OTSI Office of Transport Safety Investigations

BUS SAFETY REPORT

BUS FIRES IN NEW SOUTH WALES IN 2015

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THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of accidents and incidents 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, and confirmed by amending legislation as an independent statutory office on 1 July 2005, OTSI is responsible for determining the causes and contributing factors of accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence. Importantly, however, OTSI does not confine itself to the consideration of just those matters that caused or contributed to a particular accident; it also seeks to identify any transport safety matters which, if left unaddressed, might contribute to other accidents.

BUS FIRES IN NEW SOUTH WALES IN 2015

Introduction

In June 2013, the Office of Transport Safety Investigations (OTSI) released an investigation report into common safety-related issues that had been revealed through its examination of the nature and circumstances of bus and coach fires in the period 2005 to 2012 inclusive (the 2005 - 2012 Report).[1] The 2005 - 2012 Report was followed by a report published in April 2014 summarising bus fire events in NSW in 2013 and a report published in February 2015 summarising bus fire events in NSW in 2014.[2] Monitoring of the extent, origins and causes of bus fires reported to OTSI was continued through 2015.

During 2015 all reported fires were documented and included events which did not progress to a fire but involved excessive heat and the generation of smoke. Most fires were of a minor nature and did not result in significant damage. Additionally, in most cases the origin and cause of the fire was readily identifiable and did not require an in-depth investigation. OTSI investigators examined vehicles on six occasions following the report of a fire. Two incidents were formally investigated and documented in OTSI bus safety investigation reports.

This report contains a summary of the information gathered in 2015 and provides commentary on comparisons with the information reported in previous years. These comparisons are provided for interest only, as the numbers of incidents in each category and in total are too small for meaningful statistical analysis. The report also briefly records further progress in implementation of recommendations made in the 2005 - 2012 Report.

Data for this report comes primarily from information provided by operators using the same methodology as used for recording occurrences in 2013 and 2014.

The Numbers

Forty fires were reported in 2015, and were distributed through the year as shown in *Figure 1*. Brief details of each incident are recorded at *Appendix A*.

1 OTSI Bus Safety Investigation Report, *An Investigation into Bus Fires in NSW 2005 - 2012*, available at www.otsi.nsw.gov.au

2 Both reports are also available at www.otsi.nsw.gov.au

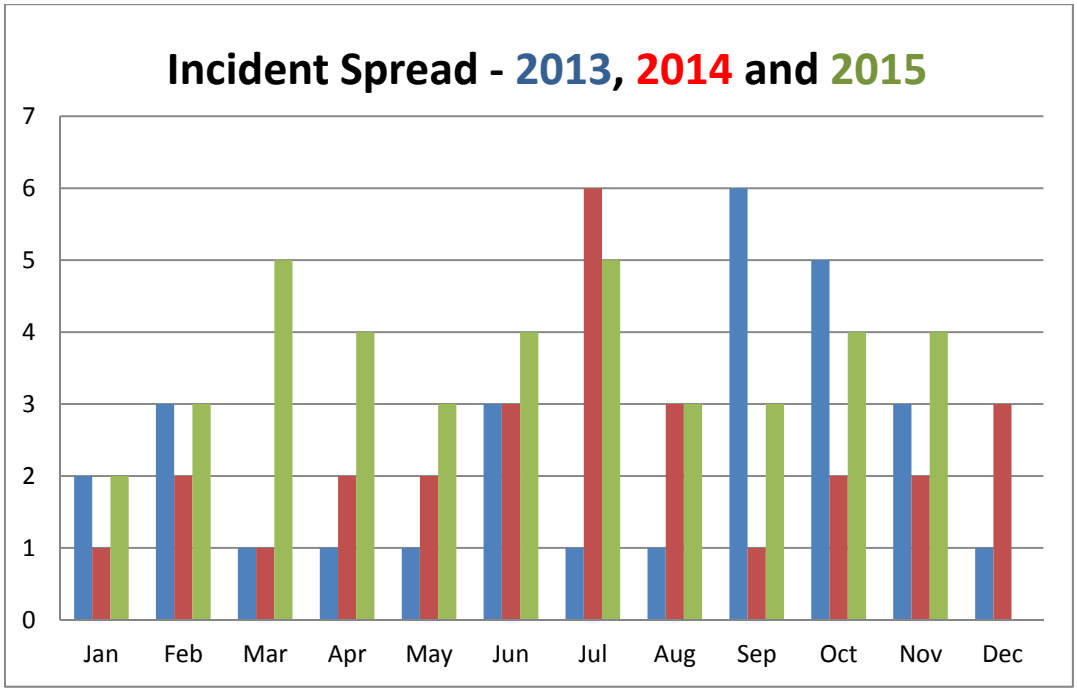

Figure 1

The total represents a significant increase over prior years; 29 in 2014 and 28 in 2013.

