



Office of Transport Safety Investigations

BUS SAFETY INVESTIGATION REPORT

**CHARTER BUS FIRE
HOMEBUSH, NSW
8 FEBRUARY 2017**



Source: Telfords Bus & Coach

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HOME BUSH, NSW

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Published by: The Office of Transport Safety Investigations

Postal address: PO Box A2616, Sydney South, NSW 1235

Office Location: Level 17, 201 Elizabeth Street, Sydney NSW 2000
Telephone: 02 9322 9200
Incident and accident notification: 1800 677 766
Facsimile: 02 9322 9299
E-mail: info@otsi.nsw.gov.au
Internet: www.otsi.nsw.gov.au

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Investigation Reference 04765

THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

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

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

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

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EXECUTIVE SUMMARY

On Wednesday 8 February 2017, at approximately 0710, the driver of a Telfords bus detected smoke emitting from the rear of the bus. The driver was travelling on the M4 Western Motorway, at Homebush, Sydney.

The driver exited the Motorway and secured the bus on the Homebush Bay Drive exit ramp. As the bus came to a stop, the driver noted that flames were emitting from the near side rear of the bus. The driver immediately evacuated all ten passengers to a safe location on the side of the exit ramp.

Emergency services attended and extinguished the fire. There were no injuries sustained by any of the passengers or the driver of the bus.

OTSI found that the main battery positive terminal had created an electrical short-circuit with the metal battery retainer assembly. As a result of the short circuit, the batteries ignited and the ensuing fire propagated into the rear of the passenger saloon area.

As a result of the investigation, it is recommended that Telfords reinforce their vehicle operation training procedures, include battery security checks in their safety inspections, ensure compliance with OEM configuration and implement improvements to the battery retainer assemblies.

It is also recommended that the RMS ensure that HVIS Inspectors and bus operators are provided information in relation to the potential use of non OEM battery restraint systems.

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

PART 1 FACTUAL INFORMATION

Introduction

- 1.1 Approximately 0710¹ on Wednesday, 8 February 2017, whilst travelling westbound on the Western Motorway (M4) at Homebush, Sydney, the driver of a Telfords Bus & Coach (Telfords) bus detected smoke emitting from the rear of the bus. The driver exited the M4, secured the bus and evacuated the passengers onto the exit ramp near the intersection of Homebush Bay Drive. The rear of the bus then became engulfed in flames resulting in the bus being severely damaged by the fire.

The Occurrence

- 1.2 On the day of the incident, the driver signed on at 0600. After a brief preparation of the bus, the driver operated the bus to Strathfield as an empty service and departed Strathfield railway station travelling towards Homebush with 10 passengers on board.
- 1.3 Whilst driving onto the M4 at Strathfield, the driver saw smoke emitting from the near side rear² (NSR) of the bus. The driver initially thought that the smoke was from the exhaust of the bus. However, as the driver travelled along the M4, the driver observed that the amount of smoke was increasing.
- 1.4 Passengers reported to the driver that there was smoke present in the rear of the passenger saloon area.
- 1.5 The driver then exited the M4 onto the Homebush Bay Drive exit ramp securing the bus just short of Homebush Bay Drive (*see Figure 1*).
- 1.6 The passengers then moved toward the front of the bus. Some passengers unsuccessfully attempted to operate the centre door emergency exit button.
- 1.7 The driver then opened the front door via the emergency door release button located at the bottom of the stairwell to safely evacuate all on-board.

¹ Times in this report are in 24-hour clock form in Australian Eastern Standard Time.

² Near side refers to the left hand side of a vehicle as viewed from the driver's seat.

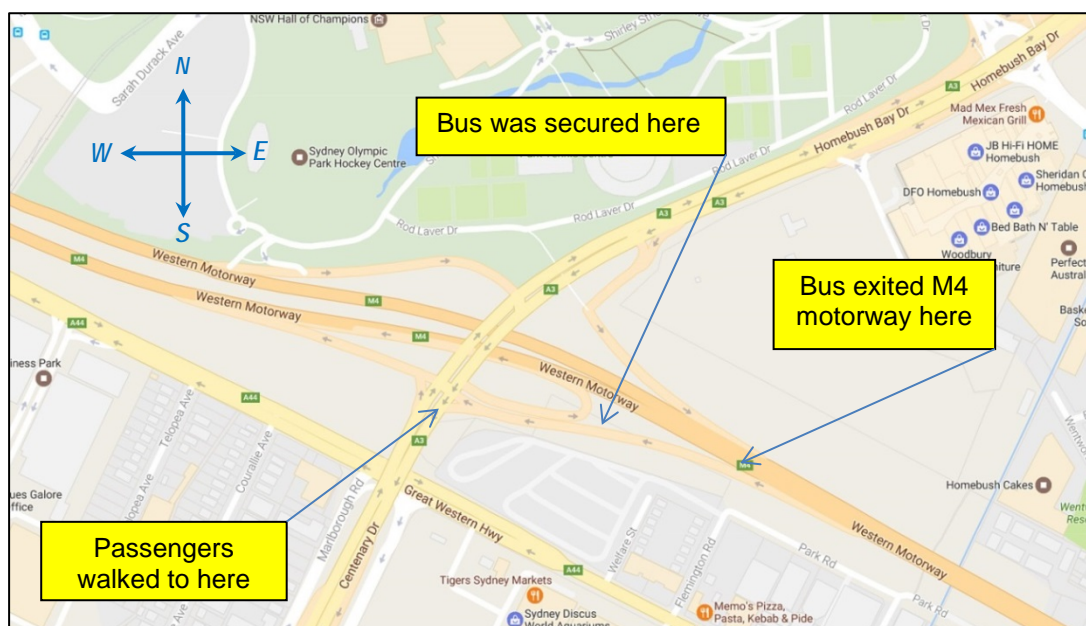
- 1.8 The passengers then made their way up the exit ramp onto Homebush Bay Drive to catch other transport services to finish their journeys. No passengers were injured in the incident.
- 1.9 With the bus secured, the driver inspected the rear of the bus and decided not to attempt to extinguish the fire as the fire was too intense.

