



Office of Transport Safety Investigations

## BUS INCIDENT FACTUAL FINDINGS

### FIRE INVOLVING STATE TRANSIT AUTHORITY (STA) BUS MO 1189

MARSFIELD, NSW

14 February 2013



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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 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 Transport Administration Act 1988 and 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.

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## Abstract

While embarking a passenger on the morning of 14 February 2013, the driver of a State Transit Authority bus was alerted to a fire in the engine bay by a motorist who had been following the bus. The driver instructed his passengers to disembark and reported the situation to his Network Control Centre. He then activated the emergency fuel shut off valve. After some delay caused by the time it took to inspect the rear of the bus and then return to the driver's console to collect a fire extinguisher, he attempted to extinguish the fire. Although it initially appeared the fire was extinguished, it subsequently reignited and was ultimately extinguished by Fire and Rescue NSW appliances.

The fire was caused by coolant spraying from a split in a coolant hose and saturating lagging on the manifold which then ignited. The split was in a part of the hose that could not be seen in the course of a routine visual inspection. During examination of the incident it became apparent that the training of STA bus drivers in handling fires is very limited and that they receive no instruction on safe emergency evacuation in the event of a bus fire.

## The Incident

Just after 0900 on 14 February 2013, the driver of State Transit Authority (STA) bus (MO 1189) stopped on Vimiera Road in Marsfield to pick up a passenger when he was alerted to the presence of fire in the engine bay by a following motorist. The bus was operating a Route 551 service out of the STA Ryde Depot and at the time had 11 passengers onboard including primary school children.

The following sequence of events was constructed using the bus' onboard CCTV recordings and recordings of radio transmissions between the driver and the operator at the STA Network Control Centre:

- At 9:09:55 the bus was stationary while the driver opened the front entry/exit door to allow another passenger to board the bus.

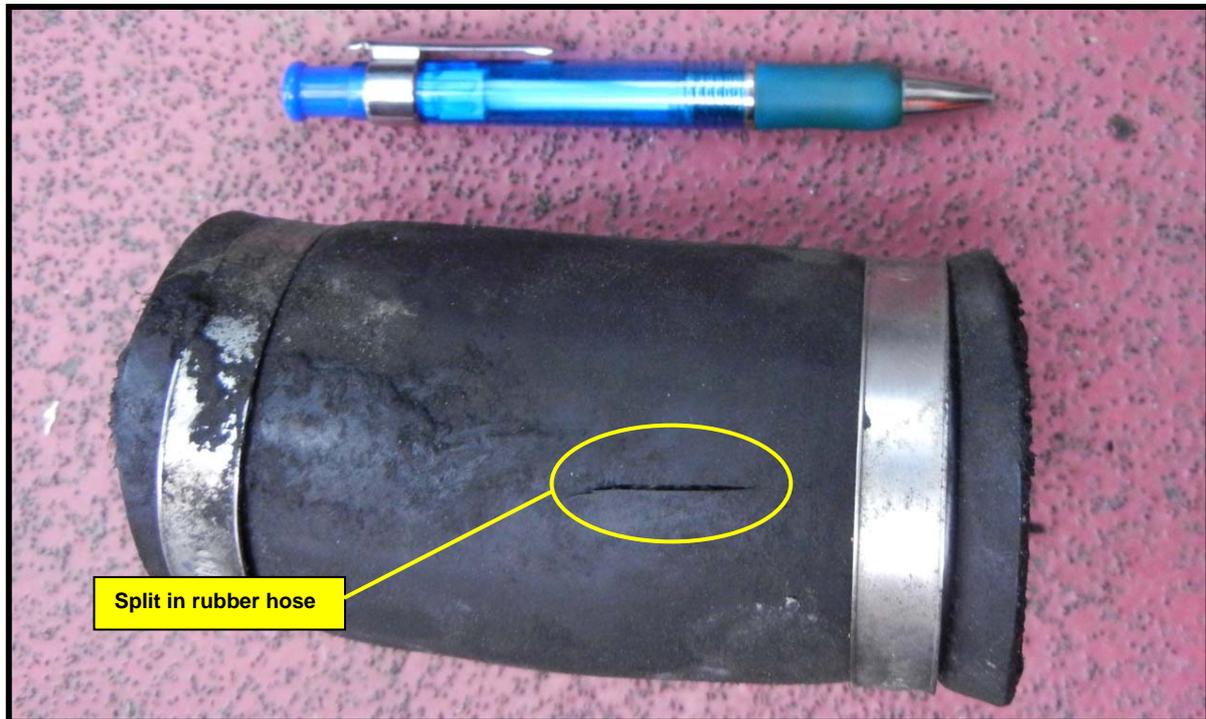
- At 9:10:09, before the bus had resumed its journey, the driver of a car who had been following the bus called to the bus driver from outside, informing him of flames emanating from the back of the bus. The car driver then departed.
- At 9:10:33 the bus driver, after looking in his rear view mirrors while still remaining seated, instructed the passengers to vacate the bus. They disembarked through the front and middle doors with the last passenger exiting at 9:10:48, some 39 seconds after the driver was advised of the fire.
- At 9:10:58 the driver reported the situation to the Network Control Centre. He gave his location as Balaclava Road near Yangala Street near Macquarie University.
- At 9:11:18, after the network control officer had asked the driver to remove the passengers and turn off the engine, the driver stood up and activated the emergency Compressed Natural Gas (CNG) fuel shut off valve located to the rear of his seat.<sup>1</sup> The network control officer then asked him to check the rear of the bus, take the fire extinguisher and report back. The driver acknowledged the request.
- At 9:13:36 the driver exited the bus and walked to the rear without the extinguisher. After inspecting the rear of the bus he ran back to the driver's console and removed the portable 2.5kg dry powder fire extinguisher. He returned to the rear of the bus and discharged the extinguisher into the engine bay of the bus. The time was then 9:14:22; a total of 4 minutes and 13 seconds had elapsed since the driver was alerted to the fire.
- Fire and Rescue NSW units arrived at 9:26:28 and extinguished the fire. [The driver reported initially that he had extinguished the fire but it reignited a short time after he had discharged his extinguisher.] Police also attended.

