the train was in motion and the removal or deactivation of internal door opening devices.

Although the action of locking the doors resulted in a decline in the number of injuries, a consequence of this action was the ability of passengers to self evacuate in an emergency was removed. There is no evidence to indicate that the decision to implement a door security policy and remove the door opening mechanisms for passengers was based on a proper risk assessment.

Other countries studied in this project afford passengers the capability to self evacuate from a train in an emergency. In some countries it is mandatory that there be door opening devices fitted for passengers to self evacuate. In fact, recent accidents highlight that it is not enough to have the ability to open doors and windows in the event of an emergency but that the equipment must be maintained to ensure it will work, the equipment must be able to be used easily without the use of tools, the action of operating such equipment must pose no extraordinary difficulty for the average person and there needs to be sufficient signage or instructions to ensure passengers understand how to operate the equipment.

Several accidents are reviewed in this report. Some of the accidents that involved fire resulted in fatalities when passengers were unable to escape due to locked doors, faulty equipment or the inability to find and active emergency door release devices quickly enough.

There are examples of rail accidents where the emergency services have been unable to access the train due to lack of familiarity regarding emergency door opening devices coupled with inadequate signage external to the train and/or faulty door opening devices. In some cases this delay has led to the death of some passengers. There are examples of train accidents within NSW where the emergency services did not know how to open the train doors and were delayed in gaining access to the train and allowing passengers out, two notable examples being the accidents at Waterfall and at Linden-Woodford.

Within NSW, passenger trains operated by RailCorp have external emergency door release (EDR) mechanisms installed to facilitate entry by the emergency services. These are located behind a panel on both sides of each car. In some cases these devices require the use of a key. There is no clear sign that directs emergency services personnel to the location and the purpose of this mechanism, rather the acronym “EDR” is used, located on a placard either above or adjacent to the device. This lack of identification is intended to discourage unauthorised access to the train.

After considering rail accidents that have occurred overseas and within Australia, this project has determined that firstly, members of the public should be afforded the opportunity to escape from a train in extreme circumstances. Secondly, that external emergency door release mechanisms should be clearly identified to facilitate quick activation by the emergency responders and that their use should not require the use of any key.

In recommending the installation or reactivation of door opening devices the associated risks must be recognised and adequate protection put in place. Door opening devices must be designed to prevent accidental opening or deliberate misuse. It is appreciated that the danger of vandalism to trains does exist, but this should not override the protection of passengers.
A recent tragedy in the Sydney suburb of Matraville (Sydney Morning Herald, 8 June 2004), where a woman and her two children died in a house fire, highlights the dangers that can occur when the fear of crime overcomes the requirement of safety. To prevent burglary the house was fitted with deadlocks, so when the fire started the occupants were locked in the house unable to escape the flames.

Apart from the risk of passengers falling or jumping from moving trains, the other risk of fitting emergency door opening devices is that of passengers self evacuating into what may be a dangerous environment. For example, the hazards associated with oncoming trains and from electrical wires. This is a legitimate concern and it is the reason that the preferred option is most certainly for passengers to remain on the train and be evacuated under crew control when it has been established that it is safe to do so.

However in an extreme emergency, where to remain on the train would pose the greater threat and passengers need to evacuate, the rail operator’s emergency procedures should provide for the quick and efficient establishment of as safe an environment as is reasonably possible.

The subject of poor crew performance following an accident and limited training is an issue that surfaces repeatedly in accident reports. Generally crews were found to be ill prepared for an emergency situation. Crew emergency procedures must be effective and crew must be adequately trained if they are to effectively manage an emergency situation. Each crew member should have an emergency checklist located in their work area that is prominently displayed. These procedures must be practised to ensure crew are competent. If passengers are to follow directions from the crew they must have confidence in them. Crew must be adequately trained so that they can effectively manage an emergency situation and instil confidence in the passengers so that they will comply with the crew instructions. This training should not be limited to just the driver and the guard but to all crew working on a train, including passenger service staff and security officers, as evidenced by the accident at Linden-Woodford.

An issue that will need further investigation is the issue of fire ratings of different train types. In NSW there have been few fires on trains that would have posed a danger to passengers similar to that experienced by some of the overseas operators. The majority of fires on NSW trains are class “A” fires started by vandals using waste paper and are easily extinguished. Materials used within passenger carriages are unlikely to burn easily.

However, one hazard that has changed in only recent times is the threat of terrorism. Until recently Australia has been in the enviable position of being well isolated from the terrorist threat. However, it may well be that recent world events have, to an extent which is still unclear, increased the risk. The events in Madrid in March this year provide an example of the disastrous repercussions of such an attack. Fire is not the only threat as terrorism can take many other forms.

So although it may be argued that the event of a catastrophic fire is low, there are potential situations that could arise that would require the speedy evacuation of a train. It must also be recognised that the crew, positioned as they are at the front and often, depending on the number of cars, the rear of the train, can be vulnerable to injury and may be unable for a variety of reasons to conduct an evacuation. Passengers must be given an alternative.

The research for this project illustrates that passengers need to be able to escape from a train in extreme circumstance when the situation is serious enough that to remain on the train would pose a greater threat.
12.0 RECOMMENDATIONS

In light of reviewed accident reports and the standards in place in other developed countries, it is the recommendation of the project team that passengers should have the means to escape a train of their own accord if the situation is serious enough to warrant it. This will entail the installation of emergency door opening devices. The risks associated with vandalism and passengers escaping into an unsafe environment are recognised and should be taken into account when implementing this recommendation.

It is recommended that external emergency door release mechanisms should be accessible without the use of a key and clearly identified. The abbreviation “EDR” is not recognised by all members of the emergency services and it would be virtually impossible to train all personnel. The issue of emergency responders being delayed in accessing the train is a reoccurring theme throughout several of the accident reports.

