OTSI Office of Transport Safety Investigations

TECHNICAL INSPECTION FINDINGS

FIRE INVOLVING CYC TOURS BUS TV 4153

HUME HIGHWAY, HOLBROOK

8 FEBRUARY 2010

TECHNICAL INSPECTION FINDINGS

FIRE INVOLVING CYC TOURS BUS TV 4153
HUME HIGHWAY, HOLBROOK

8 FEBRUARY 2010

Investigation Reference: 04470

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
Accident and incident notification: 1800 677 766
Facsimile: 02 9322 9299
E-mail: info@otsi.nsw.gov.au
Internet: www.otsi.nsw.gov.au

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.

OTSI's investigations are conducted under powers conferred by the Rail Safety Act 2008 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.

It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI strives 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.

The Incident

At approximately 3:15pm on Monday 8 February 2010, the driver of a tour bus operated by CYC Tours Pty Ltd[1] was travelling South to Melbourne on the Hume Highway when he experienced an unusual vibration or shudder from the rear of the bus. The driver stopped the bus on the side of the Highway approximately 18km North of the township of Holbrook.

The CYC tour guide exited the bus and saw what appeared to be smoke emanating from the nearside rear wheel arch area. He described the smoke as being initially white in colour, and then becoming black. The guide attempted unsuccessfully to extinguish the fire using a fire extinguisher from the cabin of the bus, whilst the bus driver safely evacuated the 23 passengers and contacted emergency services. However, by the time the NSW Fire Brigade arrived on scene the bus was beyond saving, and they turned their attention to the nearby grass and trees which were well alight. The extent of the fire damage to the bus and surrounding property can be seen in *Photographs 1* and *2*.

Photograph 1: Incident site showing area affected by the spread of fire

Although the bus was destroyed and many of the personal belongings of those on board were lost, there were no reports of injuries, and the driver, tour guide and passengers continued their journey in a replacement bus.

1 CYC Tours Pty Ltd is accredited by Transport NSW (Accred No 33182) and operates under CYC Travel Services Pty Ltd. CYC management indicates that the company has been in operation for approx 20 years, but has done so under a number of names.

The Bus

Whilst the bus identification and compliance plates were destroyed by the fire, records provided by CYC and Volvo showed the bus to be a late 2005 Volvo B7R-108490 chassis on which was a tour coach body constructed by Northcoast Bus & Coach Pty Ltd. Maintenance records show the bus had been regularly maintained throughout its life by the manufacturer's service division.

OTSI Involvement

OTSI was notified of the incident through representatives of NSW Transport and Infrastructure (now Transport NSW), who had become aware of the incident via Police reports. Since Police were in attendance and the bus was to be recovered to a holding yard in Wagga Wagga, arrangements were made to inspect the bus at that location the following week.

OTSI investigators interviewed the tour company manager, driver and tour guide, visited the incident site and viewed relevant operational and maintenance records. A similar bus (six months older) was also examined at the Zetland holding yard used by CYC so as to gain a better knowledge of the vehicle.

During February and March 2010, the wreckage of the bus was examined by various parties including the insurer (Zurich), Volvo and OTSI investigators, at a holding yard at Wagga Wagga (*Photograph 2*).

Photograph 2: Wreckage of the bus

Particular attention was given to the area around the left side rear wheels where the tour guide first saw smoke.

Examination of the Wreckage

The rubber of the left side rear tyres had been consumed by the fire, leaving the steel reinforcing cord exposed. *Photograph 3* shows steel bead[2] cord from the outer tyre still largely contained within the rim's profile. Bead cord from the inner tyre can also be seen, located inboard of the rim. There was also cord, not visible in the photographs, between the rims.

The radial steel reinforcing from the left hand tyre sidewalls was no longer in place, with some visible on the ground around the wheels. The remainder was missing, most likely having fallen out during recovery and transport of the bus.

There were remnants of rubber remaining from the right side rear tyres, and much of the steel reinforcing cord remained in place (*Photograph 4*).