Emergency Response

- 1.10 A number of the passengers contacted '000' for emergency assistance whilst the bus driver contacted Telfords maintenance depot for assistance.
- 1.11 NSW Fire and Rescue arrived approximately ten minutes later and extinguished the fire.
- 1.12 The bus was severely damaged by the fire and was later determined a total loss.

Incident Location

- 1.13 The incident occurred in the suburb of Homebush, located approximately 17 km, south-west of the Sydney CBD. At the time of the incident, the bus was travelling westbound on the M4, eventually stopping on the Homebush Bay exit (see Figure 1).



Source: Google Maps – Annotated by OTSI

Figure 1: Location of the exit ramp near Homebush Bay Drive, Homebush

Environmental Conditions

- 1.14 At the time of the incident, the Bureau of Meteorology recorded a temperature of 25.1° C with an east-southeast wind direction of 20 km/h at Sydney Olympic Park, which is approximately 2kms from the incident site.
- 1.15 Apart from the likely effect of wind on the promotion of the fire and the dispersal of smoke, it was determined that the environmental conditions played no part in the incident.

Operator Information

- 1.16 Telfords operations and maintenance are based at the Sydney suburb of Turrella. The company provides various services including charter, tourist and educational transport services. Telfords has a mixed fleet of approximately 87 buses and coaches.

Bus Information

- 1.17 The bus was a diesel fuelled 1992 model Volvo B10M. The body was manufactured by Austral Denning QLD and was registered in NSW as TV8308. The bus had been purchased from Transit Systems in April of 2016 however; Transit Systems had not operated the bus. The bus had previously been part of the Brisbane City Council bus fleet and had travelled approximately 980,000 km.
- 1.18 The bus was fitted with a 4.5 Kg 40ABE type dry chemical portable fire extinguisher located in the driver's cabin area.
- 1.19 The bus was not equipped with an engine bay fire suppression system or engine bay fire alarms.
- 1.20 A Roads and Maritime Services (RMS) Heavy Vehicle Inspection Scheme (HVIS) inspection was carried out on the 17th of January 2017. The bus passed this inspection with no issues identified specific to this incident.
- 1.21 The bus also underwent a pre HVIS safety inspection on the 11th of January 2017 carried out by Telfords maintenance department. The bus had no issues identified during this inspection specific to this incident.

Driver Information

- 1.22 The driver had been employed with Telfords since November 2016. The driver had charter bus experience previous to his employment with Telfords.

Related Fire Occurrences

- 1.23 OTSI has collated and published summaries of reported bus fire incidents in NSW since 2012. Electrical faults are found to be a common initiation source for bus fires. The results have been 18 (23%) in 2016, 11 (28%) in 2015, 6 (21%) in 2014, 8 (29%) in 2013 and 4 (27%) in the 2½ years to 30 June 2012. The majority of the incidents were caused by electrical short circuits.



Source: OTSI

Figure 2: Identical model bus to TV8308 with a different livery

PART 2 ANALYSIS

Introduction

- 2.1 OTSI analysed several sources of information relating to the incident in parallel with an inspection of the bus following the event.
- 2.2 These sources included an internal investigation report and service history of the bus submitted by Telfords, RMS HVIS inspection records, the National Heavy Vehicle Inspection Standards (NHVIS) and the driver's version of events.
- 2.3 The investigation focussed primarily on the factors that contributed to the initiation of the fire, evacuation of passengers, maintenance and driver training.