To prevent unauthorised access to the train when it is stabled, the train should be locked so that it is secure and the emergency door release mechanism rendered inoperative. The locking system should be designed in such a way that it is impossible to move the train while the release mechanism remains inoperative, i.e. it should not depend on crew remembering to reactivate the release mechanism.

In recommending that the facility should exist for passengers to open doors, the possibility of vandalism and inappropriate use of the door opening device must be recognised. There are very real dangers associated with passengers opening doors when the train is moving, as well as that of escaping onto nearby tracks where there is the hazard posed by oncoming trains. As a result the following parameters should be incorporated into the installation of door opening devices:

- **a)** The doors should be locked when the train is moving. The doors should lock automatically when the train is about to commence to move. This will guard against people opening doors and falling out when the train is moving.

- **b)** When the train comes to a stop (away from a station), for any non-emergency situation, the train crew should be able to ensure the doors remain locked. Passengers must not be able to detrain themselves in such a situation. Should a passenger attempt to operate a door this action should alert the train crew, most probably via the use of an alarm. The crew can then actively “re-lock” the door. However this re-locking should only apply for a period of time, after which it would need to be reactivated if still desired. There should be some signal to the crew that the time has arrived for a decision as to whether to reactivate the locks, otherwise, crew who are busy with other duties might overlook the situation. After a predetermined interval of time, failure to reactivate the locks will leave passengers free to detrain.  

- **c)** The emergency door opening device located in the carriages must be designed and positioned such that it cannot be operated accidentally.

- **d)** The emergency door opening device should be guarded in such a way that it will discourage as far as possible acts of vandalism. There must be some type of cover or barrier over the device and it would be possible for the device to be alarmed so if it is tampered with, the train crew would be alerted.

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3 Reactivation should be an option available to either the driver or the guard because there may be a situation where one member of the crew is required to leave the train, such as when track protection has to be achieved.
e) There should be a suitable penalty imposed for those persons found guilty of tampering with safety equipment and/or emergency door opening devices. This is a crime of a different nature from that associated with acts of vandalism such as graffiti, rather this is a crime that endangers public safety.

f) Train crew emergency procedures and training will need to be reviewed to encompass any new equipment and procedures that result from a change to door policy.

To support the installation of door emergency opening devices, it is recommended that the following plans, procedures and infrastructure be put in place:

g) The placement of signage regarding emergency evacuation and escape needs research and consideration. The Australian Standard for safety signage should be adhered to when developing emergency signs for the inside of the carriages. The placement of information in seat pockets, on the back of seats, at emergency exits or on tickets, all needs to be reviewed. This review must take into account any differences between metropolitan and country operations.

h) The installation of additional safety equipment needs to be reviewed; the reviewed accident reports frequently refer to the benefit of placing equipment such as torches and loudhailers on board.

i) There needs to be an investigation into the ability of the PA system, the emergency lighting and the emergency door opening operation to continue in the event of the loss of power. Many accident reports mention the failure of the PA system and inadequate emergency lighting. This should be reviewed to ensure the system works when power is lost.

j) The facility for communications between the passengers and the train crew and the facility for communication between the passengers and train control or other location external to the train needs further investigation.

k) The ability to operate internal doors (i.e. those that facilitate passage between cars) when the cars are on their sides needs further investigation.

l) The ability to open doors from both the inside and the outside, when the train is on its side, needs further investigation.

The self evacuation of passengers from a train involved in an emergency is a last resort. It is emphasised that the first preference following an emergency would be for a controlled evacuation that is managed by the train crew. The train crew would be responsible for unlocking the doors to be used for the evacuation, they would then conduct a controlled evacuation and direct and assist all passengers to a place of safety, well away from the dangers of electrical overhead wires and railway tracks. To support the crew in this role, the following recommendations are made to ensure they are best equipped to handle any emergency situation:

m) Crew emergency plans and procedures should be rewritten to ensure they are clear and effective. Checklists for crew members should be developed from these plans. These checklists should be positioned within the crew work area so they can be readily referred to and actioned in the event of an emergency.

n) All train crew will need to be trained in emergency procedures, including evacuation procedures to ensure they can respond effectively. This training should be conducted on a regular basis, for example annually, to ensure skills are refreshed and kept up to date. This training should involve all staff who work onboard the train, including passenger service staff and security officers.
o) As part of their emergency procedures, train crew should receive training in the use of the PA in an emergency and they must have the opportunity to practise making emergency announcements during training. These skills should be assessed and crew should achieve a satisfactory standard.

To ensure the safety of passengers following an evacuation, rail operators need to have in place an effective emergency response plan that will enable quick recognition and response to an emergency situation. These plans and their supporting procedures must ensure the following:

p) Quick recognition of an emergency occurrence, including location, detail of the equipment involved and other relevant information;

q) Activation of the operator's emergency procedures to ensure appropriate notification of personnel;

r) Notification to the emergency services with timely and accurate information;

s) Activation of the appropriate emergency procedures to make the area within the vicinity of the accident "safe" especially with respect to advising and stopping of oncoming trains and the removal of electrical power;

t) Despatch of appropriate personnel to the site.

It must be taken into account in all of the above points that inherent differences in equipment and procedures between train operations within NSW need to be identified and catered for. For example metropolitan train operations and operations within tunnels may present different issues from long distance intercity or interstate travel and the historic tourist rail operators may face different issues again. Due to the differences in equipment and in operating environments, these operators and their passengers face different risks. When imposing standards across a range of operators, there must be enough flexibility to allow for these differences to ensure the safety of the travelling public. These different types of operations need recognition and consideration.
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