



Aviation Safety Investigation Report - Final

British Aerospace Plc BAe 146-100, VH-NJR

Occurrence Details

Occurrence Number:	200102467	Location:	Mackay, Aero.
Occurrence Date:	31 May 2001	State:	QLD
Occurrence Time:	1300 hours EST	Highest Injury Level:	None
Occurrence Category:	Incident	Investigation Type:	
Occurrence Class:		Investigation Status:	
Occurrence Type:		Release Date:	04 July 2002

Aircraft Details

Aircraft Manufacturer:	British Aerospace Plc	Aircraft Model:	BAe 146-100	
Aircraft Registration:	VH-NJR	Serial Number:	E1152	
Type of Operation:	Air Transport, Domestic, High Capacity, Passenger, Scheduled			
Damage to Aircraft:	Nil			
Departure Point:	Brisbane, QLD	Departure Time:		
Destination:	Mackay, QLD			
Crew Details:	Role	Class of Licence	Hours on Type	Hours Total
	Pilot-In-Command	ATPL	7000	12000

Factual Information

The BAe 146 aircraft had departed Brisbane, Qld on a flight to Mackay, Qld with a carried-forward defect that required the number-1 airconditioning pack to be used as the sole source of air for the cabin and flight deck. That situation was permissible under the terms of the aircraft's Minimum Equipment List (MEL), which allowed operation of the aircraft in non-standard configurations. The number-2 pack was not to be used because an intermittent oil leakage in the number-4 engine was a potential source of air contamination to airconditioning pack two.

During normal operation, bleed air from engines one and two was fed to pack one which in turn normally supplied conditioned air to the flight deck and cabin. Bleed air from engines three and four was fed to pack two, which normally supplied air to the cabin only. Additionally, bleed air from the auxiliary power unit (APU) was used by either pack during the takeoff and landing phases or when airconditioning was required on the ground.

The flight to Mackay was uneventful. During the approach to land, the APU was selected as the bleed air source for pack one and the configuration remained that way until the aircraft was parked, the engines were shut down and the passengers disembarked.

From the time the aircraft turned off the runway, the crew was aware of a strong oil smell coming from the air-conditioning system. The fumes were detected in the cabin as well as the flight deck. Because it was a short taxi distance and a busy period on the flight deck, the crew did not have time to investigate the origin of the contaminated air. Although the smell was generally described as oil-like, the moderate south-east surface wind may have added to the air contamination by directing engine exhaust fumes into the APU air intake.

The pilot in command vacated the aircraft to get some fresh air and a short time later he suffered headache, itchy eyes, nausea and a bad taste. Company engineers at the Brisbane and Adelaide bases were consulted by telephone and a decision was made to proceed with the scheduled return flight to Brisbane using engine air one and two as the sole source of air to pack one. As the pilot in command was still suffering from the symptoms described above, he checked with the first officer and confirmed that he was unaffected by the fumes incident and requested the first officer to be the handling pilot on the next sector.

The passengers were embarked, the doors were closed and the engine start procedure was commenced. During the turnaround, the airconditioning had been turned off and remained off during the engine start. However, the cabin fan, which distributed air to the cabin through individual louvres above each passenger seat, was on. After starting three of the four engines the pilot in command felt increasingly unwell and the cabin staff also became aware that they were being affected by the fumes. The pilot in command then cancelled the flight and later expressed concern that he had considered attempting a flight while still feeling the effects of the air contamination. He stated that he may have been influenced by his desire to consult his Designated Aviation Medical Examiner in Brisbane as soon as possible. He also noticed that he had made simple errors during the flightdeck preparation and put those errors down to the effect of the fumes on his thought processes. Previous incidents have indicated that operating crews were not aware of their impairment and the subsequent effect on their decision making ability. The seriousness of that aspect was reflected in the decision by the Civil Aviation Safety Authority (CASA) to adopt a United Kingdom Air Accidents Investigation Branch (AAIB) recommendation requiring flight crew to use oxygen masks selected to 100 percent when there is a suspicion of flight deck or cabin air contamination.