Damage

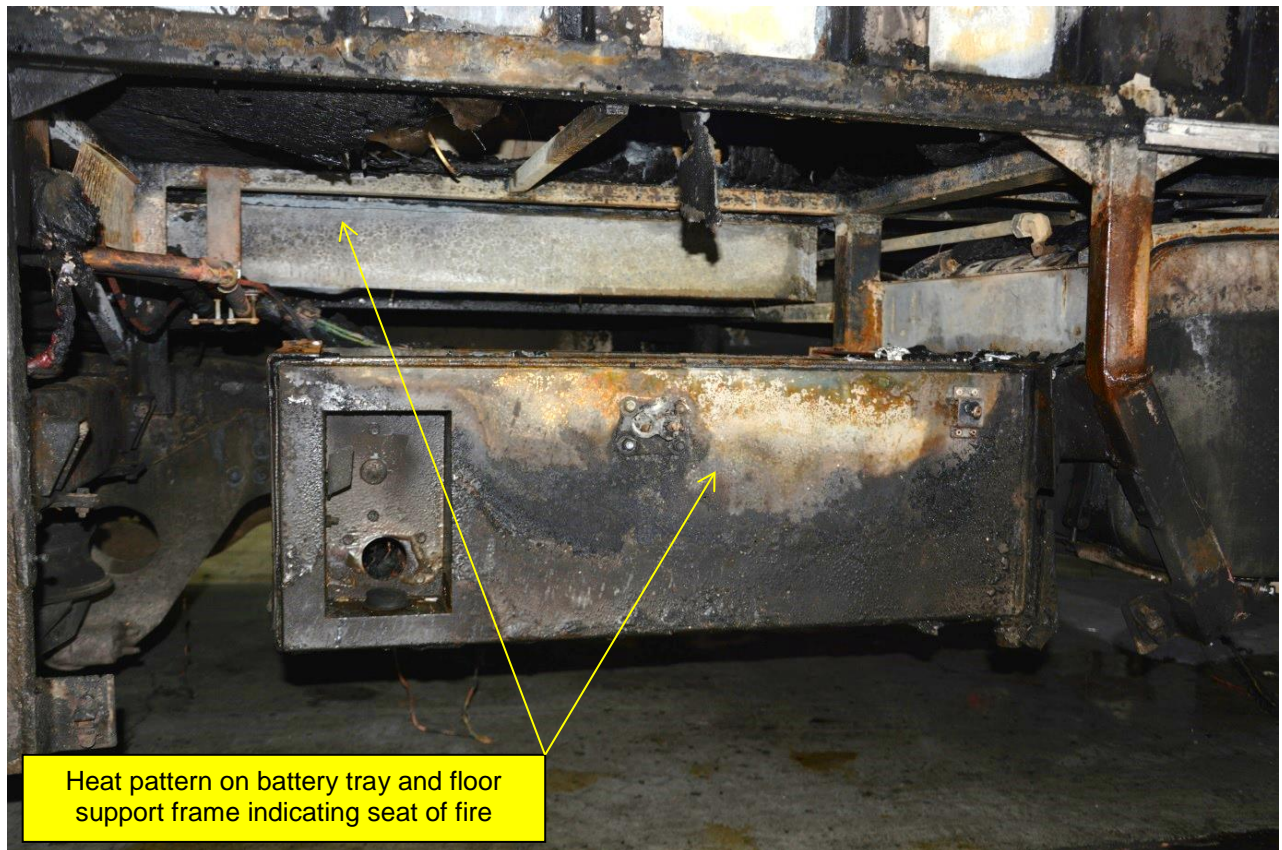
- 2.4 The majority of the fire damage was confined to the NSR corner of the bus.
- 2.5 The rear bumper, engine access door, rear passenger window, last two windows on NSR and rear panels were affected by fire.
- 2.6 The passenger saloon area was severely heat affected with some plastic and foam components consumed by fire.
- 2.7 The heat damage from the fire was most prominent in the battery tray and floor substrate areas.

Initiation and Spread of Fire

- 2.8 The positive battery cable terminal exhibited evidence of an electrical short circuit between the terminal and the metal battery retainer attached to the battery storage tray (see *Figure 5*).
- 2.9 Heat patterns observed on the side of the battery storage tray and floor support frame indicated that the fire initiated from the two 12V DC batteries (see *Figure 3*).

2.10 The fire then consumed flammable materials in the vicinity of the battery tray and penetrated into the passenger saloon area through the timber flooring directly above the battery storage area.

2.11 The fire then spread into the rear of the passenger saloon area.



Source: OTSI

Figure 3: Heat pattern on battery tray assembly

Evacuation of bus

2.12 From the driver's statement and internal investigation supplied by Telfords, it was established no one was on board at the time the fire penetrated the passenger saloon area.

2.13 Passengers reported to the driver that there was smoke present in the rear of the passenger saloon area. The passengers then moved toward the front of the bus. Some passengers unsuccessfully attempted to operate the centre door emergency exit button located above the centre door.

