



**Office of Transport Safety Investigations**

## **BUS SAFETY INVESTIGATION REPORT**

**MULTIPLE BUS FIRES**

**SYDNEY AIRPORT, MASCOT, NSW**

**4 DECEMBER 2016**



Image source: Channel 7 News

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Released under the provisions of  
Section 45C (2) of the *Transport Administration Act 1988* and  
Section 46BBA (1) of the *Passenger Transport Act 1990*

Investigation Reference 04764

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# THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

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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](http://www.otsi.nsw.gov.au).

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## EXECUTIVE SUMMARY

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On Sunday 4 December 2016, while operating between Sydney Airport Terminal 2 and Terminal 3, the driver of Carbridge bus TV5179 noted a red warning light on the bus instrument panel. The driver performed a reset of the bus management system, the warning light extinguished, and the driver then continued with the intended trip.

A short time later the same warning light illuminated. The driver then performed another reset; however the warning light remained on. Following a short conversation with the Carbridge Duty Manager the driver was instructed to discharge the passengers at the first carpark stop and park the bus in a holding area. The driver complied and exited the bus.

A fire ignited in TV5179 shortly after being parked. The fire destroyed the bus and ignited two adjacent buses. One of the adjacent buses was destroyed by fire and the other received significant damage.

There were no passengers or operator personnel on board any of the buses at the time of the incident.

It was difficult to define the fire initiation point due to the extensive damage to TV5179. However, the fire likely commenced at the rear of the bus.

As a result of the investigation, OTSI recommended that Carbridge reinforce their training procedures including; reporting bus faults, overheating scenarios and bus evacuation.

Full details of the Findings and Recommendations of this bus safety investigation are contained in Parts 3 and 4 respectively.

## PART 1 FACTUAL INFORMATION

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### Events Leading Up To the Occurrence

- 1.1 On the day of the incident, the driver signed on at 1415<sup>1</sup> on working roster coded BD1. Initially, the driver's roster required a meal break relief for another driver on roster BD2 who at the time was in control of bus TV5179. At 1424 the relief was carried out.
- 1.2 As part of Carbridge's handover procedures, drivers are required to perform a pre-departure check. TV5179 was noted as satisfactory with no issues identified.
- 1.3 The driver operating roster BD1 departed with TV5179 from the Blu Emu Car Park (BECP) Transit Lounge at 1424. As the driver approached the DHL traffic lights (see *Figure 1, 'DHL Traffic Lights 1<sup>st</sup> Fault'*) the driver noted an audible alarm and a red warning light illuminated on the driver's dashboard. While stationary at the traffic lights, the driver performed a reset<sup>2</sup> of the system by turning the bus off and then restarting it. As a result of this reset process, the audible alarm and red warning light deactivated. The driver then continued.
- 1.4 Shortly afterwards, the bus arrived at Terminal 2 at the Sydney Airport where the bus stopped briefly to conduct a drop-off/pick-up of passengers. The bus then travelled to Terminal 3 for another drop-off/pick-up. When the bus departed Terminal 3, the bus was full, including the standing area.
- 1.5 After departing Terminal 3, the bus was still operating correctly however, after stopping at a set of traffic lights on the corner of Robey Street and Qantas Drive (see *Figure 1, '2<sup>nd</sup> Fault'*), the audible alarm and the red warning light reactivated.