A Licensed Aircraft Maintenance Engineer (LAME) was dispatched to Mackay to investigate the source of the fumes. The engineer carried out an inspection in accordance with a CASA airworthiness directive AD/BAe146/086, issued 30 March 2001, and British Aerospace Systems Information Service Bulletin (ISB) 21-150. The ISB required certain actions to be performed whenever a cabin air quality problem was identified, which was suspected of being associated with oil contamination of the air supply from the airconditioning packs. The engineer's inspection of the airconditioning system, engines and APU revealed no signs of oil contamination or oil leaks. The aircraft was ferried to Brisbane where further investigation, including an air test, confirmed that the number-4 engine was producing fumes during the climb and the descent and the APU was continuously producing fumes. Subsequently the number-4 engine and the APU were replaced.

The two cabin staff received medical advice and resumed their flying duties. Medical tests were carried out on the pilot in command but no abnormalities were detected and he resumed flying duties one week after the incident. The co-pilot was unaffected by the fumes.

Particular attention has been paid to this type of problem in Australia since July 1997 due to apparently similar incidents and crew reaction. A number of organisations, including the ATSB, have been conducting investigations into the subject of air quality in BAe146 aircraft. Evidence from previous incidents of air system contamination on this type of aircraft has indicated that the fumes are associated with engine or APU oil contamination of the airconditioning system. As a result, operators have incorporated various modifications to the cabin air system, APU and engines. They have also introduced improved maintenance practises to further address the issue. However that action has not completely solved the problem. The air supplied to the air conditioning packs is protected from contamination by oil seals in the engines and APU. A technical defect arising in one of these seals can result in oil entering the cabin air conditioning system with the first signal of the defect being an awareness of fumes by the members of the crew. The difficulty of identifying the origin of the contamination is exacerbated by the often intermittent nature of the fume events.

Analysis

The short taxi distance after landing limited the opportunity for the crew to investigate the origin of the contaminated air. However, only one airconditioning pack was in use and the APU was the sole source of air to that pack. The APU was found to be producing fumes during the day following the incident and it is considered that it was likely to have been producing fumes on the day of the incident.

By the time the aircraft was parked, the APU had almost certainly been passing oil fumes to the number-1 pack for about five minutes. Some of the crew felt increasingly unwell during the subsequent engine start even though no air supply source was selected. That may have been a result of residual fumes in the airconditioning ducting being circulated by the cabin fan.

There was no doubt that fumes contaminated the cabin and flight deck. The pilot in command became aware that the fumes had caused a detrimental effect to his performance and he took appropriate steps to terminate the flight. The implication that the fumes may have had a subtle but adverse affect on the pilot's decision-making process was not conclusively determined.

Safety Action

On 6 September 1999, the then Bureau of Air Safety Investigation issued recommendation R19990052 to the Civil Aviation Safety Authority. That recommendation stated that:

The Civil Aviation Safety Authority, in conjunction with the aircraft manufacturer, British Aerospace Plc, address deficiencies that permit the entry of fumes into the cockpit and cabin areas of BAe 146 aircraft. These deficiencies should be examined by the regulatory authority as part of its responsibilities for initial certification and continued airworthiness of the BAe 146 aircraft.

The Civil Aviation Safety Authority responded on 14 March 2000 stating:

"In the lengthy period between the incident and the release of your report, CASA has investigated this issue in considerable detail, in conjunction with the aircraft manufacturer and the major Australian operators. As a result of this work, and discussions with the certifying authority (the UK Civil Aviation Authority), CASA is satisfied that the BAe146 aircraft in service in Australia are safe for public transport. CASA technical specialists are available to brief your investigators on the scope and findings of this work.

"As your recommendation does not specify the nature of any additional deficiencies that the Bureau believes need to be addressed by CASA and the aircraft manufacturers, I am seeking details of any deficiencies that you believe have not been appropriately dealt with. It would also assist us in providing a meaningful and constructive response to your recommendations if you were to provide us with details of any incidents that have occurred since the original incident in 1997.

"In the meantime, we will continue to monitor the situation and review any information that comes to hand."

The Bureau classified the response as "Open" and initiated further correspondence with CASA. On 12 October 2000, the Senate Rural and Regional Affairs and Transport References Committee tabled its report into Safety and Cabin Air Quality in the BAe 146 Aircraft. The Government tabled its response to the References Committee's report on 28 June 2002.