- 2.14 The driver then opened the front door via the emergency door release button located at the bottom of the stairwell safely evacuating all on-board.
- 2.15 The driver said in an interview following the event that due to the number of different models of buses in the Telfords fleet, it was difficult to identify critical components such as door emergency release buttons and battery isolation switches.

Fire Extinguisher and Alarms

- 2.16 The bus was fitted with a 4.5 Kg, 40B-E type portable fire extinguisher located in the driver's cab.
- 2.17 The vehicle was not fitted with heat sensors within the engine / transmission bay area.
- 2.18 The bus was not equipped with an engine bay fire suppression system.

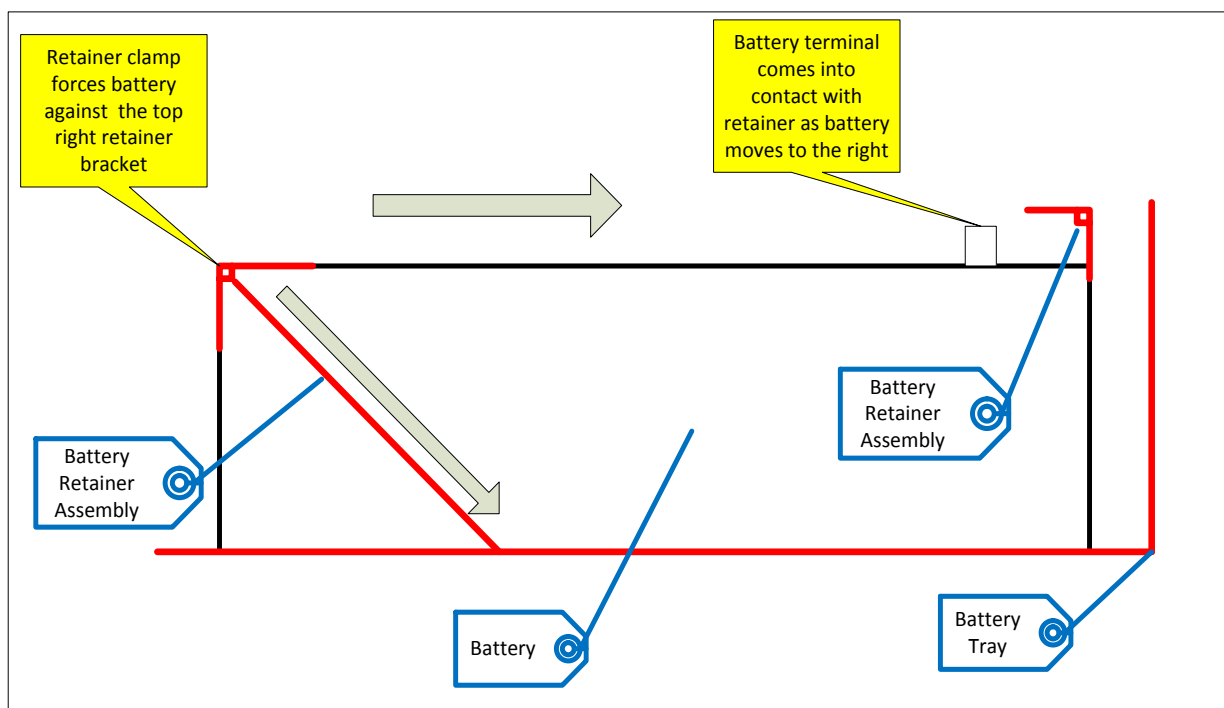
Batteries and Retainer

- 2.19 The batteries are located under the floor at the NSR of the bus behind the rear axle (*see Figure 2*). A "swing out" tray provides accessibility during maintenance.
- 2.20 The batteries are secured to the tray by two right-angled metal retainers. The metal retainers run across the upper corners of each end of the two 12V DC batteries and are secured to the battery tray assembly.
- 2.21 Inspection of a similar model bus indicated that a gap of approximately 15mm between the rearward retainer and the battery that could allow the terminal end of the battery to move under the retainer allowing the positive terminals to contact the metal retainer causing an electrical short circuit³ of the battery (*see Figure 6 and 4*).

³ A "shorted" lead acid battery has the capability of delivering an extremely high current, 100 to 1000 times the typical discharge current used in most applications. The amount of time to achieve maximum current depends upon such factors as the captive and inductive reactance of the battery and the external circuit, as well as the battery's electrochemical response. Without some form of protection such as a fuse or breaker, a short circuit condition can cause permanent damage to the battery. If the weakest link is within the battery, melting and opening of an internal connection has the potential to ignite the hydrogen/oxygen gas mixture contained within the battery headspace, resulting in a potentially dangerous situation. Often, the peak short current occurs within 5 to 15 milliseconds. While an external failure typically results in a more benign open circuit condition, severe and/or prolonged overheating may lead to permanent battery and equipment damage, including the potential for fire.