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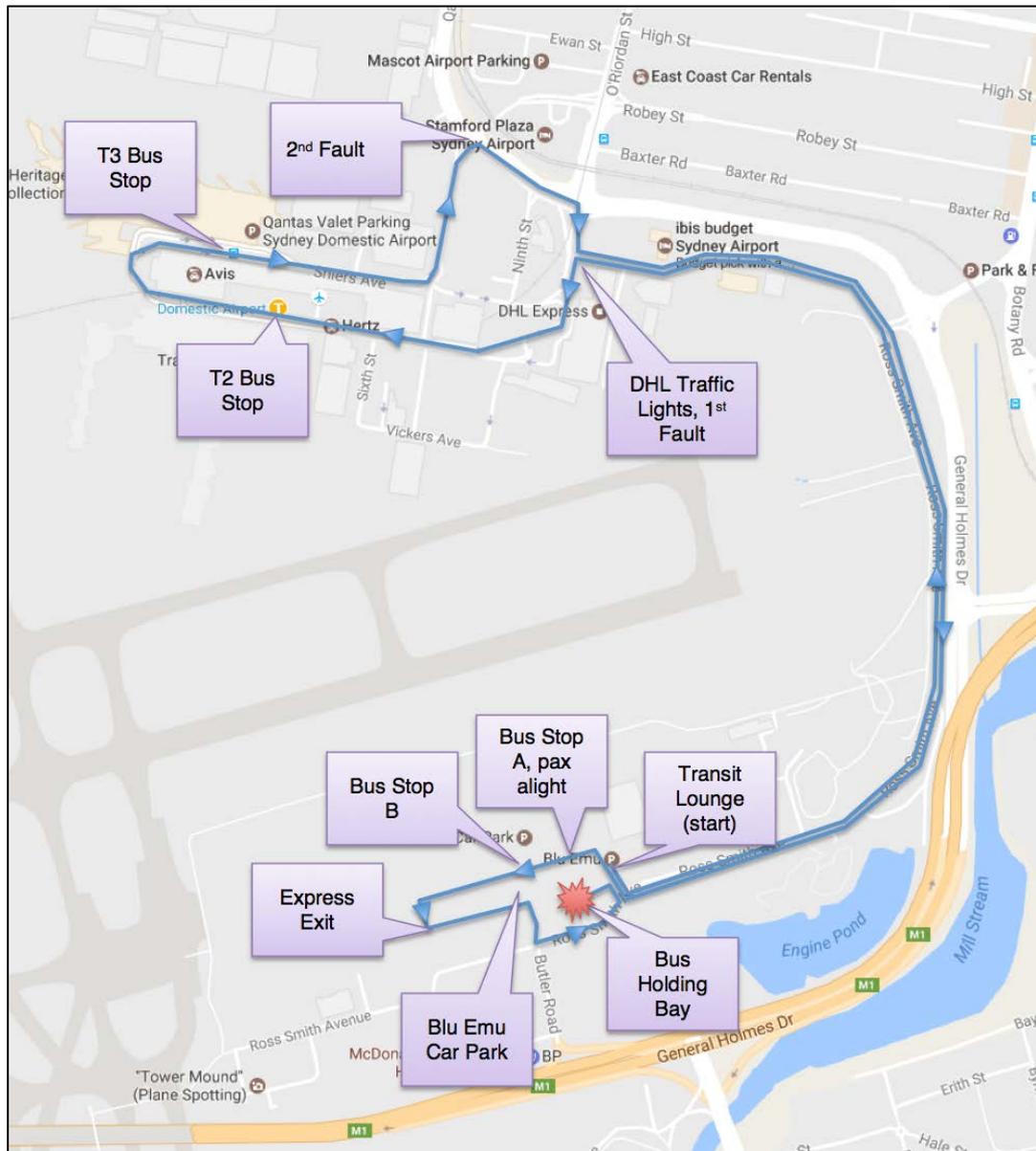
<sup>1</sup> Times in this report are in 24-hour clock form in the Australian Eastern Daylight Saving Time.

<sup>2</sup> A reset is performed by bringing the vehicle to a secure stop, switching off the ignition and following a slight delay, restarting the vehicle. This procedure allows any intermittent faults stored by the engine management system to be cleared.