Two reports of fires have not been included in the data. One involved schoolchildren igniting a deodorant aerosol spray with a cigarette lighter in the back of the bus. The other resulted from misdirected exhaust gases entering the cabin and being mistaken for smoke from a fire.

Unlike the previous two years where there was a discernible peak in incidents, in 2015 the distribution was comparatively even, averaging 3 to 4 incidents a month. For the first time in the three years there was a month during which no incident was reported – December.

As was also the case in 2014, the ages of the buses involved, with two exceptions, ranged between one and 16 years (see *Figure 2*). Seven different makes of vehicle were involved and no make or model trends were identified. Only two of the buses were CNG-fuelled, one experienced a fault in the air conditioning compressor solenoid and the other a coolant leak from a split pipe.

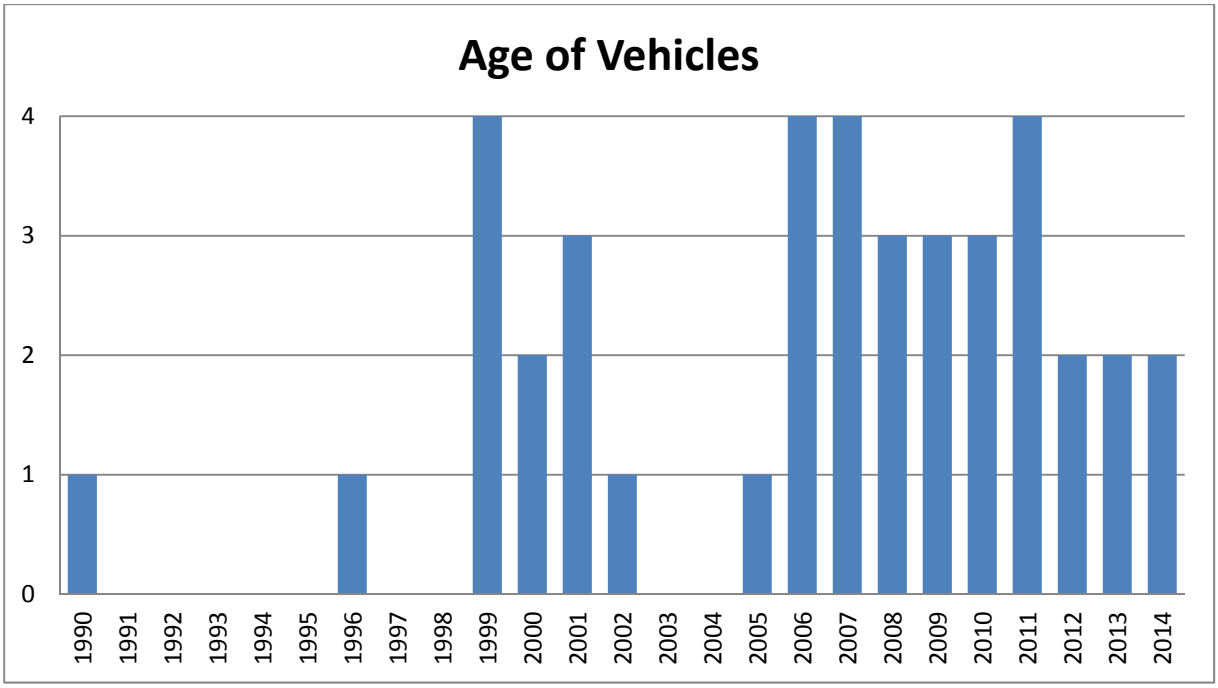

Figure 2

Two vehicles were effectively destroyed, two vehicles were assessed as having suffered major damage and three were assessed as having suffered moderate damage. Based on operator reports, 33 incidents (83%) were assessed (subjectively) as resulting in minor, negligible or nil damage.