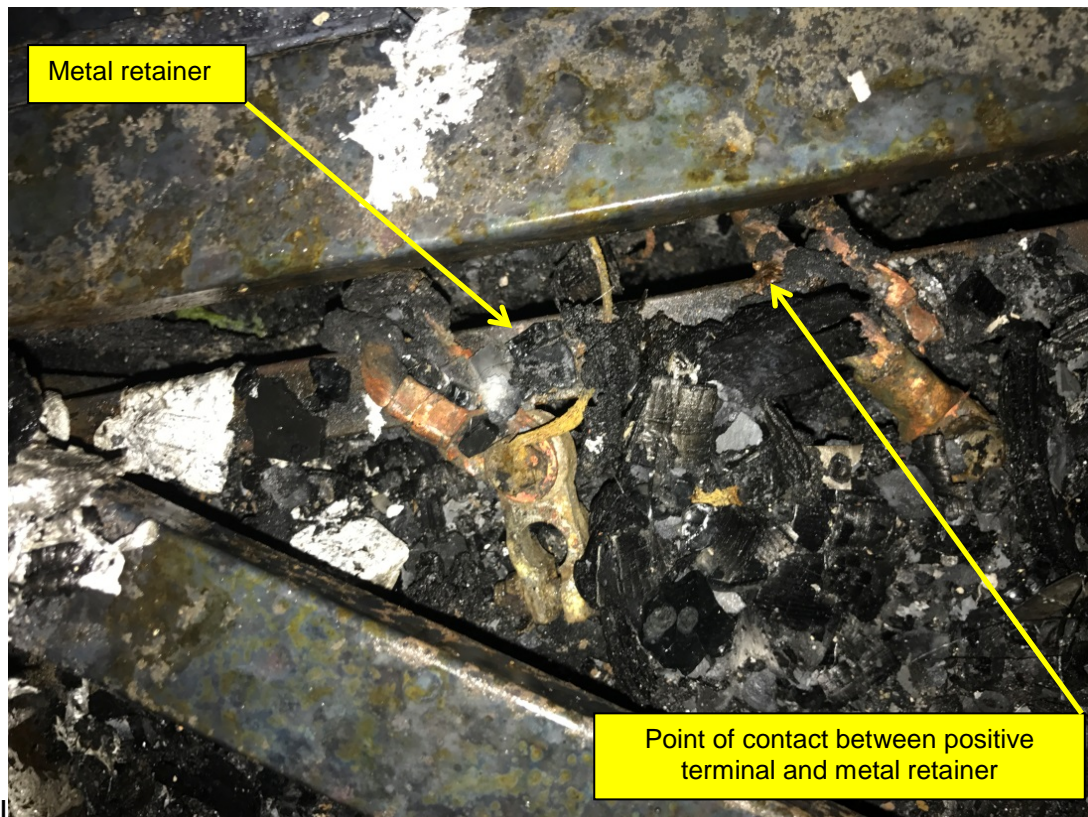
C&D Technologies, "Battery Short Circuit Current" Publications RS 1468 3/1996

- 2.22 The configuration of the battery tray on the damaged bus and other similar model Volvo B10M's had been unaltered since they were introduced into in the Telfords fleet, however information supplied by the Original Equipment Manufacturer (OEM) (*Volvo Bus Australia*) indicated that the battery retainer fitted to the bus at the time of the incident was not as originally designed (see *Figure 8*).
- 2.23 An inspection of the bus revealed that the positive terminal had come into contact with the rearmost metal retainer causing the terminal to short circuit (see *Figure 5*).
- 2.24 It was determined the heat generated by the short circuit initiated the fire and the fire propagated through the timber flooring and into the rear of the bus.
- 2.25 Telfords maintenance records for the bus indicate that the batteries fitted at the time of the incident were installed on the 4th of November 2016.



