



Office of Transport Safety Investigations

TECHNICAL INSPECTION FINDINGS

FIRE ON APPLE CITY COACHES BUS 3503MO

M2 NORTH ROCKS

1 NOVEMBER 2013



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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.

This OTSI investigation was conducted under powers conferred by the Passenger Transport Act 1990. OTSI investigators normally seek to obtain information cooperatively when conducting an accident investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to interview persons, enter premises and examine and retain physical and documentary evidence.

It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI's investigation reports strive to reflect a "Just Culture" approach to the investigative process by balancing the presentation of potentially judgemental material in a manner that properly explains what happened, and why, in a fair and unbiased manner.

Summary of the Incident

At approximately 1440 on Friday 1 November 2013, a convoy of two Apple City Tours buses left Milsons Point on Sydney Harbour carrying a group of high school students and teachers who were returning to Orange in the Central West of New South Wales after a two-day excursion in Sydney. The bus involved in this incident, registered in NSW as 3503MO, was the second in the convoy and was carrying 49 students and three teachers.

The driver had started the engine about 30 minutes before departure in order to use the air-conditioning to cool the interior of the bus which had been standing in the sun for about two hours.

The buses headed out along the M1, onto the M2 and through the Lane Cove Tunnel. Shortly after passing under Pennant Hills Road, the driver of the second bus was alerted by students to smoke that could be seen in the rear of the bus. At the time the bus was travelling in a dedicated bus lane adjacent to the median. When it was safe to do so, the driver steered across to the breakdown lane on the left and brought the bus to a stop near a rock face at the side of the road. As he stopped, the driver noticing that there were no warning indications showing on the instrument panel.

After stopping, the driver opened the door and turned off the ignition before ensuring that the passengers were safely evacuated from the bus, taking them forward to a safe position.

Once the passengers were safely clear, the driver returned to the bus and went to the back to check on the source of the smoke. He found the rear of the bus to be on fire and that a police officer who had been on a motorcycle in the traffic behind the bus had stopped the traffic, contacted emergency services, and was endeavouring unsuccessfully to extinguish the fire with a fire extinguisher. The driver noticed burning liquid running from beneath the engine rearward into the gutter.

In the ensuing minutes additional police officers arrived to control the site and, about 20 minutes after the bus stopped, two NSW Fire and Rescue units arrived and proceeded to extinguish the fire. The fire was extinguished in about 10 minutes.

Meanwhile, police had escorted the passengers to a bus stop further up the road where they were checked by paramedics. Some passengers experienced eye soreness and breathing difficulty but otherwise none were injured. Alternative transport was arranged to return the passengers to Orange that evening.

OTSI was notified of the incident at 1605 and an OTSI investigator was deployed to the scene, arriving at 1705. By this time the driver and passengers had departed and the fire had been extinguished. The bus was held at the scene, its removal being delayed until after the afternoon peak traffic had cleared.

Incident location

The incident occurred on the M2 Motorway, a multi-lane toll road joining the M1 at Artarmon with the M7 at Winston Hills. The location, in the suburb of North Rocks, is shown in *Figure 1*.