Apart from minor effects of smoke inhalation, only two injuries were reported as being a consequence of fire incidents. A passenger fell and sustained back injuries during evacuation when their handbag caught on a seat. The passenger was taken to hospital for treatment. A technician was injured while undertaking welding repair work which ignited surrounding flammable materials. The technician was treated at a nearby medical centre.

Approximately 459[3] passengers had their travel affected by the incidents. The largest number involved in a single incident was 50. This bus was conducting a school service when it experienced a minor fire due to a short in wiring to the starter motor. The schoolchildren were safely evacuated and the fire self-extinguished when the ignition was turned off. On a third of occasions the vehicle was empty of passengers.

[3] The number is approximate as some of the operators were only able to provide estimates of passenger numbers.

Origins and Causes

Sixteen fires (40%) originated in the engine bay (see *Figure 3*). This is a similar number to, but a lower percentage than, the prior two years. In 2013, 16 engine bay fires represented 59 % of the total number of fires. In 2014, the 14 engine bay fires represented 48% of the total.

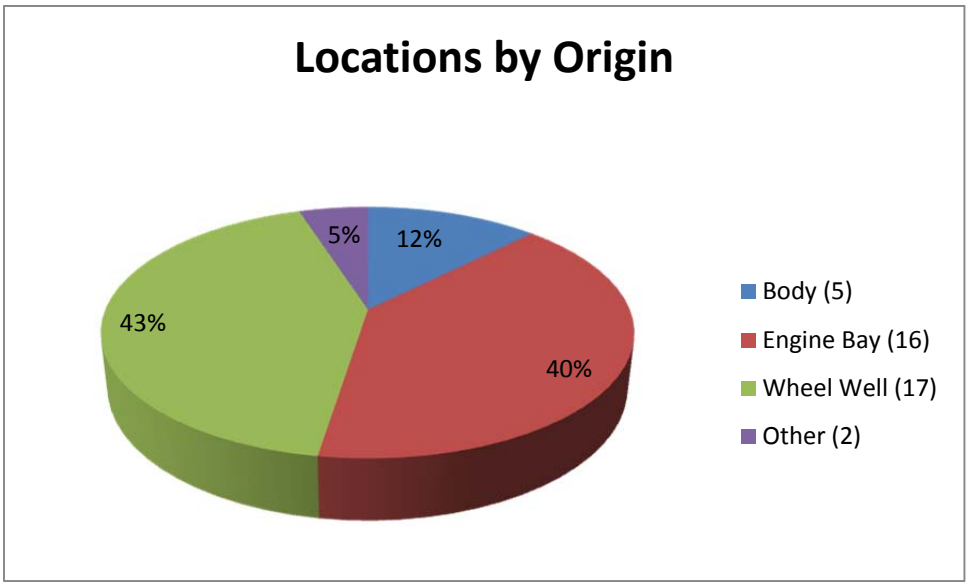

Figure 3

In 2015, 17 (43%) incidents were confined to the wheel well. In 2013, there were 6 (22%) and, in 2014, there were 11 (38%). Fortunately none resulted in damage of any significance. No detailed investigation to explore possible underlying causes or contributing factors was undertaken in the period.

A similar number of fires has originated in other locations within the body of the buses over the three years; 6 in 2013, 4 in 2014 and 5 in 2015.

Two fires have been categorised as originating in 'other' locations as the fault did not lie with the bus. One resulted from hot engine and/or exhaust components coming into contact with long dry grass at the edges of a bus parking area while the bus was manoeuvring. Only minor damage was sustained as the fire suppression system operated and, along with the on-board portable fire extinguisher, kept the fire in check until NSW Fire and Rescue arrived. The second fire resulted from the heat from welding repair work being insufficiently insulated from surrounding flammable materials.

The data for the causes of fires in 2015 are shown in *Figure 4*.

