Safety Regulation Group
Safety Investigation and Data Department

Follow-up Action on Occurrence Report

INCIDENT INVOLVING BAE146 - 200, G-JEAK, DESCENT TO BIRMINGHAM AIRPORT ON 5 NOVEMBER 2000
(FUMES IN COCKPIT)

CAA FACTOR NUMBER	:	F12/2004
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AAIB REPORT	:	AAR 1/2004

SYNOPSIS

(From AAIB Report)

The incident occurred whilst on approach to Birmingham Airport. Following reports of unusual “oily petrol” smells in the cabin, the first officer, after visiting the cabin started to feel nauseous. The first officer’s condition began to decline to an extent that he had difficulty in concentrating. The commander took over the handling duties and the first officer went onto 100% oxygen, and took no further part in the flight. The commander also felt “light headed” and had difficulty in judging height during the ensuing approach and landing. Following a successful landing, the commander was able to taxi the aircraft and began to feel better. The first officer and commander were taken to hospital and examined, but no abnormalities were found.

An engineering investigation revealed the presence of an oil leak from the auxiliary power unit (APU) generator cooling fan seal, which allowed engine turbine oil to enter the APU air inlet plenum chamber and, subsequently, fumes to enter the cabin via the Environmental Control System (ECS).

During the investigation, further incidents involving other aircraft types were reported. Therefore, the scope of the investigation was widened to include these other incidents.

The following causal factors were concluded during the investigation.

(1) There is circumstantial evidence to suggest that the flight crew on G-JEAK were affected by contamination of the air supply, as a result of oil leakage from the APU generator cooling fan seal into the APU air stream, and into the ECS system ducting. This contamination allowed fumes to develop, a proportion of which entered the cabin and cockpit air supply.

(2) Subsequent research and tests suggests that the crew of G-JEAK, and the crew of other aircraft which have suffered similar incidents, may have been exposed to turbine engine oil derived fumes in the cabin/cockpit air supply, originating from either an engine or APU, which had irritant, rather than a toxic effect.

Five safety recommendations were made during the course of this investigation.

This publication provides the initial CAA response to each Safety Recommendation made by the Air Accidents Investigation Branch, Department of Transport.

Status ‘CLOSED’ or ‘OPEN’ indicates completion or not of all actions judged appropriate by the CAA in response to the Recommendation.

The current status and the final responses to all Safety Recommendations are contained in an annual CAA report entitled PROGRESS REPORT - CAA RESPONSES TO AIR ACCIDENTS INVESTIGATION BRANCH (AAIB) SAFETY RECOMMENDATIONS. The absence of errors and omissions cannot be guaranteed.

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FOLLOW UP ACTION

The five Safety Recommendations made by the AAIB following their investigations are reproduced below, together with the CAA responses.

NOTE: The five Safety Recommendations made by the AAIB during the course of the investigation were submitted to the CAA on 8 May 2001. The CAA took safety action at that time and formally submitted its Responses to the Safety Recommendations to the AAIB on 1 August 2001. The AAIB incorporated those Responses into the subject Report. This FACTOR therefore lists updated versions of the original Responses to those Recommendations which were made to the CAA.

Recommendation 2001-04

It is recommended that the Civil Aviation Authority, as the Primary Certification Authority for the BAe146 type, takes early action in conjunction with BAE Systems to require that operators of this type should ensure that the standards of maintenance and modification of the aircraft's air conditioning system, engines and APU are such that air supply contamination by oil from the engines and/or APU, or by any other potentially hazardous substance, is avoided.

CAA Response

The CAA accepts this Recommendation. In November 2000 BAE Systems, the Type Certificate holder, issued Service Information Letter 21-45 that describes modifications to the BAe 146 air conditioning system, engines and APU, which define an improved standard of aircraft with respect to cabin air quality. On 21 March 2001 the CAA declared as mandatory, BAE Systems Service Bulletin 21-150, that reduced the risk of release of oil and/or oil breakdown products into the occupied areas of the aircraft by introducing specific and periodic inspections for oil leakage, and appropriate corrective actions. On 22 October 2002, the CAA declared as mandatory BAE Systems Service Bulletin 21-156. This required that certain ducts in the cabin/flight deck air distribution system be inspected and replaced if contaminated beyond a defined limit. These ducts are surrounded by sound attenuating material that was observed on some older aircraft to be heavily contaminated. Such contamination was predominantly composed of engine oil and its breakdown products (as subsequently confirmed by the research described in the CAA Response to AAIB Recommendation 2001-06) and thus maintenance of an acceptable air supply demanded their removal. On 30 April 2003 the CAA declared as mandatory BAE Systems Service Bulletin 49-036-36019E. This required, if not already carried out, a modified APU inlet seal be installed. The standard of seal fitted to many aircraft allowed leaking APU oil and/or exhaust fumes/mist present in the APU bay to be ingested into the APU air intake. The modified seal ensured that only outside air could be drawn into the APU. These actions have greatly reduced the likelihood of hazardous contamination of the cabin air supply by the engines and/or APU. In addition the engine manufacturer has developed further modifications to improve engine internal oil seals. These modifications are presently subject to in-service trials, which have produced very promising results to date. Full implementation of these engine modifications is expected during 2004. There has been no incident reported to the CAA, involving adverse effects to BAE 146 flight crew, due to oil contamination of ECS air, since June 2002.