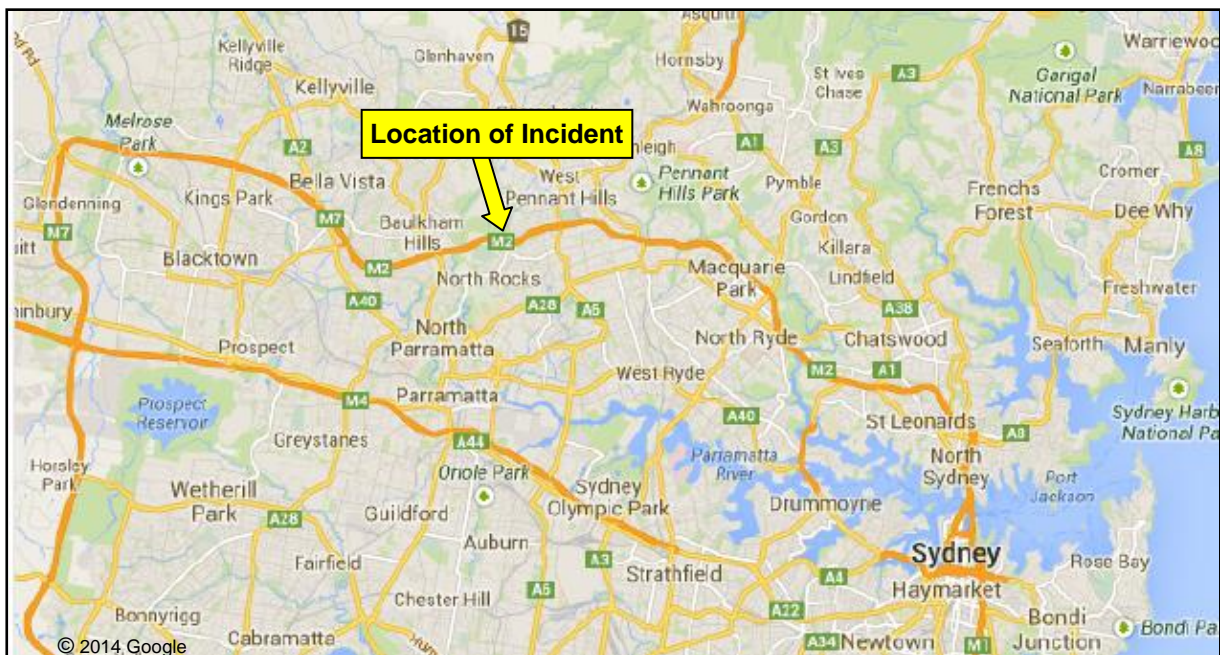


Figure 1: Location of incident

At the point where the bus came to a stop, the westbound roadway comprised two general traffic lanes bounded by a breakdown lane on the left and a dedicated bus lane on the right. At the left of the breakdown lane was a stabilised rock face as shown in *Photograph 1*. There was sufficient room between the bus and the rock face for the passengers to be evacuated and to move forward of the bus to a safe

location. The bus was also about half a metre clear of the left hand traffic lane and attending police placed marker cones to guide traffic safely past the site.

There was a bus stop a little over 500 metres west of the incident location which provided access to Barclay Road in North Rocks. This was where the passengers were taken after the incident.



Photograph 1: Breakdown lane and rock face

The driver

The driver of the bus was a 45 year old male who had been driving buses for approximately six months but had held an MR class licence¹ since the age of 17. His MR licence was augmented by a Public Passenger Vehicle Driver Authority, allowing him to drive vehicles with fare-paying passengers.

The driver was familiar with 3503MO, having driven it a number of times on school services in the Orange district.

¹ An MR (Medium Rigid) Class licence covers a rigid vehicle with 2 axles and a GVM of more than 8 tonnes, and a towed trailer of up to 9 tonnes GVM.

The bus

The bus was a 2004 model Mercedes-Benz O500m/1728/30 with a body by Coach Design. The body was constructed on a steel frame and consisted predominantly of fibreglass with some alloy panels and a plywood floor.

When purchased by Apple City Tours, the bus had front and centre doors on the left hand side but the centre door had been removed to allow additional seats to be fitted. Seating was coach style with integrated three-point seat belts.

At the time of the incident the bus provided seating for 53 passengers and a driver, with a folding seat at the front for a tour guide.

The engine was a rebuilt 6.4 litre 6 cylinder turbocharged diesel with electronically controlled direct injection. It was fitted in January 2013 after failure of the original engine. When the replacement engine was fitted, it would not start and was returned to the supplier for rectification. When fitted a second time, the engine started but was lacking turbocharger boost and had a number of other problems. A number of sensors and a cracked intercooler were replaced and the fuel system was cleaned, and the engine then performed normally.

The bus was routinely serviced at 5000 kilometre intervals, the first service after fitment of the replacement engine being in March 2013. In April it was fitted with a new fan drive jockey pulley and then with a new accelerator mechanism after it once again exhibited a loss of power.

In August, a further routine 5000 kilometre service was performed and after the bus once again lost power, the boost sensor was replaced. At this point the odometer showed 293861 kilometres. The bus then performed without any problems until the incident when the odometer reading was 295159 kilometres.