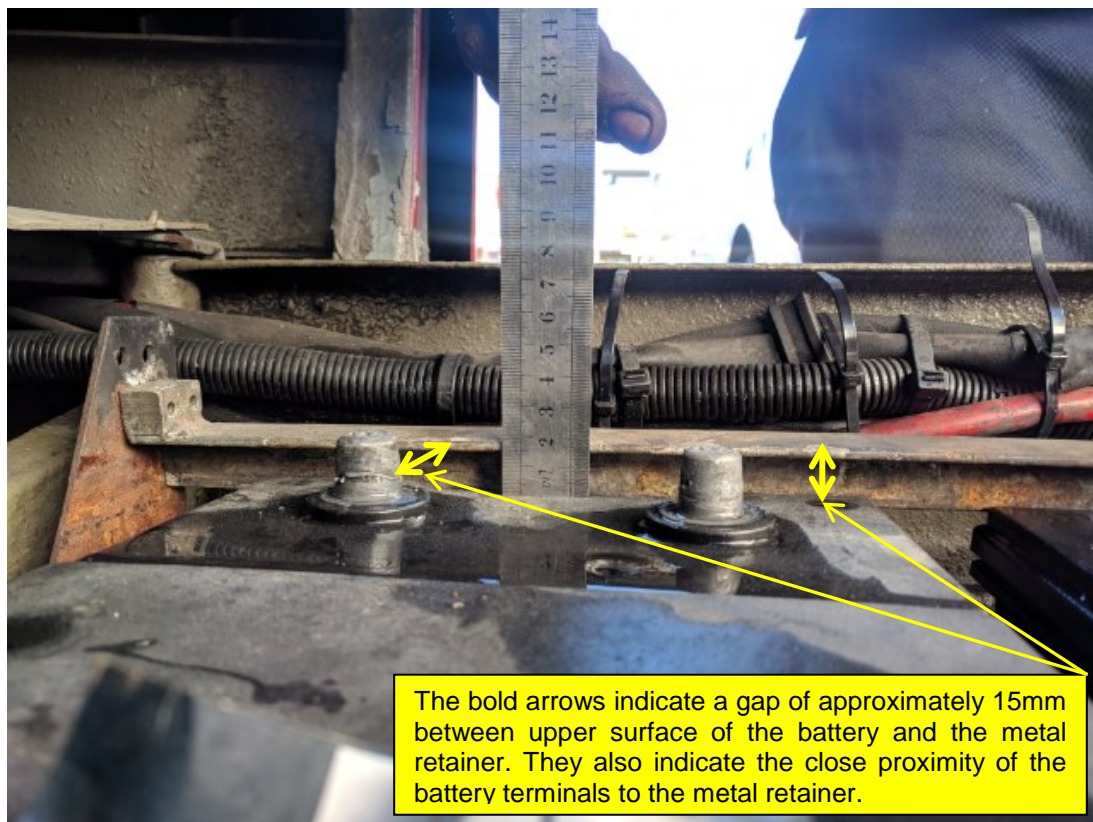
Source OTSI

Figure 4: Schematic (profile) of battery tray assembly and retainers



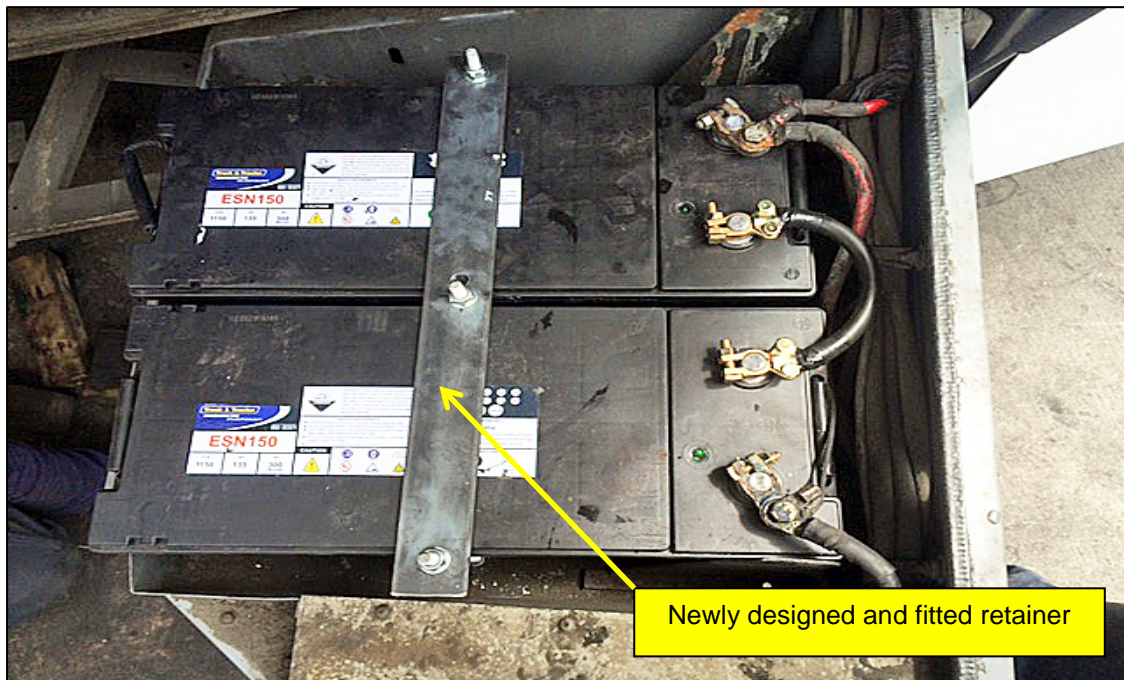
Source: OTSI

Figure 5: Demonstrates the short-circuited terminals on TV8308



Source: Telfords – Annotated by OTSI

Figure 6: Gap between batteries and retainer – identical model bus



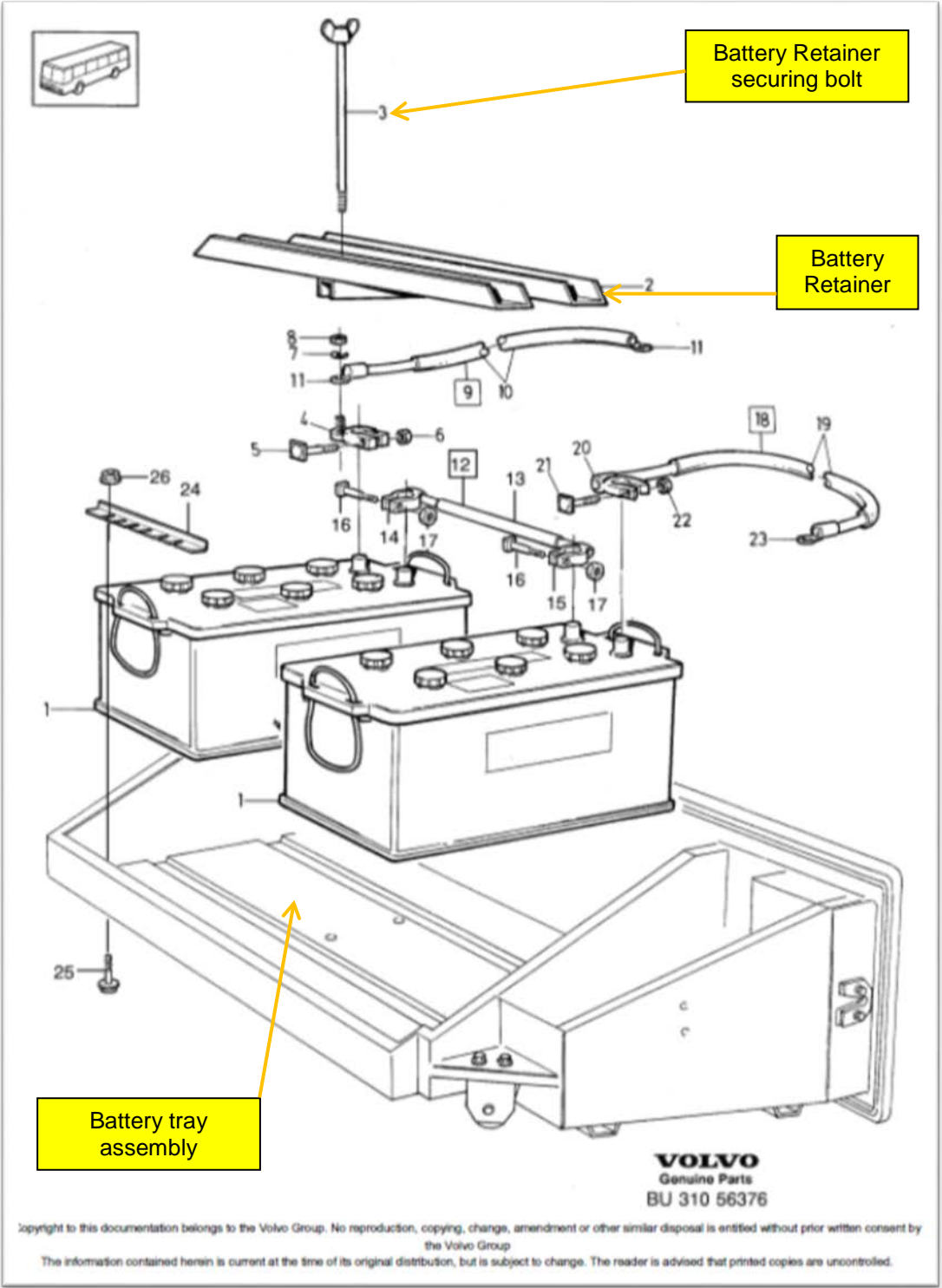
Source: Telfords – Annotated by OTSI

Figure 7: Reconfigured battery retainer

PART 3 REMEDIAL ACTIONS

3.1. During the course of and since the investigation, Telfords have implemented a number of remedial actions to prevent further similar incidents from occurring. Some of these remedial actions are as follows;

- Telfords, in conjunction with a qualified Mechanical Engineer, designed a new battery retainer that was similar in function to that of the OEM configuration. The device was retrofitted to the remaining Volvo B10M buses in the Telfords fleet as the OEM battery retainer was no longer available (see *Figure 7*).
- Telfords introduced a 'Driver Implementation' program that ensures drivers are more familiar with the operational controls of each model bus, including the location of the safety-critical devices and door controls of the bus.
- Telfords issued a 'Maintenance Alert' to all maintenance staff for the inspection of the current battery securing arrangements for the remainder of their fleet and proposed fitment of the new battery retainer (see *Appendix 1*).



