Australian Government
Australian Transport Safety Bureau

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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2008-013
Final

Fumes event
275 km WSW of Sydney, NSW
25 February 2008

Abstract

On 25 February 2008, at about 2128 Eastern Daylight-saving Time, the flight crew of a Boeing Company 747-338 (747) aircraft, registered VH-EBY, detected a smell that slowly increased in intensity. At that time, the aircraft was cruising at 37,000 ft and was about 275 km west south-west of Sydney, NSW.

The flight crew donned their emergency oxygen equipment and transmitted a PAN call to air traffic control. The aircraft was cleared direct to Sydney for landing and was escorted to the terminal by the airport fire services for disembarkation.

An inspection by the operator determined that loose terminal connections to the left windshield heat element resulted in electrical arcing and fumes on the flight deck.

The aircraft manufacturer has a programme to replace the windshields in the 747 with an enhanced windshield heater wiring connection that should address the risk of electrical arcing in that component.

FACTUAL INFORMATION

The information presented below, including any analysis of that information, was prepared principally from information supplied to the Bureau.

History of the flight

At about 2128 Eastern Daylight-saving Time[1] on 25 February 2008, a Boeing Company 747-338 (747) aircraft, registered VH-EBY, was being operated under the Instrument Flight Rules (IFR) on a regular public transport flight between Perth, WA and Sydney, NSW. During cruise at flight level (FL)[2] 370 and about 275 km west-south-west of Sydney, the flight crew detected a smell that slowly increased in intensity. Due to the unidentified nature of the odour, the flight crew donned their emergency oxygen equipment.

Shortly after, the flight crew commenced the non-normal checklist in response to the fumes. During those actions, the intercommunications (ICS) lead to the pilot in command's oxygen mask microphone inadvertently disconnected when the oxygen tube/ICS lead assembly was moved to allow freer head movement. The pilot in command was able to reconnect the ICS lead within about 38 seconds and re-establish normal communications, however, the disconnection interrupted the completion of the non-normal checklist.[3]

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Daylight-saving Time, as particular events occurred. Eastern Daylight-saving Time was Coordinated Universal Time (UTC) + 11 hours.

2 Cruising Level above 10,000 ft using a pressure reference datum of 1013.25 hPa, expressed in hundreds of feet.

3 ATSB Transport Safety Report 200605039 (available at www.atsb.gov.au) alerted crews to the possibility of degraded communication as a result of donning emergency oxygen equipment.

During the conduct of the FLIGHT DECK SMOKE/FUMES EVACUATION and the LANDING PREPARATION CHECKLIST (less the requirement to IMPACT/BRACE), the flight crew confirmed that all of the aircraft's systems were functioning correctly, and that there were no warning/caution lights illuminated or signs of smoke. When queried by the flight crew, the cabin crew confirmed that there was no smoke or fumes in the aircraft's upper or main deck cabins. The Customer Service Manager completed the LAND EVACUATION PREPARATION procedures

The copilot transmitted a PAN[4] call to air traffic control (ATC) at a recorded time of 21:31:32. The crew received a clearance to track direct to Sydney with no delay and were advised that the airport emergency plan had been activated. The pilot in command responded that they were expecting to make a normal approach and landing.

The pilot in command commenced the descent into Sydney about 5 minutes after the PAN transmission and informed the passengers of the possibility of an emergency evacuation. The aircraft landed at about 21:58.

After vacating the runway, the flight crew requested the attending fire service vehicle to carry out an external inspection of the aircraft and to then escort the aircraft to the terminal. No visible signs of smoke or fire were reported to the flight crew by the fire service officers and the aircraft taxied to the passenger terminal for disembarkation.

Aircraft information

Maintenance action

An inspection was carried out of the flight deck by the operator's maintenance personnel, but found nothing conclusive. The aircraft was ground run with no fault found and the operator decided to carry out an assessment flight of the aircraft. While taxiing for that flight, a faint electrical odour was noted and a particle counter/sensor was used to determine that fumes were emanating from the lower left corner of the left, or pilot in command's, windshield (Figure 1).

Inspection of the left windshield by the operator determined that the electrical arcing and subsequent odour was the result of loose windshield heat element terminal connections. The terminal for that heat element was close to the crash pad[6] between the windshield and number 2 window (Figure 1).

The left windshield and heat controller were replaced and a second assessment flight was carried out without incident. The operator cleared

Figure 1: Flight Deck showing the left windshield heat terminal block[5]

4 Radio transmission indicating uncertainty or alert.

5 Photograph courtesy of Qantas Airways Limited.

6 The crash pad covered the frame work and window attachment area between the pilot in command's windshield and the number 2 window.

the aircraft for return to service.

