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1 UK PUBLIC TRANSPORT SMOKE/FUMES OCCURRENCES

1.1 Introduction

- 1.1.1 The rise in the number of reported smoke/fumes events on UK Public Transport aircraft is viewed by the Civil Aviation Authority (CAA) as a potentially serious issue. This FODCOM looks at these events in more detail. Four aircraft types noted to have a higher than normal history of smoke/fumes events were selected for comparison. Only UK Public Transport reported events have been examined.

1.2 History

- 1.2.1 Between 1990 and 2001, there were 263 reported smoke/fumes events on the four selected aircraft types. Approximately 25% of these occurrences resulted in the crew or passengers suffering some degree of physical discomfort such as nausea, sore throats and light-headedness. On rare occasions, and only on two aircraft types, flight crew have been incapacitated to a greater or lesser degree.
- 1.2.2 For each of the four aircraft types there have been some aircraft that have reported more than one smoke/fumes event in the 12 year period studied. For example, there were 113 events recorded by 65 aircraft of the same type with 30 aircraft reporting two or more events. The maximum number of events recorded by individual aircraft in the time period studied was five. There are several cases of an individual aircraft reporting two or more events in a relatively short time period (e.g. a particular aircraft that reported three events in eight weeks) perhaps indicating that the causes of these events are difficult to identify.
- 1.2.3 The rate of reported events on all four aircraft types has been increasing in recent years.

1.3 Actions Taken, Ongoing and Planned

- 1.3.1 In December 2000 a Flight Operations Department Communication (FODCOM 17/2000) was issued recommending that flight crew don oxygen masks as the first action in the event of smoke or fumes on the flight deck. This FODCOM is applicable to all UK operators regardless of aircraft type.
- 1.3.2 In August 2001, FODCOM 14/2001 was published as a reminder and to expand on the instructions previously given.
- 1.3.3 With respect to one of the aircraft types:
 - a) In December 2000, the manufacturer issued an All Operators Memorandum (AOM) that instructed donning of oxygen masks when fumes or smells are evident or when there is a suspicion of a contaminated cockpit air supply. That was followed with a CAA approved Flight Manual change mandating the early donning of oxygen masks.

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- b) In January 2001, the same manufacturer issued a Service Information Letter defining "best practice" troubleshooting procedures in case of smoke or fumes events.
- c) In March 2001 the CAA issued an Airworthiness Directive imposing frequent inspections on this aircraft type for wet oil contamination of the air conditioning packs. If oil contamination is found, then the AD mandates further actions in terms of cleaning packs, and inspection and rectification of engine and APU oil leaks.
- d) Further actions are in preparation, both at the aircraft level and at the engine level.

1.3.4 With respect to another of the aircraft types:

- a) The CAA has prompted a series of meetings between an affected operator, the aircraft manufacturer and the engine manufacturer to discuss air quality.
- b) The evidence available to date indicates that only one operator of this aircraft type is suffering this phenomenon and then almost exclusively to aircraft powered by one particular model of engine. A team of all parties has defined an enhanced standard of engine rebuild practices to reduce incidence of oil leakage to the cabin bleed. This is now required for all relevant engine shop visits. In addition revised oil filling procedures are to be introduced and the manufacturer is active in defining the specific troubleshooting procedures to follow after an event. The operator has instructed the immediate donning of oxygen masks and developed its own enhanced troubleshooting techniques for the interim.

1.3.5 The actions taken and planned are considered reasonable for the interim, commensurate with the risk. The probability of future events is being minimised by the likely source being addressed (oil leakage) and by the severity of the effect at the flight deck being reduced (donning masks). Nevertheless, the CAA will continue to encourage the manufacturer for modifications at the aircraft level to eliminate the threat.

1.3.6 The actions taken by the CAA and industry as described above, appear to have made an impact on the rates of the reported high risk smoke/fume events. This is under constant review.

1.3.7 To try to better understand the phenomenon, the CAA is sponsoring research activity that investigates contamination products from engine oil that could represent a hazard to flight deck crew. The purpose is to make a general assessment of the toxic potential of the components and thermal degradation products of a synthetic ester gas turbine lubricant and contamination within the Environmental Control System. This work complements type specific investigations being conducted by the manufacturers. This data is being analysed to try to identify any toxicological links with the symptoms being reported.

1.3.8 The problem of smoke/fumes on UK Public Transport aircraft is now one of the subjects contained in the CAA Safety Regulation Group (SRG) Safety Intervention Programme and is detailed in the SRG Business Plan under the title of Hazardous Contamination of Flight Deck Cabin Air. Work is already well advanced on this subject and one task under this initiative involves a review of the service history for all UK registered large aeroplane types to identify the need for further continued airworthiness actions. In addition, the CAA is to support an FAA/JAA/Industry working group that is tasked to investigate this issue within its broader review of the design requirements related to the cabin environment.