Source – Volvo Australia – Annotated by OTSI

Figure 8: Schematic of OEM battery compartment

PART 4 FINDINGS

Contributory Factors

- 4.1. OTSI determined that the battery positive terminal made contact with the battery retainer and created a short circuit.
- 4.2. The load on the battery from the short circuit has caused the battery to overheat and catch fire.
- 4.3. The battery retainer design was different to that originally fitted by the OEM.
- 4.4. The safety inspections scheduled by Telfords maintenance department, identified as Activity ID S 1637, specify in step 97 “*Check / top up battery level & check terminals*”. However, there is no specific instruction to check the security of the batteries or battery mountings as required by the NHVIS.
- 4.5. Telfords evacuation procedures were incomplete to provide guidance for this type of incident. Telfords has acknowledged the deficiencies in the procedures and implemented changes to their existing procedures.
- 4.6. The RMS HVIS inspection carried out prior to the incident reported no non-compliances in regard to the security of the battery. It is acknowledge that a routine HVIS inspection would not necessarily detect the installation of a non OEM battery retainer system being used.

Other Safety Factors

- 4.7. That due to the variety of different models of buses in the fleet, he was unfamiliar with the door and emergency exit controls.

PART 5 RECOMMENDATIONS

It is recommended that the following additional safety actions be undertaken by the specified responsible entities.

Roads and Maritime Services

- 5.1. Consider re-issuing RMS Information Alert 2/14 to include specific instructions for the inspection of battery retainers and in particular, the integrity of cabling and protective covers on the terminal posts of batteries fitted to passenger buses.
- 5.2. Ensure that RMS HVIS Inspectors are provided information in relation to the potential use of non OEM battery restraint systems as referred to in this report. This will assist in ensuring specific checks are undertaken during routine HVIS Bus Inspections.

Telfords

- 5.3. To include the specific instruction for the inspection of battery retainers and in particular, the integrity of cabling and protective covers on the terminal posts of batteries fitted to their fleet.
- 5.4. Include operational controls, in specific, the emergency door operation functions and evacuation procedures, in their induction and training resources.

PART 6 APPENDICES

Appendix 1: Telfords Bus & Coach Maintenance Alert



09/02/2017

Maintenance Alert

On the Wednesday the 08/02/2017 at approximately 7am, bus fleet no. 9016 (TV8308) was reported by the driver as having smoke pouring out of the near side rear of the vehicle.

At Approximately 1pm an OTSI Investigator attended the Telford's depot to inspect 9016. The Investigator has indicated that the vehicle fire may have been caused by power cables/terminals arcing onto the battery frame securing mounts (see Pic. 01). Further investigations into the battery type, mounting type and battery configuration will be conducted within the coming weeks to ensure that OEM (Original Equipment Manufacturer) specification is being followed.

As a preventative measure, all 11 (eleven) remaining B10M type buses have been inspected and adjustments to battery retainer clamps made prior to returning the fleet to service on the 09/02/2017. Issues have been found in relation to the gap between the battery terminals and OEM battery retaining clamps being too close and providing a potential for power arcing. As a preventative measure during the internal investigation and possible modification, all batteries have been inspected and adjusted as required (See pic002, 003, 004 for examples).

A conclusion and repair method or modification will be provided within the final investigation report once engineering documentation and OEM specification is obtained. Within the interim as a precautionary measure, inline with Telford's Safety Policy and Quality Management Systems, all B10M buses have been inspected with battery terminals adjusted accordingly to eliminate the risk of any reoccurring fault.

Pic001



Battery Positive + Terminal

Pic002



Rubber guarding

Pic003



Proposed new clamping method

Pic004



Old Method

It is important to ensure that all vehicles are inspected according to Safety Check and HV/S Preparation schedules to eliminate the risk of similar or more substantial mechanical failures.

All battery carriers, battery terminals and high current cables must be thoroughly inspected to ensure the safety of the public and our assets. Ensure all electrical cables are secure and "P" Clamps and cable mounting devices are in serviceable condition on all fleet vehicles.

Fleet & Facilities Manager



Marrickville Bus Lines – T/AS Telford Tours Bus & Coach ABN. 74 050 034 127

65-71 Henderson Rd. Turrella. N.S.W. 2205

Tel. 02 9567-3659 Fax. 02 9597-4074 Email. info@telfordtours.com.au www.telfordtours.com.au

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Appendix 2: Sources, Submissions and Acknowledgements

Sources of Information

- Telfords Bus & Coach
- Bureau of Meteorology
- Google Maps
- National Heavy Vehicle Inspection Manual – Version 2.3

Submissions

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report. This was remedied by verifying the factual information, scrutinising the analysis, findings and recommendations, and by submitting proposals for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Telfords Bus & Coach
- Roads and Maritime Services
- Transport for New South Wales

Submissions were received from all DIPs:

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

Acknowledgements

- Telfords – Cover photo, Figure 6, Figure 7, Appendix 1
- Google Maps – Figure 1
- Volvo Bus Australia – Figure 8