No person was injured in the incident and minor damage occasioned to the bus was restricted to the engine area.

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<sup>1</sup> It is noted that the network control officer did not remind the driver to isolate the CNG supply or advise emergency services the bus was CNG-fuelled. These procedural actions were initiated by STA in response to a fire involving a CNG-fuelled bus in Hillsdale on 29 July 2011. OTSI's investigation report into this incident may be accessed at: [www.otsi.nsw.gov.au](http://www.otsi.nsw.gov.au)

After Police and Fire and Rescue units departed, STA mechanics, who had been dispatched from the Ryde Depot, inspected the bus and found a rubber connecting hose on the main coolant supply return line had split (see *Photograph 1*). This hose was replaced, the coolant topped up, and the bus driven back to the Depot.



**Photograph 1: Split in connecting hose**

## **The Driver**

The driver held a current NSW Heavy Vehicle Drivers Licence and a current Driver Authority which he had held for two and a half years. He had previous experience as a bus driver gained during service in the Australian Defence Force. He had commenced work at 0528 working a part time shift on the day.

## **The Network Control Officer**

The operation of STA buses is monitored by network control officers (NCO) from its Network Control Centre co-located within Transport for New South Wales' (TfNSW) Transport Management Centre at Everleigh. The NCO who handled the fire incident in the Centre was a cadet undergoing on-job assessment at the time.

## The Bus

Bus 1189 is one of a fleet of 299 Mercedes Benz O405NH CNG-powered buses operated by STA. Since their introduction into service in NSW commencing in 2000 there have been six fires in this model of bus.

The bus is fitted with two bi-fold entry/exit doors on the near side (left hand side), one located at the front and the other midway along the bus. There are also two window emergency exits. The bus was not fitted with fire or smoke sensors or a fire suppression system.

There are two emergency shut off valves in the CNG supply line between the storage tanks mounted on the roof towards the front of the bus and the rear mounted engine. One is located inside the bus just behind the driver's seat and the other outside at the rear offside (right hand side) corner of the bus.