CAA Status - Closed

Recommendation 2001-05

It is recommended that the Federal Aviation Administration, as the Primary Certification Authority for the Boeing 757 type, takes early action in conjunction with Boeing to require that operators of this type should ensure that the standards of maintenance and modification of the aircraft's air conditioning system, engines and APU are such that air supply contamination by oil from the engines and/or APU, or by any other potentially hazardous substance, is avoided.

CAA Response

This Recommendation is not addressed to the CAA.

CAA Status - Closed

Recommendation 2001-06

It is recommended that the Civil Aviation Authority, as the Primary Certification Authority for the BAe146 type, should as a matter of urgency sponsor a thorough programme of research to establish the full range of contaminant compounds that can enter the flight deck and cabin air supplies of the BAe146 aircraft when engine or APU lubrication oils leak into the environmental control system.

CAA Response

The CAA partially accepts this Recommendation. In 2001-2003 the CAA sponsored a programme of research into the possible contaminants that can arise in aircraft air conditioning systems as a by-product of pyrolised engine oil. However, this research was not specifically associated with fumes events on the BAe 146 which was the responsibility of BAE Systems and Honeywell (the Type Certificate (TC) holders for the aircraft, engine and APU), to technically investigate. The CAA programme was generic research with the intent of understanding what contaminants could arise in aircraft of any type and thus be best placed to judge the TC holder's proposed actions in the case of the BAE146, and to determine any similar needs for other aircraft types. The research was designed to be independent yet complementary to other research activities being undertaken by industry. The products of pyrolised engine oil and contaminants accumulated in aircraft ducting material were identified and subjected to a toxicological review by an organisation with expertise in toxicology. This review was completed in 2003 and concluded that no single component, or set of components, could be identified which, at conceivable concentrations, would definitely cause the symptoms reported in cabin air quality incidents. However, the presence of short chain organic acids that could cause irritant effects was identified. The effects of irritancy vary greatly between individuals and this variation in effect is a feature in the majority of recorded events. Therefore, it was concluded that the most likely cause of safety related problems was that pilots were experiencing the effects of 'irritancy' from these volatile organic compounds. This research evidence supports the view that the actions already taken to address the known oil leakage problems were entirely appropriate and no further actions are necessary for other aircraft types. There has been no incident reported to the CAA, involving adverse effects to BAE 146 flight crew due to oil contamination of ECS air, since June 2002.

CAA Status - Closed

Recommendation 2001-07

It is recommended that the Civil Aviation Authority reviews the types of contaminant compounds identified from the research programme recommended at 2001-6 above, to assess whether any of these compounds could induce adverse physiological and/or neurological effects in the occupants of the BAe146 or other aircraft types

CAA Response

The CAA partially accepts this Recommendation. The determination of whether contaminant compounds from engine, APU or lubrication oils could cause adverse effects on aircraft occupants, demands a specialist knowledge of human toxicology. Such expertise is not available within the CAA. Therefore, rather than undertake this review itself, the CAA commissioned an organisation with expertise in toxicology to perform the recommended review on its behalf. Specifically, the research programme sponsored by CAA, described in the response to Recommendation 2001-6, included a toxicological review of the compounds identified.

CAA Status - Closed

Recommendation 2001-47

It is recommended that the Civil Aviation Authority should consider issuing additional advice to the crews of jet transport aircraft on the best operational practice when there is a suspicion of flight deck or cabin air contamination. The advice should include the necessity for all flight crew to use oxygen masks selected to 100% and the importance of cabin crew taking an active part in monitoring the flight crew in such circumstances.

CAA Response

The CAA accepts this Recommendation. The CAA gave consideration to expanding the current advice available on dealing with flight deck or cabin air contamination, including the necessity for flight crew to use oxygen masks selected to 100% and the importance of cabin crew taking an active part in monitoring the flight crew. The CAA decided that this was necessary and Flight Operations Department Communication (FODCOM) 14/2001, dated 24 August 2001, was published. This FODCOM contained advice on these matters and on the necessity to ensure that incapacitation procedures are regularly practised during recurrent training.

Following further reported instances of flight deck or cabin air contamination, the CAA decided that it would be prudent to remind both flight crew and operators of the current guidance contained in FODCOMs 17/2000 and 14/2001. The guidance was updated and Flight Operations Department Communication (FODCOM) 21/2002, dated 29 August 2002, was published.

CAA Status - Closed