- 1.6 The driver again reset the bus, however on this occasion the audible alarm and red warning light did not deactivate. Additionally, for unknown reasons, the centre door opened without the driver's intervention.
- 1.7 With the centre door open, the driver was unable to move the bus forward due to the door interlock<sup>3</sup> mechanism being activated. The driver then re-activated the door close button which closed the door of the bus and enabled the driver to depart from the traffic lights.
- 1.8 The driver contacted the Carbridge Duty Manager (DM) via the two-way radio advising the bus was operating abnormally. The driver stated that the audible alarm and the red warning light had re-activated and that there was an engine coolant temperature reading of 120°C. The driver and DM determined that the engine of TV5179 was overheating.
- 1.9 The driver was instructed by the DM to return to the BECP and to disembark all passengers at stop "A" (see *Figure 1, 'Bus Stop A, pax alight'*), move the bus to the holding bay and wait for further instructions.
- 1.10 The bus arrived at the BECP Bus Stop "A" at 1449. The driver advised the passengers of a technical problem and instructed all passengers to disembark from the bus.
- 1.11 The driver activated the centre door release button however, the centre door failed to open. The door malfunction impeded the passengers' egress from the bus.

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<sup>3</sup> The door interlock mechanism is a safety device built into the door system as required by RMS Technical Specification 146 (TS146). The interlock disables the throttle and applies the service brakes of the vehicle.



Source: Carbridge

Figure 1: A map depicting the path of TV5179.

## The Occurrence

1.12 According to a passenger's statement, several passengers at the rear of the bus had requested the driver to open the door whilst others attempted to open the doors using the emergency exit door release button. The smell of smoke in the rear of the passenger cabin was evident. Once all the passengers had disembarked the bus, the driver walked through the bus to verify all passengers had evacuated.

1.13 The driver then drove TV5179 to the 'bus holding bay' location within the BECP (see *Figure 1, 'Bus Holding Bay'*), where the driver stabled the bus beside another three buses, one belonging to Carbridge (TV6609) and the other two buses belonging to Sydney Airport Corporation Limited (SACL), (see *Photograph 1*).



Source: Channel 7 – Annotated by OTSI

Photograph 1: Positioning of the two Carbridge buses and the two SACL buses

- 1.14 The CCTV<sup>4</sup> system on board TV5179 was damaged by fire and the recorded footage was not retrievable. OTSI was able to review footage of the incident from other Carbridge buses that were parked within the holding yard.
- 1.15 The investigation report supplied by Carbridge said that SACL CCTV footage from carpark cameras indicated a small amount of smoke emanating from TV5179 at 1451 as it passed the BECP express gates.
- 1.16 Review of the available footage indicated that at 1453 TV5179 arrived at the bus holding bay within the BECP and the driver then parked the bus. The driver exited TV5179 and walked down the length of the bus. At this point, TV5179 was parked next to Carbridge bus TV6609. A SACL bus (TV5876) was parked next to TV6609 with another, SACL bus parked alongside.

<sup>4</sup> Close Circuit Television (CCTV) are installed on most public transport vehicles.

- 1.17 At 1459 the driver reversed TV5177 and positioned the bus ready for the relieving driver to arrive. The reversing camera from this bus indicated that there was no visible fire activity on TV5179 at this point.
- 1.18 At 1459:52, the CCTV footage on TV5177 showed smoke emanating from the rear of TV5179.
- 1.19 The driver then ran towards TV5177 and obtained a fire extinguisher located in the cabin of the bus. The driver then ran towards the burning TV5179; however the DM instructed him that this was too dangerous as the rear of TV5179 was now fully ablaze.
- 1.20 The fire on TV5179 spread to the adjacent bus TV6609. The DM and the driver contacted emergency services and stood clear, away from the flames.
- 1.21 TV5179 and Carbridge bus TV6609 were both destroyed in the fire. A SCAL bus was also extensively damaged as a consequence of the fire.