1.3.9 Although the exact cause of crew incapacitation is not yet known, the most probable source is oil leaking from the engines or APU and contaminating the air supply to the cabin and cockpit through the air conditioning system. CAA specialists believe that reducing occurrences of oil contamination will also reduce the risk of flight crew incapacitation. Nevertheless, investigations continue and further mandatory actions will be taken if found necessary.

1.4 Summary

- 1.4.1 For reasons not fully understood there has been an increase in the number of events reported to the CAA during which aircraft occupants have been exposed to fumes and/or smoke. Advice to flight crew on how to deal with the immediate risks was given in FODCOMs 17/2000 and 14/2001. Research is continuing to identify the causes, however these are proving to be elusive.
- 1.4.2 FODCOM 17/2000 contained two Recommendations:
- a) The first action in the event of smoke or fumes in the flight deck should be for the flight crew to don oxygen masks and establish communications.
 - b) If during flight it appears that both pilots are suffering from some form of incapacitation or that one pilot appears to be in any way incapacitated for no obvious reason, then the flight crew should don oxygen masks without delay.
- 1.4.3 FODCOM 14/2001 also contained two Recommendations:
- a) FODCOM 17/2000, dated 28 December 2000, contains advice on incapacitation procedures. Operators are further reminded that Operations Manual procedures should contain detailed instructions to crews on such procedures. These should at least include the necessity to use oxygen masks at 100% whenever contamination is present or suspected and the need to establish communications by the appropriate switch selections. Additionally, cabin crew procedures should include monitoring of the flight deck. However, this should not be to the detriment of other emergency procedures such as dealing with cabin smoke or fires, especially where only one cabin crew member is carried.
 - b) Operators should also ensure that incapacitation procedures are regularly practised during recurrent training and that case based studies are discussed at joint flight deck/cabin crews' safety training.
- 1.4.4 The potential for a smoke/fumes event to adversely affect the subsequent operating effectiveness of the flight or cabin crew must be considered. In order to ensure that, as far as possible, the operating effectiveness of the crew is not reduced, the CAA recommends that the operator should take the following actions.

1.5 Further Recommendation

- 1.5.1 **Operators should ensure that flight crews are aware that the first action in the event of smoke or fumes in the flight deck should be for the flight crew to don oxygen masks and establish communications.**
- 1.5.2 **Operators should ensure that flight and cabin crew are advised as to the post-flight actions required following a smoke/fumes incident. These actions should include:**
- a) **A Commander's review of the in-flight incident. This should include consultation with the flight and cabin crew;**
 - b) **A determination as to whether any crew member felt unwell, or whether their performance was adversely affected; and**
 - c) **The requirement for a crew member who felt unwell, or felt their performance was affected, not to operate as a member of the crew until he/she has been assessed as fit by a medical practitioner and the crew member feels fit to operate.**
- 1.5.3 **The instructions to flight and cabin crew should be detailed in the Operations Manual.**

2 EMERGENCY PROCEDURES FOR CABIN ALTITUDE WARNING

2.1 Introduction

2.1.1 In October 1999 a Learjet 35 en route from Orlando to Dallas ran out of fuel and crashed in South Dakota. The lack of the Learjet flight crew's response to air traffic raises the possibility of flight crew incapacitation caused by a problem with the pressurisation system.

2.2 Findings

2.2.1 A Special Certification Review conducted by the Federal Aviation Administration (FAA) has discovered that some Aeroplane Flight Manuals (AFMs) do not have an emergency procedure that requires donning the flight crew oxygen masks as an immediate action when the cabin altitude aural warning is activated. However some AFMs do contain an abnormal procedure that allows the flight crew to troubleshoot the pressurisation system prior to donning the oxygen masks after the altitude warning sounds. This troubleshooting may delay the donning of the oxygen masks to the point that the flight crew may become incapable of donning their oxygen masks.

2.3 Action Taken

2.3.1 One major large aircraft manufacturer has produced an Airworthiness Directive (AD) to require that AFMs are revised to advise the flight crew to don oxygen masks as a first and immediate action when the cabin altitude warning sounds. This action is considered necessary to prevent the possibility of flight crew incapacitation due to lack of oxygen, which could result in loss of control of the aeroplane. The FAA has proposed the adoption of this AD in a Notice of Proposed Rulemaking.

2.4 Recommendation

2.4.1 **Operators should review their operating procedures and, where necessary, amend their Operations Manuals to ensure that the emergency procedure to be followed in the event of a cabin altitude warning sounding includes, as the first and immediate action, the donning of the flight crew oxygen masks and the establishment of communications.**

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29 August 2002

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