The bus was not fitted with fire detection or suppression systems but was equipped with two hand-held fire extinguishers rated at 2A:40B:E, exceeding the capacity requirements of *Australian Design Rule 58/00 – Requirements for Omnibuses Designed for Hire and Reward*. ADR 58 requires the provision of two 2A:20B fire extinguishers as specified in *Australian Standard 2444—2001, “Portable Fire Extinguishers – Selection and Location”*.

Examination of the bus

The bus was examined at the scene of the incident. The body had been extensively damaged by the fire, with the greatest damage being to the sides of the bus from the rear axle to the back panel, as shown in *Photograph 2* below.



Photograph 2: Damage to left rear of bus

The interior of the bus was also extensively heat affected, with significant damage to the seats at the rear. The damage to the seats was greatest near the left rear windows (see *Photograph 3*), suggesting that the fire had been transmitted to the interior of the bus through the windows rather than through the floor which had suffered relatively little damage.

Although the seats toward the front of the bus were not burned, the driver's windscreen blind had melted in places and dripped onto the steering wheel (see *Photograph 4*) indicating that a high temperature had been present throughout the bus.



Photograph 3: Damage to rear seats



Photograph 4: Molten plastic from driver's blind

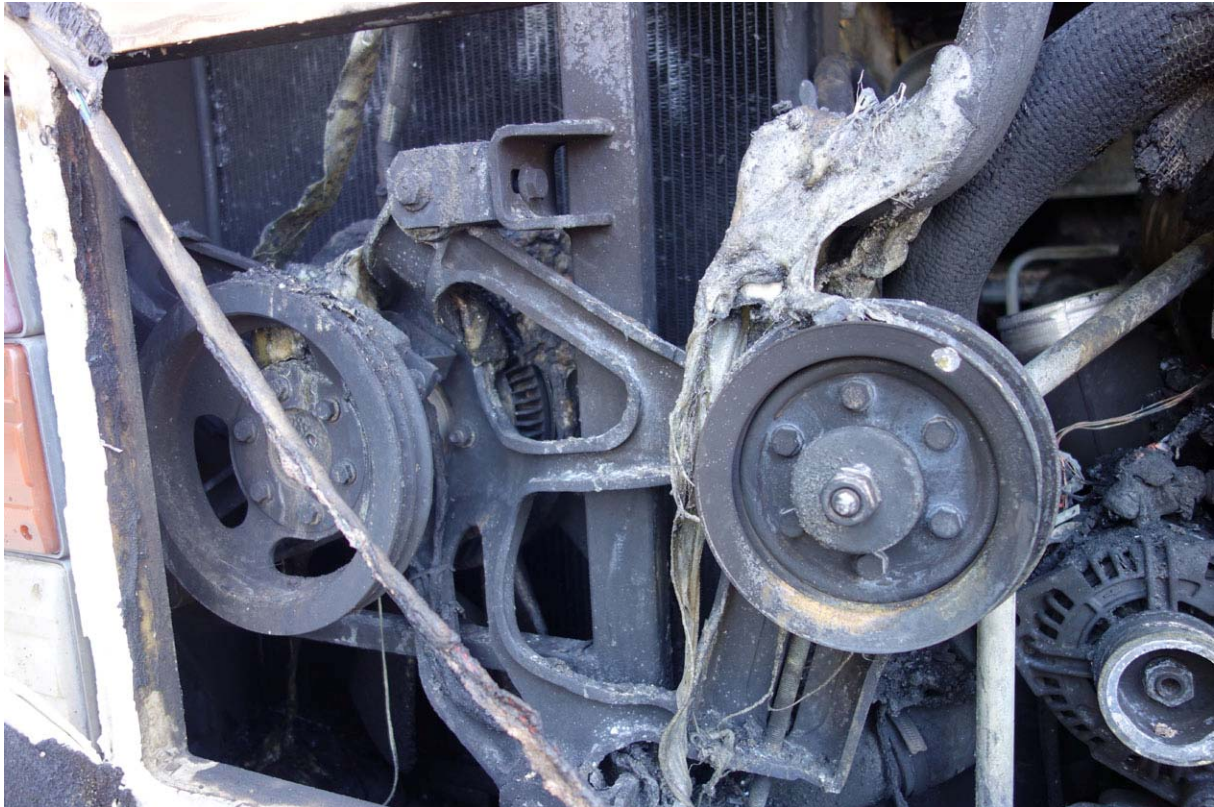
One of the bus's two fire extinguishers was found in place beside the driver's seat and appeared undamaged, while the second was found mounted to a chassis rail at the right hand rear of the bus and was severely fire damaged.