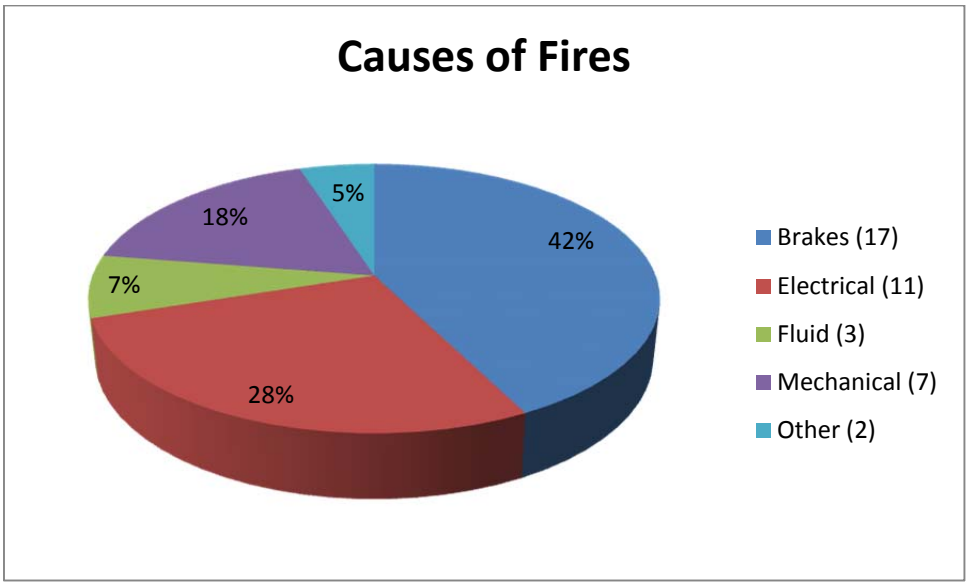

Figure 4

Brake-related incidents have increased markedly over the three years from 6 (23%) in 2013, through 10 (34%) in 2014, to 17 (42%) in 2015. In part the increase may be attributable to increased reporting of brakes-related 'thermal incidents' which were often not reported in the past as they did not involve fire. However, there appears to be grounds for concern with brake adjustment cited as the reason for all but one of the 2015 incidents. The exception was attributed to low air pressure causing the park brake to activate momentarily resulting in the brake linings overheating.

Though the number of electrical fires has varied over time, the percentage has not varied significantly. The results have been 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 short circuits, which highlights the need for extra vigilance in checking the condition and securing of electrical wiring. Of the 11 in 2015, 8 occurred in the engine bay.

There was a significant reduction in the number of incidents attributed to fluid leaks in 2015 – three (7%) compared with 10 (34%) in 2014 and 11 (39%) in 2013. All three in 2015 were caused by coolant leaking onto the manifold but causing only negligible or minor damage. One of the incidents was detected in its very early stage when passengers mistook steam for smoke. On this occasion the low coolant alarm also activated.

The number of incidents attributable to mechanical failures was significantly higher than in previous years – seven (18%) compared to two in 2014 and one in 2013. The reasons were diverse:

- exhaust gases leaking from a break in the stack ignited lagging
- a conrod penetrated the engine block and broke the injector pump governor housing
- catastrophic failure of the turbocharger impeller
- engine bay insulation came loose and fell onto hot engine components
- air conditioning compressor seized
- air conditioning unit overheated
- noise suppression insulation detached and fell on to the exhaust.

Detection of Fire

In 2015 bus drivers were the first to either see or smell smoke or see flames on 58% of occasions. This was similar to 2013 (63% of occasions) but somewhat less than in 2014 (79%). On four occasions the driver was first alerted to a problem through brake or steering behavioural anomalies. On one of these occasions the activation of the ABS warning light was the first alert to a problem the driver received.

Passengers were the first to detect smoke and/or fire on five occasions including one where steam coming from coolant leaking onto the manifold was initially thought to be smoke. External parties raised the alarm on the remaining 12 (30%) occasions. They included the drivers of following buses on four separate occasions.

Fire Fighting

Portable fire extinguishers were used on 26 (65%) occasions. The sole use of portable extinguishers was successful on 19 of those occasions. An extinguisher was unsuccessful in defeating the fire on two occasions. On three occasions an extinguisher was partially successful in suppressing the fire. One of these occasions was the fire under the bus parked over long dry grass where the fire extinguisher combined with the vehicles fire suppression system and NSW Fire and Rescue units defeated the fire before major damage had occurred. On two occasions an extinguisher was not required but the driver chose to discharge one anyway as a precaution against any subsequent flare-up.