### **Events following the occurrence**

- 1.22 At 1510, Sydney Airport Fire Brigade arrived and extinguished TV5179, TV6609 and minimised the damage to bus TV5876. Fire and Rescue NSW arrived shortly afterwards and assisted in extinguishing the fire. Once the fire was fully extinguished and the area was determined to be safe, both Fire and Rescue NSW and ARFF departed the scene.
- 1.23 Carbridge contacted Sydney Airport Spill Response and Botany Council to attend the site to assist with cleaning up the residual debris.
- 1.24 Both TV5179 and TV6609 were later transported to the Carbridge Depot. TV5876 was able to be driven from the incident site. The other SACL bus was not damaged and was able to be driven away.

### **Incident Location**

Mascot is a suburb of Sydney. It is located approximately 7 km south of the CBD and is the location of Sydney Airport. The BECP is located within the grounds of the Sydney Airport and is a bus parking area for Carbridge buses (*see Figure 1*).

## Environmental Conditions

- 1.25 The Bureau of Meteorology recorded a temperature of 26.2°C at Sydney Airport at 1500 with the wind recorded from the east-north-east at 30 km/h.
- 1.26 The effect of the wind present at the time of the incident, likely assisted the spread of the fire to the other buses and the dispersal of smoke.

## Operator Information

- 1.27 Carbridge provides bus transport services within and around the Sydney international and domestic airports. Carbridge provides similar services at Melbourne, Brisbane, Perth and Adelaide airports.
- 1.28 In addition to aviation bus transport, Carbridge provides transport consultancy, specialised bus design and manufacture, specialised passenger transport and other ground services for airlines and airports.

## Bus Information

- 1.29 The bus was a diesel fuelled 2004 model Mercedes OC500LE. The body was built by Volgren and was registered in NSW as TV5179 (*see Photograph 2*).
- 1.30 The odometer reading at the time of the incident was 774,158 km. Maintenance records indicate that the bus had a routine service on 31 October 2016. There were no defects detected in the engine bay area during this check. A Roads and Maritime Services (RMS) Heavy Vehicle Inspection Scheme (HVIS) inspection was carried out on the 29 July 2016. No defects were recorded as a result of this inspection.
- 1.31 The bus was authorised to carry 73 passengers, 44 seated and 29 standing. At the time of the incident it was unknown how many passengers were on board. The bus had two door openings, one next to the driver and one mid-way towards the rear. Both were on the near side of the bus and both consisted of two door leafs.
- 1.32 There were no previous reported fire incidents for TV5179.



Source: Carbridge

Photograph 2: Carbridge Bus TV 5179 prior to the fire.

## Driver Information

- 1.33 The driver of the bus was 56 years of age and joined Carbridge in December 2015. According to Carbridge, the driver had passed all training as required for new drivers.
- 1.34 The driver had over ten years experience with heavy rigid type buses. The driver held a current NSW Heavy Rigid (HR) bus driver licence and an Authorised Bus Driver accreditation both of which were issued by the RMS.

## Related Fire Occurrences

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.

## PART 2 ANALYSIS

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### Introduction

- 2.1 OTSI analysed several sources of information related to the incident in parallel with an inspection of the bus following the event.
- 2.2 These sources included an independent forensic report instigated by the insurer, interviews conducted with passengers directly involved, an internal investigation report submitted by Carbridge and the driver's version of events as supplied by Carbridge.
- 2.3 The investigation focussed principally on the factors that contributed to the initiation of the fire, evacuation of passengers, emergency response, and driver training.

### Damage

- 2.4 The construction of the bus body frame consists of extruded aluminium sections bolted together at the intersecting points. The intensity of the fire was such that most of the off side and upper body frame was either melted or deformed and no longer in place. The front and rear header frames were mainly intact with the rear upper light assemblies mostly undamaged. The combustible interior components had been mainly consumed by fire along with the offside and centre roof sections.
- 2.5 The heat damage from the fire was most prominent in the engine bay. All combustible / flammable<sup>5</sup> components and fluids had been consumed within the engine bay. The aluminium engine intercooler, heat exchanger, inlet manifold and valve covers either completely melted or were partially destroyed.