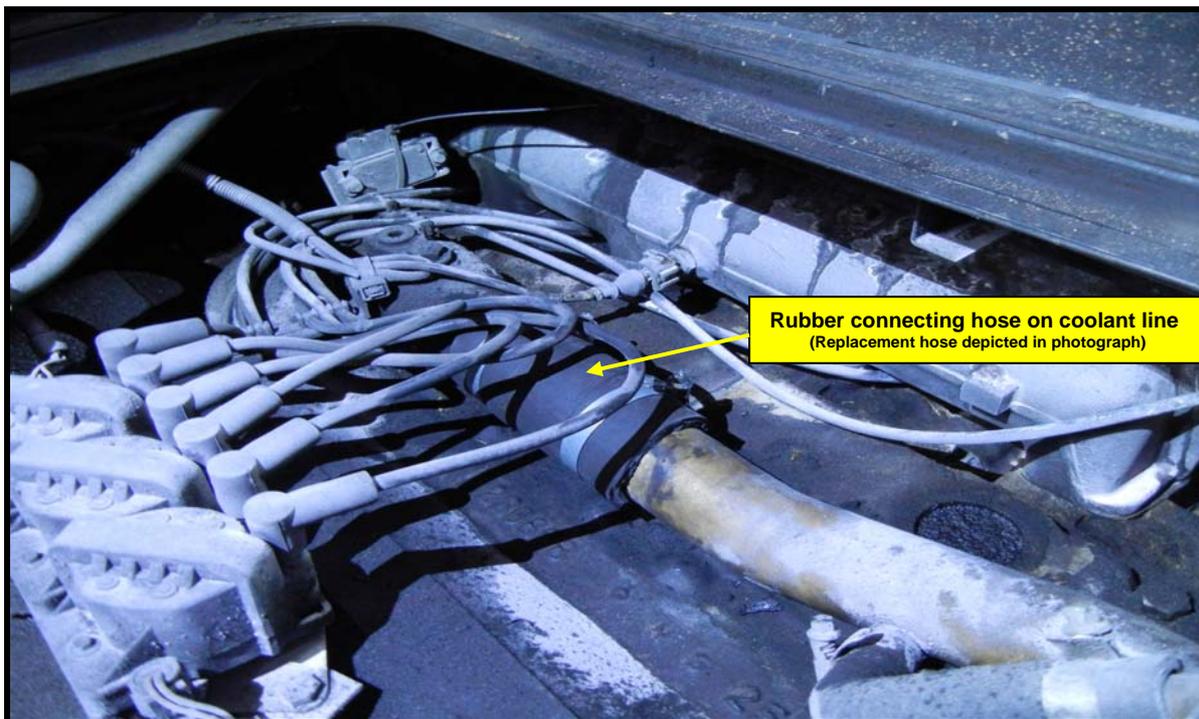
## Vehicle Inspection

OTSI and STA investigators inspected the bus on its return to Ryde Depot. The inspection confirmed the fire was due to the split rubber connection hose on the main coolant return line which ran across the top of the engine block (see *Photograph 2*).<sup>2</sup> This allowed coolant to spray over the top and side of the engine and onto the hot exhaust manifold located on the near of the engine. The coolant used in the bus cooling system consists of a mixture of 50% Glycol and 50% water and circulates under an operating pressure of 70kPa.

The lagging removed from the exhaust manifold was saturated with coolant and scorched in the area where it had been in contact with the manifold joining flanges (see *Photograph 3*). A section of lagging had ignited and burnt (see *Photograph 4*). Fire damage was restricted to the lagging on the exhaust manifold.

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<sup>2</sup> STA is currently in the process of arranging for the rerouting of the air-conditioning coolant booster pump and associated lines and hoses away from hot surfaces on this model bus in response to a previous fire. The connecting hose involved in this incident is not part of that system.



**Photograph 2: Coolant connection hose**



**Photograph 3: Exhaust lagging**



**Photograph 4: Burnt lagging**

An analysis of the characteristics of ethylene glycol-based coolants indicates that under certain conditions coolant can ignite.<sup>3</sup> This occurs when the water content of the coolant evaporates, leaving pooling of the residual ethylene glycol. It can also ignite in circumstances where the glycol impregnates other materials such as lagging or shielding and is then exposed to the combination of a heat source and air.

The split in the connecting hose was situated on the underside of the hose which is separated from the top of the engine block by only a small gap. Consequently, this part of the hose is not visible from direct observation especially from the service hatches in the bus floor above, so defects or damage in this area will not be detected during routine visual inspections. The difficulty associated with inspecting this hose is well illustrated in *Photograph 2*.

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<sup>3</sup> Hull, WC, et al, 'Analysis of Ethylene Glycol-Based Engine Coolant as a Vehicle Fire Fuel', *International Symposium on Fire Investigation Science and Technology*, Sarasota, FL, 2008.