A fire extinguisher was not required on fourteen occasions. These were in circumstances of minor electrical faults and where smoke was associated with brake problems. On three of those occasions the smoke or flames ceased when the vehicle was stopped and the ignition switched off.

NSW Fire and Rescue was called upon to attend 11 (28%) of the fires. Predictably, apart from the two occasions they were called as a precaution only, these were mainly the well-developed fires resulting in the most damage to the vehicles.

One of the coolant fires was suppressed using a portable fire extinguisher but continued to flare-up until it was extinguished by NSW Fire and Rescue. In haste, the driver had overlooked the need to first turn off the engine.

On one occasion NSW Fire and Rescue is reported to have conducted an air quality test inside a bus before passengers reboarded and the service was resumed following a minor fire in the engine bay.

Driver Training

Driver training in the supervision of vehicle evacuation and use of onboard fire fighting equipment was not examined. However, operators were asked if the drivers involved in the incidents being reported were so trained. In only one incident was it reported the driver had not been trained in evacuation procedures. All evacuations appeared to have been conducted effectively. Two instances of drivers not having been formally trained in the use of onboard fire extinguishers were reported. However, on both occasions the drivers used the extinguisher effectively. On another occasion a trained driver was unsuccessful in an attempt to discharge the extinguisher.

Progress on Implementing Recommendations

Based on advice from Transport for NSW (TfNSW), the Roads and Maritime Services (RMS) and the State Transit Authority (STA), the status of actions in response to the key recommendations contained in the 2005 - 2012 Report is as set out below.

The TfNSW Bus Procurement Panel (#2) has used the revised TfNSW bus specifications which adopted the risk based approach outlined in the Bus Industry Confederation's *Fire Mitigation Advisory* to minimise the likelihood of bus fire and the severity if one should occur. One of the options included the fitment of an automatic

engine bay fire suppression system. Subsequently TfNSW has determined that automatic engine bay fire suppression systems will be fitted as a standard requirement for all buses supplied under the Bus Procurement Panel (where available).

Following a bus fire in May 2015, the STA initiated a program to retrofit fire suppression systems to the remainder of its fleet which did not already have such systems installed. Subsequently, the Minister for Transport and Infrastructure confirmed this program and announced a similar program for private operator buses.[4] STA and TfNSW are managing the programs separately with completion expected by November 2016 and June 2018 respectively. Both projects are using international standards for designing, testing and installation of automatic fire suppression systems to ensure consistency of the solution.[5]

The RMS communicates key information to operators in various ways such as by distributing OTSI bus safety investigation reports and issuing information alerts. For example, Information Alert 2/14 was issued on 17 March 2014 to reiterate that operators should conduct risk assessments for fires on buses as part of their Safety Management Systems (SMS). Operators were reminded that part of the risk assessment should cover evacuation procedures for all passengers including wheelchair users, the elderly and children, training procedures for drivers, and fire extinguisher access.

Conclusions

The increase of some 38% in the number of incidents over the two previous years was due to significant increases in brakes-related issues and mechanical failures. Fortunately, there was not a corresponding increase in severity of damage to vehicles as a result. The apparent trend with brakes-related issues warrants further monitoring to determine if there are systemic issues that need to be addressed. OTSI will undertake this monitoring through 2016.

[4] A Constance (Minister for Transport and Infrastructure), *Safety Boost for Bus Customers*, media release, Sydney, 6 August 2015

[5] For example, the P-Mark certification process developed and controlled by the SP Technical Research Institute of Sweden, consisting of a series of tests (SP Method 4912) to rate suppression performance and limitations of fire suppression systems installed in engine compartments of buses and coaches.

The decision to retrofit fire suppression systems to buses operating under the Sydney Metropolitan and Outer Metropolitan contracts not already so fitted is noteworthy, as is the decision to specify more rigorous standards in future bus purchase contracts. However, it must also be acknowledged that fire suppression systems do not constitute an absolute solution.