Photograph 3: Rear wheel rims showing location of steel tyre cord

2 The beads of a tyre are the inner circumferences that locate the tyre on the rim.

Photograph 4: Remaining rubber from right outer rear tyre

The left hand side inner and outer wheel rims were removed to facilitate examination of the rear hub, brake disc and axle.

Components inboard of the hub were severely fire affected, and it was noted in particular that the spring brake chamber was missing, having separated from its mounting flange, as can be seen in *Photograph 5*. As a consequence there was no need to release the brakes to check movement of the hub, which was found to rotate freely.

Photograph 5: Missing spring brake chamber

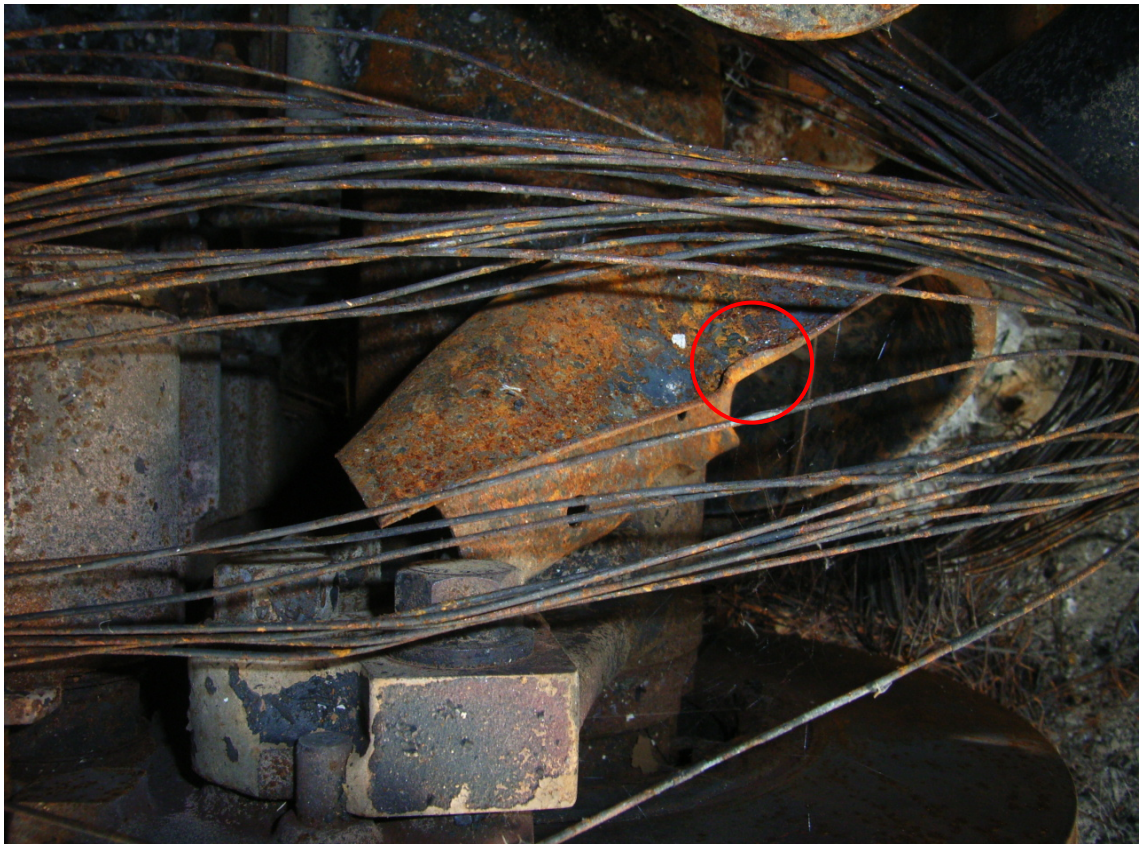
The brake disc showed no evidence of deformation, scoring or abnormality and although the linings were well worn, there was sufficient pad thickness remaining to provide effective braking. This was consistent with the driver's statement that there

were no brake warnings activated and the bus braked normally when he brought it to a stop at the side of the Highway.

Examination of the service history of the bus showed the rear brake pads as having 35% life remaining one month before the incident and needing to be scheduled for relining.