The bus's rear-mounted engine had been destroyed by the fire, with most flammable materials totally consumed and alloy components severely burnt and charred. The most severe damage was on the right of the motor, when viewed from the rear, and involved the cylinder head and fuel injection system. The extent of this damage can be seen in *Photograph 5*.



Photograph 5: Damage to right side of engine

It is significant that alloy components in this area of maximum damage showed evidence of burning rather than melting, suggesting that they were directly involved in the fire, rather than having been affected by high temperatures from a heat source that did not directly involve them. In contrast, a number of components on the other side of the engine were melted, as seen in *Photograph 6*.



Photograph 6: Melting of components on left of engine

Analysis

In order for a fire to develop and be sustained for a significant time, four elements are necessary:

- an initiator
- combustible material
- an oxidising agent, in this case oxygen in air
- a path by which the fire can spread.

The initiator

Common sources of the temperature needed to initiate a fire in a bus engine compartment are high turbocharger and exhaust temperatures, exhaust leaks and electrical short circuits.

The high level of damage on the right side of the engine suggests that this was the area in which the fire commenced. While the location of the turbocharger and exhaust on the left side of the engine reduces the likelihood of either of these

initiating the fire, it remains a possibility that the fire could have been initiated in this area.

As the bus was operating without any apparent problem even while smoke was visible, and the instrument panel gave no indication of any malfunction, it is unlikely that the fire was initiated electrically.

The extent of damage to the engine and associated components prevented positive identification of the initiator.

Combustible material

The location of the greatest damage around the cylinder head and fuel injection system suggests the probability that the fire involved diesel fuel. This is supported by the report that flaming liquid was seen on the roadway beneath the bus and running into the gutter. It seems likely that the fire was started by leaking diesel fuel coming into contact with a hot surface in the engine compartment. Because of the fire damage to the engine, the cause of the fuel leak could not be established.

Propagation path

The temperature reached as a result of burning diesel fuel in an enclosed space would have been sufficient for the fire to spread to other combustible materials in the engine compartment, and to result in the level of damage seen in *Photographs 5 & 6*. The development of the fire would also have been facilitated by the fact that the bus continued to operate after the fire commenced, until the driver was made aware of the presence of smoke in the rear of the bus and was able to steer to the breakdown lane and to stop.

The damage to the rear tyres and to the sides of the bus, as seen in *Photograph 7*, indicate that the fire was spread to the left hand side of the rear axle by burning diesel fuel running down the slope of the roadway. The flames would then have travelled up the side of the bus causing the rear side windows to shatter, at which time the fire could enter the passenger space and involve the interior linings and seats before being extinguished. There was no evidence of the fire entering the passenger space of the bus through the plywood flooring.



Photograph 7: Fire damage to side of bus

Conclusions

Although the cause of the fire could not be determined with certainty, it is most likely that it was caused by leaking diesel fuel igniting when it came into contact with a hot surface on the engine. The leaking fuel then continued to burn, involving other combustible materials in the engine compartment. The fire then spread as further leakage of fuel occurred. When the bus came to a stop, leaking fuel spread beneath the bus, allowing the fire to involve the rear wheels and travel up the side of the bus. This in turn would have caused the side windows to shatter, allowing the fire to enter the passenger compartment.

The absence of any fire detection or suppression equipment in the engine compartment provided time for the fire to take hold before the driver was aware of it and was able to stop the bus. The fact that all passengers were able-bodied and were evacuated in an efficient manner by the driver averted what may otherwise have been far more serious consequences than the loss of the bus.

On the basis of these findings OTSI has concluded its examination of the circumstances of this incident and has determined that it does not require further investigation by this Office under the provisions of Section 46BA (1) of the *Passenger Transport Act 1990*.

Copies of these findings have been provided to Apple City Tours and Roads and Maritime Services.