Appendix A

BUS FIRES RECORDED IN 2015

MONTH	VEHICLE TYPE	YEAR	LIKELY FIRE SOURCE LOCATION	LEVEL of DAMAGE	ONBOARD FIRE EQUIPMENT USED
Jan	Bus	2010	Brake callipers had over-adjusted	Minor	Not used – smoke only
Jan	Bus	2007	Brake calliper sticking	Nil	Yes - successful
Feb	Bus	2000	Exhaust leak from break in stack ignited lagging	Minor	Yes - successful
Feb	Coach	2011	Brake linings overheated when low air pressure caused park brake to momentarily activate	Nil	Yes, as a precaution – smoke only
Feb	Bus	2011	Brake lining overheated	Minor	Not required
Mar	Bus	2001	Conrod penetrated the engine block allowing oil to contact exhaust pipe	Moderate	Yes – successful #
Mar	Bus	2008	Brake callipers had over-adjusted	Minor	Yes - successful
Mar	Bus	2001	Suspected electrical fault in panel next to alternator	Moderate	Not used #
Mar	Bus	2009	Hot engine components came into contact with long dry grass	Minor	Yes + fire suppression system - partially successful #
Mar	Bus	2008	Short in electrical wiring in the engine bay	Negligible	Not required – smoking ceased when ignition switched off
Apr	Bus	2009	Brakes incorrectly adjusted	Negligible	Yes - successful
Apr	Articulated Bus	2006	Catastrophic failure of the turbocharger	Destroyed	Yes – unsuccessful #
Apr	Articulated Bus	2006	Short in electrical wiring damaged when cable support tray broke loose	Negligible	Not used – smoke only
Apr	Bus	2009	Wiring insulation came loose and fell onto hot engine components	Minor	Yes - successful
May	Bus	1999	Faulty air conditioning compressor solenoid	Minor	Yes - successful
May	Bus	2007	Brake callipers had over-adjusted	Negligible	Yes - successful
May	Bus	1999	Short circuit in main alternator cable	Major	Not used #

MONTH	VEHICLE TYPE	YEAR	LIKELY FIRE SOURCE LOCATION	LEVEL of DAMAGE	ONBOARD FIRE EQUIPMENT USED
Jun	Bus	2001	Short in wiring to starter motor	Minor	Not required - fire extinguished when ignition turned off
Jun	Bus	2012	Incorrect brake adjustment	Negligible	Yes - successful
Jun	Bus	2014	Electrical fault in wiring in ceiling mounted electrical shelf	Destroyed	Yes – unsuccessful #
Jun	Bus	1999	Coolant leak onto manifold	Minor	Yes – suppressed fire #
Jul	Bus	2011	Brake calliper had over-adjusted	Negligible	Yes - successful
Jul	Bus	2012	Incorrect brake adjustment	Minor	Yes - successful
Jul	Bus	2008	Sticking brakes	Minor	Yes – successful ##
Jul	Bus	1990	Coolant leak onto manifold	Negligible	Not required – suspected smoke was only steam
Jul	Bus	2014	Brake calliper had over-adjusted	Minor	Yes - successful
Aug	Bus	2007	Overheating brakes	Negligible	Yes - successful
Aug	Articulated Bus	2006	Seized air conditioning compressor	Minor	Yes - successful
Aug	Bus	2006	Sticking brakes	Nil	Not required
Sep	Bus	2011	Wire to the turbocharger air intake sensor shorted	Minor	Yes, as a precaution – a little smoke only
Sep	Coach	2000	Air conditioning unit overheating	Minor	Not required
Sep	Bus	1999	Engine coolant leaking from a split hose onto exhaust lagging	Minor	Not used #
Oct	Bus	2013	Brake calliper had over-adjusted	Minor	Yes - successful
Oct	Coach	2010	Brake adjustment	Minor	Not used – smoke only
Oct	Bus	2002	Noise suppression insulation became unglued and fell onto hot exhaust	Minor	Yes – successful ##
Oct	Bus	2013	Defective starter motor and solenoid overheated	Minor	Yes - successful
Nov	Bus	1996	Non-standard installation of air conditioning components	Minor	Not required – smoking ceased when ignition switched off

MONTH	VEHICLE TYPE	YEAR	LIKELY FIRE SOURCE LOCATION	LEVEL of DAMAGE	ONBOARD FIRE EQUIPMENT USED
Nov	Bus	2007	Brake calliper had over-adjusted	Nil	Yes - successful
Nov	Bus	2005	Suspected electrical fault	Moderate	Not used #
Nov	Articulated Bus	2010	Welding repair work on air conditioning unit was not sufficiently isolated/insulated	Major	Yes - successful

# Denotes attendance by NSW Fire and Rescue.

Extinguisher used solely as a precaution.