## **Servicing and Maintenance**

Examination of the servicing and maintenance records for the bus revealed that the connecting hose on the coolant return line was not included in any regular scheduled servicing or replacement program, but the coolant system is scheduled to be visually inspected at least every three months. Additionally, the hose is visually inspected from the floor hatch inside the bus during all six monthly inspections and physically felt to determine if there is any sponginess present.

Every three years the coolant system is pressure tested and hoses and connections inspected. Unless a hose is replaced due to a failure or problem identified during pressure testing, the hose remains in service.

Maintenance Work Order 00236699 recorded the engine as having been steam cleaned on 15 January 2013. However, none of the boxes against the ten items to be cleaned had been signed off, although a completion date had been entered. From the examination of the engine on 14 February 2013, it was evident from the accumulated road grime that this work had not been completed as indicated on the work order.

## **Driver Training**

The current training for new STA drivers was introduced in 2001. It consists of a nine day training period which includes modules of the TLI 31210 Certificate III in Driving Operations (Bus), followed by five days of route familiarisation. The only training in fire fighting and use of a portable fire extinguisher consists of watching a video of an extinguisher being used on a burning timber pallet. Additionally, during the nine day period drivers have to familiarise themselves with the operation of the 11 different types of buses in the STA fleet.

No instruction on the safe emergency evacuation of buses is incorporated in the training. In this incident, evacuation of the passengers, which included children, was not supervised and no indication of the bounds of a safe area was specified by the driver. Safe assembly areas away from burning buses are particularly important

in relation to gas-fuelled buses as fuel storage is on top and to the front of the bus rather than under the body and to the rear.

Drivers already qualified receive up to two hours of training on new types of buses at the time of their introduction into service. No training has been given on the additional considerations in operating a CNG-fuelled bus compared to diesel-fuelled other than on the activation of the emergency gas shut off valve.

## Reporting of Location

The driver incorrectly reported the location of the bus being on Balaclava Road instead of Vimiera Road. This incorrect information initially led to confusion on the part of the NCO but was resolved through reference to the Public Transport Information and Priority System (PTIPS).<sup>4</sup> The NCO's assessor had quickly realised there was a location or service number error but allowed the NCO to resolve the anomaly.

## Findings

The examination of the circumstances of this incident highlighted the following safety issues:

- The hose that split could not be thoroughly inspected visually in situ and was not included in a replacement programme.
- The delay between initial notification of the fire and the attempt to extinguish it was excessive and largely due to an inefficient response process undertaken by the driver.
- The training of STA bus drivers in handling fires is very limited and contains no practical instruction or assessment. Drivers receive no instruction on safe emergency evacuation in the event of a bus fire.
- The fire was not fully extinguished after being attacked with the fire extinguisher provided on the bus.

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<sup>4</sup> PTIPS employs global positioning systems and radio data communications to deliver information about buses and their location that is then used to give them priority at traffic signals by altering the sequencing and timing of the signals.

## Remedial Action

The STA has advised that the following remedial actions have been undertaken at this stage.

Mercedes-Benz was approached seeking approval to reduce the amount of glycol in the coolant in this model bus. The manufacturer's permission is required for any deviation from their specification so that existing service arrangements and warranties on the buses are not affected. Subsequently, Mercedes-Benz confirmed the availability of a suitable non glycol-based coolant. STA intends to progressively introduce this product into its fleet of Mercedes O405NH buses.

An instruction has been given to leading hands (supervisors) at the Ryde Depot that work is not to be considered to be complete without the paperwork being fully and correctly completed prior to closing off the work order in the 'Ellipse' maintenance management system.

A review of initial driver induction training and the ongoing driver development training undertaken at two yearly intervals has been initiated with the view of strengthening emergency evacuation procedures.

It is intended to adopt fire suppression systems as standard equipment in new buses coming into service. This position stems from STA's risk-based assessment showing that emissions technology in modern buses results in higher fire risk scores.

RMS has advised that it will review STA's remedial actions in relation to its maintenance program and relevant operator training through processes provided under the Bus Operator Accreditation Scheme (BOAS).

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

A copy of these Findings has been provided to the State Transit Authority and the Roads and Maritime Services (as the NSW Bus Regulator).