The brake shield located inboard of the brake disc was severely deformed, as can be seen in *Photograph 6* where it is compared with a similar undamaged shield. There was an impact mark, evidenced by visible burring, on the edge of the shield (*Photograph 7*) and, although the shield remained secured to the brake calliper mounting bracket by a bolt at each end, it had separated from a third bolt approximately mid-way between the other two.

Photograph 6: Comparison of the damaged shield (left) with an undamaged shield (right)



Photograph 7: Evidence of impact damage on edge of deformed brake shield

The bus was fitted with two powder type fire extinguishers, one (the one used by the guide) located behind the driver's seat and the other located in a compartment on the driver's off-side, behind a panel between the engine bay and wheel well (visible in *Photograph 8*). On the bus examined at the Zetland holding yard, the second fire extinguisher was located on the opposite side. Neither the driver nor the guide was aware of this difference, their assumption being that for buses of the same model it would always be found on the same side.

Photograph 8: Position of second (rear) fire extinguisher in relation to rear wheels

Analysis

Warning Indicators

When the bus driver was interviewed he stated that he had carried out a routine pre-departure check at Zetland before starting the tour. Once underway, he did not encounter any faults, warning lights or abnormal operation enroute, or during a rest stop at Gundagai approximately one hour before the incident.

As part of the vehicle's diagnostic system, various warning lamps and gauges provide information to the driver on the overall condition of the brakes, including braking system air pressure, brake pad wear, high brake temperature and failure of the ABS. However, the driver stated that none of these were activated prior to the incident, or while the bus was slowing and stopping from an estimated 100km/h highway speed.

No evidence was found of any pre-existing fault that could have contributed to the initiation of the fire.

The bus was not fitted with a low tyre pressure warning system, so the driver would have had no warning of loss of air from a tyre while travelling unless the handling of the bus was noticeably affected.

Tyres

The presence of the steel cord from the beads of both left side tyres in a relatively tidy and untangled condition in or adjacent to the wheel rims is an indication that it is unlikely that the tyres burned away or disintegrated while the bus was travelling at speed.

The absence of any tyre rubber remaining in the vicinity of the left side wheels, unlike the right side wheels where some rubber remained, supports the premise that the fire started on the left side of the bus.

Brakes

The bus was equipped with air operated disc brakes, with the rear brakes incorporating a spring brake chamber to provide a parking brake function. As noted earlier, the spring brake chamber on the left hand rear wheels was missing, having separated from its mounting flange, rendering the spring brake inoperative. The report by the driver that the brakes operated normally when he brought the bus to a stop indicates that the spring brake chamber was present at this stage, and became separated as the fire intensified.

Examination of the brake disc and pads did not show any obvious abnormalities other than fire damage.

The damaged brake shield was examined and compared with an undamaged shield on another bus of the same model. It was considered that the damage to the shield was unlikely to have been caused by the tyre cord after the tyre disintegrated, as the cord was found to be lying loosely around the shield rather that caught and tangled on it.

The burring to the edge of the shield had the appearance of having been due to impact by a hard object, rather than by rubber from a disintegrating tyre. This, and the location of the undamaged shield within the profile of the rim and with a relatively small clearance from the rim, suggests that the damage to the shield may have been caused by some hard object being trapped between the rotating wheel and the bus body and suspension components, and being forced into the gap between the rim and the shield. This raises the possibility of the damage to both the tyre and the shield being caused by some object thrown up from the roadway.

Wheel Hub

Whilst the hub was not dismantled for inspection, the exterior of the hub was checked for ease of rotation and for signs of lubrication leakage, deformation, melted components (as a result of high friction temperatures), or obvious degradation. No abnormalities were identified and the hub could be easily rotated by hand.