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<sup>5</sup> Flammable and combustible materials are classified based on their flashpoints. Flashpoint is the lowest temperature at which the liquid gives off enough vapor to be ignited. Flammable materials are those that can catch fire and burn easily at normal working temperatures. Whereas, combustible materials are the ones that have the ability to burn at temperatures that are above working temperatures.

## Initiation and Spread of Fire

- 2.6 A definitive fire initiation point could not be ascertained due to the level of damage to the bus. However, it is likely the fire initiated in the engine bay where the greatest fire damage occurred
- 2.7 Following the commencement of the fire, it is likely that the fire spread throughout the engine bay consuming flammable materials.
- 2.8 The fire progressed into the passenger compartment and eventually destroyed a portion of the aluminium body frame.

## Evacuation of bus

- 2.9 From passenger interviews and the driver's statement supplied by Carbridge, it was established no one was on board at the time the fire entered the passenger compartment.
- 2.10 Information provided by the passengers and footage from CCTV indicated smoke was present and likely that there was thermal activity whilst the passengers were on board and prior to the bus being parked.
- 2.11 One passenger said the smell of smoke was present in the rear of the passenger compartment. Some passengers unsuccessfully attempted to exit the bus by operating the centre door emergency exit button. Eventually the driver opened the rear door and the passengers then disembarked.
- 2.12 Carbridge's evacuation procedures were limited in providing guidance for this type of incident. Carbridge has acknowledged opportunities to improve the deficiencies in the procedures.

## Fire Extinguisher and Alarms

- 2.13 An Australian Design Rule (ADR 58/00)<sup>6</sup> specifies that buses are to be equipped with a readily accessible fire extinguisher selected and located in accordance with the applicable Australian Standard.<sup>7</sup> Next to the driver's seat there was one compliant 2.5 kg Dry Chemical Powder fire extinguisher.

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<sup>6</sup> Australian Design Rule 58 *Requirements for Omnibuses Designed for Hire and Reward*

<sup>7</sup> Portable fire extinguishers and fire blankets – Selection and location. Australian Standard (AS) 2444—2001.

## Remedial Actions

2.14 Carbridge identified certain aspects within the organisation that could be improved to enhance safety for the organisation and the public travelling on Carbridge's buses. Carbridge has adopted and implemented the following:

- Carbridge has retrofitted 33 buses operating at Sydney Airport with an Engine Bay Fire Suppression System (EBFSS).
- Where dual-pole battery isolators fitted, Carbridge has replaced with new dual-pole battery isolating knife switches.
- In relation to the maintenance regime, all battery isolating switches, where fitted, are to be replaced on an annual basis.
- The maintenance regime has been amended so that safety critical electrical components on Carbridge buses are to be checked within regular maintenance schedules.

## **PART 3 FINDINGS**

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### **Contributory Factors**

- 3.1 Due to the level of damage to the bus, a definitive initiation point could not be ascertained, however witness accounts, dash alarms and CCTV footage indicate that the commencement may have been toward the rear of the bus.

### **Other Safety Factors**

- 3.2 The Carbridge emergency evacuation procedures were limited to deal with this type of situation.

## **PART 4 RECOMMENDATIONS**

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

### **Carbridge**

- 4.1 Undertake a review of policy and procedures in reference to emergency evacuations.
- 4.2 Reinforce to drivers and operational staff of the importance in taking prompt action when alerted to safety related alarms and situations.

## **PART 5 APPENDICES**

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### **Appendix 1 Sources, Submissions and Acknowledgements**

#### **Sources of Information**

- Carbridge Pty Ltd
- Kennedy's Engineering & Forensic

#### **Submissions**

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

- Carbridge Pty Ltd
- Transport for New South Wales

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**

- Carbridge Pty Ltd internal report
- OTSI Published report, 'Bus Fires in New South Wales 2016'.
- Google Maps
- Channel 7 photographs
- Bureau of Meteorology