Previous Maintenance

The operator had previously experienced a number of windshield heater terminal arcing problems in their 747 fleet. In response, an Engineering Instruction (EI)[7] was developed in January 2006 that called for a one-time inspection of the terminal. The requirements of the EI were carried out on the aircraft on 7 July 2006.

The incident flight occurred about 17 flight hours after the aircraft underwent maintenance at a contracted maintenance facility. During that maintenance, an unrelated EI was carried out in the vicinity of the left windshield that required the crash pad to be removed and refitted. The right windshield was not inspected, as it was not affected by that EI.

Manufacturer actions

Fleet Team Digest article 747-FTD-56-03001

The manufacturer released Boeing Fleet Team Digest article 747-FTD-56-03001 on 5 May 2003, which discussed the potential for windshield heater terminal arcing problems. The article included an interim action that was associated with the release of the subsequent Boeing Service Bulletin (SB) 747-30-2081, and had the same compliance intent as that bulletin.

Service Bulletin 747-30-2081

Boeing SB 747-30-2081 indicated that the manufacturer had received nine reports of similar electrical problems with flight deck windows in the 747. On a number of occasions, the associated windshield heater terminal arcing resulted in open flames. In one case, an operator indentified damage to a terminal block and retightened it, not realising that there was also internal damage. Less than 6 months later, the operator reported an open flame incident on that windshield.

The Boeing SB 747-30-2081 was issued on 8 August 2006 and related to the inspection and replacement of the aircraft's windshields. That SB reflected the inspection requirements of the operator's January 2006 EI, and recommended that:

> ...EACH OPERATOR EXAMINE THIS SERVICE BULLETIN IMMEDIATELY.

The period for operators of aircraft with similar windshield/electrical connection combinations to comply with the requirements of the SB was stipulated as 'within 500 flight hours of [the] release of this bulletin.'

A follow-on 6,000 hour recurring inspection was included in the SB, and had effect until all relevant windshields were replaced by the new design windshield. The new design windshield incorporated a different electrical connection that removed the requirement for the recurring inspection.

At the time of this incident, the aircraft had about 751 airframe hours remaining before the required 6,000 hours recurring inspection.

ANALYSIS

The fumes that were experienced by the flight crew were consistent with an electrical arcing event as highlighted by the aircraft manufacturer in Boeing Service Bulletin (SB) 747-30-2081. The correct operation of high voltage equipment, such as the windshield heater, requires positive contact with the relevant terminals. Any wiring insecurity increases electrical resistance and the risk of electrical arcing. The identification by the operator of loose terminal connections to the left windshield heat element suggested that had been the case in this instance.

The potential for the recent maintenance in the vicinity of the left windshield/crash pad to have contributed to the insecurity of the left windshield terminal connections could not be determined. In any case, the redesign of the windshield by the manufacturer to improve the security of the windshield heater wiring connection should address the risk of electrical arcing.

The action by the flight crew to don their emergency oxygen equipment mitigated any risk associated with the fumes as a result of the electrical arcing. The risk of communication

7 An in-house maintenance document that was raised within the operator's system of maintenance and which defined any inspections or modification requirements that resulted from the Service Literature.

difficulties in such cases has been highlighted previously. The safe resolution of this emergency, despite the interruption to the pilot in command's ability to communicate, confirmed the priority of 'flying the aeroplane'.

FINDINGS

From the evidence available, the following findings are made with respect to the fumes event involving Boeing Company 747-338 aircraft, registration VH-EBY that occurred 275 km west-south-west of Sydney, NSW on 25 February 2008. They should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The loose terminal connections to the left windshield heat element increased the electrical resistance and resulted in electrical arcing and fumes on the flight deck.

Other safety factors

- The pilot in command's intercommunication system (ICS) lead was inadvertently disconnected when the flight crew donned their emergency oxygen equipment.

Other key findings

- The potential for the recent maintenance in the vicinity of the left windshield/crash pad to have contributed to the insecurity of the left windshield terminal connections could not be determined.
- The redesign of the windshield by the manufacturer to improve the security of the windshield heater wiring connection should address the risk of electrical arcing in that component.

SOURCES AND SUBMISSIONS

Sources of information

The main sources of information were the aircraft operator, onboard and other recorded information, and the aircraft manufacturer

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the aircraft operator, the aircraft captain and first officer, the Civil Aviation Safety Authority (CASA) and the aircraft manufacturer.

A submission was received from the aircraft operator. That submission was reviewed and where considered appropriate, the text of the report was amended accordingly.