Fuel Lines

A thermoplastic line from the fuel tank (diesel) to the engine is located in the undercarriage, in the vicinity of the cross member behind the inner wheel and above the axle hub. Leakage from this fuel line was considered as a possible source of the

fire, but was discounted on the basis of the witness account that white smoke was initially visible before turning black, whereas burning diesel fuel would have been black from the outset. It is probable that the fuel line was intact while the bus was in motion, but was subsequently damaged during the early stages of the fire and became a source of fuel to accelerate the fire's development. This could, in part, also explain why the smoke changed colour from white to black and the fire spread rapidly underneath the bus and beyond the capabilities of the extinguisher used by the tour guide.

Propagation and Spread of Fire

Smoke was first seen emanating from the left rear wheel region by the tour guide. The smoke was reported to be white in colour when first seen, but rapidly changed to black. Smoke with a light grey or white appearance is consistent with smoke from rubber heated by friction, such as seen from aircraft wheels at touchdown or from intentionally spun wheels of motor vehicles. The presence of such smoke suggests the likelihood of a damaged tyre rubbing on body or chassis components prior to the bus coming to a stop.

It is probable that the cooling airstream from the movement of the bus prevented the tyre from igniting until the bus stopped, at which time the tyre burst into flames and gave off the black smoke seen by the tour guide.

The heat from the fire as it spread under the bus would have then caused the fuel line to fail, providing a source of diesel fuel to feed the fire and accelerate its development. In this bus, the panels inside the wheel well were lined with stainless steel which acted for a period of time as a barrier to the fire. However, as the fire intensified above the wheel well, it burned through the exterior composite material and underlying sidewall insulation, and spread into the interior of the bus. By this time the fire would have been beyond the control capability of hand-held extinguishers, and would have continued to spread into the bus bodywork and to the interior of the bus.

Propagation of the Fire and Design Rules

As the bus was ultimately destroyed by fire, OTSI also considered the propagation of the fire and the ability of the bus's construction materials to limit the potential for flame to spread into the passenger compartment area.

Australian Design Rule 58/00[3] specifies that interior linings not be readily flammable. It does not set standards for fire resistance of bus body materials.

Fire Extinguishers

The Design Rules require buses to be equipped with fire extinguishers selected and located in accordance with *Australian Standard 2444—2001*: *Portable fire extinguishers and fire blankets — Selection and location*. Two 2.0kg ABE powder type extinguishers were fitted to the bus, one attached to the panel behind the driver's seat and the other under a side cover behind the rear axle on the left hand side of the bus. The type, size and location of these extinguishers satisfied the minimum rating and location requirements of the Standard.

3 Australian Design Rule 58/00: *Requirements for Omnibuses Designed for Hire and Reward.*

It is clear from the Standard that the extinguishers were chosen as suitable for initial ”knock-down” of a developing fire in the passenger compartment or engine of the bus, but could not be expected to extinguish a fuel-fed fire that was well established in the structure of the bus.

When the guide became aware of the fire, he attempted unsuccessfully to extinguish it using the extinguisher that was mounted behind the driver’s seat. Once the fire was established, the second extinguisher, located behind a side panel behind the left hand rear wheel, would no longer have been accessible due to the spread of the fire. However, as the fire had become more firmly established despite use of the first extinguisher, inability to access the second extinguisher is not considered to have had any significant bearing on the events that followed.

Both the guide and driver stated that the spread of the fire under the bus prevented access to the second extinguisher, which they incorrectly assumed was on the other side of the bus. They indicated that they had not received any training in the use of extinguishers since commencing employment with CYC, although the driver had used one in previous employment.

Conclusion

The most likely cause of the fire was ignition of rubber residue from a failed right inner rear tyre due to friction. The tyre failure was probably due to a foreign object being thrown up from the roadway and being forced into the gap between the brake shield and wheel rim, in such a way as to damage both the brake shield and the tyre. The white smoke initially seen by the tour guide is characteristic of rubber heated by friction before it ignites, while the black smoke seen shortly after the bus came to a stop is characteristic of burning rubber or fuel, due to the tyre igniting from the concentration of heat once the bus came to a stop.

On the basis of these findings OTSI has determined that the incident does not require further investigation under the provisions of *Section 46BA (1)* of the *Passenger Transport Act 1990 (NSW)*.

A copy of these Technical Inspection Findings has been provided to CYC Tours Pty Ltd.